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—Evidence from Sri Lanka—

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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 time allocation for social capital investment, such as 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.

Keywords: Social capital formation, Credit constraints, Infrastructure, Persistent shocks

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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 play 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) 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 of time can have large effects on the equilibrium level of social capital investment (Mobius 2001). Moreover, the opportunity costs of the investment change over time (Glaeser et al. 2002). The second goal is to investigate the persistent effect of changes in social capital investment over time on the level of social capital stock. 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 by the authors in Sri Lanka, this study investigates household time allocation for social capital investment when a credit constraint is binding or not binding. 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). The impact of credit constraints on the time allocation for 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. To do so, the authors estimate the impact of past credit constraints on the trust relationships 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 time allocation for social capital investment, such as 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 1, which describes the study site, while the second part discusses the dataset. Section 2 examines the short-term impacts of credit constraints on social capital investment, while Section 3 considers the persistent impacts on social capital stock. Finally, we provide the conclusion of this paper.

1. Study Site and Data Description

1.1 Community participation and social capital in Uda Walawe irrigation area

Previous studies examine case studies of Sri Lanka to show that social capital 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). 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 irrigation 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 communal work 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.

The site of this study is the Walawe Left Bank (WLB) area in southern Sri Lanka. The government initiated the irrigation development program in the area in 1997. The WLB project provided farmers with 0.2 ha of land for use as a residence, and 1.0 ha of irrigated paddy field or 0.8 ha of field for other food crops. The construction of canals was begun in the north of WLB close to Uda Walawe reservoir in 1997 and gradually extended toward the south, but otherwise the entire area of WLB is agro-climatically and geographically similar (JBIC Institute 2007). As of 2001, when the authors conducted the first household survey, around 67% of households

already had access to irrigation. By 2008, almost all households had acquired access.

This area has a unique characteristic, in that randomly chosen farmers had to resettle in new communities. According to settlers' subjective assessments of land allocation, summarized in Aoyagi et al. (2010), around half of the households were able to receive their preferred land at the plot level, when they received the irrigated plots and land for residence. While the majority acquired the land they claimed, different distribution rules applied for the remaining households. Intriguingly, the government used lotteries to distribute land for the settlement of 30% of farmers. Based on the results of the lottery, households received plots for certain crops regardless of their characteristics. As a consequence, individuals' observed characteristics are similar across canal communities (Aoyagi et al. 2010). The authors therefore consider that the timing of settlement in the current community and its community size were exogenously determined for households.

1.2 Data description

This study uses a uniquely collected long panel dataset from the WLB irrigation area. When selecting 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, 2009).

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. These two more recent surveys were distinguished from their first five predecessors by the addition of general social survey (GSS) questions on the trust relationships. The data also include a number of social capital investment questions, covering such topics as community work participation.

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 concerns.

Figu

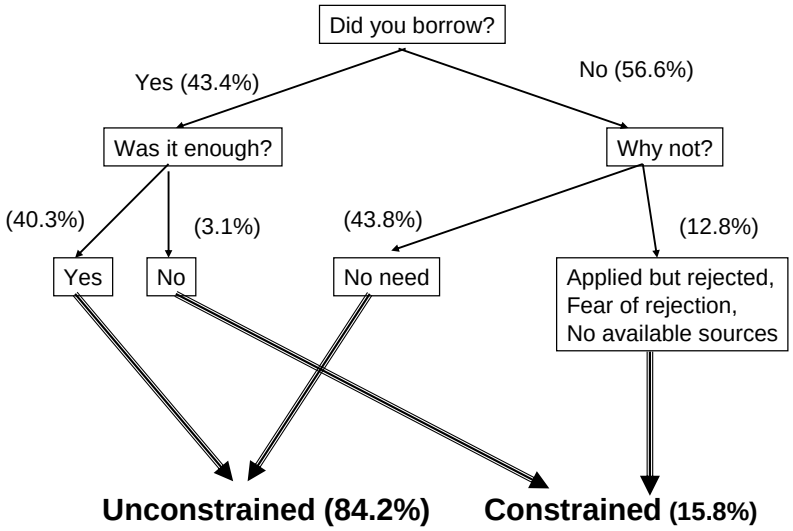


Table 1 presents the characteristics of the credit-constrained and credit-unconstrained observations separately. Around 15.8% of observations faced a binding credit constraint during the surveys.[1] Panel A of the table shows that households with lower income are more likely to have binding credit constraints. Also, the amount of loans in the constrained group is less than the unconstrained for all credit sources, and interest rates higher.

The social capital formation variables include binary variables on participation in community work – such as cleaning communal roads or taking part in religious festivals – by the household head or any of the household members, as broader measures of participation in social capital investment, as well as participation in irrigation maintenance 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 the table shows that constrained households are more likely to participate in community works and irrigation maintenance. It also appears that households with poor access to irrigation and/or households whose fields were damaged by wild animals face credit constraints.

[1] 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.

