SOCIAL CAPITAL, INSTITUTIONS, AND ECONOMIC DEVELOPMENT IN CHINA

by

Shun Wang

B.A., Peking University, 2002
M.A., Peking University, 2004

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY
in
The Faculty of Graduate Studies
(Economics)

THE UNIVERSITY OF BRITISH COLUMBIA
(Vancouver)

September 2012

Abstract

This thesis investigates the impact of social capital and institutions on economic development in China. Specifically, Chapters Two and Three address issues regarding social capital and cooperation, and Chapter Four studies the effect of a specific institution on economic status.

In Chapter Two, I study whether social capital has an effect on household decisions to participate in Rotating Labor Associations (ROLAs) in rural China. I find that households in communities with higher levels of social capital are more likely to participate in ROLAs using household data collected from the Gansu province in China. The presence of village temple prior to 1949 is employed as an instrument for social capital. Numerous falsification exercises are performed to evaluate the efficacy of the instrumental variables approach.

In Chapter Three (joint with Kathy Baylis and Yazhen Gong), we compare the effect of bridging versus bonding social capital on the management of a common pool resource. We develop a theoretical model and show that bonding social capital increases vulnerability to social sanction, while by giving communities an outside option, bridging social capital can reduce people's vulnerability to social sanction, and reducing the enforcement capability of the community. However, bridging social might decrease people's consumption by providing financial support to those who have few options to self-insure against risk. We then show that the empirical analysis using household level data on firewood collection from the Yunnan province in China supports the theoretical findings.

In Chapter Four, I study the long-term impact of class identity (*chengfen*) on individuals' income and households' wealth in urban China. The Chinese government launched movements to make income and consumption in cities substantially homogeneous and assigned an inheritable class identity to each family in the 1950s. The government then implemented class-based discriminatory policies against the rich and middle class until 1978. This chapter shows that individuals with poor class origins have significantly lower income and family assets per capita than those from the rich class in 2002, however individuals with revolutionary background and Chinese Community Party

(CCP) members from the poor class do not have lower income than those from the rich.

Preface

Chapter 3 is a joint work with Kathy Baylis and Yazhen Gong. I contributed to the development of research idea, theoretical model development, data analysis, and preparation for manuscript. Kathy Baylis contributed to the development of research idea, data analysis and preparation for manuscript. Yazhen Gong contributed to the development of research idea, survey design, data collection, and preparation for manuscript.

Table of Contents

List of Tables

Acknowledgements

I offer my enduring gratitude to the faculty, staff and my fellow students at the UBC, who have inspired me to continue my work in this field. I would like to show my deep gratitude to my thesis supervisor, Dr. Patrick Francois, for his supervision and support with great patience. I am greatly indebted to Dr. Kathy Baylis, Dr. Shinichi Sakata, and Dr. Paul Beaudry who offer invaluable guidance and help in many ways. I thank Dr. Yazhen Gong and Dr. Jintao Xu for sharing me survey data. I am also grateful to Dr. Marcos Agurto, Dr. Loren Brandt, Dr. Hongbin Cai, Dr. Mukesh Eswaran, Dr. Nicole Fortin, Dr. John F. Helliwell, Dr. Carol McAusland, and Dr. Thomas Lemieux for their valuable comments that led to improvements.

I gratefully acknowledge the financial support from the Environmental and Economic Program in South and East Asia (EEPSEA).

Special thanks are owed to my parents and my wife, who have fully supported me throughout my years of education. I also own particular thanks to my friends, Jiye Yang, Wenbin Tang, and Binggang Su for their kind help in these years.

Dedication

To my beloved Yang, Alex, and Chris

Chapter 1
Introduction

The roles of formal and informal institutions in economic development have attracted increasing attention in both theoretical and applied research. This thesis investigates the economic impact of one type of informal institution, social capital, and one type of formal institution, family class system (*chengfen*) in the context of China. Specifically, three questions are addressed using survey data: (1) Is social capital associated with the formation of Rotating Labor Associations (ROLAs) in rural China? (Chapter Two) (2) How does different type of social capital, bonding and bridging, play roles in the community management of common pool resources? (Chapter Three) (3) Does the family-class-origin-based discrimination policies existed in early 1950s to late 1970s have long-term impact on households' current political, educational, and economic status? (Chapter Four)

There is a growing literature on the effect of social capital on economic growth, public good provision and management of common pool resources (CPRs) (for a good review, see Durlauf and Fafchamps, 2005). In terms of the definition of social capital, a commonly-used concept in empirical economics is "trust, concern for one's associates, a willingness to live by the norms of one's community and to punish those who do not" (Bowles and Gintis, 2002). The effects of social capital has been posited previously in many settings: On voluntary cooperation in the management of irrigation systems (Dayton-Johnson 2000; Isham and Kähkönen, 2002a,b; Kähkönen, 1999; Meinzen-Dick *et al*., 2002; Ostrom, 1990, 1992;), in watershed management (Krishna and Uphoff, 2002), in soil conservation (Cramb, 2005), in solid waste management (Pargal *et al*., 2002), and in public goods provision in rural China (Tsai, 2007). This type of social capital is referred to as bonding social capital (Putnam, 2000). Another type of social capital, as measured by networks among diverse communities has been shown to improve economic growth and opportunities (Algan and Cahuc, 2010; Fafchamps and Minten, 2002; Palloni *et al*., 2001; Narayan, 1999; Woolcock, 1998). This type of social capital is often referred to as "bridging" social capital (Putnam, 2000).

In Chapter Two, I study one channel through which bonding social capital might be having an effect on development outcome, by focusing on household decisions to participate in Rotating Labor Associations (ROLAs). Such associations have been seen to play a major role in rural daily life but, as with all such informal rotating associations, have been theoretically conjectured to depend critically on social connectedness in their establishment and functioning. By using household data collected from the Gansu province in China, I present evidence that social capital makes a strong positive contribution to villagers' participation in ROLAs. The presence of village temple prior to 1949 is employed as an instrument to tackle the potential endogeneity problem. The reported frequency of weather disasters is used as an alternative instrument to check the robustness of results. The logic behind the instruments is that more weather disasters can lead to higher social capital in the communities through building and maintaining village temples for rain praying. In the arid and semi-arid areas in China, rituals centered around requesting rain from the Gods were historically an important collective undertaking, especially in areas that were subject to frequent weather disasters (Yang *et al*., 2005; Chau, 2006; Zhao and Bell, 2007). Village temples were constructed in dedication to the Dragon King who was believed to control the rain, and other local deities who were thought to guard the villages, as collective acts to appease the Gods and stave off adverse weather shocks. Note that these village temples are fundamentally different from those lineage halls to memorize ancestors. The latter, which is generally maintained by relatives and members of the same lineage groups, are often found in Southeast China (Tsai, 2002, 2007), however, it is very rare in the study areas in Gansu province.

The conjecture here is that the building of such temples and the long-lasting process of maintaining them by villagers from different lineage groups in the same village, and villagers' continual coming together collectively to pray for the support of the Gods to stave off inclement weather, lead to the building of social capital in areas that suffered more frequent weather disasters. Moreover, the social capital formed during the process is beyond lineage groups. The majority of village temples were destroyed during the Cultural Revolution in the 1960s due to party edicts, however, social capital laid down over such long intervals is likely to have persisted through the intergenerational transmission of internal values and beliefs.

In Chapter Three, we study the different roles played by different type of social capital, bonding and bridging, in the community management of common pool resources. We first develop a model of social capital as facilitating risk-pooling, and demonstrate how bridging might erode the effect of vulnerability to social sanction induced by bonding social capital. We next test this relationship between bonding and bridging empirically, by comparing the collection of firewood on public lands to our measures of individual bridging and bonding social capital. As in our theoretical model, we find that the two types of social capital both reduce consumption, but that they also act as substitutes for each other. Although we cannot say definitively which type of social capital erodes the other, we do see evidence that bridging appears to erode bonding, whereas the reverse is not as likely. For example, when using alternative measures of bridging social capital, such as the percent of household members who work outside the township, bridging social capital rarely has a significant effect on its own, and only acts through the interaction term on bonding social capital. Similarly, when we calculate the marginal effects of bridging and bonding, bridging only significantly reduces firewood consumption at the lowest levels of bonding, while bonding social capital significantly reduces consumption of firewood at median levels of bridging social capital.

Our findings are consistent with the results of Dayton-Johnson (2000), who shows strong evidence that bonding social capital is good for cooperation and some evidence that bridging social capital is bad for cooperation. He finds that a higher wage, and therefore higher opportunity cost decreases a communities ability to cooperate in maintaining an irrigation system. We posit that there may be another explanation in this context, where high wage implies higher ability to make money from outside the village, then less vulnerability to social sanction, and thus less willing to cooperate. Cases collected in Berkes and Folke (1998) shows that strong kinship-based relationships is essential for promoting and enforcing collective action, moreover relatively isolated systems perform better.

When we further interact bridging and bonding social capital with sensitivity to resource use and asset ownership, we observe that while none of the bonding interaction terms were significantly different from zero, bridging social capital appears to reduce sensitivity to resource capacity and reduce consumption for those asset-poor households.

Once these interaction terms are included, the direct effect of bridging social capital essentially disappears. Since we do not find that households are particularly sensitive to resource capacity, it is particularly concerning that connections with outsiders further induces consumption of low-yielding resources. We believe this may be reflecting a tragedy of the commons argument, where households hurry to consume a weakened resource fearing that if they do not, their neighbours will rush to consume it first.

Because we might be concerned that both types of social capital are jointly determined alongside community resource management, we instrument for bridging and bonding using various household and village characteristics. While we cannot be completely certain that none of these characteristics are associated with firewood collection, we cannot reject the hypothesis of no overidentification, while we do find that they help explain the levels of social capital. In particular, village size, the existence and size of the a fishpond, the variance of housing assets in the village and the number of women in the household all go to explain the household level of social capital. For bridging social capital we use instruments meant to capture the ease of access to outside work. Thus, we use the household registration system to identify those members who can legally work off-farm and thus have greater legal freedom of movement, which proves to be highly-significant in explaining the percent of days household members work outside the township. Second, we find that the larger the household overall, the higher the percent working outside the township. Last, we find that having more pre-school age children decreases the probability that household members work far away from home. Again, we find none of these factors affect firewood collection directly.

When we use these instruments, we find similar qualitative results as before, in that both types of social capital reduce collection of firewood on public lands in the absence of other social capital, but that the two types of social capital appear to act as substitutes for each other, each decreasing the effect of the other when social capital is high. In conclusion, we find that when considering a village's ability to successfully manage a common pool resource, one may need to consider both levels of bonding and bridging social capital. That is, the ability of strong levels of trust and social norms within the village to enforce resource use agreements appears to be affected by the strength of social networks outside the village.

In Chapter Four, I study the long-term impact of class identity (*chengfen*) on individuals' income and households' wealth in urban China. In the 1950s, the communist government of the People's Republic of China (PRC) launched the movement of expropriation of merchants and capitalists and nationalization of industrial and commercial enterprises in urban China. This movement led to substantial homogeneity of income and consumption in cities (Lee and Selden, 2007). The government also assigned an inheritable class identity (*chengfen*) that was considered permanent to each family and implemented discriminatory policies based on class identities. Their intention was to reprimand affluent citizens who were thought to be gaining wealth by exploiting others, while rewarding both citizens who were considered exploited and citizens who supported the socialist revolution. The main determinants of a family's class status were the source of income, job type, and political status of the member of the family in the years prior to the formation of PRC in 1949. There were four broad status categories: (1) the revolutionary class, which includes revolutionary cadres, member of the Chinese Community Party (CCP) and army men; (2) the poor class, which includes poor or landless peasants, lower-middle-income peasants and industrial workers; (3) the middle class, which includes upper- and middle-income peasants, office workers, petty proprietors, teachers, and professionals; (4) the rich class or the exploiting class, which includes rich peasants, landlords and capitalists who earned land or capital rents (Deng and Treiman, 1997).

Prior to its official abolition in 1979, family class origins were vitally important political labels for each individual throughout the Maoist era (Huang, 1995; Unger, 1982; Watson, 1984; Zhang, 1998). Rich and middle class families were discriminated in many aspects, including education, employment, and admission into the armed forces and the CCP. Li (2006), Zhou *et al*. (1998), Sato and Li (2007, 2008), and Zhang (1998) all find strong correlations between family class origins and educational achievements. Using China Household Income Project (CHIP) survey data in 2002, I also find the effects of discrimination: individuals with poor and revolutionary class origins obtain CCP membership more easily and achieve a higher level of education in the three decades wherein the discriminatory policy was formally in effect.

In 1979, China government implemented market-oriented economic reform. The

class system and class-based discriminatory policy were also officially abolished. University admissions returned to merit-based enrollment in 1977. The regression results in this chapter show that individuals with a revolutionary class background are continue to be more likely to be granted CCP membership even after the abolition of the class system. However, descendants of the poor class no longer enjoyed this political benefit. The descendants of the rich who received education after the late 1970s were more likely to achieve a higher level of education than all other classes, after controlling for fathers' education, occupation, and CCP membership. These results could indicate their strong preference over education. Once the social discrimination against them was abolished and the education system returned to merit-based, invested more on education.

Furthermore, after controlling for the CCP membership and educational attainment which can transmit the effects of family class background, I find that the descendants of the poor and middle class continue to have significantly lower income and family assets than those of the rich class. Specifically, individuals with poor class origins have 12% lower monthly income and 27% lower family assets per capita than those with rich class origins. The results suggest that physical capital within families is transmitted across generations even after homogenization of income and properties and the long term social discrimination against the previous well-off families. Moreover, individuals with a revolutionary class background have the same income and assets per capita as those with rich class origins. This result implies that families with a revolutionary background have become a new elite group in contemporary China.

Chapter 2

Social Capital and Rotating Labor Associations: An Instrumental Variables Approach

2.1 Introduction

Rotating associations in rural areas, such as rotating savings and credit associations (ROSCAs), have been intensively explored (Besley *et al*., 1993; Anderson and Baland, 2002; Anderson *et al*., 2009). But similar mutual-aid organizations organized around labor, rotating labor associations (ROLAs), have not received much attention. ROLAs are not only well-known in sub-Saharan Africa (van den Brink and Chavas, 1997), but also widely found in contemporary Rural China, and seem to be occurring with increased frequency (Yu, 2001). ROLAs were even broadly existed before 1949, the foundation of the People's Republic of China. The usefulness of mutual aid impressed the government officials so much that they determined to organize farmers into formal agricultural mutual aid teams during the land reform in early 1950s. The mutual aid system was simple in the beginning and farmers only shared some temporary labor and capital before the involvement of government. Individual households still owned their lands and were responsible for own production. However, the slack mutual aid system was transferred rapidly into agricultural collectives in which individual households did not own any land and production materials. The agricultural collectivization system collapsed in late 1970s. Land was contracted to individual households upon Deng Xiaoping's economic reform. The slack mutual aid teams, emerged again in rural China after decades of the reform. In this chapter, I aim to explore the conditions for villagers' participation in ROLAs, using field data collected from Gansu province in northwest China.

Unlike saving money in a "pot" to purchase durable goods in ROSCAs, villagers in ROLAs generate a labor "pot" for production. In ROLAs, usually four to five households who reside in the same community, voluntarily gather together frequently to work on sowing or harvesting in peak farming seasons, or in some cases villagers help each other in building or maintaining their houses. No material payment is incurred in the process. Villagers exchanging labor for labor is the most common case, but some villagers also

exchange labor for the use of production animals or machines. During a typical farming season, they work on one member's land one day, and then move to another member's the other day. The sequence of receiving the "pot" is neither predetermined nor randomly chosen, instead, it is usually determined by the urgency of members' demands through their internal negotiation. For example, in the case of harvesting crops, the sequence of harvest is often determined by the maturation conditions of crops, which often vary a little across parcels of land due to the small difference in timing of planting or land conditions.

There are many potential advantages for members joining ROLAs. Firstly, all the members can finish their work earlier than by working alone. Agricultural tasks can be finished quickly since each villager only has around one third of an acre of farmland. Since finishing sowing and harvesting in time is important, all villagers are potentially better off by participating in ROLAs. Secondly, labor pooling enables specialization since there are a lot of different activities within the tasks of sowing or harvesting. Thirdly, labor pooling can allow some agricultural activities to be undertaken that could not be done alone. For example, transporting agricultural outputs from the land to home typically requires more than one person. This is especially important for the old and female labor. Fourthly, villagers sometimes have different skills that make cooperation more efficient than working alone. For example, some villagers have agricultural machine specific skills, while others do not.

In contemporary China, a large proportion of rural laborers are conducting nonfarm work in cities and towns, leaving labor shortages especially in rural peak farming seasons[1]. It seems intuitive that such labor shortage may have triggered demand for ROLAs, and that this explains their recent growth. But demand is not sufficient to ensure their existence since the voluntarily-organized associations rely on strong internal enforcement mechanisms to sustain themselves. This has been formally demonstrated by Anderson *et al*. (2009) who show that members in ROSCAs who receive the first money "pot" always have incentive to deviate from the arrangement, even in an infinitely repeated game, without extra enforcement mechanisms to ensure compliance. Without

[1] There are some villagers having seasonal nonfarm jobs and go back home to perform agricultural activities, but most of them do not go back due to the opportunity cost including travel expenses and the loss of nonfarm work earnings.

going into much details of that theoretical contribution, the main reason underlying Anderson *et al*.'s (2009) result is that the threat of future omission from a ROSCA is insufficient to act as a deterrent from absconding with the pot. The intuition for this result is that the first receiver is at least always able to replicate the best he/she can hope for in a ROSCA by saving on her own.

The upshot is that these organizations cannot be sustained without relying on some sort of extra means of enforcement. An analogous enforcement problem applies directly to members of ROLAs[2], though in these cases the enforcement problem will even be worse because unlike the caste of ROSCAs where monetary contributions are provided to a pot, with ROLAs there is also the difficulty of ascertaining whether labor contributions, which are not perfectly observable due to potential shirking, have in fact been correctly provided.

It thus seems reasonable to hypothesize that social capital, which generally refers to "trust, concern for one's associates, a willingness to live by the norms of one's community and to punish those who do not" (Bowles and Gintis, 2002), may be key in allowing the formation of ROLAs. The effects of social capital has been posited previously in many such cooperative settings: On voluntary cooperation in the management of irrigation systems (Ostrom, 1990, 1992; Kähkönen, 1999; Isham and Kähkönen, 2002a,b; Meinzen-Dick *et al*., 2002), in watershed management (Krishna and Uphoff, 2002), in soil conservation (Cramb, 2005), in solid waste management (Pargal *et al*., 2002), and in public goods provision in rural China (Tsai, 2007). However, the endogeneity of social capital is generally not taken fully into account in much of this empirical work, as discussed in Durlauf and Fafchamps (2005).

In the present study, similarly to previous ones, OLS results do show that social capital is significantly correlated with villagers' participation in ROLAs. However, there are many reasons for not interpreting this relationship as causal. The first concern is reverse causality that may have originated from: more experience of mutual help in ROLAs leading to the accumulation of higher social capital, or villagers tending to report higher level of trust (which will be the main measure of social capital here) when they are

[2] If higher efficiency can be achieved from specialization when working together, the exclusion punishment will play a more important role in ROLAs than ROSCAs, since the expected cost of being excluded will be larger.

active members of ROLAs. Secondly, there are likely to be measurement errors in aggregating and constructing the indicator of social capital. Lastly, and perhaps most importantly, there may also be omitted determinants of participation that are correlated with social capital. A contribution of this chapter is the attempt to addresses the endogeneity of social capital by employing the historical presence of village temple as an instrumental variable, as explained below[3].