Table 1. Summary Statistics by Credit Constraint Status

	Credit Constrained			Credit Unconstrained			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							
Participation in community works by head (Hrs per day)	572	0.39	0.74	3038	0.32	0.63	**
Participation by any household members (Hrs per day)	572	1.47	12.30	3038	2.81	24.65	
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	*
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 (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	
Size of farmer organization community (households)	572	114.98	33.73	3038	115.21	34.07	
Years since settlement	572	26.95	12.56	3038	28.04	13.25	**
Distance to nearest city (km)	572	4.90	3.86	3038	5.01	4.10	
Distance to daily market (km)	555	1.18	2.06	2966	1.27	2.13	
Holdings of clocks/watches (Rs)	572	0.34	0.42	3038	0.49	0.59	***

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

2. Impact of credit constraints on social capital investment

2.1 Estimation methodology

This section seeks to show the short-term impact of credit constraints on the investment to social capital. Credit constraints may affect the social capital investment decision through various channels, but here the focus is on the changes in time allocation. This is straightforward since social capital could be accumulated through meetings with other villagers and socializing with them (Durlauf and Fafchamps 2005, pp1644). Therefore, the level of investment should be measured in terms of time spent socializing with their community members (Glaeser et al. 2002).

This study investigates the issue by estimating the following binary model:

$$T_{it}^{j} = 1[C_{it}\alpha^{j} + X_{it}\beta^{j} + \varepsilon_{it}^{j} > 0]. \quad (1)$$

where, T_{it}^{j} is a binary variable that takes the value of one if household i is involved in the social capital investment j (j = 1, 2, 3) during the period t and zero otherwise. C_{it} is also a binary variable which takes unity if household i binds the credit constraint during the period t. X_{it} denotes the other household characteristics and finally ε_{it}^{j} is the residual that follows $E[\varepsilon_{it}^{j}] = 0$ and $Var[\varepsilon_{it}^{j}] = 1$.

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. Given the unavailability of data on social capital stock for each period, this study controls for it using the time since households moved to the current community, the community size, and distance to markets. As described in Section 1, the timing of settlement, community size, and location of residences were exogenously determined

in the process of irrigation development program in the study area. However, there is the potential to omit factors correlated with both participation and social capital stock, causing the estimation to be biased. Consequently, this study employs an instrumental variable model to mitigate the endogeneity by estimating the following equation jointly with equation (1) using the recursive bivariate probit model:

$$C_{it} = 1[Z_{it}\,\gamma + X_{it}\,\delta + \omega_{it} > 0] \qquad (2)$$

where, Z_{it} denotes instrumental variables and ω_{it} the residual that follows $E[\omega_{it}] = 0$, $Var[\omega_{it}] = 1$, and $cov\{\varepsilon_{it}, \omega_{it}\} = \rho$.

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 participation 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. 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 and various geographic characteristics such as community size and distance to markets.

2.2 Estimation results

To begin, three binary outcome variables regarding the investment in social capital are examined: (1) participation in community works such as cleaning communal roads and other community events by any member of the household and (2) by the household head, and (3) participation in the maintenance of communal irrigation canals. Overall, credit-constrained households are found to be less likely to participate into these activities.

2.2.1 Determinants of credit constraints

Table 2 presents the results of the equation (2) examining the determinants of credit constraint. The first estimation model presents the result of bivariate probit estimation whose outcome variable in equation (1) is the participation in community works by any household members. The second model shows the result of the linear probability model with household-level fixed effects. 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. Furthermore, eight households are dropped in the fixed effect model since they include only one observation available for estimation.

The covariates of the regression include the valid instruments – watches/clocks holdings and its interaction term with the attack by wild animals – as well as land holdings, approximation of social capital stock, demographics, household head characteristics, geographic characteristics and period-block specific fixed effects. 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, 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: 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 1.97% 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 3.57%. However, when households hold liquid assets worth 270 rupees, negative shocks increase the probability by only 1.64%. The second column also shows a comparable result. As for the other coefficients, households with more land holdings are less likely to be credit constrained as expected. Also, the more unproductive children are in the household, the more likely the households are to face credit constraints.

Table 2: Determinants of Credit Constraints

	Bivariate Probit		Linear Probability Model	
	MEM	S.E.	Coefficient	S.E.
Instruments				
Holdings of watches/clocks	-0.0728***	0.0158	-0.0454***	0.0144
Watches/clocks × wild animals	-0.0712***	0.0275	-0.0725**	0.0368
Attacks by wild animals	0.0357*	0.0183	0.0332	0.0278
Size of irrigated land	-0.0090**	0.0045	-0.0133**	0.0092
Size of nonirrigated land	-0.0102*	0.0062	-0.0182	0.0080
Holdings of fixed/mobile phones	0.0002	0.0028	0.0033	0.0037
Number of males	0.0094	0.0077	0.0214	0.0175
Number of females	0.0078	0.0064	0.0324*	0.0173
Number of children	0.0078*	0.0045	0.0136	0.0138
Years of schooling of head	-0.0017	0.0023	-0.0101	0.0082
Age of head	0.0004	0.0007	0.0014	0.0029
Size of farmer organization community	-0.0001	0.0002		
Years since settlement	-0.0005	0.0007		
Distance to nearest city	-0.0011	0.0021		
Distance to daily market	-0.0066**	0.0032	-0.0078**	0.0035
Period-block specific fixed effects	Yes		Yes	
Household fixed effects	No		Yes	
Obs.	3519		3511	
F stat. for instruments	43.54***		9.82***	

MEM denotes the marginal effect at the mean. Cluster-adjusted robust standard errors are reported. *** 1% significant, ** 5% significant, * 10% significant, respectively

The inclusion of the fixed effects in the second model does not change the signs of any coefficients. However, given that the predicted probability of more than one quarter of the observations does not range between zero and one, the magnitude of coefficients becomes unstable in this column. Also, the estimated coefficients are no longer efficient in the linear probability model by structure.