In the arid and semi-arid areas in China, rituals centered around requesting rain from the Gods were historically an important collective undertaking, especially in areas that were subject to frequent weather disasters (Yang *et al*., 2005; Chau, 2006; Zhao and Bell, 2007). Village temples were constructed in dedication to the Dragon King who was believed to control the rain, and other local deities who were thought to guard the villages, as collective acts to appease the Gods and stave off adverse weather shocks. Note that these village temples are fundamentally different from those lineage halls to memorize ancestors. The latter, which is generally maintained by relatives and members of the same lineage groups, are often found in Southeast China (Tsai, 2002, 2007), however, it is very rare in the study areas in Gansu province.

The conjecture here is that the building of such temples and the long-lasting process of maintaining them by villagers from different lineage groups in the same village, and villagers' continual coming together collectively to pray for the support of the Gods to stave off inclement weather, lead to the building of social capital in areas that suffered more frequent weather disasters. Moreover, the social capital formed during the process is beyond lineage groups. Another conjecture is that it may be other factors make social capital higher in such villages and therefore the temples are a historical reflection of this higher social capital.

Although the majority of village temples were destroyed in the Cultural Revolution, social capital laid down over such long intervals is likely to have persisted through the intergenerational transmission of internal values and beliefs. Durante (2010) provide evidence that bad weather in the history led to the accumulation of social trust, through the channel of mutual insurance triggered by the need to cope with climatic risk in the

[3] Droughts are the most common weather disasters which have great impact on agricultural activities in the research areas, but there are also some villages close to the Yellow River experienced floods.

context of Europe. The hypothesis of long-term persistence of social capital is a theme in much previous work, and has received strong support in other contexts. Putnam *et al*. (1993) conjecture that the significant differences in social capital between the North and South of Italy today can be traced back to the history of independence that cities in the North experienced in the Middle Age. Guiso *et al*. (2008b) present strong evidence supporting the conjecture. Moreover, they find that the past free-city-state experience can explain the variations in social capital within the Northern regions. Tabellini (2010) shows that the levels of education and the extent of democracy in the 18th century within Europe are determinants of current trust. Durante (2010) shows that the variation of social trust in contemporary Europe is driven by historical rather than recent variability of weather. Nunn and Wantchekon (2011) attribute high levels of mistrust in current day Africa to the past slave trade which resulted in an environment of insecurity and mistrust among individuals.

Studies also show that the persistence of social capital is mainly through internal values and beliefs. Nunn and Wantchekon (2011) show that the internal channel accounts for around 75% of the slave trade's total effect on trust. Guiso *et al*. (2004) find that individual's financial decisions are not only affected by the social capital in the province where the individual is currently living, but also by social capital in the province where the individual was born. Giuliano (2007) shows that living arrangements of second generation migrants to the United States between 1970 and 2000 are affected not only by economic conditions, but also by the changes in the country of origin over the same time period. Similarly, Fernandez and Fogli (2007) show that the work and fertility choices of second-generation American women are affected by the female labor force participation and fertility rates of their ancestors' country of origin[4]. Theoretical analysis also emphasize the importance of the internal channel in the intergenerational transmission of social capital (Francois and Zabojnik, 2005; Guiso *et al*., 2008a).

This chapter proceeds by first establishing that the presence of village temple prior to 1949 does strongly contribute to social capital at the village level. By then using the temple presence as the instrument, I perform 2SLS estimation of the effect of social

[4] See the review article by Guiso and Sapienza (2006) for a summary of these and other relevant studies.

capital on villagers' participation in ROLAs. The advantage of using this historical information is that the impacts of omitted variables reflecting contemporary economic or social conditions can be greatly isolated. The results show that social capital has a strong positive and causal effect on villagers' participation in ROLAs. The coefficients on social capital using the instrumental variables approach are significantly larger than those obtained via ordinary least squares.

I then conduct various robustness checks to substantiate the results. Firstly, I investigate whether social capital has effect on villagers' participation in ROLAs by controlling for additional variables which could potentially link with both social capital and mutual help. I find that none of these overturn the results, and the coefficients of social capital almost remain the same as in the baseline model when including a number of other such variables. Secondly, I use the reported frequency of weather disasters as an alternative instrument to do the robustness check. Thirdly, to tests the exogeneity of instruments, I include both the presence of temple and the frequency of weather disasters as instruments for social capital to perform an overidentification test. The results show that the null hypothesis of is not rejected, which provide extra evidence of the validity of the instrumental variables approach.

This chapter is organized as follows. Section 2.2 provides the descriptive statistics of the field data, and the method of constructing the indicator of social capital. Section 2.3 estimates the correlation between social capital and villagers' participation in ROLAs. Section 2.4 estimates the causal effect of social capital on villagers' participation in ROLAs using an instrumental variable approach. Section 2.5 performs various robustness checks to substantiate the main results. Section 2.6 draws conclusions.

2.2 Data and Descriptive Statistics

The field work is conducted by me in the three river basins in Gansu province in northwest China in 2008, supported by the Environmental and Economic Program in South and East Asia (EEPSEA). The research area comprises an arid and semi-arid region. The perennial average rainfall ranges from 100 to 250 mm and annual average evaporation ranges from 1600 to 2,600 mm. Irrigation water is generally not sufficient for agricultural production in most areas, hence the agricultural harvest is highly

weather-dependent. The province is one of the poorest provinces in China. The GDP per capita in 2007 is 9,527 CNY (Chinese Yuan, approximately 1,361 US Dollars using the exchange rate 7:1), which ranks it 29th of the 31 provincial-level administrative units in mainland China. In the survey, there are 690 households randomly taken from 275 communities. Three counties are randomly selected from each river basin from upstream to downstream areas along with Yellow River, Shiyang River, and Heihe River respectively. The number of observations taken from each county is roughly proportional to the total agricultural population.

Social capital is constructed from villagers' responses to the following four statements on trust: (1) Generally speaking, most villagers can be trusted; (2) I can trust my neighbors to look after our house when we are away; (3) I can trust my neighbors to take care of my children when we are away; 4) Most villagers can expect others to help them when they are in really difficult situations, such as when they are very sick or their houses are burned down. There are five levels of responses to the statements, in which 1 to 5 stands for "strongly disagree" to "strongly agree" respectively.

Table 2.1: Correlation Matrix of Community Trust

	General trust	Trust neighbors to look after house	Trust neighbors to take care of children	Most villagers can expect others to help them in really difficult situations
General trust	1.000			
Trust neighbors to look after house	0.371*** (0.000)	1.000		
Trust neighbors to take care of children	0.388*** (0.000)	0.830*** (0.000)	1.000	
Most villagers can expect others to help them in really difficult situations	0.441*** (0.000)	0.334*** (0.000)	0. 407*** (0.000)	1.000

This set of measures of trust have some advantages over more general trust questions that are generally asked in other surveys such as the World Values Surveys and the General Social Surveys. The trust question in these Surveys is: "Generally speaking, would you say that most people can be trusted or that you can't be too careful when

dealing with people?" The first question in my survey is similar to this one. The potential shortcoming of this measure is that when a respondent is asked about trusting others, it is not specified what they trust them to do. This is why I included the three extra measures which specify trust in specific contexts. These specific trust contexts are also designed to describe situations that have salience with the lives of these largely agrarian individuals. Table 2.1 shows that those trust measures are significantly correlated. ***, **, and * indicates significance at the 1, 5, and 10% level respectively. This rule is applicable throughout the following chapters.

To reduce the dimension of trust measures which are highly correlated, I perform factor analysis to generate one comprehensive measure of individual trust. Table 2.2 reports the factor loadings and the eigenvalue of the first principal factor. The first principle factor is the only one used to represent social capital since only the first eigenvalue is greater than one.

Table 2.2: Factor Loadings

Community Trust	Factor1
General trust	0.507
Trust neighbors to look after house	0.841
Trust neighbors to take care of children	0.870
Most villagers can expect others to help them in really difficult situations	0.502
Eigenvalue	1.973

I then show that it is the community trust instead of individual trust that is associated with households' participation in ROLAs, by performing simple inter-group tests after generating a factor of individual trust through factor analysis. I first show that there is no significant difference in individual trust between the group of villagers participating in ROLAs and not in ROLAs, in the villages with ROLAs. I then show that the group of villagers in the villages without ROLAs has significantly lower trust than the group of villagers in the villages with ROLAs. Detailed results on the inter-group comparisons are reported in Table 2.3 and Table 2.4. Table 2.5 reports the descriptive statistics of these trust measures and the induced social capital measure.

Table 2.3: Comparison of Trust between Two Groups

Group	Obs.	Mean	Std. Err.	Std. Dev.	95% Confidence	Interval
0	70	0.271	0.063	0.525	0.146	0.396
1	141	0.405	0.062	0.739	0.282	0.630
Combined	211	0.361	0.047	0.677	0.269	0.452
Diff		-0.133	0.008		-0.308	0.040
diff = mean(0) - mean(1)		t = -1.516				
Ho: diff = 0		Satterthwaite's degrees of freedom = 183.727				
Ha: diff < 0		Ha: diff != 0		Ha: diff > 0		
Pr(T < t) = 0.066		Pr(T > t) =0.131		Pr(T > t) = 0.934		

Notes: Group 0 is comprised of villagers participating in ROLAs in the villages with ROLAs. Group 1 is comprised of villagers not participating in ROLAs in the villages with ROLAs.

Table 2.4: Comparison of Trust between Two Groups

Group	Obs.	Mean	Std. Err.	Std. Dev.	95% Confidence	Interval
0	479	-0.159	0.044	0.964	-0.245	-0.072
1	211	0.361	0.047	0.677	0.269	0.452
Combined	690	0.000	0.035	0.918	-0.069	0.069
Diff		-0.519	0.064		-0.645	-0.393
diff = mean(0) - mean(1)		t = -8.096				
Ho: diff = 0		Satterthwaite's degrees of freedom = 557.455				
Ha: diff < 0		Ha: diff != 0		Ha: diff > 0		
Pr(T < t) = 0.000		Pr(T > t) = 0.000		Pr(T > t) = 1.000		

Notes: Group 0 is comprised of villagers in the villages without ROLAs. Group 1 is comprised of villagers in the villages with ROLAs.

Table 2.5: Descriptive Statistics of Community Trust

Variable	Obs	Mean	Std. Dev.	Min	Max
General trust	275	4.052	0.542	2	5
Trust neighbors to look after house	275	3.732	0.728	1.75	5
Trust neighbors to take care of children	275	3.830	0.743	1.75	5
Most villagers can expect others to help them when in really difficult situations	275	4.119	0.613	1	5
Social capital	275	0.068	0.958	-2.721	1.962

Table 2.6 summarizes the dependent variable and other independent variables. The dependent variable in my regressions is a dummy variable indicating whether a household joins a ROLA in 2007, the year before the survey year[5]. About 20% of households are members of ROLAs in the survey. A ROLA is often composed of

[5] No minimum amount of labor is required in defining the participation in ROLAs.

neighbors and relatives instead of just people in the same linage group in the survey area. The role of linage group is much weaker in the survey area than some Southwest regions in China, evidenced by the rare existence of lineage halls or temples.

The set of variables directly linked with households' demand for mutual help include the proportion of household laborers conducting nonfarm work,[6] and land per household laborer. Intuitively more nonfarm work and larger farmland per laborer induce higher demand for ROLAs. Villagers' labor contribution to the construction and maintenance of canals might have positive effect on villagers' participation in ROLAs, since villagers might be more willing to cooperate if they are able to cooperate on the construction and maintenance of canals.

Table 2.6: Descriptive Statistics of Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
ROLA's membership	690	0.204	0.404	0	1
Percent of household laborers conducting non-farm work	676	0.347	0.307	0	1
Land per household laborer	690	3.564	2.845	0	23
Labor contribution to the maintenance of canals	682	0.922	2.267	0	16.667
Age	690	47.913	10.456	25	84
Age squared/100	690	24.048	10.610	6.25	70.56
Years of education	690	6.862	3.451	0	15
Married	690	0.968	0.176	0	1
Village leader	690	0.110	0.313	0	1
Estimated value of houses	678	3.513	3.569	0	20
The distance to the farthest neighbor	690	0.859	1.004	0.001	6
The distance to the nearest neighbor	690	0.017	0.096	0	1.5
The distance to the nearest big road	690	1.207	2.409	0	15

Notes: The unit of land per household laborer is *mu* (a unit of land area generally used in China, 1 *mu* is approximately equal to 0.165 acre). The unit of labor contribution to maintenance of canals is hours/member. The unit of estimated value of houses is 10,000 CNY. The unit of distance to the farthest neighbor, nearest neighbor, and the nearest big road is kilometer.

Demographic and geographic variables are also controlled for in the cross-sectional regressions. Individual controls include information on household head, such as age, age squared divided by 100, years of education, a dummy for marital status, and a dummy indicating whether the respondent is a village leader. These controls are intended to pick

[6] A household laborer is defined as an individual who has worked in 2007.

up factors likely to affect villagers' incentive to participate in ROLAs. The elderly and the non-married are likely to have larger incentive to join ROLAs, and years of education and village leader dummy are potential proxies of personal income. Household control refers to the estimated value of houses. This control is also intended to measure households' long term income, which are potentially correlated with villagers' participation in ROLAs.

Geographic controls include the distance to the farthest neighbor and the nearest neighbor in the same community, and the distance to the nearest big road. The distances to neighbors are intended to link with villagers' mutual help by their effects on transaction costs. The hypothesis is that if villagers live far away from each other, they tend to cooperate less. The distance to the nearest big road which indicates the level of connection with outside market and job opportunities will potentially affect villagers' incentive to participation in ROLAs. County dummies indicate the county where respondents live. The county fixed effects are included to capture county-specific factors.

2.3 Social Capital and Participation in ROLAs: OLS Estimates

I begin the analysis by first testing the empirical relationship between social capital and villagers' participation in ROLAs. The regressions are for a latent variable model:

$$y_{ij}^{*} = \alpha + \beta S_i + L_{ij}'\gamma + X_{ij}'\delta + \varepsilon_{ij},$$
$$Y_{ij} = \begin{cases} 1 & if\ y_{ij}^{*} > 0, \\ 0 & if\ y_{ij}^{*} \le 0, \end{cases} \tag{2.1}$$

where i and j denote the village and the household, Y_{ij} is a dummy indicating whether the household is a member of ROLAs, S_i denotes social capital in village i, L_{ij}' is the vector of variables denoting the demand for ROLAs and villagers' labor contribution to the construction and maintenance of canals, X_{ij}' is a vector of other covariates, and ε_{ij} is the random error term. The coefficient of interest is the impact of social capital, β.

There are four columns in Table 3 reporting the OLS results. The first three models include different sets of control variables. Column (1) only considers individual controls

and county dummies; column (2) includes individual controls, household controls and county dummies; column (3) includes geographic controls besides individual controls, household controls, and county dummies. Column (4) includes all the controls but exclude communities with only one observation. Standard errors in all models are clustered at the village level to account for the possible intra-village correlations of errors, and ***, **, and * indicates significance at the 1, 5, and 10% level respectively. This rule is applied to all the tables reporting statistical significance in this thesis.

The results in Table 2.7 show that there is a strong correlation between the measure of social capital and households' participation in ROLAs. The coefficient of social capital is stable across models, ranging from 0.072 to 0.086. The adjusted R-squared ranges from 0.127 to 0.148 across different models, which implies that a significant proportion of variation in villagers' cooperation is associated with variation in the set of explanatory variables. All six variables indicating potential demand for ROLAs are not significant, which might imply that the potential demand for labor exchange does not always lead to the formation of ROLAs, due to social capital limitations, or that this demand is relatively homogeneous across the sample. Since the dependent variable is binary, I also perform probit regressions, with similar results reported in Appendix A.1.

Table 2.7: Determinants of Villagers' Participation in ROLAs

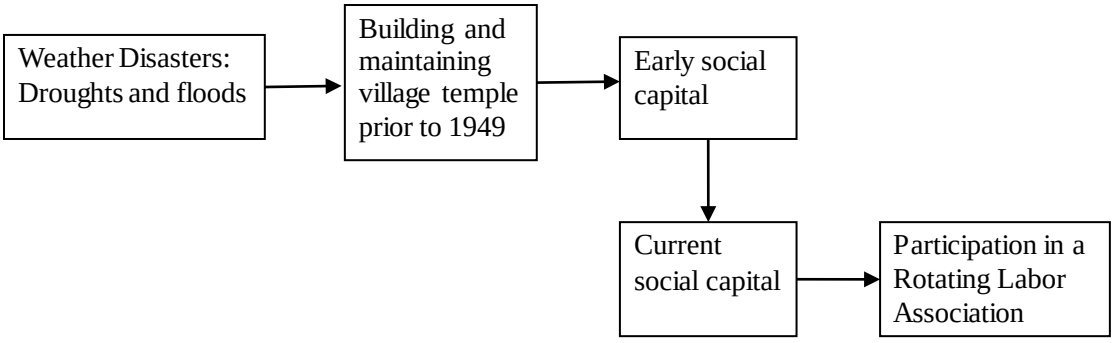
	(1)	(2)	(3)	(4)
	Dependent Variable: Participation in a ROLA			
Social capital	0.086***	0.082***	0.079***	0.072***
	(0.021)	(0.021)	(0.020)	(0.023)
Percent of household laborers	0.056	0.059	0.061	0.043
conducting non-farm work	(0.057)	(0.056)	(0.056)	(0.059)
Land area per laborer	0.005	0.004	0.003	0.003
	(0.006)	(0.006)	(0.006)	(0.007)
Labor contribution to maintenance	0.018*	0.017	0.017	0.017
of canals	(0.011)	(0.011)	(0.011)	(0.012)
Individual controls	Yes	Yes	Yes	Yes
Household controls	No	Yes	Yes	Yes
Geographic controls	No	No	Yes	Yes
County dummies	Yes	Yes	Yes	Yes
Restricted sample	No	No	No	Yes
Number of obs.	668	656	656	581
Adjusted R-squared	0.127	0.132	0.144	0.148

Table 2.7 demonstrates the strong correlation between social capital and villagers' participation in ROLAs, however, there are many important reasons for extreme caution in interpreting the relationship as causal. The first concern is reverse causality that may have originated from two sources: more experience of mutual help in ROLAs may lead to the accumulation of greater social capital, also villagers may tend to report higher levels of trust when they are active members of ROLAs. Secondly, there is likely to be measurement errors in aggregating and constructing the indicator of social capital. Lastly, there might be omitted determinants of participation that are correlated with social capital. To address these problems, instrumental variables, which have an impact on social capital but have no direct effect on voluntary labor exchange, can potentially be used. Section 4 proceeds to do this.

2.4 Social Capital and Participation in ROLAs: IV Results

2.4.1 Identification Strategy

The majority of households in the research area rely heavily on rainfall in irrigating their land. Weather disasters thus have great impact on livelihoods in such weather-dependent producing regions. Praying for rain historically became an important group ritual performed in areas with particularly severe and frequent weather disasters (Chau, 2006; Yang *et al*., 2005; Zhao and Bell, 2007).



Village temples, dedicated to the Dragon King, who was believed to control the rain, and other local deities who were thought to guard villages, are likely to have been built by villagers in regions where the need for such protection was seen as particularly pressing. The hypothesis here is that the building of such temples for the communal good,

and the ongoing and long lived process of maintaining such temples and regularly coming together to hold rain-praying rituals, contributed to the accumulation of social capital in the areas subject to the most frequent weather disasters. Although the vast majority of village temples would have been destroyed in the 1960s, social capital is likely to continue to persist today through the intergenerational transmission of internal values and beliefs. The theory is described in the graph above.