2.2.2 The Impact of credit constraints on participation in community works

Table 3 presents the results of the equation (1) evaluating the impact of credit constraints on social capital investment. Dependent variables of the first and second regressions are participation in community works by any household members and by the household head, respectively. In the third regression, the outcome variable is one if the household attends the communal irrigation maintenance. Therefore, the third model uses only 2334 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 12.98% less likely to participate in irrigation maintenance and 35.65% less likely to take part in other community works (household head). While social capital is essential for economic development in the long run, vulnerable individuals who face binding credit constraints have to reduce the time allocation for the investment. The appendix A2 presents the results from the linear probability model with household-level fixed effects.

Table 3. Impact of Credit Constraint on Participation to Social Works: Bivariate Probit Models

	Participation in community works by any of household members		Participation in community works by household head		Maintenance of irrigation	
	MEM	S.E.	MEM	S.E.	MEM	S.E.
Credit constraints [endogenous]	-0.2475	0.1643	-0.3565**	0.1643	-0.1298**	0.0587
Attacks by wild animals	-0.0362	0.0351	0.0060	0.0290	0.0071	0.0246
Size of irrigated land	0.0340***	0.0100	0.0182**	0.0084	-0.0161	0.0130
Size of nonirrigated land	0.0087	0.0079	0.0085	0.0075	-0.0145	0.0127
Holdings of fixed/mobile phones	-0.0026	0.0031	-0.0031	0.0037	0.00002	0.00325
Number of males	0.0142	0.0113	0.0116	0.0074	0.0178**	0.0085
Number of females	-0.0069	0.0082	-0.0057	0.0072	-0.0015	0.0132
Number of children	0.0088	0.0062	0.0105**	0.0052	0.0113	0.0097
Years of schooling of head	0.0122***	0.0030	0.0059***	0.0020	-0.0046	0.0030
Age of head	-0.0028***	0.0009	0.0002	0.0007	-0.0025**	0.0010
Size of farmer organization community	0.0003	0.0003	0.0003	0.0002	0.0003	0.0005
Years since settlement	0.0004	0.0015	0.0007	0.0012	-0.0003	0.0012
Distance to nearest city	-0.0014	0.0027	-0.0012	0.0017	-0.0001	0.0032
Distance to daily market	-0.0053	0.0071	-0.0090	0.0062	0.0063	0.0044
Period-block specific fixed effects	Yes		Yes		Yes	
Household fixed effects	No		No		No	
Correlation of error terms (Chi^2)	1.98		3.25*		2.92*	
Obs.	3519		3519		2397	
F stat. for first-stage instruments	43.54***		36.04***		31.26***	

MEM denotes the marginal effect at the mean. 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

3. Persistent effect of credit constraints on the social capital

The previous section shows that the credit constraint affects the decision to participate in community meetings. 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. 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:

$$S_{i2007}^{k} = 1[ExpC_{i2001}\,\theta^{k} + X_{i2001}\,\mu^{k} + \psi_{i}^{k} > 0] \quad (3)$$

$$ExpC_{i2001} = 1[Z_{i2001}\,\pi + X_{i2001}\,\sigma + \tau_{i} > 0\,] \quad (4)$$

where, S_{i2007}^{k} are five binary variables of social capital stock reported in Table 4. Also, $ExpC_{i2001}$ 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 4.Stock of Social Capital: Trust Relationships with Community Members

	Households with Experience of Credit Constraints in 2001&2002		Households without Experience of Credit Constraints in 2001&2002		
Social Capital Variable	Mean	S.D.	Mean	S.D.	
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	
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	*
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	
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	
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 presents the persistent effects of credit constraints. It is clear that past declines in investment caused by credit constraint indeed persist. Households who have been constrained during 2001 and 2002 are 44.5% less likely to trust the other villagers by, and 53.7% less likely to trust their trading partners, even five years later, although the second model marginally has an issue with weak instrument variables: the p-value for the joint significance of the instruments is 15.0%. Similarly, constrained households are 44.2% less likely to consider the others to be fair.

As for the other coefficients, it is shown that the coefficients on land holdings 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 2.1, 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.