The two equations below describe the relationship illustrated in the graph.

$$S_i = \alpha_R + \beta_R T_i + X'_{ij}\delta_R + v_{R_{ij}}, \tag{2.2}$$

$$T_i = \alpha_T + \beta_T D_i + X'_{ij}\delta_T + v_{T_{ij}}, \tag{2.3}$$

where T_i is the dummy variable of historical existence of village temples, D_i is the number of reported weather disasters in the past five years, X'_{ij} is a vector of other covariates, and $v_{R_{ij}}$ and $v_{T_{ij}}$ are the random error terms.

I employ the instrument, a dummy variable indicating the existence of a village temple prior to 1949, to test the effect of social capital on participation. There is 63.6% of villages reported the historical existence of temples. The advantages of using the historical existence of village temples include: first, a lot of village temples were destroyed in the Cultural Revolution in 1960s, so those remaining today cannot truly indicate the influence of contemporary weather disasters; second, using the historical information can help to isolate the impacts of omitted variables reflecting contemporary economic or social conditions.

Table 2.8: Temple Presence Prior to 1949 and Social capital

	(1)	(2)	(3)	(4)
	Dependent Variable: Social Capital			
Temple presence prior to 1949	0.575***	0.568***	0.566***	0.603***
	(0.121)	(0.122)	(0.121)	(0.134)
Individual controls	Yes	Yes	Yes	Yes
Household controls	No	Yes	Yes	Yes
Geographic controls	No	No	Yes	Yes
County dummies	Yes	Yes	Yes	Yes
Restricted sample	No	No	No	Yes
Number of obs.	668	656	656	581
Adjusted R-squared	0.157	0.161	0.164	0.173

Table 2.8 reports regression results for the effects of the temple presence prior to 1949 on social capital. To save space, I only report the coefficients and standard errors of temple presence in the table. The OLS results show that temple presence have a strong positive impact on the level of social capital. Moreover, the coefficients of the temple presence prior to 1949 under the varying specifications are very stable.

2.4.2 IV Regressions

In this section I estimate the impact of social capital on villagers' voluntary participation in ROLAs by exploiting the historical existence of village temple as the instrumental variable. Social capital is treated as endogenous and modeled as:

$$S_i = \mu + \rho D_i + X_{ij}'\gamma + v_i, \tag{2.4}$$

where S_i is social capital, and D_i is the presence of temple prior to 1949, X_{ij}' is a vector of other covariates, and v_i is the random error term.

I perform the IV regressions mainly by using 2SLS. Angrist and Krueger (2001) and Wooldridge (2002) suggest that 2SLS is a robust estimation method even in the presence of a dichotomous dependent variable in the second stage, since strong specification assumptions are required to justify other nonlinear second-stage model specifications. In this case, the 2SLS typically capture an average effect of social capital analogous to the LATE parameter. To address the functional form issue, I employ a nonlinear regression method "IV-probit" which report conditional maximum-likelihood estimators to estimate the effect of social capital. The regressions reported in Appendix A2. show similar qualitative results to those in 2SLS reported in Table 2.9.

Panel A shows the second-stage results of 2SLS regressions. The coefficients of social capital are stable across models, and all are significant at 5% confidence level except in the model (6). The results show that social capital has a significantly positive effect on villagers' participation in ROLAs. The coefficient of social capital in model (4), the baseline model, is 0.169, which indicates that a 1 percentage point increase in social capital increases the likelihood of participation by nearly 0.17 percentage points.

The coefficients and standard errors of the set of controls directly related with the demand for mutual help are also reported in panel A. The coefficients of the dummy

indicating the respondent's non-farm employment, the percent of household laborers conducting nonfarm work, and farm land per laborer are not significant in all the four models, suggesting that the demand for mutual help does not seem to play a significant role in determining villagers' participation.

Table 2.9: IV Regressions of Participation in ROLAs

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A	Dependent Variable: Participation in a ROLA					
Social capital	0.230***	0.170**	0.210***	0.169**	0.193**	0.142*
	(0.076)	(0.079)	(0.076)	(0.077)	(0.077)	(0.080)
Percent of household laborers conducting non-farm work	0.040	0.042	0.044	0.045	0.028	0.024
	(0.061)	(0.060)	(0.059)	(0.059)	(0.066)	(0.065)
Land area per laborer	-0.003	0.005	-0.004	0.004	-0.003	0.003
	(0.006)	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)
Labor contribution to maintenance of canals	0.020*	0.015	0.014	0.015	0.013	0.015
	(0.010)	(0.010)	(0.011)	(0.011)	(0.012)	(0.012)
Panel B	Dependent Variable: Social Capital					
Temple presence prior to 1949	0.597***	0.568***	0.586***	0.566***	0.620***	0.603***
	(0.122)	(0.122)	(0.120)	(0.121)	(0.131)	(0.134)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	No	No	Yes	Yes	Yes	Yes
County dummies	No	Yes	No	Yes	No	Yes
Restricted sample	No	No	No	No	Yes	Yes
Number of obs.	656	656	656	656	581	581
Partial R-squared of the excluded instrument	0.096	0.086	0.093	0.087	0.106	0.098
Kleibergen-Paap Wald rk F statistic	24.057	21.722	23.908	21.727	22.467	20.124

Panel B shows the relationship between temple presence and social capital. I only report the coefficients and standard errors of weather disasters to save space. The coefficients on weather disasters in the different specifications are quite similar, and all of them are significant at 1% confidence levels. The results suggest that more weather disasters lead to higher levels of social capital, as consistent with the instrumenting hypothesis.

To show the strength of the instrumental variable, I report the partial R-squared of

the excluded instrument in the first stage regressions, and the Wald F statistic based on the Kleibergen and Paap (2006) rk statistic to test for weak identification in the presence of non i.i.d. residuals. Baum, Schaffer and Stillman (2007) suggest to apply the "rule of thumb" that the F statistic should be at least 10 for weak identification not to be considered as a problem (Staiger and Stock, 1997), since Stock and Yogo's (2005) critical values for the weak identification test are compiled for the case of i.i.d. residuals. The Kleibergen-Paap statistics in column (1) - (6) are between 20.124 and 24.057. That no F statistic in the model is less 10 and the partial R-squared of the excluded instrument is relatively large together suggests that there is no weak instrument problem. The reduced form regressions are also reported in the appendix A3 to show that the instrument partially and sufficiently strongly correlated with social capita once other independent variables are controlled for.

Table 2.10: Determinants of Villagers' Participation in ROLAs

	(1)	(2)	(3)
Panel A	Dependent Variable: Participation in a ROLA		
Social capital (excluding personal trust)	0.253**	0.231*	0.230*
	(0.127)	(0.126)	(0.125)
Percent of household laborers conducting non-farm work	0.043	0.045	0.053
	(0.070)	(0.067)	(0.066)
Labor contribution to maintenance of canals	0.006	0.005	0.004
	(0.008)	(0.008)	(0.008)
Panel B	Dependent Variable: Social Capital		
The presence of temple prior to 1949	0.424***	0.415***	0.409***
	(0.125)	(0.126)	(0.126)
Individual controls	Yes	Yes	Yes
Household controls	No	Yes	Yes
Geographic controls	No	No	Yes
County dummies	Yes	Yes	Yes
Number of obs.	598	588	588
Partial R-squared of the excluded instrument	0.044	0.042	0. 041
Kleibergen-Paap Wald rk F statistic	11.489	10.928	10.562

The coefficients of social capital using the instrument are about twice as large as the coefficients using OLS, suggesting that reverse causality is not a major problem. To confirm this, and to account for the self-reporting problem, I construct a measure of

social capital for each respondent which does not include his or her own reported trust. The 2SLS results using this measure of social capital reported in Table 2.10 show very similar results to those in the main regressions reported in Table 2.9, though the significance of social capital is slightly lower.

2.5 Robustness Checks

2.5.1 Additional Controls

The validity of the results in Table 2.9 depends on the assumption that temple presence has no direct effect on villagers' participation in ROLAs, or has no effect through channels other than social capital. Although this presumption appears reasonable, I proceed by substantiating it further by directly controlling for more variables that could plausibly be correlated with both villagers' participation and temple presence, and checking whether adding these variables affects the estimates. The summary statistics of these additional controls are reported in Table 2.11.

Table 2.11: Summary Statistics of Additional Controls

Variable	Obs	Mean	Std. Dev.	Min	Max
Number of kids aged 0 to 6	690	0.326	0.587	0	3
Number of kids aged 7 to 14	690	0.430	0.657	0	3
Number of the elderly (65+)	690	0.307	0.596	0	2
Dummy for wheat	690	0.688	0.463	0	1
Dummy for corn	690	0.717	0.451	0	1
Dummy for cash crops	690	0.667	0.472	0	1
Dummy for concrete-lined canal	275	0.298	0.458	0	1
Dummy for underground water	687	0.141	0.348	0	1
Distance to the ground water source	274	0.341	0.423	0	1.85
Awareness of the existence of WUAs	690	0.312	0.463	0	1
Ratio of surface water	690	0.671	0.415	0	1

Note: The unit of distance to the ground water source is kilometer.

The first concern is that the historical temple presence might be correlated with the irrigation conditions such as the availability of alternative irrigation water, and alternative water resources which might influence villagers' voluntary cooperation. It is natural to suspect that villagers will be less likely to rely on village temples if there is enough irrigation water from reservoirs, rivers or wells. However, this is unlikely to be the case in

the area of study. Shortages in irrigation water are still highly prevalent in the research area today. Although there has been improvement in irrigation facilities since the formation of P.R. China in 1949, the significantly increased demand for water from the industrial sector has marginalized irrigation water to the agricultural sector. Moreover, the increase in areas under croppage in rural areas, and the poor management of irrigation water have also contributed to sometimes acute shortages in irrigation water (Wang *et al*., 2005).

To formally account for the influence of the alternative water source, I add the dummy indicating whether the sub-lateral canal is concrete-lined[7], a dummy indicating whether the irrigation water is ground water, and village's distance to the water source when using ground water as additional control variables to the baseline model, i.e. model (4) in Table 2.9. Concrete-lined sub-lateral canals and smaller distance to the source of ground water are potentially linked with more alternative irrigation water. The results reported in column (1) of Table 2.12 show that none of these variables is statistically significant, and the coefficient of social capital is very close to the baseline estimate in model (4) of Table 2.9[8].

The second concern is that crop choice may be a function of perceived weather disasters and certain type of crops may require varying amounts of labor, so that the channel of effect of weather disasters and village temple on ROLA membership is through variation in crops, not social capital. If this were true, then we should observe large variations in crop choices amongst villagers. Moreover, there should also be differences in crop choices between groups in and not in ROLAs. However, the data shows that there is very little variation in villagers' crop choices. Corn and wheat are the two major crops in the research area, with 71.7% and 68.8% of households in the survey planting corn and wheat respectively. If we just restrict attention to households participating in ROLAs these numbers become 74.5% and 70.9% households planting corn and wheat. Though slightly higher than the sample averages, this is statistically indistinguishable at regular confidence levels, and seems much more supportive of the hypothesis that households both within and outside ROLAs grow equivalent crops.

[7] Almost all the main canals in the research areas are concrete-lined, but many sub-lateral canals are not.

[8] Only additional controls and social capital are reported in Table 2.12 to save space.

Moreover, I include dummy variables for corn, wheat, and cash crops as additional controls in column (2) of Table 2.12. The regression shows that all those variables are not statistically significant and have little impact on the coefficient of social capital.

Table 2.12: Robustness Checks: Inclusion of Additional Controls

	(1)	(2)	(3)	(4)	(5)
Panel A	Dependent Variable: Participation in a ROLA				
Social capital	0.175**	0.169**	0.171**	0.179**	0.143*
	(0.078)	(0.076)	(0.078)	(0.079)	(0.082)
Dummy for concrete-lined canal	0.012			0.010	0.016
	(0.050)			(0.050)	(0.055)
Dummy for underground water	-0.008			-0.019	-0.000
	(0.076)			(0.079)	(0.079)
Distance to the source of ground water	-0.133			-0.128	-0.145
	(0.086)			(0.091)	(0.102)
Dummy for wheat		-0.010		-0.009	0.038
		(0.041)		(0.042)	(0.043)
Dummy for corn		0.062		0.012	0.038
		(0.050)		(0.053)	(0.056)
Dummy for cash crops		0.054		0.037	0.042
		(0.039)		(0.040)	(0.041)
Number of kids aged 0 to 6			0.015	0.011	0.008
			(0.024)	(0.025)	(0.026)
Number of kids aged 7 to 14			-0.034	-0.036	-0.027
			(0.024)	(0.024)	(0.026)
Number of the elderly (65+)			-0.005	-0.007	0.002
			(0.029)	(0.028)	(0.031)
Panel B	Dependent Variable: Social Capital				
The presence of temple prior to 1949	0.569***	0.582***	0.562***	0.574***	0.618***
	(0.124)	(0.118)	(0.122)	(0.122)	(0.136)
Number of obs.	653	656	656	653	578
Partial R-squared of the excluded instrument	0.086	0.090	0.086	0.086	0.098
Kleibergen-Paap Wald rk F statistic	21.131	24.321	21.237	22.067	20.816

There are some demographic variables such as the number of kids and the elderly aged 65+ in the household, which could also affect villagers' potential demand for mutual help. I add those variables in column (3) of Table 2.12. These variables are statistically insignificant, and the coefficient of social capital is very close to the baseline estimate.

This implies that these variables have little impact on the basic results. I include all these additional controls together in column (4) and (5), in which column (5) reports the regression with restricted sample.

Despite the large number of controls, the coefficients of social capital are still significant at 5% confidence level (except in model (5)) and very close to that in the baseline model in Table 2.9. Overall, Table 2.12 shows that none of these additional controls overturn the effect of social capital. The results support the assumption underlying the instrument, i.e., the historical presence of village temple is not likely to have an effect on villagers' participation in ROLAs through these other posited channels.

2.5.2 An Alternative Instrumental Variable

According to this identification strategy proposed, historical weather disasters can be used as an alternative instrument for social capital. I then test the robustness of results using weather disasters in this section. Due to the non-availability of historical data on village-level weather disasters, I use current information on weather disasters over the past five years to obtain an estimate of the underlying propensity to be subject to such shocks. This adds noise to the measurement of shock propensity but not any clear biases since there have been no remarkable changes in climate in the research areas in recorded history (Lin and Lu, 2004; Wang *et al.*, 2009; Yang, 2005). I thus proceed to measure the frequency of weather disasters by the total number of major weather disasters including droughts and floods experienced in the past five years as reported by respondents and averaged up to the community level.

Table 2.13 reports the results of 2SLS regressions. The historical existence of village temple has a strong positive contribution to social capital today. The Kleibergen-Paap F statistics in in first two models are greater than 10, and that in the third model is close to 10, suggesting that there is no severe weak instrument problem. The coefficients of social capital in all models are significant at 1% confidence levels, but are slightly larger than that in Table 2.9.

Table 2.13: IV Regressions: Weather Disasters as An Instrument

	(1)	(2)	(3)
Panel A	Dependent Variable: Participation in a ROLA		
Social capital	0.408***	0.426***	0.329**
	(0.157)	(0.158)	(0.152)
Percent of household laborers	0.013	0.011	0.026
conducting non-farm work	(0.072)	(0.073)	(0.065)
Land area per laborer	-0.004	-0.005	-0.005
	(0.008)	(0.008)	(0.007)
Labor contribution to maintenance	0.017	0.015	0.013
of canals	(0.011)	(0.011)	(0.011)
Panel B	Dependent Variable: Social Capital		
Weather disasters	0.088***	0.088***	0.084***
	(0.025)	(0.025)	(0.027)
Individual controls	Yes	Yes	Yes
Household controls	No	Yes	Yes
Geographic controls	No	No	Yes
Number of observations	668	656	656
Partial R-squared of the excluded instrument	0.039	0.040	0.032
Kleibergen-Paap Wald rk F statistic	11.922	12.160	9.600

2.5.3 An Overidentification Test

To test the exogeneity of instruments, I include both the presence of temple and the frequency of weather disasters as instruments for social capital in this section to perform an overidentification test. Table 2.14 present the results. The Hansen J statistic and p-value indicate that the models are not over-identified. Though this test is supportive of the procedure used here, it should be noted that this method is not foolproof since it is based on the assumption that one of the instruments is valid. Such overidentification test might not lead to a rejection even when all instrumental variables are not valid, provided they are highly correlated with each other.

Table 2.14: An Overidentification Test

	(1)	(2)	(3)
Panel A	Dependent Variable: Participation in a ROLA		
Social capital	0.177***	0.160***	0.155**
	(0.069)	(0.069)	(0.070)
Panel B	Dependent Variable: Social Capital		
The temple presence prior to 1949	0.583***	0.576***	0.574***
	(0.122)	(0.118)	(0.122)
Weather disasters	0.068*	0.068*	0.061*
	(0.035)	(0.035)	(0.035)
Individual controls	Yes	Yes	Yes
Household controls	No	Yes	Yes
Geographic controls	No	No	Yes
County dummies	Yes	Yes	Yes
Number of observations	668	656	656
Partial R-squared of the excluded instrument	0.101	0.099	0.097
Kleibergen-Paap Wald rk F statistic	11.804	11.599	11.370
Hansen J statistic and p-value	0.178	0.117	0.254
	(0.673)	(0.732)	(0.614)

2.6 Concluding Remarks

Macro country level studies presenting evidence of large and significant causal effects of social capital on development outcomes are increasingly common in the development literature; see for example Algan and Cahuc (2010) and Tabellini (2010) for persuasive recent studies. The present chapter studies one channel through which such social capital might be having an effect at the micro level, by focusing on household decisions to participate in Rotating Labor Associations. Such associations have been seen to play a major role in rural daily life but, as with all such informal rotating associations, have been theoretically conjectured to depend critically on social connectedness in their establishment and functioning. By using novel instruments to elicit exogenous sources of variation in social capital, and by using household data collected from the Gansu province in China, I present evidence that social capital makes a strong positive contribution to villagers' participation in ROLAs. This finding survives numerous robustness checks, suggesting that such communal level associations may be an important channel through which social capital affects development outcomes.

Chapter 3

Bridging vs. Bonding Social Capital and the Governance of Common Pool Resources[9]

3.1 Introduction

As in many developing regions, firewood is the primary source of fuel for heating and cooking in the Yunnan province of China, and demand for firewood has caused deforestation. The mountains in Yunnan have been deemed a "biological hotspot" by Conservation International, and firewood collection, along with illegal logging, has destroyed habitat for endangered species, such as the red panda (Conservation International, 2007; Xu and Wilkes, 2004). Because much rural land is held collectively, village forests are common pool resources (CPR), where it is difficult, if not impossible, to exclude use, and overconsumption is common. A number of authors have suggested that, with sufficient social capital, village-level management of CPRs can be successful, since village members can better detect over-use of the resource and often can enforce consumption rules more effectively. Because social capital can aid information flow and enforcement, it can help communities overcome the tragedy of the commons often associated with common pool resources (Acheson, 2000; Bowles and Gintis, 2002; Hardin, 1968; Ostrom, 1990, 1999). In this chapter, we consider how social capital affects firewood collection in Yunnan.

There is a growing literature on the effect of social capital on economic growth, public good provision and management of CPRs (for a good review, see Durlauf and Fafchamps, 2005). Social capital, as measured by networks among communities has been shown to improve economic growth and opportunities (Fafchamps and Minten, 2002; Palloni *et al*., 2001; Narayan, 1999; Woolcock, 1998). This type of social capital is often referred to as "bridging" social capital (Putnam, 2000). Other studies have shown that ethnic homogeneity (Costa and Kahn, 2003; Easterly and Levine, 1997), increased vulnerability to social sanction (Anderson *et al*., 2009) and higher levels of trust (Helliwell, 1996; Knack and Keefer, 1997; La Porta *et al*., 1997) can increase growth,

[9] This chapter is a joint work with Kathy Baylis and Yazhen Gong.

public good provision and improve co-management of CPRs. However, how the two types of social capital affect the management of a CPR is not clear. In this chapter, we develop a model that compares the effect of bridging versus bonding social capital on the management of a CPR. We find that bonding social capital, by increasing the benefits of community, and therefore the cost of social sanction, always improves the community's ability to manage their CPR. By contrast, by giving communities an outside option, bridging social capital can reduce people's vulnerability, making them less susceptible to social sanction, and reducing the enforcement capability of the community. However, bridging social capital can also reduce the stress of the CPR for those people near the subsistence level. Therefore, we find the effect of bonding social capital to be clearly positive in terms of CPR management, while the effect of bridging social capital is mixed[10].