Table 5. Persistent effect of credit constraint on trust relationships

	Trust (general)		Trust (villagers)		Trust (business)		Helpful (general)		Fairness (general)	
	MEM	S.E.	MEM	S.E.	MEM	S.E.	MEM	S.E.	MEM	S.E.
Past credit constraints [endogenous]	-0.2077	0.4511	-0.4452***	0.0260	-0.5371***	0.0341	0.2628	0.4613	-0.4416*	0.2351
Attacks by wild animals	0.1647**	0.0826	0.0949	0.0863	0.0996	0.1036	-0.1085	0.1162	-0.0410	0.0856
Size of irrigated land	-0.0461	0.0419	-0.0457**	0.0219	-0.0355	0.0307	0.0415	0.0725	-0.0661***	0.0198
Size of nonirrigated land	-0.0384*	0.0207	-0.0142	0.0190	-0.0121	0.0231	0.0143	0.0264	-0.0128	0.0204
Holdings of fixed/mobile phones	0.1478**	0.0740	0.1290***	0.0157	-0.1659***	0.0121	0.1508***	0.0189	-0.1597***	0.0234
Number of males	-0.0107	0.0334	-0.0233	0.0296	0.0112	0.0321	-0.0020	0.0482	0.0226	0.0389
Number of females	0.0036	0.0380	0.0267	0.0305	-0.0084	0.0338	-0.0152	0.0383	0.0316	0.0317
Number of children	-0.0563	0.0507	0.0018	0.0146	-0.0015	0.0201	-0.0386	0.0410	0.0905**	0.0380
Years of schooling of head	-0.0161*	0.0097	-0.0110	0.0096	-0.0058	0.0071	-0.0031	0.0111	-0.0006	0.0130
Age of head	-0.0043	0.0055	-0.0023	0.0028	-0.0012	0.0027	0.0005	0.0046	0.0035	0.0033
Size of farmer organization community	0.0015	0.0013	0.0009	0.0005	0.0002	0.0007	0.0015	0.0010	-0.0017	0.0012
Years since settlement	0.0035	0.0044	0.0013	0.0020	-0.0014	0.0035	-0.0051	0.0043	0.0030	0.0050
Distance to nearest city	0.0248	0.0205	0.0040	0.0149	0.0108	0.0136	0.0363*	0.0191	-0.0430***	0.0118
Distance to daily market	0.0116	0.0139	-0.0017	0.0115	0.0111	0.0105	-0.0096	0.0150	-0.0048	0.0111
Block specific fixed effects	Yes		Yes		Yes		Yes		Yes	
Correlation of error terms (Chi^2)	0.35		25.57***		41.75		0.11		0.88	
Obs.	193		193		193		193		193	
F stat. for first-stage instruments	5.01*		3.79		16.94***		7.02**		8.57**	

MEM denotes the marginal effect at the mean. 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

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 time allocation for social capital investment. The authors 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 levels 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

A concern in the identification strategy used in this study is the possibility of correlation between the instruments – particularly the holdings of watches and clocks – and household unobservable characteristics that could be correlated with the social capital. Although it is difficult, needless to say, to identify what the unobservable characteristics are, the correlation between the instrument and some observable characteristics can be checked to guess potential candidates. To do this, the authors non-parametrically regress various household characteristics on the holdings of watches and clocks using the Lowess estimator.

Figure A2 shows the regression results of 15 characteristics: the credit constraint, equivalent-scale agricultural income from the major five crops, and 13 characteristics that are used in the covariates *X*. First, the credit constraint and the instrument are negatively correlated, consistent with our expectation. Otherwise, only few characteristics seem to be correlated strongly such as attacks by wild animals, headcount of males and children, the education level of the head, and years since settlement.

Figure A1. Credit constraint (upper left), agricultural income (upper right), attacks by animals (lower left), irrigated land (lower right)