We test our theoretical results using a survey data and a field experiment from the province of Yunnan. Yunnan is of particular interest because its great biological diversity is threatened by firewood collection, and because it is ethnically diverse. Therefore, there is reason to believe that the level of social capital might vary from village to village. We collect data from 20 randomly-selected households in 30 villages in rural Yunnan. Specifically, we interview households on the amount of firewood collected on common land, the quality and use of private land, income, expenditure and their level of trust. To measure bonding social capital, we engage villagers in a field experiment, where villagers are given money and told that any funds sent to an anonymous other village member will be doubled, and that the recipient has the ability to return any portion of the financial gift to the sender.

We use the percent of days household members spend outside the township as an indicator of bridging social capital. The idea is that the more time a household member spends outside the region, greater the connection with the outside world, and therefore the greater the potential insurance against village-specific shocks. One might be concerned that this variable could affect firewood demand simply by reducing the cooking requirements of the household. To control for this concern, we include the

[10] Note that we do not address the other common concern with bonding social capital in that it can limit people to not wanting to deviate too far from the norm.

number of household members living at home in the regression for firewood. As alternative measures for bridging social capital, we also use the number of household members working outside the township, the percent of members working outside the township, and the percent of days worked outside the county, and all returned qualitatively similar results. Following Jensen and Oster (2009) we also use cable TV ownership to proxy for connections with the outside world, and although some statistical significance is lost, we again see generally similar results.

We then compare the effect of these two types of social capital on the amount of firewood collected on communal lands. We find that bonding social capital reduces firewood collection directly, and by affecting how members react to what others are doing. Bridging social capital slightly decreases consumption of the CPR at low levels of bonding social capital, but erodes the effect of bonding social capital at higher levels of community trust. We also find evidence that it makes villagers less sensitive to the quality of the CPR.

This chapter has several contributions. First, unlike previous theoretical literature which has focused primarily on the effect of bonding social capital we model and contrast the effect of both bonding and bridging social capital. Second, we explicitly model how social capital can affect vulnerability, which in turn, will determine the effectiveness of social sanction and the community's ability to enforce a cooperative solution. Third, we show that under some circumstances, some types of social capital, in fact, can nearly erode the community's ability to manage CPRs. Fourth, like Schechter (2007), we use measures from a field experiment to capture trust within a village, and then empirically test whether this trust affects CPR management.

3.2 Background

Yunnan is a largely mountainous, rural province in the southwest of China. Over 60 percent of the land is forested, and has traditionally been used for logging. It contains the headwaters of six major rivers including the Yangtze, and has been labeled a biodiversity 'hot spot' (Conservation International, 2007). Deforestation is threatening habitat of endangered species such as the red panda, and has been blamed for severe flooding and landslides in the late 1990s.

Developing successful community forest management in Yunnan has long been a problem. For example, after the Household Responsibility System reallocated land to households in 1985, anecdotal evidence showed "*…villagers ventured into the forest to log at night, fearful that their neighbors would cut remaining forests* (Su, 2002)"[11]. On the other hand, a number of villages, such as Wenming and Mabuchong have track records of successful forest management. By exploring the nature of social capital in the villages, we hope to be able to identify some of the characteristics that can help explain why local resource management has been successful in some regions and failed in others.

Yunnan is one of the poorest provinces in China. In our data, median cash rural income, not counting the value of agricultural and forest products consumed for home use, is under 6,000 CNY per household, or slightly over 2,000 CNY per working individual. Younger men are often sent to work in the neighbouring towns and cities and send money back to support the family, and around 12 percent of the household income comes from remittances. As in many developing countries, households are larger than the nuclear family: on average, our households have 1 child under the age of 16, and slightly fewer than 3 adults, and are 46% female.

Even after tenure reform in 2006, all villages have some communal land, which is managed by the natural villages. The head of the natural villages coordinates the local land use decisions largely through village-level meetings. Income from communal lands is divided among members either proportionally by household or by the number of hectares of land each household holds. Most households have some privately-owned land after tenure reform in 2006. A large majority of the households in our sample (80%) have some land for forestry (averaging 1.3 ha). All but three households have a small plot of land for agricultural production (average 0.5 ha and all households in our sample produce some agricultural product). Our sample largely consists of subsistence farmers, with only one quarter of their agricultural produce being sold on the market.

3.3 Model

3.3.1 Risk Sharing and Vulnerability to Social Sanction

In this section, we model the relationship between social capital and vulnerability to

[11] This is quoted from Weyerhaeuser *et al*. (2006).

social sanction for bridging and bonding social capital. The setting for this chapter is a village economy where the community manages common land for firewood collection. All members have access rights, implying that the community is not able to exclude members who violate the rule of consumption. Each household has a certain level of bonding social capital, which allows them to help each other when one family has a negative shock, such as an illness in the family, and to benefit from unexpected boons, such as an extra high yield of watermelons from their individual plot. Some families in the village also have ties to other villages or cities, whether through a family member sending remittances, or through friends or relatives that have since moved to a larger urban centre. Having these connections outside the village helps a family cope with not only an idiosyncratic shock but also a village-level shock, such as a bad crop year, by giving them access to outside employment income, or to informal credit from those not suffering the shock. These shocks can be thought of as not only financial, but also emotional, such as a death in the family.

Assume that there are $N > 2$ community members in a village sharing the common source of firewood. A typical villager derives utility from using a quantity of firewood c_i and consuming the numeraire good c_{0i}. In our model, villager *i*'s consumption of the numeraire is subject to an idiosyncratic shock, μ_i, such as illness or injury. For simplicity, we assume the shock is normally identically distributed with mean zero and variance σ_μ^2.

Bramoullé and Kranton (2005, 2007) show that risk-sharing networks exist in rural communities. Assume there are N villagers in the village and M_i individuals outside the village directly share risks with user *i* in the stable risk-sharing network. Assume villager *i* shares risks with each of the $N-1$ individuals in the same village at the ratio r_A, and shares the risk with the M_i individuals outside the village who are directly bridging with at the ratio r_{mB}. Moreover, villager *i* can also indirectly share risks with the $\sum_{n\neq i}^{N} M_n$ individuals through other villagers in the same village at the ratio $r_A r_{nB}\left(n \neq i\right)$. We assume the M_i individuals directly bridging with user *i* is subject to the normally

identically distributed shock $\mu_{im}\left(m=1,2,\cdots,M_i\right)$ with mean zero and variance σ_μ^2. User i's consumption of the numeraire with risk-sharing is then denoted by:

$$c_{0i}+\theta_i\mu_i+r_A\sum_{n\neq i}^{N}\mu_n+r_{iB}\sum_{m=1}^{M_i}\mu_{im}+\sum_{n\neq i}^{N}\left(r_Ar_{nB}\sum_{m=1}^{M_n}\mu_{nm}\right),$$

where $\theta_i\equiv 1-\left(N-1\right)r_A-Mr_{iB}-\sum_{n\neq i}^{N}M_nr_Ar_{nB}\in\left(0,1\right)$ is the residual of own risk. Moreover, we have $\theta_i\geq r_A$ and $\theta_i\geq r_{iB}$, which means that the degree of risk sharing is between zero and full.

Following the idea that the magnitude of risk sharing is positively correlated with the level of social capital (Carter and Maluccio, 2003; De Weerdt and Dercon, 2006), we assume r_A is an increasing function of bonding social capital, $A_i\left(i=1,2,\cdots,N\right)$, i.e. $r_A=f\left(A_1,A_2,\cdots,A_N\right)$ and $\frac{\partial r_A}{\partial A_i}>0\left(i=1,2,\cdots,N\right)$, and r_{iB} is an increasing function of villager i's bridging social capital, B_i, i.e. $r_{iB}=f\left(B_i\right)$ and $\frac{dr_{iB}}{dB_i}>0$.

Assume each villager's numeraire consumption has a CARA utility function with the form, $v(x)=-\exp(-\gamma x)$, where γ is Arrow-Pratt coefficient of relative risk aversion. Villager i's expected utility with the risk-sharing network is:

$$EU_i^a=u\left(c_i\right)+v\left(c_{0i}\right)-\frac{1}{2}\gamma\sigma_{1i}^2,$$

where

$$\sigma_{1i}^2=\left(1-\left(N-1\right)r_A-M_ir_{iB}-\sum_{n\neq i}^{N}M_nr_Ar_{nB}\right)^2\sigma_\mu^2+\left(\left(N-1\right)\left(r_A\right)^2+M_i\left(r_{iB}\right)^2+\left(r_A\right)^2\sum_{n\neq i}^{M}M_n\left(r_{nB}\right)^2\right)\sigma_\mu^2.$$

If villager i is excluded from the risk-sharing network within the village, he can only share risks with those $M-1$ individuals outside the village who are directly bridging with. Villager i's consumption of the numeraire good with shocks is then denoted by:

$$c_{0i}+\left(1-M_ir_{iB}\right)\mu_i+r_{iB}\sum_{m=1}^{M_i}\mu_{im}.$$

The expected utility of villager i will be:

$$EU_i^b = u(c_i) + v(c_{0i}) - \frac{1}{2}\gamma\sigma_{2i}^2,$$

where $\sigma_{2i}^2 = \left((1 - M_i r_{iB})^2 + M_i (r_{iB})^2\right)\sigma_\mu^2$.

It is easy to show that the variance of consumption with less mutual insurance is greater than with more mutual insurance, i.e. $\sigma_{2i}^2 > \sigma_{1i}^2$. Thus, expected utility is higher with insurance, i.e. $EU_i^a > EU_i^b$. In other words, villagers benefit from pooling their risks with more villagers. We will formally show this result in the proof for the following proposition 3.1.

We model social sanction as excluding a villager from the risk-sharing network in the village. Assume that the deviators in the village will face the probability of being excluded from the risk-sharing networks, η, thus we can define the villager's vulnerability to social sanction as:

$$m_i = \eta\left(EU_i^a - EU_i^b\right).$$

Substituting EU_i^a and EU_i^b into the definition of vulnerability above and rearranging yields:

$$\begin{aligned} m_i = {} & \gamma\eta\sigma_\mu^2(1 - M_i r_{iB})\left((N-1) + \sum_{n\neq i}^{N} M_n r_{nB}\right) r_A \\ & - \frac{1}{2}\gamma\eta\sigma_\mu^2\left((N-1) + \sum_{n\neq i}^{N} M_n (r_{nB})^2 + \left((N-1) + \sum_{n\neq i}^{N} M_n r_{nB}\right)^2\right)(r_A)^2. \end{aligned} \tag{3.1}$$

We then have the following proposition on the relationship between the vulnerability and social capital.

Proposition 3.1. *Villager i's vulnerability to social sanction is increasing with bonding social capital and decreasing with bridging social capital. Mover, the marginal effect of bonding social capital is decreasing with bridging social capital, i.e.:*

$$\frac{\partial m_i}{\partial A_i} > 0, \quad \frac{\partial m_i}{\partial B_i} < 0, \text{ and } \quad \frac{d^2 m_i}{dA_i dB_i} < 0. \tag{3.2}$$

Proof: *See Appendix B.1.*

3.3.2 Social Capital and Community Governance of CPRs

We now consider how social capital affects the cooperative level of resource consumption. We know that individuals have the incentive to extract more CPR than the socially-optimal level since each individual only internalizes their direct costs of consumption, ignoring the externalities their consumption imposes cost on their neighbors. However, existence of some enforcement mechanism might alleviate the problem. In this section, we consider peer monitoring and social sanction in the form of excluding individuals from risk-sharing networks as the enforcement mechanism, and analyze the implications for CPR consumption.

Resource consumption is modeled as a two-stage game: In the first stage, the community coordinates to set a cooperative level of consumption and establishes a mechanism to enforce this level based on peer monitoring and social sanction; In the second stage, members of the community consume the CPR. Whether individuals deviate from the consumption level set in the first stage depends on two conditions: first, whether the expected utility of consuming the cooperative level is greater than under deviation, second, whether the ex-post consumption is greater than a subsistence level. If an individual with few resources who lives right at the subsistence level realizes a large negative income shock, they might consume more CPR to survive regardless of the threat of social sanction.

Assume that individuals with access to the CPR live in a closely knit community with frequent interaction. Thus, individuals may be able to determine their neighbour's consumption level based on mutual monitoring. Further, assume that monitoring is not costless, and that player *i*'s probability of being detected if deviated from the agreed-on consumption of the CPR is an increasing function other players' total monitoring effort. This monitoring investment includes activities such as hiking in the communal forest, or record keeping. Individuals are able to impose penalties on those who deviate from the cooperative level of consumption in the form of social sanction.

The game can be solved by backward induction. In the second stage of the game, each player has two strategies: one is to cooperatively extract the CPR at the level determined by a joint utility maximization, and the other is to non-cooperatively extract the CPR based on individual utility maximization, or individual utility from the CPR.

Each player must expend constant marginal cost *d* (e.g. costs of fishing, or timber harvesting and selling on the market) to extract each unit of the CPR. Following McCarthy *et al*. (2000), we specify the utility from using the CPR as:

$$u(c_i) = c_i\left(a - b\sum_{n=1}^{N} c_n\right) - dc_i \quad , \tag{3.3}$$

where *a*, *b* and *d* denote the resource capacity, sensitivity to consumption, and constant marginal cost of consumption respectively.

In the case of non-cooperation, the reaction function of player *i* as a function of all other players' consumption (c_{-i}):

$$c_i(c_{-i}) = \frac{a-d}{2b} - \frac{1}{2}\sum_{n\neq i}^{N} c_n \, . \tag{3.4}$$

The structure of other players' reaction function is the same. Combing them gives the non-cooperative equilibrium consumption for each player and for the group:

$$\tilde{c} = \frac{1}{N+1}\frac{a-d}{b}, \tilde{C} = \frac{N}{N+1}\frac{a-d}{b} \quad . \tag{3.5}$$

If there exists some costless enforcement mechanism that enables the players to internalize the externalities associated with their consumption, the optimal consumption level should be the amount that maximizes the sum of each household's utility:

$$(\overline{c}_1, \overline{c}_2, \cdots, \overline{c}_N) = \underset{\{c_1, c_2, \cdots, c_N\}}{\arg\max} \sum_{n=1}^{N} u(c_n).$$

Substituting the specific utility function form in (3.2) and solving the maximization problem gives the cooperative levels of consumption for each player and for the group:

$$\overline{c} = \frac{1}{2N}\frac{a-d}{b}, \overline{C} = \frac{1}{2}\frac{a-d}{b}. \tag{3.6}$$

In the rest of this chapter, this level of consumption will be taken as the baseline to see whether there is over-consumption of the CPR given various levels of social capital. Since monitoring is not costless, the above optimal consumption is not enforceable since the marginal benefit of achieving the cooperative solution will be less than the marginal cost of that last unit of monitoring effort, and individuals always have incentive to deviate

to obtain higher payoff.

Next, we assume that the level of enforceable cooperative consumption level is $\hat{c}_i \left(i = 1, 2, \cdots, N\right)$ and solve for player *i*'s level of consumption given that he deviates. We solve for the expected penalty and the required level of monitoring effort needed to keep player *i* from deviating and to enforce the cooperative solution.

If all other players cooperate and player *i* is not monitored, player *i*'s consumption under deviation is:

$$c_i\left(\hat{c}_{-i}\right) = \frac{a-d}{2b} - \frac{1}{2}\sum_{n\neq i}^{N}\hat{c}_n \,. \tag{3.7}$$

Player *i*'s utility from deviation is:

$$u\left(c_i\left(\hat{c}_{-i}\right), \hat{c}_{-i}\right) = c_i\left(\hat{c}_{-i}\right)\left(a - b\left(c_i\left(\hat{c}_{-i}\right) + \sum_{n\neq i}^{N}\hat{c}_n\right)\right) - dc_i\left(\hat{c}_{-i}\right), \tag{3.8}$$

and his utility from cooperation is:

$$u_i\left(\hat{c}_i, \hat{c}_{-i}\right) = \hat{c}_i\left(a - b\sum_{n=1}^{N}\hat{c}_n\right) - d\hat{c}_i \,. \tag{3.9}$$

Assume that the probability of being caught if deviated, π_i, is an increasing function of other users' total monitoring effort, $\sum_{n\neq i}^{N} s_n$. To simplify the analysis, we choose a simple form of monitoring technique following McCarthy *et al*. (2001):

$$\pi_i\left(\sum_{n\neq i}^{N} s_n\right) = \frac{\alpha\sum_{n\neq i}^{N} s_n}{1+\alpha\sum_{n\neq i}^{N} s_n}.$$

Player *i* will not deviate from the cooperative level of consumption if and only if: 1) the expected penalty is not less than the extra utility from deviation, where his penalty is his vulnerability to social sanction times the probability he gets caught; 2) the ex-post consumption is not lower than the subsistence level[12]. Thus we have the two following conditions for cooperation:

[12] Some of the resource users are poor and their consumption is not far above subsistence consumption. If a negative shock drives their consumption below subsistence level, they will consume as much resources as they can to survive, without following the rule of cooperative consumption.

$$\pi_i\left(\sum_{n\neq i}^{N} s_n\right) m_i \geq \left(1-\pi_i\left(\sum_{n\neq i}^{N} s_n\right)\right)\left(u\left(c_i\left(\hat{c}_{-i}\right),\hat{c}_{-i}\right)-u\left(\hat{c}_i,\hat{c}_{-i}\right)\right), \tag{3.10}$$

and

$$\beta\hat{c}_i + c_{0i} + \theta_i\hat{\mu}_i + r_A\sum_{n\neq i}^{N}\hat{\mu}_n + r_{iB}\sum_{m=1}^{M-1}\hat{\mu}_{im} + \sum_{n\neq i}^{N}\left(r_A r_{nB}\sum_{m=1}^{M-1}\hat{\mu}_{nm}\right) \geq \underline{c}, \tag{3.11}$$

where β is a coefficient of transferring the firewood to numeraire goods, $\underline{c}$ is the subsistence level of consumption, and $\hat{\mu}_i$ and $\hat{\mu}_{im}$ denote the realized shocks.

First we consider the case where the subsistence constraint (3.11) is not binding and focus on the penalty constraint (3.10). The monitoring effort by players to force player *i* to cooperate must be greater than or equal to some minimum effort such that it just equals the increase in utility from deviation divided by *i*'s vulnerability to social sanction:

$$\sum_{n\neq i}^{N} s_n \geq \sum_{n\neq i}^{N}\hat{s}_n = \frac{u\left(c_i\left(\hat{c}_{-i}\right),\hat{c}_{-i}\right)-u\left(\hat{c}_i,\hat{c}_{-i}\right)}{\alpha m_i}. \tag{3.12}$$

Resource player *i*'s perceives his choices as being: (a) extracting the cooperative level, $\hat{c}_i$ and monitoring other players at the cost $\hat{s}_i$, or (b) extracting the non-cooperative level of $c_i\left(c_{-i}\right)=\frac{a-d}{2b}-\frac{1}{2}\sum_{n\neq i}^{N} c_n$ without monitoring other players. For the cooperative equilibrium to exist, all players must have larger payoffs under option (a) than (b).

Next, we explicitly find the conditions that allow a cooperative equilibrium to exist. Returning to the first stage of the game, the community maximizes the total welfare by choosing the cooperative consumption levels. The community's problem is to maximize joint utility less the required enforcement costs[13]:

$$\max_{\{c_1,c_2,\cdots,c_N\}} \sum_{i=1}^{N}\left(u\left(c_i\right)-\sum_{n\neq i}^{N} s_n\right)$$

s.t.

$$c_i = \begin{cases}\hat{c}_i & \text{if } s_i \geq \hat{s}_i \\ c_i\left(c_{-i}\right) & \text{otherwise}\end{cases} \quad \text{for any } i=1,2,\cdots,N.$$

[13] The utility from consuming the numeraire goods is not included in the objective function since it is not related with the consumption of the CPR.

Substituting the minimum level of monitoring effort needed to sustain the cooperative equilibrium, $\hat{s}_k$, into the problem above, the group's cooperative level of consumption is thus given by:

$$\hat{c}_i = \arg\max_{\{\hat{c}_1,\hat{c}_2,\cdots,\hat{c}_N\}} \sum_{i=1}^{N}\left(\left(1+\frac{1}{\alpha m_i}\right)u\left(\hat{c}_i,\hat{c}_{-i}\right)-\frac{1}{\alpha m_i}u\left(c_i\left(\hat{c}_{-i}\right),\hat{c}_{-i}\right)\right). \tag{3.13}$$

For the cooperative equilibrium to be enforceable, we also need to have the condition that the utility for each player from cooperative consumption and monitoring must be greater than the utility from no monitoring together with deviation[14], i.e.:

$$\hat{U}_i \equiv u\left(\hat{c}_i,\hat{c}_{-i}\right)-\sum_{n\neq i}^{N}\hat{s}_n \geq \tilde{U}_i \equiv u\left(\tilde{c}_i,\tilde{c}_{-i}\right) \quad for\ \forall i=1,2,\cdots,N. \tag{3.14}$$

Substituting $\hat{s}_k$ into the condition (3.14), we then have:

$$\left(1+\frac{1}{\alpha m_i}\right)u\left(\hat{c}_i,\hat{c}_{-i}\right)-\frac{1}{\alpha m_i}u\left(c_i\left(\hat{c}_{-i}\right),\hat{c}_{-i}\right)\geq u\left(\tilde{c}_i,\tilde{c}_{-i}\right) \quad for\ \forall i=1,2,\cdots,N. \tag{3.15}$$

Therefore the enforceable consumption for user *i* is given by (3.13) if the condition in (3.15) is satisfied, otherwise the enforceable consumption is equal to the non-cooperative equilibrium consumption given in (3.5).

Proposition 3.2: *If the subsistence constraint is not binding, the enforceable consumption of the CPR for player i is*:

$$\hat{c}_i = \frac{2\left(\sum_{n=1}^{N}m_n-(N-1)m_i\right)+(N+1)}{4\sum_{n=1}^{N}m_n+(N+1)^2}\frac{a-d}{b} \qquad if\ \max_{\{j=1,2,\cdots,N\}}\left(m_j\right)\leq f\left(\bar{m}\right), \tag{3.16}$$

$$\hat{c}_i=\tilde{c}_i=\frac{1}{N+1}\frac{a-d}{b} \qquad otherwise,$$

in which $f\left(\bar{m}\right)=\left(1+\frac{N-1}{(N+1)^2}\right)\bar{m}+\frac{(N-1)(3N+5)N\bar{m}}{(N+1)^2\left(4N\alpha\bar{m}+(N+3)\right)}$, *and* $\bar{m}$ *denotes the*

[14] Assume in the non-cooperative equilibrium, no social sanction is imposed and the mutual insurance still exists.

average vulnerability of the users' group. Moreover, if $\max_{\{j=1,2,\cdots,N\}}\left(m_j\right) \le f\left(\bar{m}\right)$, *user i's enforceable consumption is decreasing with his/her vulnerability by a decreasing rate, i.e.:*

$$\frac{d\hat{c}_i}{dm_i} < 0 \quad \text{and} \quad \frac{d^2\hat{c}_i}{d\left(m_i\right)^2} > 0. \tag{3.17}$$

Proof: *See Appendix B.2.*

Proposition 3.2 implies that cooperative consumption under costly monitoring exists if and only if each user's vulnerability to social sanction is not much bigger than the average vulnerability. The intuition is that, for each user *i*, the bigger vulnerability to social sanction, the lower cooperative consumption of the CPR and then the lower utility. If user *i*'s vulnerability is bigger than a specific critical value, he/she will deviate from the cooperative consumption and all the users will be end up with the non-cooperative consumption.

Summation of (3.13) over *i* gives the group's total consumption under costly monitoring,

$$\hat{C} = \sum_{n=1}^{N}\hat{c}_n = \frac{2\sum_{n=1}^{N} m_n + N\left(N+1\right)}{4\sum_{n=1}^{N} m_n + \left(N+1\right)^2}\frac{a-d}{b} \qquad \textit{if } \max_{\{j=1,2,\cdots,N\}}\left(m_j\right) \le f\left(\bar{m}\right),$$

$$\hat{C} = \sum_{n=1}^{N}\tilde{c}_n = \frac{N}{N+1}\frac{a-d}{b} \qquad \textit{otherwise,} \tag{3.18}$$

Expression (3.18) implies that the cooperative consumption of CPRs induced by mutual monitoring and social sanction lies between cooperative consumption under costless monitoring and the non-cooperative consumption, i.e. $\bar{C} \le \hat{C} \le \tilde{C}$. In short, community governance may mitigate the overconsumption of CPRs, but cannot completely eliminate it.

When the condition $\max_{\{j=1,2,\cdots,N\}}\left(m_j\right) \le f\left(\bar{m}\right)$ is satisfied, the enforceable cooperative level of consumption will be changing with the stock of bonding and bridging social

capital. The relationship between player *i*'s consumption and the two types of social capital is given by the following proposition.

Proposition 3.3. *If the subsistence constraint is not binding, player i's consumption of CPR under cooperative strategy is decreasing with bonding social capital and increasing with bridging social capital. Moreover, the marginal effect of bonding social capital is decreasing with bridging social capital, i.e.*

$$\frac{\partial \hat{c}_i}{\partial A_i} < 0 \quad , \quad \frac{\partial \hat{c}_i}{\partial B_i} > 0 \quad , \quad \text{and} \quad \frac{\partial^2 \hat{c}_i}{\partial A_i \partial B_i} > 0 \quad . \tag{3.19}$$

Proof: *See Appendix B.3.*

Proposition 3.3 implies that higher bonding social capital induces a more restrictive cooperative level of consumption given a fixed level of bridging social capital, while higher bridging social capital reduces enforceability consumption outcomes, implying the feasible cooperative level of CPR consumption is larger. The result also implies that the combination of high bonding and high bridging social capital might result in the same level of CPR consumption as a combination of low bonding and low bridging social capital. That said, a combination of high bonding and low bridging social capital induces lower consumption of CPRs than that of low bonding and high bridging social capital. These results may help explain the conflicting findings often seen in empirical research: that high bonding social capital cannot induce lower consumption of CPRs for certain. The point is that they neglect the offsetting effect of bridging social capital on the effectiveness of bonding social capital. Two communities endowed with similar resource characteristics and bonding social capital but different enough bridging social capital will for certain have different levels of consumption of CPRs in equilibrium.

Now we need to look at the subsistence constraint in (3.11). The sum of players' shocks will still be approximately equal to zero. For simplicity, consider the case that only player i is subject to a large negative shock, $\hat{\mu}_i < 0$, $\sum_{n \neq i}^{N} \hat{\mu}_n = 0$ and

$\sum_{m=1}^{M_i} \hat{\mu}_{nm} = 0$ *for* $\forall n = 1, 2, \cdots, N$. Assume the negative shock $\hat{\mu}_i$ is big enough such that player *i*'s ex-post consumption under the cooperative strategy is below the subsistence level, i.e. $\beta \hat{c}_i + c_{0i} + \theta_i \hat{\mu}_i < \underline{c}$. User *i* will over-consume the CPR at the level $\widehat{c}_i > \hat{c}_i$ so that his/her total consumption equal to the subsistence level, then we have:

$$\widehat{c}_i = \frac{1}{\beta}\left(\underline{c} - c_{0i} - \theta_i \hat{\mu}_i\right). \tag{3.20}$$

Then we have the following proposition on the relationship between the consumption and social capital.

Proposition 3.4: *If the subsistence constraint is binding, player i's consumption of CPR is decreasing with both bonding social capital and bridging social capital. Moreover, the marginal effect of bonding social capital is not changing with bridging social capital, i.e.:*

$$\frac{\partial \widehat{c}_i}{\partial A_i} < 0 \quad , \quad \frac{\partial \widehat{c}_i}{\partial B_i} < 0 \quad , \quad \text{and} \quad \frac{\partial^2 \widehat{c}_i}{\partial A_i \partial B_i} = 0 \quad . \tag{3.21}$$

Proof: *See Appendix B.4.*

If there is a large negative shock realized, a villager with high level of bridging social capital is more capable of getting financial aid from outside the community, therefore the incentive to over-consume the CPR to maintain the subsistence level is not as high for a villager with low bridging social capital. Therefore, for individuals close to the subsistence level, bridging social capital can be good for maintaining cooperation in the community governance of CPR.

From our propositions, we get the following testable hypotheses:

(H1) Bonding social capital increases vulnerability to social sanction, and therefore decreases consumption.

(H2) bridging social capital decreases vulnerability and thus may erode the effect of bonding social capital, increasing consumption.

(H3) However, given a subsistence level of consumption, by providing access to risk

sharing, bridging social capital can help conserve CPR.

3.4 Data

We survey 600 families in 30 villages in Yunnan Province, covering a total of 2,818 people. We select 5 counties in northwestern and southwestern Yunnan Province[15], randomly select 6 administrative villages in each, and then randomly select 20 households from each administrative village. In our survey, we ask extensive questions about income, household characteristics and purchasing behaviour. In particular, we are interested in the consumption of fuel. We also ask about the amount of time household members spend outside the village and village-level characteristics, such as the distance to the nearest road. We use these measures of connection with the outside world as indicators of bridging social capital.

3.4.1 Trust Game: Bonding Social Capital

To determine the level of bonding social capital, we conduct a field experiment to measure villager's trust of each other closely following Schechter (2007)[16]. We randomly select household heads from each village and pair them with another anonymous village member. To ensure each partner's identity remains hidden, we conduct the interviews in the home as opposed to meeting in a central hall.

In the game, each player is randomly chosen to be a sender or a recipient. We give all players 20 CNY at the beginning of the game, about the equivalent of one day's wages. Then the sender is given a choice of sending 0, 5, 10, 15 or 20 CNY to the anonymous recipient, who they know lives in the same village. They are told that the recipient will receive double the amount sent, and will then have a choice of how much to send back. Because fairness is a powerful motivating force in Chinese culture, the sender is also informed that the recipient also received 20 CNY, to eliminate equity concerns as a motivation for sending money. The sender then puts the amount they wish to send into an envelope for the enumerator. The sender is then asked how much money she expects to receive back.

[15] The counties covered are Yongping, Jianchuan, E'shan, Pingbian, and Jinggu.
[16] For details on the game and results, see Gong *et al*. (2010).

When the recipient receives the envelope containing now double the amount sent, he is asked how much he expects to receive. Then, after opening the envelope, he is asked how much he wishes to return. That amount is then given to the sender.

Although we observe the amount sent by each, to have a comparable measure across senders and recipients, we use the amount the sender and recipient expect to receive as a measure of bonding social capital. This amount reflects the degree to which people trust their fellow villagers to behave in a trustworthy manner. As one might expect, this figure is highly correlated with the amount sent by the sender (87%) while it is less correlated with the amount sent by the recipient.

As found in other trust games, the majority of our sample sent money and expected to receive money. The average amount sent was about 9 CNY, and is only one CNY less than the average amount returned. Of people that sent some positive amount, they sent approximately 11 CNY, which is more than half of their starting amount. On average, the recipients returned 60 percent of the funds sent. The summary of the findings of the game are given below in Table 3.1[17].

Table 3.1: Results of Trust Game

Player 1	Obs	Mean	Std. Dev.	Min	Max
Money expected	297	8.906	7.675	0	40
Money sent	300	8.383	6.385	0	20
Money received	300	10.073	8.673	0	35
% who sent money	230	76.7			
% of money sent, returned	230	119.8	41.1	0	300
Player 2					
Money expected to be sent (1/2 amount expected to be received)	300	8.85	5.40	0	20
Money received	300	16.77	12.77	0	40
Money Returned	300	10.01	8.66	0	35
% who sent money (of those who received money)	223	97.0			
% of returned of money received	230	59.5	19.6	0	150

Although we trained players in the nature of the game using tokens before asking them to send money, we were still concerned that those players with higher education

[17] The authors hope to develop a close friendship with the recipient who returned 150% of the money s/he received.

understood the game better, and may have sent more. Since we do not have any explicit reason to believe trust is improved with education, we are concerned that is we directly use the amount players expect to receive, it might contaminate our results if both that amount and firewood management are affected by education. So to generate our measure of bonding, we first regress the amount expected against education of the household head and whether the person is the sender or the receiver, and then use the residuals plus the constant as our measure of bonding social capital. As an aside, results did not qualitatively change when we used the expected amount directly. Results for this initial regression are given in Table 3.2. Interestingly, the player number did not appear to matter, while education was highly significant in determining the amount sent.

Table 3.2: Amount Expected Regressed on Education and Player Number

Amount Expected	Coef.	Std. Err.	P>|t|
Education of hh head	0.316	0.080	0.000
Recipient (1 = player 2)	-0.210	0.538	0.696
Constant	7.201	0.577	0.000
Number of obs = 597			
R-squared = 0.025			

Authors have debated whether social capital should be considered primarily at the village or at the individual level. We find as much within-village variation in our bonding social capital measure as we observe among villages as well as observing substantial variation in firewood collected within a village. Thus, we use bonding at the individual level to explain the individual decision of how much firewood to collect on public lands.

3.4.2 Bridging Social Capital

It is not feasible to conduct a similar trust game to capture how well are villagers connected with the outside world since villagers could connect with people in neighborhood villages, in towns or cities nearby, or even in some very distant regions[18]. To capture bridging social capital, we use the percentage of days members of the household worked outside of the township. The idea is that the more time a household

[18] It is very likely the case that villagers have friends or relatives working in very distant cities, given the fact that many farmers are conducting nonfarm jobs in cities far away from their hometown in contemporary China.

member spends outside the region, greater the connection with the outside world, and therefore the greater the potential insurance against village-specific shocks. One might be concerned that this variable could affect firewood demand simply by reducing the cooking requirements of the household. To control for this concern, we include the number of household members living at home in the regression for firewood.

As alternative measures for bridging social capital, we also use the number of household members working outside the township, the percent of members working outside the township, and the percent of days worked outside the county, and all returned qualitatively similar results. Following Jensen and Oster (2009) we also use cable TV ownership to proxy for connections with the outside world, and although some statistical significance is lost, we again see generally similar results.

3.4.3 Measure of the CPR

We are interested in observing how the two types of social capital affect firewood management. While we would ideally like to know how much land is publically held per village, we only observe the amount of total land per administrative village. Thus, to measure firewood collection, we use the logged amount of firewood collected on public lands divided by the amount of forestland in the administrative village to get a measure of firewood collected per forest. We are missing information on forestland on one administrative village, dropping our sample size to 580. Summary statistics are presented in Table 3.3.

Table 3.3: Summary Statistics

Variable	Obs	Mean	Std. Dev.
ln(firewood collected per mu)	580	-6.399	3.653
Bonding SC	597	7.201	6.541
Bridging SC	600	28.241	29.805
Natural village forest yield (kg/mu)	600	4.120	2.816
HH resource capacity (kg)	599	58.374	169.419
Dummy if family owns pigs	600	0.448	0.498
Number of hh members at home	600	4.035	1.548
Slope (high number = low slope)	599	1.155	0.786
Household expenditure less energy (1,000 CNY)	600	8.415	6.921
ln(productive assets) (CNY)	600	6.698	2.786

3.5 Empirical Model and Results

We are interested in observing how the amount of firewood collected on communal land is affected by the amount of bonding and bridging social capital, the consumption of other villagers, the average village resource capacity, the productive assets and total income of the household and the weighted slope of household forest plots.[19] Thus, we are interested in estimating the following relationship:

$$c_{iv} = \mu + \alpha A_{iv} + \beta B_{iv} + \lambda A_{iv} B_{iv} + r_1 \alpha_v + r_2 d + \delta_1 x + \varepsilon_i,$$

where i and v stand for household and village, c is the (log) quantity of firewood consumed per area of land, μ is an intercept term, which for several models includes village fixed effects, A is bonding social capital, and B is bridging social capital. The variable a is the quality of the resource, d is the cost of consuming firewood on the household's private land, which includes the slope of the land and the quality and quantity of the household forest resource, and x is a vector of household characteristics, such as number of members living at home, whether the family owns pigs and household expenditure. As in our model, we also control for carrying capacity or forest yield of those lands. While we do not explicitly observe the cost of villagers collecting firewood on public lands, we do have measures of the cost to the household of consuming their private resources. Thus, we also want to control for the cost to a household of collecting firewood on their private lands, so we include the household forest resources defined as forest plot area × yield, and the area-weighted average slope of the household forest plots. We also included distance to the household forest plots, but this measure was highly correlated with slope so we did not include it in our final model specification.

Anecdotally, we heard that firewood demand is affected by whether the family owns pigs or not, since food is often cooked for the livestock. Thus, we include a dummy for pig ownership. Last, since the amount of fuel to use is determined alongside household expenditure, we include total household expenditure, less expenditure on energy. We cluster errors by natural village. Results are presented in Table 3.4. As alternative measures for bridging social capital, we use the percent of household members working

[19] We also tried including the amount of grain harvested under the assumption that grain stalks might be used as fuel. However, we were informed that this practice is not common in Yunnan, which corresponded with the insignificance of the estimated coefficient.

outside the township and cable TV ownership, and all returned qualitatively similar results as reported in Table 3.4A[20].

In the first model in Table 3.4, we run the regression with no fixed effects. In the second model, we include dummy variables for the administrative villages. As our model suggests bridging social capital may erode the vulnerability to social sanction provided by bonding social capital, in models 3 and 4, we include an interaction term between the two types of social capital. In the first two models in Table 3.4, without the interaction term, we see some weak evidence that bonding decreases consumption of firewood, although the coefficient is only significant at the 6 percent level in the model with administrative village fixed effects. Bridging social capital on its own does not appear to have a significant effect on firewood collection. However, when we include the interaction term, both bridging and bonding social capital coefficients become highly significant. One might be concerned that these results are a product of multicollinearity, but our tests indicate that this is not the case (all variance inflation factors are less than 3.5). We observe that, on their own, both types of social capital reduce the consumption of firewood. For those 25 percent of households with no measured bridging social capital, a one CNY increase in bonding social capital generates an 8 percent decrease in the collection of firewood. For those approximately 18 percent of households who, in the trust game, did not expect any money to be sent or returned, a one percent increase in the number of days household members are away decreased the amount of firewood collected by 0.9 to 1.3 percent.

Observing the effect of each type of social capital in the presence of the other is more complicated since interaction term between Bridging and Bonding is positive and significantly different from zero. When calculated at the median amount of bridging and bonding social capital, only the effect of bonding social capital remains significant, reducing firewood consumption by around 5 percent (see Table 3.5). At high levels of bridging social capital, bonding appears to have no effect, while bridging social capital only reduces firewood consumption at the lowest levels of bonding.