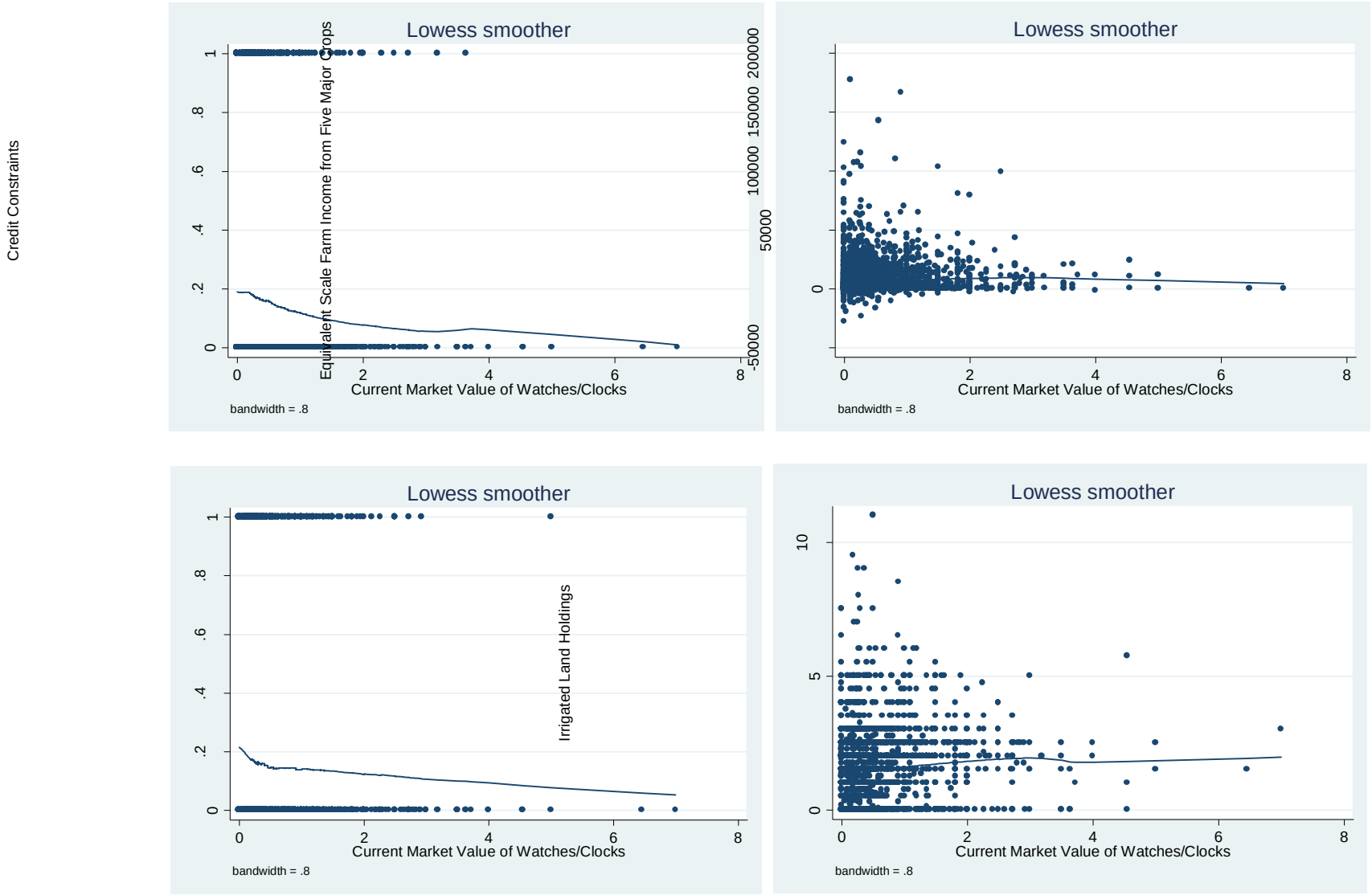


Figure A1. Rainfed rand (upper left), fixed/mobile phones (upper right), males (lower left), females (lower right)