The signs on the control variables are mostly as expected. The lower the household's

[20] We also use the number of members working outside the township and the percent of days worked outside the county as alternative indicators of bridging social capita, and all returned qualitatively similar results. Those results are not reported to save space.

resource capacity, and the higher the slope, the more firewood collected on public lands. The yield of the village forest and the total number of household members living at home appear to have little effect on firewood collection.

Table 3.4: Firewood Collected Per Area Regressed on Social Capital

Independent variables	(1)	(2)	(3)	(4)
Bonding SC (money expected)	-0.033	-0.043**	-0.077**	-0.084***
	(0.021)	(0.017)	(0.032)	(0.028)
Bridging SC (% days working away)	-0.002	-0.006	-0.013*	-0.016**
	(0.006)	(0.006)	(0.007)	(0.006)
Bond*Bridging			0.001*	0.001**
			(0.001)	(0.001)
Natural village forest yield	-0.152	-0.139	-0.146	-0.138
	(0.110)	(0.146)	(0.110)	(0.147)
HH resource capacity	-0.004***	-0.002***	-0.004***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Dummy if family owns pigs	-0.006	0.006	-0.006	0.006
	(0.005)	(0.004)	(0.005)	(0.004)
Number of hh members at home	0.095	-0.002	0.106	0.006
	(0.110)	(0.087)	(0.111)	(0.088)
Slope (high number = low slope)	-0.792***	-0.174	-0.815***	-0.196
	(0.252)	(0.182)	(0.252)	(0.184)
Total Expenditure less energy (10000s)	-0.021	-0.046*	-0.017	-0.043*
	(0.030)	(0.024)	(0.029)	(0.023)
Administrative village fixed effects	No	Yes	No	Yes
R-squared	0.092	0.317	0.096	0.321
Number of obs.	576	576	576	576
Number of clusters	58	58	58	58

Table 3.4A: Results Using Other Measures of Bridging Social Capital

	(1A)	(2A)	(3A)	(4A)	(5A) Cable TV
Bonding SC	-0.033	-0.043**	-0.055*	-0.071***	-0.060***
	(0.021)	(0.017)	(0.028)	(0.023)	(0.021)
Bridging SC (% of household members working outside of township except Model 5A, where it is cable TV)	-0.002	0.002	-0.014	-0.014	-0.801
	(0.009)	(0.008)	(0.013)	(0.010)	(0.579)
Bonding * Bridging			0.002	0.002**	0.050
			(0.001)	(0.001)	(0.032)
Natural village forest yield	-0.151	-0.144	-0.146	-0.138	-0.134
	(0.110)	(0.148)	(0.111)	(0.151)	(0.156)
HH resource capacity	-0.004***	-0.002***	-0.004***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Dummy if family owns pigs	-0.006	0.006	-0.005	0.006	0.006
	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)
Number of hh members at home	0.095	0.029	0.097	0.028	0.030
	(0.108)	(0.094)	(0.108)	(0.094)	(0.085)
Slope (high number = low slope)	-0.789***	-0.178	-0.801***	-0.201	-0.172
	(0.251)	(0.183)	(0.252)	(0.186)	(0.182)
Total Expenditure less energy (10000s)	-0.023	-0.054**	-0.023	-0.054**	-0.048**
	(0.031)	(0.025)	(0.032)	(0.025)	(0.023)
Administrative village fixed effects	No	Yes	No	Yes	Yes
R-squared	0.092	0.315	0.093	0.319	0.316
Number of obs.	576	576	576	576	576
Number of clusters	58	58	58	58	58

Table 3.5: Marginal Effect of Social Capital at Different Percentiles of Bonding and Bridging Calculated from Regression Results Presented in Table 3.3

Model 3 (no fixed effects)	25%	Median	75%
Marginal effect of Bonding at percentiles of Bridging SC	-0.077**	-0.046**	-0.006
	(0.032)	(0.022)	(0.024)
Marginal effect of Bridging at percentiles of Bonding SC	-0.009	-0.002	0.001
	(0.006)	(0.006)	(0.006)
Model 4 (village fixed effects)			
Marginal effect of Bonding at percentiles of Bridging SC	-0.084***	-0.055***	-0.017
	(0.028)	(0.019)	(0.018)
Marginal effect of Bridging at percentiles of Bonding SC	-0.013**	-0.006	-0.003
	(0.006)	(0.006)	(0.006)

Next, we interact the bridging and bonding measures with the resource quality and productive assets. Results are presented in Table 3.6.

Table 3.6: Interacting Social Capital with Forest Resource Quality and Productive Assets

	(5)	(6)
Bonding SC	-0.170**	-0.162***
	(0.076)	(0.057)
Bridging SC	-0.033***	-0.018
	(0.012)	(0.012)
Bonding * Bridging SC	0.001*	0.001*
	(0.001)	(0.001)
Bonding* forest yield	0.005	0.002
	(0.008)	(0.006)
Bonding* productive assets	0.011	0.010
	(0.009)	(0.008)
Bridging* forest yield	-0.004**	-0.005***
	(0.002)	(0.002)
Bridging* productive assets	0.006***	0.004***
	(0.001)	(0.001)
Natural village forest yield	-0.071	0.003
	(0.122)	(0.132)
HH resource capacity	-0.004***	-0.002***
	(0.001)	(0.001)
Dummy if family owns pigs	-0.004	0.005
	(0.004)	(0.004)
Number of hh members at home	0.122	0.012
	(0.108)	(0.087)
Slope (high number = low slope)	-0.881***	-0.264
	(0.268)	(0.198)
Total Expenditure less energy (10,000s)	-0.024	-0.047**
	(0.024)	(0.018)
ln(productive assets)	-0.355***	-0.194**
	(0.098)	(0.092)
Administrative village fixed effects	No	Yes
R-squared	0.123	0.333
Number of obs.	576	576
Number of clusters	58	58

First, we see that bridging reduces firewood collection if people are asset-poor, but also reduces people's sensitivity to resource capacity. Since people do not seem to be sensitive to resource quality to begin with, this result may be picking up the tragedy of the commons. In other words, at high levels of bridging social capital, villagers actually

collect more firewood if forests are already depleted in a rush to consume the resource before it is gone.

Neither bonding interactions are significantly different from zero. Overall, bonding social capital is significant on its own at zero levels of bridging social capital and average forest quality and asset levels. When the marginal effects are calculated, bridging social capital no longer has a significant effect on its own. It appears to act primarily through the interaction terms with bonding, resource capacity and assets.

Endogeneity of social capital

One might well be concerned that bridging and bonding social capital, along with forest management, are outcomes of underlying individual and community characteristics, and are therefore all co-determined. To address this concern about endogeneity, we instrument for bridging and bonding social capital.

Because much of the factors that affect bridging and bonding social capital are measured at the administrative village level, we use township fixed effects for our first stage regressions. For bonding social capital, we use the number of women in the household, the number of sick people in the household, and the percent of family members over the age of 65 in 2000. We include whether the family is in the majority ethnic group, whether they have the same last name as the dominant family in the village. We also include the length of time the household has been in the village, the number of households in the village and whether the village had a fish pond. No single variable was a particularly strong instrument for bonding social capital, so we included several. None of these variables individually or collectively affected firewood collection (collectively they had a p-stat of 0.555).

The argument for including the number of women and the percent of senior citizens is that both of these groups may be more likely to interact with their fellow villagers than the working men. We consider the number of senior citizens from six years earlier on the assumption that newly retired family members may take some time before developing a community of village colleagues. Second, if a household has a sick member, they may be forced to rely more on their fellow villagers for help and moral support, building trust. Third, we assume that the longer a household has lived in a village, the stronger ties they

may have to their neighbours. Fourth, both relationship variables might capture the relative status of the household in the village. Fifth, we show in the model that larger villages may be able to provide better insurance against idiosyncratic shocks, increasing an individual's cost of social sanction. That said, we might anticipate that after reaching some critical number of households, people in larger villages might not be able to interact as much as those in smaller communities, decreasing the level of bonding social capital. Last, a village with a fish pond will have more incentive to develop rules regulating its use, which in turn might build management capacity and trust.

The percent of days members of a household spend working outside the township are likely a function of accessibility, education and whether the household has surplus labor. Thus, our instruments for bridging social capital include the number of household members who are registered as non-agricultural, making migration easier. Second, we include the level of education of the household head, assuming that more highly educated households may have better information and access to off-farm employment. Last, we include the overall household size and the number of children in the house under the age of 6, assuming that the former may indicate excess labor, whereas the latter places demand on that labor at home. Because the percent of days spent outside the township is censored at zero, we estimate the first stage using a tobit and use both the predicted levels and predicted probability of observing a non-zero outcome as instruments (see Baylis and Perloff 2010 for a proof). Results from the first stages are given in Table 3.7.

Last, to instrument for the interaction term, we interact the bridging and bonding variables predicted by our first stage regressions. R-squared for the first stages are relatively low, ranging from 0.09 for bonding to 0.16 for Bridging. However, all three regressions allow us to reject the weak instrument hypothesis, while also allowing us to reject overidentification.

Given that the error terms for the various first stage regressions are likely correlated, we use three-stage least squares for our regression. Table 3.8 presents our results for firewood consumption with instrumented social capital. As can be seen, these results are qualitatively very similar to those above in Table 3.3. An interesting result is that the instrumented social capital terms have larger coefficients than those without. This finding might indicate that the endogeneity acts to suppress the coefficient - that is, that reduced

firewood collection induces lower bonding and bridging social capital - as opposed to inducing increased social capital.

Table 3.7: First Stage of IV Regression

Bonding		Bridging (% days worked outside township)	
# of women in household	0.401*	# of non-agricultural hukou	6.238***
	(0.211)	members in household	(1.870)
# of self-reported sick household	1.971	Years of schooling for	0.766
members	(1.432)	household head	(0.669)
% of senior citizens in 2000	2.349	# of household members	5.769***
	(1.985)		(1.134)
Member of the largest ethnic	0.252	# of preschool children in	-7.809***
group	(1.030)	household	(2.682)
Member of the largest village	-0.708	Age of household head	-0.061
surname	(0.546)		(0.153)
# of years living in village	-0.022		
	(0.015)		
# of households in village	0.024***		
	(0.006)		
# of households in village^2 (/100000)	-0.162***		
	(0.051)		
Fishpond (mu)	0.124**		
	(0.068)		
Standard deviation of village	-2.684***		
housing assets	(0.816)		
Township fixed effects	Yes		Yes
R-squared	0.09		NA
R-squared of excluded instruments	0.07		0.11
Test of excluded instruments (F-stat)	11.68		16.10
Number of obs.	588		600

Table 3.8: Three-Staged Least Squares Result on Firewood Collection as a Function of (Instrumented) Social Capital

	(1)	(2)	(3)	(4)
Bonding SC	0.025	-0.440***	-0.323*	-0.678***
	(0.073)	(0.149)	(0.168)	(0.174)
Bridging SC	0.003	-0.007	-0.094**	-0.123***
	(0.017)	(0.015)	(0.044)	(0.039)
Bond*Bridging			0.012**	0.016***
			(0.006)	(0.006)
Natural village forest yield	-0.138**	-0.069	-0.086	-0.124
	(0.057)	(0.106)	(0.073)	(0.112)
HH resource capacity	-0.005***	-0.002*	-0.005***	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Dummy if family owns pigs	-0.002	0.003	-0.001	0.006
	(0.003)	(0.004)	(0.004)	(0.004)
Number of hh members at home	-0.063	0.103	-0.022	0.168
	(0.139)	(0.143)	(0.167)	(0.152)
Slope (high number = low slope)	-0.659***	-0.296	-0.857***	-0.471**
	(0.198)	(0.209)	(0.240)	(0.225)
Total Expenditure less energy (10,000s)	0.195**	-0.037	0.235***	-0.008
	(0.082)	(0.069)	(0.081)	(0.071)
Village fixed effects	No	Yes	No	Yes
Number of obs.	567	567	567	567

3.6 Discussion and Conclusions

We find that bonding and bridging social capital appear to act as substitutes for one another, where both types of social capital reduce consumption of firewood in the absence of the other, but where high levels of both do not generate strong levels of common pool resource management. We first develop a model of social capital as facilitating risk-pooling, and demonstrate how bridging might erode the effect of vulnerability to social sanction induced by bonding social capital.

We next test this relationship between bonding and bridging empirically, by comparing the collection of firewood on public lands to our measures of individual bridging and bonding social capital. We find that the two types of social capital both reduce consumption, but that they also act as substitutes for each other. Although we cannot say definitively which type of social capital erodes the other, we do see evidence that bridging appears to erode bonding, whereas the reverse is not as likely. For example,

when using alternative measures of bridging social capital, such as the percent of household members who work outside the township, bridging social capital rarely has a significant effect on its own, and only acts through the interaction term on bonding social capital. Similarly, when we calculate the marginal effects of bridging and bonding, bridging only significantly reduces firewood consumption at the lowest levels of bonding, while bonding social capital significantly reduces consumption of firewood at median levels of bridging social capital.

Our findings are consistent with the results of Dayton-Johnson (2000), who shows strong evidence that bonding social capital is good for cooperation and some evidence that bridging social capital is bad for cooperation. He finds that a higher wage, and therefore higher opportunity cost decreases a communities ability to cooperate in maintaining an irrigation system. We posit that there may be another explanation in this context, where high wage implies higher ability to make money from outside the village, then less vulnerability to social sanction, and thus less willing to cooperate. Cases collected in Berkes and Folke (1998) shows that strong kinship-based relationships is essential for promoting and enforcing collective action, moreover relatively isolated systems perform better.

When we further interact bridging and bonding social capital with sensitivity to resource use and asset ownership, we observe that while none of the bonding interaction terms were significantly different from zero, bridging social capital appears to reduce sensitivity to resource capacity and reduce consumption for those asset-poor households. Once these interaction terms are included, the direct effect of bridging social capital essentially disappears. Since we do not find that households are particularly sensitive to resource capacity, it is particularly concerning that connections with outsiders further induces consumption of low-yielding resources. We believe this may be reflecting a tragedy of the commons argument, where households hurry to consume a weakened resource fearing that if they do not, their neighbours will rush to consume it first.

Last, because we might be concerned that both types of social capital are jointly determined alongside community resource management, we instrument for bridging and bonding using various household and village characteristics. While we cannot be completely certain that none of these characteristics are associated with firewood

collection, we cannot reject the hypothesis of no overidentification, while we do find that they help explain the levels of social capital. In particular, village size, the existence and size of the fishpond, the variance of housing assets in the village and the number of women in the household all go to explain the household level of social capital. As our model predicts, bonding social capital initially increases with the size of the village until it reaches around 740 households, when increasing the village size further dilutes trust. The existence and size of a fishpond implies that villagers have another resource to manage, which may help build cooperation. Fishponds are also associated with a higher probability of having irrigation in the village, which also poses another common pool resource problem for the community to solve. While we might believe that the percent of women in a household may affect firewood collection, the specific number should not, as long as we control for household size. However, given that women are more likely to interact with other women in the village, particularly around trust-building events, such as child-rearing, having more women in the house may induce more trust. Last, somewhat intuitively, we find that those villages with a higher variance in housing assets had lower levels of trust. We choose housing assets since these assets are usually highly visible to fellow villagers. If there is a sense in the village that some are obviously much wealthier than others, this disparity may arguably erode trust.

For bridging social capital we use instruments meant to capture the ease of access to outside work. Thus, we use the household registration system to identify those members who can legally work off-farm and thus have greater legal freedom of movement, which proves to be highly-significant in explaining the percent of days household members work outside the township. Second, we find that the larger the household overall, the higher the percent working outside the township. Last, we find that having more pre-school age children decreases the probability that household members work far away from home. Again, we find none of these factors affect firewood collection.

When we use these instruments, we find similar qualitative results as before, in that both types of social capital reduce collection of firewood on public lands in the absence of other social capital, but that the two types of social capital appear to act as substitutes for each other, each decreasing the effect of the other when social capital is high.

Other results indicate that villagers are sensitive to how much firewood their

neighbours collect on public lands, tending to increase their consumption alongside their fellow villagers. We also observe that the more costly and less abundant wood is from their private lands, the more villagers tend to collect from public lands. Last, income, as proxied by household expenditure on non-fuel goods, appears to be negatively correlated with firewood collection, implying that firewood is likely an inferior good.

In conclusion, we find that when considering a village's ability to successfully manage a common pool resource, one may need to consider both levels of bonding and bridging social capital. That is, the ability of strong levels of trust and social norms within the village to enforce resource use agreements appears to be affected by the strength of social networks outside the village.

Chapter 4

The Long-Term Consequences of Family Class Origins in Urban China

4.1 Introduction

In the 1950s, the communist government of the People's Republic of China (PRC) launched the movement of expropriation of merchants and capitalists and nationalization of industrial and commercial enterprises in urban China. This movement led to substantial homogeneity of income and consumption in cities (Lee and Selden, 2007). The homogeneity sustain to late 1970s and early 1980s when the income inequality measured by gini coefficient is around 0.17 in urban China (Ravallion and Chen 2007, Wang 2008). The government also assigned an inheritable class identity (*chengfen*) that was considered permanent to each family and implemented discriminatory policies based on class identities. Their intention was to reprimand affluent citizens who were thought to be gaining wealth by exploiting others, while rewarding both citizens who were considered exploited and citizens who supported the socialist revolution.

The main determinants of a family's class status were the source of income, job type, and political status of the member of the family in the years prior to the formation of PRC in 1949. There were four broad status categories: 1) the revolutionary class, which includes revolutionary cadres, member of the Chinese Community Party (CCP) and army men; 2) the poor class, which includes poor or landless peasants, lower-middle-income peasants and industrial workers; 3) the middle class, which includes upper- and middle-income peasants, office workers, petty proprietors, teachers, and professionals; 4) the rich class or the exploiting class, which includes rich peasants, landlords and capitalists who earned land or capital rents (Deng and Treiman, 1997).

Before abolition of the class system, the family class background was officially recorded within the household registration (*hukou*) of each family, and was required to be reported on any application for schools, jobs, and promotion. In addition, a family's class status was made public within their local community and to friends and relatives outside their community, which fostered discrimination within social settings.

Prior to its official abolition in 1979, family class origins were vitally important political labels for each individual throughout the Maoist era (Huang, 1995; Unger, 1982; Watson, 1984; Zhang, 1998). Rich and middle class families were discriminated in many aspects, including education, employment, and admission into the armed forces and the CCP. Li (2003), Zhou *et al*. (1998), Sato and Li (2007, 2008) and Zhang (1998) all find strong correlations between family class origins and educational achievements. Sato and Li (2007) show that CCP membership is affected by family class origins in rural China. There are also studies that discuss the intergenerational transmission of socioeconomic status such as official position, marriage, and fertility in China (Campbell and Lee, 2003, 2006; Deng and Treiman, 1997; Ting, 2004). However, there are few studies on the intergenerational transmission of wealth in China. The radical institutional change after 1949 depleted the capital of affluent families and led to substantial homogeneity of income and consumption in cities (Lee and Selden, 2007). The homogeneity sustain to late 1970s and early 1980s when the income gini coefficient is only around 0.17 in urban China (Ravallion and Chen, 2007; Wang 2008). Further, class-based discrimination is known to negatively influence the descendants of formerly rich in terms of CCP membership and educational achievements. Because of the expropriation and the subsequent discrimination, it might be expected that the descendants of the previously better-off families are not economically better off than the formerly poor.

Contrary to expectation, using data of China Household Income Project (CHIP) survey data in 2002, Sato and Li (2007) demonstrate that descendants of the poor class continue to possess relatively less capital than those of rich peasants and landlords in rural China. In fact, after controlling for the education of the male household heads and CCP membership, the results remain the same. Szelényi (1988) shows that, in rural Hungary, the ‘peasant entrepreneurs’ capitalizing upon market opening in the 1970s are more likely to be the decedents of well-off and entrepreneurial families before the political and economic transformation. One might believe that status and wealth is more difficult to change in rural areas due to the relatively isolated economic environment and slow economic development. A question then arise naturally: what happens in the urban areas where there are rapid economic changes? This chapter will discusses whether there is any long-run impact of the wealth redistribution associated with class status on the

economic outcomes of urban residents in the PRC. And if so, how large is this effect? Urban and rural areas of China are very different in many aspects. The market economy in urban cities is more developed than in villages. Further, occupation and income data are available for urban residents in the CHIP 2002, which gives researchers the opportunity to examine the impact of family class background on income besides family assets.

This chapter begins by analyzing the association between family class status on CCP membership and educational attainments for urban respondents. I demonstrate that individuals with poor and revolutionary class origins are more likely to obtain CCP membership and achieve a higher degree of educational attainment while the discriminatory policy was formally in effect. Even after the abolition of the class systems in 1979, individuals with the revolutionary class background are still more likely to be permitted to join CCP. The descendants of the rich who received education after the late 1970s were more likely to achieve a higher degree of educational attainment than all other classes. This association signals their strong preference for education, which was not apparent while social discrimination against them was abolished in the 1970s. Since 1977, the education system returned to merit-based.

This then demonstrates that the descendants of the poor and middle class have significantly lower income and family assets per capita than those of the rich class after controlling for the CCP membership, educational attainment, and other characteristics[21]. Specifically, individuals with poor class origins have 12% lower monthly income and 27% lower family assets than those with rich class origins. This social experiment that lasted over half century in the PRC provides an example of strong intergenerational transmission of wealth status.

The transmission seems not likely to occur through inheriting physical capital due to the movements of homogenization of income and properties in the first three decades of PRC. Despite the movement of expropriation of merchants and capitalists and nationalization of industrial and commercial enterprises in 1950s, many properties were confiscated but never returned or even destroyed during the movement to “smash the four olds” along with the Cultural Revolution. In the summer of 1966 all over China, the “Red

[21] The results hold even only region dummies are controlled.

Guards" began to search homes and confiscate properties of the families of "bad" class, i.e. the decedents of the rich class and the middle class, and even of many government officials who were deemed to be anti-party or anti-revolution elements (Macfarquhar and Schoenhals, 2006). A lot of antiques and art works were destroyed. The diary of a lab technician on August 26, 1966, cited by Macfarquhar and Schoenhals (2006, pp. 118), documented the situation: "First they targeted capitalists and landlords, but soon they entered cadres' homes and the homes of persons attacked in the movement as well. At this point it is still getting worse, with similar things occurring in factories and enterprises." As documented by an official document in October 1966, the confiscation by "Red Guards" all over China of a total of 65 tons of gold was praised as the "confiscation of the ill-gotten wealth of the exploiting classes" (Wang, 2009).

After the Cultural Revolution, in some cities such as Shanghai, the government set up the "Bureau for Sorting Looted Goods" to return those confiscated items to their owners, but much of them had probably disappeared due to theft or misplace (Cheng, 1988). Moreover, it was difficult to find the original owners due to lack of accurate records under the situation of bureaucracy chaos during the Cultural Revolution. Therefore, even though the possibility of hiding wealth such as gold, silver, antiques or art works cannot be completely ruled out, it is not likely to play major roles in determining the intergenerational transmission of wealth. Moreover, the story of hiding wealth might help explain the difference in family assets between the rich and the poor, it cannot explain the difference in income once education level is controlled to reduce the impact of wealth on income through education. The social experiment provides evidence that the intergenerational transmission of wealth does not solely come through physical capital. There must be some non-material channels playing roles. Though the focus of this chapter is not to identify the exact channel, some potential mechanisms will be discussed later.

The subsequent discussions in this chapter are structured as follows. Section 4.2 describes the data and measurement of variables. Section 4.3 estimates the correlation between family class origins and individuals' CCP membership, educational attainment, and economic outcomes including personal income and family assets per capita. Section 4.4 draws conclusions.

4.2 Data and Measurement

The data source for this chapter is a national cross-sectional survey of Chinese urban households conducted in 2003 by the Chinese Household Income Project (CHIP) under the auspices of the Chinese Academy of Social Sciences. The sampling frame for the survey is a sub-sample of the official household survey conducted by the National Bureau of Statistics (NBS)[22], conducted in 2002. The survey covers 6,835 urban households distributed across 77 cities in 12 provincial-level administrative units in the PRC. Survey respondents used for analysis are limited to household heads aged 22 to 71 resulting in 12,906 male and female respondents.

Table 4.1: Summary Statistics of Personal and Family Characteristics

Variables	Obs	Mean	Std. Dev.	Min	Max
Male	12906	0.488	0.500	0	1
Age	12906	46.548	10.023	22	71
Married	12906	0.970	0.170	0	1
Years of education	12900	10.506	3.336	0	23
CCP membership	12763	0.315	0.464	0	1
Rustication experience	12500	0.188	0.391	0	1
Pre-rustication cohorts dummy	12906	0.267	0.442	0	1
Post-rustication cohorts dummy	12906	0.133	0.340	0	1
Occupation					
Skilled or non-skilled laborers	8326	0.450	0.498	0	1
Clerical/office staff	8326	0.204	0.403	0	1
Professional	8326	0.223	0.416	0	1
Cadre	8326	0.122	0.328	0	1
Log of monthly income	8273	6.765	0.705	0	9.498
Log of family asset per capita	6292	10.251	1.339	0	13.776

The survey includes data on personal and family characteristics such as gender, age, marital status, personal rustication experience[23], years of education, CCP membership, occupation, personal income and family assets. It also has information on family background such as fathers' CCP membership, education level and occupation. Table 4.1

[22] See Gustafsson *et al.* (2008) for more details of the sampling framework and sampling method of the CHIP 2002 survey.

[23] Many individuals in urban areas were sent down to rural areas to do manual labor during the Cultural Revolution. Most of them returned to urban areas after the Cultural Revolution. Some literatures show that there is long-term impact of the rustication experience on later life outcomes (Li *et al.*, 2010; Xie *et al.*, 2008; Zhou, 2010; Zhou and Hou, 1999).

presents the summary statistics of personal and family characteristics. The average age of respondents is 46.5. Virtually all (97%) of the respondents are married and 31.5% of them are CCP members. They have an average of 10.5 years of education. Nearly a half of the respondents are skilled or non-skilled laborers, and 12% of them are employed by the government. The average log of monthly income and family assets is 6.765 and 10.251, which translates to 867 CNY and 28,311 CNY respectively [24].

Table 4.2 presents the summary statistics of family background. The first two sets of variables are the family class origins of male household head and of respondents respectively. The two set of variables are different only for female respondents. Females generally finished their education before getting married. Therefore education for females is expected to be related with their own family class origins. However, their political and economic achievements are more likely to be affected by their husbands' family class status since they are treated as family members of their husbands after getting married. The summary statistics show that approximately 5% respondents are descendants of rich class, and 3% are from revolutionary class. Most of them are offspring of the poor class.

In this chapter I use two measures of the father's CCP membership. One is in regards to the respondents' father and the other is regarding the father of the male household head. Similar to family class origins, these two variables are only different for female respondents. For education, I use the CCP membership of respondents' fathers and for all other outcomes I use the CCP membership of male household heads' fathers. Approximately 29% of respondents' fathers are CCP members.

The education of respondents' fathers is categorized into five groups, no school, elementary school, junior high school, senior high school or equivalence, and college. The data show that the education levels of fathers are generally low, with 63% of them never entered school or just finished elementary school and only 6% had college education. Regarding occupation of the fathers of the male household head, 65.3% are skilled or non-skilled workers and 18.6% are in the cadre group. By contrast, the proportion of individuals having labor work and government jobs is 45.6% and 22.3%, respectively. Thus, the proportion of survey respondents with professional or other

[24] Since there is a small number of respondents reported zero income or asset, the log of income and asset in this paper is actually the log of one plus income or asset.

white-collar jobs are significantly higher than their fathers.

Table 4.2: Summary Statistics of Family Background

Variables	Obs	Mean	Std. Dev.	Min	Max
Family class origins of male household head					
Rich class	12136	0.052	0.223	0	1
Middle class	12136	0.125	0.330	0	1
Poor class	12136	0.797	0.402	0	1
Revolutionary class	12136	0.026	0.160	0	1
Family class origins of respondents					
Rich class	12385	0.051	0.221	0	1
Middle class	12385	0.124	0.329	0	1
Poor class	12385	0.798	0.402	0	1
Revolutionary class	12385	0.027	0.163	0	1
CCP membership of respondent's father	12789	0.292	0.455	0	1
CCP membership of male household head's father	12545	0.284	0.451	0	1
Education level of respondent's father					
No school	12898	0.300	0.458	0	1
Elementary school	12898	0.333	0.471	0	1
Junior high school	12898	0.187	0.390	0	1
senior high school or equivalence	12898	0.120	0.324	0	1
College	12898	0.061	0.239	0	1
Occupation of male household head's father					
Non-skilled and skilled laborers	11907	0.653	0.476	0	1
Clerical/office staff	11907	0.067	0.249	0	1
Professional	11907	0.094	0.291	0	1
Cadre	11907	0.186	0.389	0	1

4.3 Empirical Analysis

This section of this chapter estimates the impact of family class background on individuals' CCP membership, years of education as well as personal income and family's assets per capita using cross-sectional regression analysis. Logistic regressions are employed for CCP membership model, and OLS regressions are used for all other models. City dummies are included in all the models to control for regional variations in policy and social-economic environment. Standard errors of coefficients are clustered at city level to account for the possible correlation within cities.

4.3.1 Family Class Origins and CCP Membership

CCP membership can be viewed as an investment in political capital, therefore joining it is a decision based on a cost-benefit analysis of private material advantage. Joining the CCP not only brings more political opportunities and economic benefits (Morduch and Sicular, 2000; Liu, 2003; Appleton *et al*., 2009; Li *et al*., 2006), but it is also one of the few ways of reducing the potential discrimination for individuals with un-favorable class backgrounds. Comparing to the benefits, the costs of joining CCP are small (Appleton *et al*., 2009). The main costs for obtaining the membership are those associated with a formal application and participation in study sessions and community service with monitoring. The costs after admission include time devoted to CCP activities, submission to scrutiny and discipline, and a low membership due. Therefore we can ignore the supply side and focus on the screening of CCP members. If we observe a negative link between unfavorable class origins and CCP membership, we can fully or at least largely attribute it to the CCP preferences over class background especially before 1979.

Table 4.3: CCP Membership and Age of Joining CCP by Cohorts and Classes

	Proportion of CCP membership			Age of joining CCP
Class origins	All	1931-1961	1962-1980	All
Rich class	0.292	0.305	0.273	34.077
Middle class	0.320	0.339	0.244	33.196
Poor class	0.316	0.350	0.237	30.494
Revolutionary class	0.411	0.429	0.365	30.938
Total	0.315	0.348	0.242	31.115
Number of obs.	12763	8792	3971	3947

Table 4.3 presents CCP membership and the age the individual joined the CCP by cohort and class origins. The 1931-1961 cohorts were potentially directly affected by the class-based discriminatory policies since they were at least 18 years of age in 1979. For all the samples, those with a revolutionary class background have the highest percentage of CCP membership. Individuals with a poor or middle class background have almost the same proportion of CCP members. The descendants of the rich class have the lowest CCP membership. The 1931-1961 cohorts follow the same patterns. However, the 1962-1980 cohorts present a different pattern. Individuals from the revolutionary class still have

highest CCP members, while citizens from poor and middle also have higher than average CCP membership. The only change is that the rich class ranks second. The data also shows that it takes longer for descendants of rich class to join the CCP. The age at which individuals with poor and rich class background join the CCP are 30.5 and 34 respectively.

The study then conducts logistic regressions to examine the correlation between family class origins and CCP membership. Table 4.4 presents the impact of class origins on CCP membership and the age at which the respondent joined the CCP. The first three columns show the impact of class origins on the respondent's probability of joining CCP. Column (4) demonstrates the impact of class origins on the age when the individual joined the CCP. Each of the four models control for personal characteristics, such as gender, age, marital status, personal rustication experience, pre- and post-rustication cohorts dummies, years of education, as well as CCP membership, occupation and education level of male household head's father and the respondent's father, respectively.

Column (1) uses all the samples covering individuals born from 1931 to 1980. It shows that individuals with revolutionary or poor class background are more likely to join the CCP. Column (2) restricts the sample to include only the 1931-1961 birth cohorts to capture the greater effect of the family class designation. The coefficient of regression for the poor class and the revolutionary class are positive and significant, which suggests that CCP membership is biased towards the aforementioned classes. However, the coefficient of the revolutionary class is only significant at a 10% confidence level, which implies there is no conclusive evidence that individuals from the revolutionary class of this birth cohort were favored. This result might be attributed to the political campaign against cadres who were deemed to have betrayed CCP during the Cultural Revolution. Column (3) considers only the 1962-1980 birth cohorts. In this later group, only the coefficient of regression for the revolutionary class is positive and significant, which might imply that individuals with revolutionary class background are more favored in terms of CCP membership after the abolition of the class system.

Table 4.4: Class Origins and CCP Membership

	Probability of joining CCP			Age of joining CCP
Independent variables	(1)	(2)	(3)	(4)
	All	1931-1961	1962-1980	All
Male	0.732***	0.711***	0.818***	-2.559***
	(0.070)	(0.089)	(0.079)	(0.366)
Age	0.087***	0.083***	0.133***	0.120***
	(0.008)	(0.008)	(0.018)	(0.033)
Married	0.069	-0.110	0.460	-1.628
	(0.193)	(0.215)	(0.417)	(1.238)
Years of education	0.268***	0.255***	0.317***	0.104*
	(0.011)	(0.012)	(0.025)	(0.062)
Rustication experience	-0.180**	-0.196***	0.030	2.395***
	(0.072)	(0.075)	(0.716)	(0.393)
Pre-rustication cohorts dummy	0.086		0.211	-1.322***
	(0.103)		(0.150)	(0.433)
Post-rustication cohorts dummy	-0.520***	-0.442***		0.922
	(0.123)	(0.124)		(0.651)
Family class origins of male hh head				
Middle class	0.144	0.229	0.118	-1.097
	(0.132)	(0.170)	(0.214)	(0.837)
Poor class	0.337***	0.464***	0.108	-2.346***
	(0.112)	(0.158)	(0.194)	(0.665)
Revolutionary class	0.475**	0.454*	0.755**	-1.558
	(0.210)	(0.269)	(0.360)	(1.014)
ccp membership of male hh	0.243***	0.245***	0.311**	-1.062**
head's father	(0.071)	(0.095)	(0.138)	(0.463)
Education level of respondent's father				
Elementary school	-0.010	0.023	-0.132	1.339***
	(0.063)	(0.070)	(0.144)	(0.485)
Junior high school	-0.056	0.033	-0.198	1.428**
	(0.070)	(0.082)	(0.156)	(0.564)
Senior high school or	-0.058	-0.061	-0.066	1.895***
equivalence	(0.081)	(0.121)	(0.160)	(0.597)
College	-0.174*	-0.124	-0.301	2.437***
	(0.105)	(0.149)	(0.208)	(0.766)
Occupation of male hh head's father				
Clerical/office staff	-0.050	0.045	-0.259	1.247
	(0.108)	(0.143)	(0.182)	(0.805)
Professional	-0.205**	-0.136	-0.396**	0.993*
	(0.096)	(0.109)	(0.181)	(0.587)
Cadre	-0.016	-0.008	-0.128	-0.014
	(0.077)	(0.111)	(0.139)	(0.484)
City dummies	Yes	Yes	Yes	Yes
Pseudo/Adjusted R-squared	0.165	0.154	0.208	0.117
Number of obs.	11049	7425	3614	3413
Number of clusters	77	77	76	77

Besides the impact of family class origins, many other variables have effects on individuals' CCP membership. The CCP membership of fathers and their offspring is positive and significant in all three models, suggesting the impact of a father's CCP membership to their offspring's membership. Furthermore, consistent with the fact that males are more actively involved in the political activities, males are more likely to join the CCP. In addition, younger individuals and individuals with less education are less likely to obtain CCP membership. The CCP define themselves as the group of leaders and the pioneers of working class, tends to accept more educated individuals.

Results in column (4) show that CCP members within the poor class join the CCP an average of 2.3 years earlier than those within the rich class. Individuals with revolutionary class background join the CCP an average of 1.6 year earlier than those with other rich class origins, although the coefficient of regression on the revolutionary class is not significant. The results are consistent with the fact that individuals from the revolutionary class were not significantly favored in terms of CCP membership before 1979, as shown in column (1). The results also show that those who have rustication experience join CCP an average of 2.4 years later than non-rusticated individuals. Again, the father's CCP membership matters. Offspring of CCP members join the CCP an average of 1.1 years earlier.

4.3.2 Family Class Origins and Educational Attainment

The Chinese government expanded the educational system in 1949, raising the education level of the entire population. Moreover, the government tried to promote the educational achievement of descendants of poor class at the expense of those from rich and middle classes especially during the Cultural Revolution[25]. Students with "bad" class background were discriminated and humiliated by others in schools and many of them dropped off schools due to the discrimination. Universities were all closed in the first five years of the Cultural Revolution, and were not open until 1970. In 1970-1976, the admission to universities was not based on college entrance exams. Only those "industrial workers, farmers, and soldiers" nominated by local government officials or military officers could

[25] See Deng and Treiman (1997), Giles *et al*. (2008), Sato and Li (2008), and Zhou *et al*. (1998) for more details.

enter universities. Therefore, people with revolutionary and poor class background were strongly favored. People with rich class origins almost had no chance at all. Individuals born before 1960 were affected by the discrimination policy.

This chapter tests the hypothesis that the rich and middle class are less educated for different age cohorts. Respondents born 1931-1980 are grouped into five cohorts: 1931-1940, 1941-1950, 1951-1960, 1961-1970 and 1971-1980. Table 4.5 presents the years of education by cohorts and class origins. Individuals born before 1970s with poor family class are always the least educated by lowest number of years of education. Individuals born after the early 1960s with the rich family class origins have the highest years of education. This indicates the strong incentives the rich family class has to invest in education while not being constrained by the discrimination policy.

Table 4.5: Educational Attainment by Cohorts and Classes

	Years of education					
Class origins	All	1931-1940	1941-1950	1951-1960	1961-1970	1971-1980
Rich class	11.138	10.361	10.209	10.516	12.524	12.265
Middle class	10.626	9.071	10.481	10.567	11.742	11.100
Poor class	10.425	8.610	9.689	10.144	11.379	12.130
Revolutionary class	11.613	11.067	10.457	11.724	11.861	12.067
Total	10.506	8.767	9.887	10.270	11.494	12.127
Number of obs.	13245	1196	2564	4736	3719	685

OLS regressions are then conducted to examine the effect of family class origins on educational attainment. Table 4.6 presents the regression results. Male individuals have more years of education than female respondents. There is no significant education diversification among classes in 1941-1950 cohorts. Individuals in 1951-1960 cohorts with revolutionary class background have significantly more years of education than those with rich class origins. However, the descendants of the rich who received education after the late 1960s were more likely to achieve more years of education than all other classes.