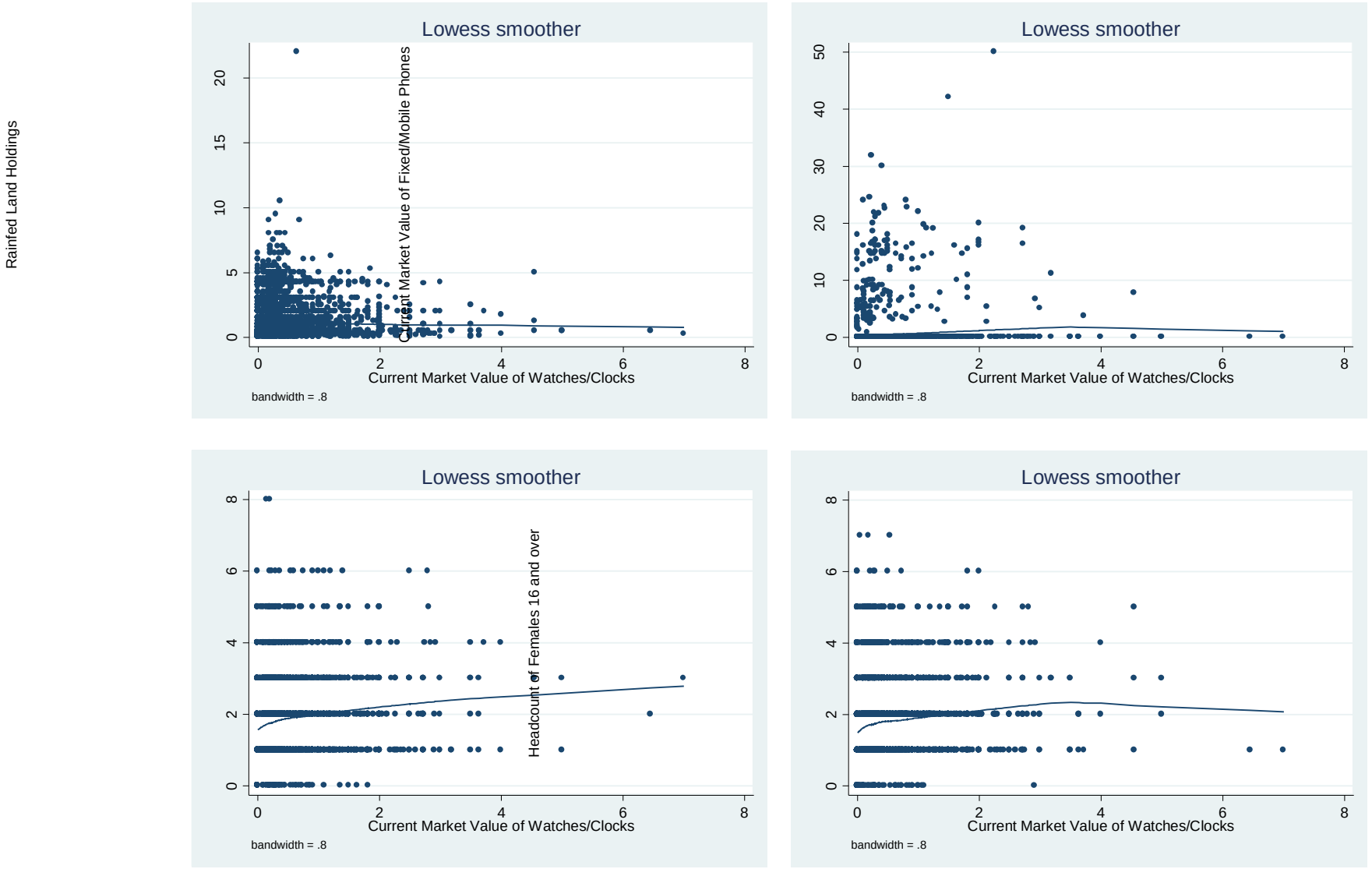


Figure A1. Children (upper left), education (upper right), age (lower left), community size (lower right)

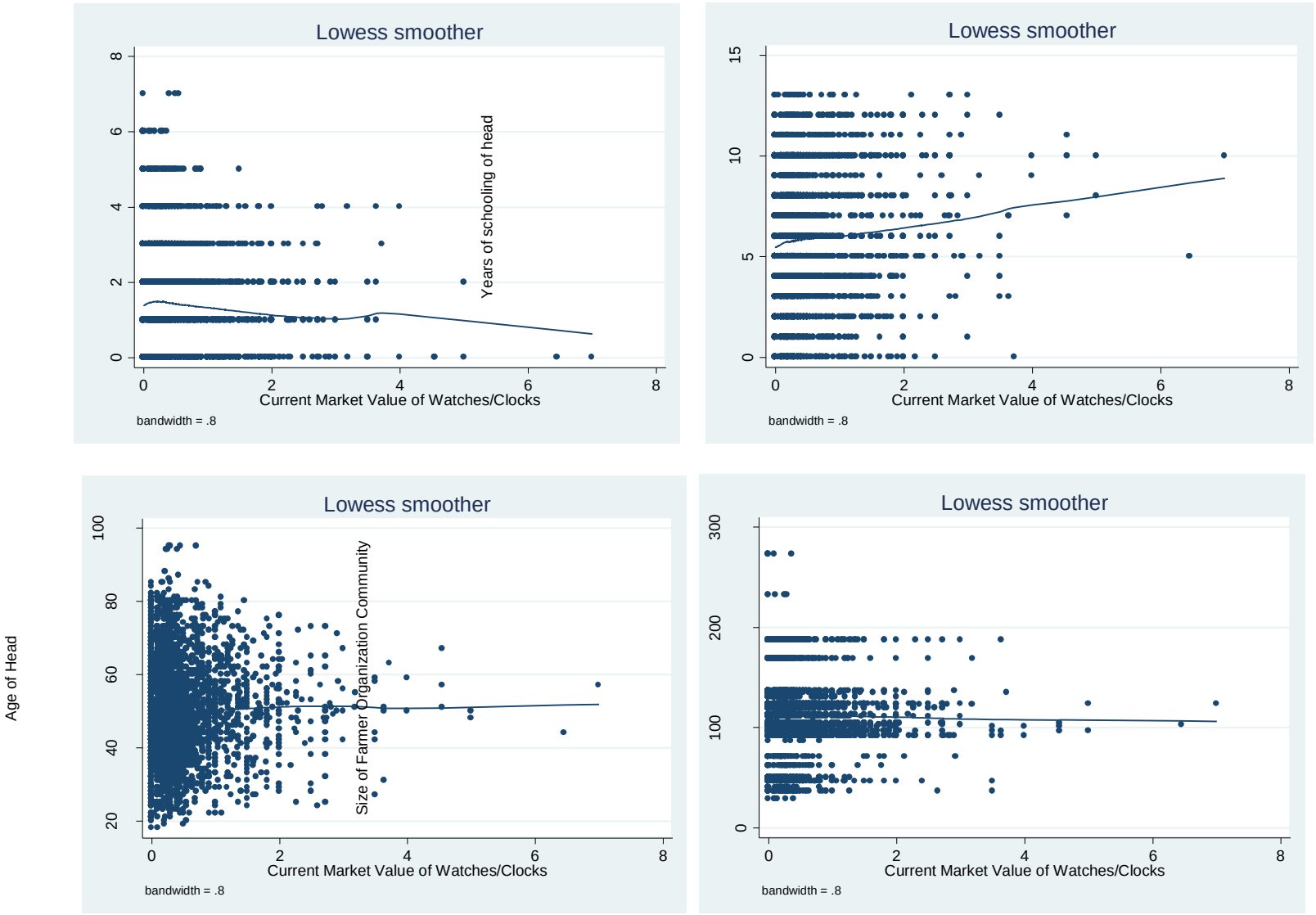
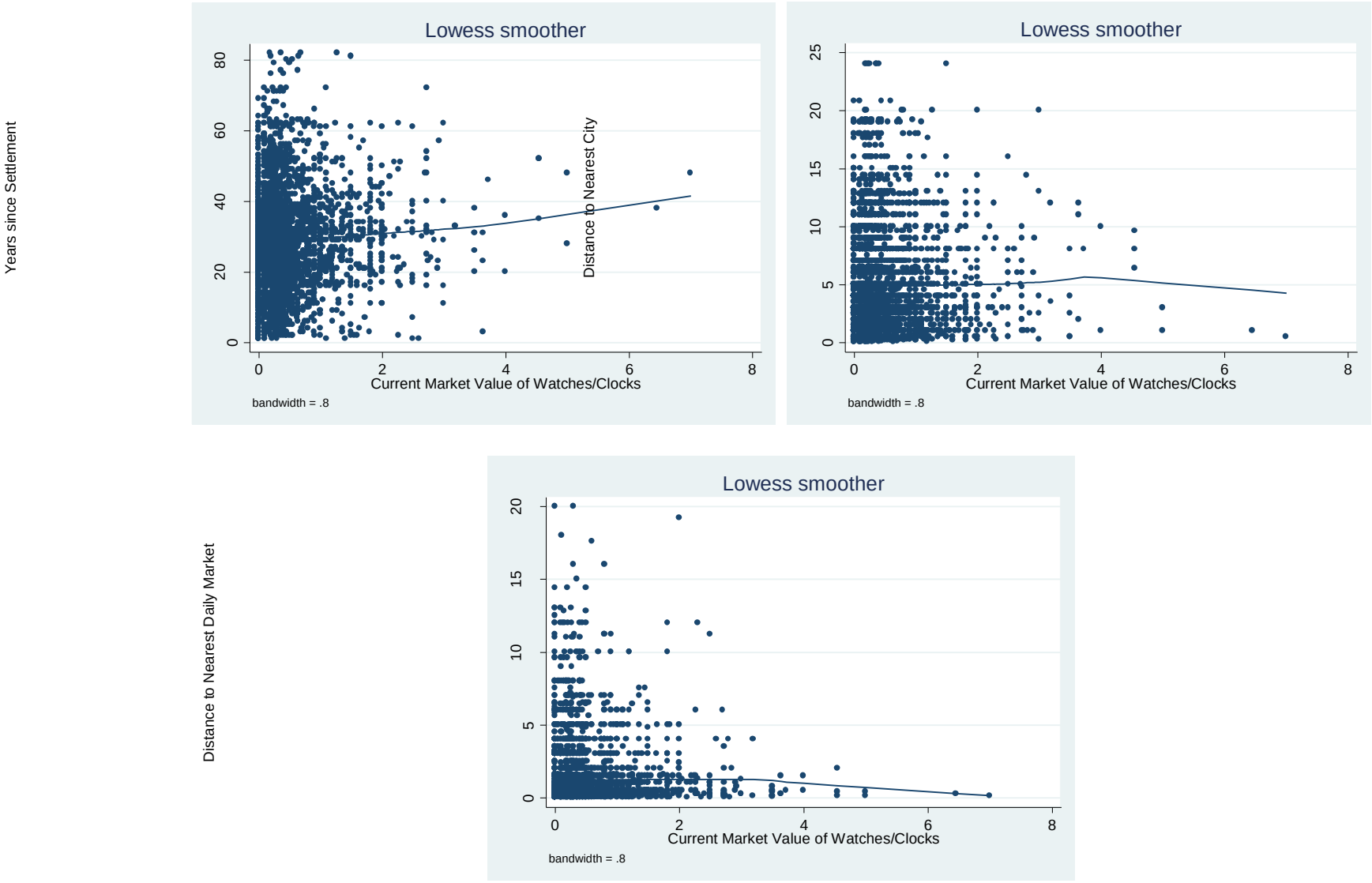


Figure A1. Years since settlement (upper left), distance to city (upper right), distance to market (lower)



It is counterintuitive, but physical assets and income do not seem to be closely correlated with the instrument. According to these figures, this study considers that the possibility of bias due to the correlation between the instrument and omitted household characteristics could be safely ignored.

A2. Robustness check1 (linear probability model with households fixed effect)

Table A1 shows the result of the linear probability model with household-level fixed effects and an endogenous credit constraint variable. This methodology controls for observable and unobservable time-invariant determinants of social capital investment, although this is not efficient by structure. Also, as shown in Table 2 the predicted probabilities of more than a quarter of the observations do not range between zero and one in the first stage estimation. As a result of these issues, the coefficient of credit constraints in the second stage equation is unstable. Only one of the three estimations shows the significant and negative impact of credit constraints on the social capital investment.

Table A1.Impact of Credit Constraint on Participation in Community Works:

IV Linear Probability Model with Household Fixed Effects

	Participation in community works by household members		Participation in community works by household head		Maintenance of irrigation	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Credit constraints [endogenous]	0.0177	0.2856	0.0123	0.2801	-0.9811**	0.4402
Attacks by wild animals	-0.0330	0.0290	0.0050	0.0285	-0.0005	0.0415
Size of irrigated land	0.0113	0.0122	0.0124	0.0120	-0.0129	0.0196
Size of nonirrigated land	-0.0067	0.0114	0.0041	0.0112	-0.0189	0.0175
Holdings of fixed/mobile phones	-0.0008	0.0048	0.0015	0.0047	0.0038	0.0058
Number of males	0.0458**	0.0229	0.0205	0.0224	0.0250	0.0347
Number of females	0.0192	0.0233	-0.0025	0.0229	0.0643**	0.0307
Number of children	0.0238	0.0178	0.0137	0.0175	0.0436	0.0275
Years of schooling of head	0.0282***	0.0108	0.0254**	0.0106	-0.0290*	0.0162
Age of head	-0.0054	0.0037	-0.0005	0.0037	-0.0029	0.0054
Distance to daily market	-0.0053	0.0049	-0.0084*	0.0048	0.0052	0.0068
Period-block specific fixed effects	Yes		Yes		Yes	
Household fixed effects	Yes		Yes		Yes	
Obs.	3511		3511		2334	
F stat. for first-stage instruments	9.82***		9.82***		5.41***	

Cluster-adjusted robust standard errors are reported.

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

A3. Robustness check2 (unbalanced panel)

As described in Section 1, 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 using the six wave panel of 193 households. Also, given that access to irrigated land changes over time, the data for the estimation of irrigation maintenance patterns is unbalanced. Therefore, it is not estimated in this section. The estimation results are reported in Table A2 and are robust. Again, the credit constraints reduce the time allocation for social capital investment.

Table A2. Unbalanced panel data

	Participation in community works by household members		Participation in community works by household head	
	MEM	S.E.	MEM	S.E.
Credit constraints [endogenous]	-0.5446***	0.0546	-0.5435***	0.0753
Attacks by wild animals	0.0167	0.0200	0.0006	0.0158
Size of irrigated land	-0.0054	0.0120	0.0100	0.0149
Size of nonirrigated land	-0.0073	0.0074	-0.0118	0.0097
Holdings of fixed/mobile phones	0.0020	0.0085	-0.0042	0.0090
Number of males	0.0119	0.0078	0.0170	0.0118
Number of females	0.0074	0.0094	0.0126	0.0105
Number of children	0.0128	0.0083	0.0064	0.0127
Years of schooling of head	0.0012	0.0031	0.0040	0.0049
Age of head	-0.0001	0.0007	-0.0039**	0.0016
Size of farmer organization community	0.0003	0.0004	0.0002	0.0006
Years since settlement	0.0033***	0.0012	0.0040*	0.0021
Distance to nearest city	-0.0011	0.0032	0.0036	0.0066
Distance to daily market	-0.0098*	0.0057	-0.0108	0.0079
Period-block specific fixed effects	Yes		Yes	
Household fixed effects	No		No	
F stat. for first-stage instruments	7.47**		6.68**	
Correlation of error terms (Chi^2)	19.95***		5.73**	
Obs.	1053		1053	

MEM denotes the marginal effect at the mean. 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

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 Maha 2001, Maha 2002, and those who do not have access as of Maha 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.

Table A3. Multinomial logit estimation for the timing at which irrigated plots are received

	Between Maha 2001 and Maha 2002		Before Maha 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		
Obs.	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 Maha 2002.
*** 1% significant, ** 5% significant, * 10% significant, respectively

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Abstract (in Japanese)

要約

本稿はスリランカで収集された独自の家計レベルパネルデータを用い、信用市場が完全には機能しない状況における社会関係資本の蓄積メカニズムを分析する。この家計パネルデータを解析した結果によると、信用制約に直面した家計は、コミュニティ活動への参加といった社会関係資本への投資に関連する活動時間の配分を有意に減少させることが発見された。また、このような一時的な投資減少が、社会関係資本の長期的な低下をもたらすことも示した。これらの分析結果は、信用市場への不十分なアクセスが社会関係資本の低下を引き起こすという可能性を示唆している。社会関係資本の蓄積が信用市場へのアクセスを改善する上で重要であるという逆の因果関係については既存研究においても明らかにされている。本研究の分析結果と既存研究の知見とを総合的に考えると、社会関係資本の蓄積メカニズムと信用市場アクセスの改善は相互に補完関係にあり、両者が十分に機能しない場合には、貧困の罠が生み出される可能性がある。

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"Impact Assessment of Infrastructure Projects on Poverty Reduction"

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A Case Study of an Irrigation Project in Sri Lanka
Yasuyuki Sawada, Masahiro Shoji, Shinya Sugawara and Naoko Shinkai