Table 4.6: Family Class Origins and Educational Attainment by Cohorts

	Years of education				
	(1)	(2)	(3)	(4)	(5)
Independent variables	1931-1940	1941-1950	1951-1960	1961-1970	1971-1980
Male	2.257***	1.297***	0.581***	0.941***	0.926***
	(0.215)	(0.151)	(0.095)	(0.091)	(0.229)
Age	-0.267***	0.062*	-0.152***	-0.100***	0.002
	(0.048)	(0.034)	(0.023)	(0.020)	(0.084)
Married	0.942	-0.835*	-0.238	0.123	-0.368
	(0.613)	(0.490)	(0.271)	(0.329)	(0.618)
Rustication experience		0.268	0.225**	-0.385	
		(0.230)	(0.107)	(0.506)	
Family class origins of respondent					
Middle class	0.935*	0.436	0.070	-0.451*	-0.409
	(0.547)	(0.366)	(0.206)	(0.249)	(1.004)
Poor class	0.086	-0.166	0.028	-0.877***	0.006
	(0.524)	(0.357)	(0.182)	(0.199)	(0.923)
Revolutionary class	3.016***	0.086	0.703**	-0.612**	1.166
	(0.775)	(0.575)	(0.290)	(0.301)	(1.212)
CCP membership of	-0.195	0.411*	0.494***	0.479***	-0.153
respondent's father	(0.578)	(0.232)	(0.117)	(0.103)	(0.319)
Education level of respondent's father					
Elementary school	1.594***	0.687***	0.326***	0.495***	1.584***
	(0.339)	(0.168)	(0.090)	(0.185)	(0.469)
Junior high school	1.780***	1.101***	0.702***	0.717***	1.716***
	(0.448)	(0.280)	(0.148)	(0.223)	(0.487)
Senior high school or	2.857***	1.680***	0.977***	1.316***	1.995***
equivalence	(0.434)	(0.344)	(0.165)	(0.248)	(0.480)
College	3.855***	2.394***	1.134***	1.916***	2.188***
	(0.667)	(0.425)	(0.205)	(0.287)	(0.593)
Occupation of male hh head's father					
Clerical/office staff	0.004	0.047	0.034	-0.202	1.340***
	(0.586)	(0.301)	(0.134)	(0.165)	(0.477)
Professional	0.364	-0.005	0.563***	0.291	1.488***
	(0.672)	(0.337)	(0.132)	(0.215)	(0.463)
Cadre	0.474	0.244	0.312***	0.226	0.893**
	(0.664)	(0.273)	(0.113)	(0.168)	(0.422)
City dummies	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.271	0.172	0.167	0.158	0.207
Number of obs.	1006	2142	4213	3412	632
Number of clusters	74	77	77	77	73

The coefficients of regression for the father's education level are positive and significant at 1% confidence level for all birth cohorts. This result show stronger effects

of parental education than previous work by Zhou *et al*. (1998), who uses samples in urban China and Sato and Li (2008), who uses samples in rural China. The results suggest a consistently strong correlation between father's and descendants' educational attainment in urban China. Moreover, the coefficients of regression for each level of father's education show a U-shape across birth cohorts. The effect of the Father's education continues to decrease in the first three decades of PRC, and reaches the minimum level for the 1951-1960 cohorts who were impacted by the Cultural Revolution. Since the reform and opening up of the economy of the PRC in late 1970s, the connection between the education of the father and his children has gradually re-strengthened. These U-shapes generated from this nationally representative cross-sectional survey of Chinese urban households confirm the results of Giles *et al*. (2008) who use data from the China Urban Labor Survey (CULS) conducted in 5 large cities in 2001.

4.3.3 Family Class Origins and Economic Outcomes

This section studies the impact of family class background on personal income and family assets. The subjects are limited to respondents with data on income and occupation. Table 4.7 shows the summary statistics of personal income by cohorts and classes. For the entire sample, as well as the 1951-1960 and 1961-1980 cohorts, income of individuals from the rich class ranks as the second highest among the four classes. Table 4.8 presents the family assets per capita by cohorts and classes. Individuals with revolution class origins consistently have the highest level of assets in across all age cohorts. The family assets of respondents with rich class origins are always higher than those from the poor class.

Table 4.7: Personal Income by Cohorts and Classes

	Natural log of monthly income			
Class origins	All	1941-1950	1951-1960	1961-1980
Rich class	6.887	6.871	6.910	6.873
Middle class	6.833	6.970	6.843	6.740
Poor class	6.735	6.913	6.743	6.683
Revolutionary class	6.977	7.160	7.030	6.878
Total	6.765	6.925	6.779	6.708
Number of obs.	8273	1051	3456	3766

Table 4.8: Family Asset by Cohorts and Classes

	Natural log of family assets per capita			
Class origins	All	1941-1950	1951-1960	1961-1980
Rich class	11.475	11.553	11.610	10.196
Middle class	11.482	11.606	11.487	10.292
Poor class	11.305	11.451	11.297	10.087
Revolutionary class	11.754	11.874	11.932	10.320
Total	11.329	11.471	11.330	10.108
Number of obs.	5577	1370	2287	1946

Table 4.9 gives the estimated effects of family class origins on the respondent's log of monthly income. The first column presents the regression using all samples of individuals born from 1941 to 1980. It excludes the 1931-1940 birth cohorts because most of the individuals in the former cohort are retired or otherwise out of the labor market and thus have no wages. The results show that, on average, individuals with middle and poor class origins have significantly lower monthly income than those from the rich class, yet there is no significant difference in the income between individuals from the revolutionary and the rich class. Individuals from the poor class and the middle class have 12% and 8% lower income than those from the rich class.

Columns (2) through (4) demonstrate the results for different cohorts. Column (2) shows that there is no significant difference in income among individuals from different classes for individuals born in 1941-1950. However, we do observe a difference for those born after early the 1950s. Individuals with a poor and middle class background have lower monthly income than those from the rich class, although the coefficients of regression for the middle class are only significant at 10% confidence level for 1951-1960 cohorts.

Thus, we see evidence that the class-based social discriminatory policy to oppress the rich and middle class and benefit the poor and the revolutionary class does not affect income. Individual with rich class background have the highest monthly income, and individuals with the poor class background have the lowest monthly income. The only group of individuals who benefit is those with the revolutionary class background, i.e. the decedents of revolutionary cadres, CCP members, and army men, whose incomes are not significantly different from those from the rich class.

Table 4.9: Class Origins and Log of Monthly Income

	Natural log of monthly income			
	(1)	(2)	(3)	(4)
Independent variables	All	1941-1950	1951-1960	1961-1980
Male	0.230***	0.147***	0.233***	0.242***
	(0.021)	(0.051)	(0.027)	(0.027)
Age	0.006***	0.004	0.011**	0.009**
	(0.002)	(0.008)	(0.005)	(0.004)
Married	0.013	0.151	0.058	-0.029
	(0.078)	(0.191)	(0.098)	(0.118)
Years of education	0.037***	0.029***	0.035***	0.043***
	(0.003)	(0.007)	(0.005)	(0.005)
CCP membership	0.096***	0.111***	0.083***	0.108***
	(0.017)	(0.036)	(0.031)	(0.023)
Occupation				
Clerical/office staff	0.205***	0.228***	0.220***	0.173***
	(0.025)	(0.075)	(0.033)	(0.030)
Professional	0.313***	0.360***	0.340***	0.262***
	(0.024)	(0.065)	(0.039)	(0.035)
Cadre	0.306***	0.344***	0.378***	0.193***
	(0.031)	(0.071)	(0.036)	(0.050)
Rustication experience	-0.016	0.056	-0.016	-0.030
	(0.024)	(0.042)	(0.030)	(0.087)
Pre-rustication dummy	0.020			
	(0.025)			
Post-rustication dummy	0.010			
	(0.047)			
Family class origins				
Middle class	-0.078**	0.063	-0.090*	-0.094**
	(0.030)	(0.096)	(0.049)	(0.044)
Poor class	-0.111***	0.061	-0.118***	-0.125***
	(0.027)	(0.087)	(0.043)	(0.040)
Revolutionary class	-0.022	0.041	-0.045	-0.020
	(0.044)	(0.163)	(0.060)	(0.066)
Father's CCP membership	0.044**	0.119	0.057**	0.016
	(0.020)	(0.072)	(0.026)	(0.029)
Fathers' education level				
Elementary school	0.027*	-0.063	0.051*	0.013
	(0.015)	(0.040)	(0.027)	(0.028)
Junior high school	0.050**	-0.110**	0.071**	0.056
	(0.022)	(0.046)	(0.034)	(0.042)
Senior high school or equivalence	0.041	-0.100	0.092**	0.029
	(0.026)	(0.076)	(0.035)	(0.044)
College	0.095**	0.030	0.138**	0.067
	(0.036)	(0.117)	(0.054)	(0.054)
Occupation of male hh head's father	Yes	Yes	Yes	Yes
City dummies	Yes	Yes	Yes	Yes
Adjusted R-squared	0.305	0.321	0.303	0.298
Number of obs.	7282	879	3019	3384
Number of clusters	77	77	77	77

Individuals' years of education, CCP membership and occupation each demonstrate a significantly positive contribution to monthly income. On average, one additional year of education increases personal monthly income by approximately 4%. CCP members have approximately 10% higher income than non-members. Respondents who are government officials, professionals, and other white collars have approximately 36%, 37%, and 23% higher income than skilled or non-skilled laborers, respectively. Furthermore, the experience of rustication does not have significant effect on income, as shown in Xie *et al*. (2008) and Zhou (2010).

Table 4.10 presents the estimated effects of family class origins on the respondent's log of family assets per capita. Only the male heads of household born between 1941 and 1980 are used as subjects. The reason for not using female heads of household is that males are usually the main sources of family income and have a larger impact on family assets. There are four models in Table 4.10. The first model includes all the families with male heads of household born from 1941 to 1980. The second to the fourth models conduct regressions for the 1941-1950, 1951-1960, and 1961-1980 birth cohorts respectively. I do not run the regression separately for the 1971-1980 birth cohorts because the number of observations in this group is small and the respondents are so young that their current family assets might not be a proper measure of the family's economic status over a long period of time.

The results in column (1) show that households with poor and middle class backgrounds have significantly lower family assets per capita than those with rich class origins, after controlling other measures of individual and family characteristics. Specifically, families with poor class origins have approximately 27% lower asset values and families with middle class origins have 14% lower asset values than those from the rich class. Performing a similar analysis using rural samples of the same survey, Sato and Li (2007) show that the difference in assets per capita between descendants of the poor and the rich is 6% for respondents born 1943-1967, and is 13% for those born 1955-1967. The results in this study find the difference is 25% and 21% for these two birth cohorts respectively[26]. The differences in family assets per capita in urban China are much larger

[26] To make this comparison, I conduct regressions using Sato and Li's definition of cohorts. The full results are not reported here to save space.

than in rural China. This difference could imply that the factor that makes the descendants of the rich better off gives them a higher return in the more market-oriented environment. Households with the revolutionary class background have lower family assets per capita, but the difference is small and not statistically significant. The revolutionary class seems to have become a new elite class in contemporary China[27].

Other family characteristics, such as fathers' CCP membership, occupation and education, are not significant, while respondents' years of education, CCP membership and occupation types are significant determinants of family assets per capita. One more year of education increases the family assets per capita by approximately 5%. The difference in family assets owned by CCP members and non-members is very large. CCP members have approximately 21% higher family assets per capita than those non-members. Respondents who are government officials, professionals, and other white collars have approximately 34%, 29%, and 17% higher family assets per capita than skilled or non-skilled laborers respectively. The experience of being sent-down to rural areas does not have any significant effect on family assets per capita.

The family class origins are not significant determinants of wealth for 1941-1950 cohorts, but are significant for the remaining cohorts. The respondents with poor and middle class who were born in 1951-1960 have significantly lower family assets per capita, and the respondents who were born in 1961-1980 with poor class background have significantly lower family assets per capita. In addition, individuals born after 1950 were accumulating their wealth in the era of market economy, which explains the divergence in family assets among classes and might further suggest that decedents of the rich class are more adaptive to the market economy than others.

[27] It is not likely due to their wealth are less redistributed in the Cultural Revolution since the descendants of the revolutionary class are actually affected more severely during it (Worden *et al*., 1987). Moreover, their relatively higher income provides evidence of their sources of assets.

Table 4.10: Family Class Origins and Log of Family Assets Per Capita

	Natural log of family assets per capita			
	(1)	(2)	(3)	(4)
Independent variables	All	1941-1950	1951-1960	1961-1980
Age	0.012***	0.016	0.027**	0.025**
	(0.004)	(0.019)	(0.011)	(0.010)
Married	-0.182*	-1.066***	-0.105	-0.026
	(0.109)	(0.330)	(0.167)	(0.141)
Years of education	0.047***	0.068***	0.042***	0.048***
	(0.007)	(0.013)	(0.011)	(0.012)
CCP membership	0.194***	0.219**	0.174***	0.187***
	(0.034)	(0.096)	(0.052)	(0.050)
Occupation				
Clerical/office staff	0.157***	-0.039	0.226***	0.158*
	(0.058)	(0.125)	(0.077)	(0.083)
Professional	0.255***	0.0505	0.249**	0.254***
	(0.052)	(0.126)	(0.100)	(0.077)
Cadre	0.291***	0.165	0.360***	0.194**
	(0.044)	(0.109)	(0.063)	(0.093)
Rustication experience	0.056	0.054	0.098**	0.143
	(0.039)	(0.099)	(0.049)	(0.239)
Pre-rustication dummy	-0.060			
	(0.062)			
Post-rustication dummy	0.038			
	(0.100)			
Family class origins				
Middle class	-0.132**	0.052	-0.242***	-0.072
	(0.062)	(0.194)	(0.083)	(0.119)
Poor class	-0.236***	-0.134	-0.345***	-0.197**
	(0.053)	(0.171)	(0.076)	(0.087)
Revolutionary class	-0.068	0.413	-0.156	-0.052
	(0.087)	(0.454)	(0.124)	(0.163)
Father's CCP membership	0.082*	0.022	0.104*	0.114*
	(0.045)	(0.112)	(0.062)	(0.060)
Fathers' education level				
Elementary school	0.064	0.183	-0.097*	0.239**
	(0.045)	(0.111)	(0.049)	(0.101)
Junior high school	0.087	0.147	0.024	0.212**
	(0.055)	(0.120)	(0.079)	(0.104)
Senior high school or equivalence	0.061	0.047	-0.136	0.311***
	(0.066)	(0.198)	(0.105)	(0.104)
College	0.117	0.386**	-0.037	0.253**
	(0.074)	(0.177)	(0.098)	(0.115)
Occupation of male hh head's father	0.083	-0.144	-0.007	0.156
City dummies	Yes	Yes	Yes	Yes
Adjusted R-squared	0.242	0.300	0.227	0.215
Number of obs.	4147	713	1785	1649
Number of clusters	77	77	77	77

4.4 Conclusions

In a radical social experiment the physical capital of wealthy Chinese families was expropriated. The government further imposed a class system to restrict the political and educational rights of the rich for nearly three decades. Family members of the poor and revolutionary class were favored during this period. Using data in 2002, I show that individuals with poor and revolutionary class origins obtain CCP membership more easily and achieve a higher level of education in the three decades wherein the discriminatory policy was formally in effect.

In 1979, China government implemented market-oriented economic reform. The class system and class-based discriminatory policy were also officially abolished. University admissions returned to merit-based enrollment in 1977. The regression results in this chapter show that individuals with a revolutionary class background are continue to be more likely to be granted CCP membership even after the abolition of the class system. However, descendants of the poor class no longer enjoyed this political benefit. The descendants of the rich who received education after the late 1970s were more likely to achieve a higher level of education than all other classes, after controlling for fathers' education, occupation, and CCP membership. These results could indicate their strong preference over education. Once the social discrimination against them was abolished and the education system returned to merit-based, invested more on education.

Furthermore, after controlling for the CCP membership and educational attainment which can transmit the effects of family class background, I find that the descendants of the poor and middle class continue to have significantly lower income and family assets than those of the rich class. Specifically, individuals with poor class origins have 12% lower monthly income and 27% lower family assets per capita than those with rich class origins. Moreover, individuals with a revolutionary class background have the same income and assets per capita as those with rich class origins. This result implies that families with a revolutionary background have become a new elite group in contemporary China.

This social experiment over half a century in the PRC provides evidence that the intergenerational transmission of wealth does not solely come through physical capital. There are some other potential mechanisms for the transmission of wealth. First is the

intergenerational transmission of ability. Second is that entrepreneurship or the spirit of capitalism embodied in those previously well-off families was preserved through family education throughout the era of planning economy, and began to play roles after the revival of the market economy. Third is that individuals from wealthy pre-1949 families may have been more likely to have relatives overseas. Fourth is families with different background may have different family sizes due to different fertility decisions (family planning policies beginning in 1981 were not binding for these cohorts) and children's' survival chances. The latter two mechanisms are easily to be sort out if data on oversee relatives and sizes of extended family (at least the number of siblings) are available. More studies are needed to identify the channels of transmission in the future.

Bibliography

Acheson, J. (2000). 'Varieties of institutional failures', Presented as the Keynote Address at "Constituting the Commons: Crafting Sustainable Commons in the New Millennium", the Eighth Conference of the International Association for the Study of Common Property, Bloomington, Indiana, USA, May 31 - June 4, 2000, http://dlc.dlib.indiana.edu/archive/00000195/00/iascpkeynote.pdf.

Algan, Y. and Cahuc, P. (2010). 'Inherited trust and growth', *American Economic Review*, vol. **100**(5), pp.2060-92.

Anderson, S. and Baland, J. (2002). 'The economics of Roscas and intrahousehold resource allocation', *Quarterly Journal of Economics*, vol. **117**(3), pp. 963-95.

Anderson, S., Baland, J. and Moene, K.O. (2009). 'Enforcement in informal saving groups', *Journal of Development Economics*, vol. **90**(1), pp. 14-23.

Angrist, J.D. and Krueger, A.B. (2001). 'Instrumental variables and the search for identification: from supply and demand to natural experiments', *Journal of Economic Perspectives*, vol. **15**(4), pp. 69-85.

Appleton, S., Song, L., Knight, J. and Xia, Q. (2009). 'The economics of Communist Party membership - the curious case of rising numbers and wage premium during China's transition', *Journal of Development Studies*, vol. **45**(2), pp.256-75.

Baum, C.F., Schaffer, M.E. and Stillman, S. (2003). 'Instrumental variables and GMM: estimation and testing', *Stata Journal*, vol. **3**(1), pp. 1-31.

—— (2007). 'Enhanced routines for instrumental variables/GMM estimation and testing', *Stata Journal*, vol. **7**(4), pp. 465-506.

Baylis, K. and Perloff, J. (2010). 'Trade Diversion from Tomato Suspension Agreements', *Canadian Journal of Economics*, vol. **43**(1), pp. 127-51.

Berkes, F. and Folke, C., eds., (1998). *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*, Boston: Cambridge University Press.

Besley, T., Coate, S. and Loury, G.C. (1993). 'The economics of rotating savings and credit associations', *American Economic Review*, vol. **83**(4), pp. 792-810.

Bowles, S. and Gintis, H. (2002). 'Social capital and community governance', *Economic*

Journal, vol. **112**(483), pp. 419-436.

Bramoullé, Y. and R. Kranton (2005). 'Strategic experimentation in networks', NajEcon Working Paper Reviews No. 784828000000000417, www.najecon.org.

—— (2007). 'Risk-sharing networks', *Journal of Economic Behavior and Organization*, vol. **64**(3-4), pp. 275-94.

Campbell, C. and Lee, J. (2003). 'Social mobility from a kinship perspective: rural Liaoning, 1789-1909', *International Review of Social History*, vol. **48**(1), pp. 1-26.

—— (2006). 'Kin networks, marriage and social mobility in Late Imperial China', *Social Science History*, vol. **32**(2), pp. 175-214.

Carter, M. and Maluccio, J. (2003). 'Social capital and coping with economic shocks: an analysis of stunting of South African children', *World Development*, vol. **31**(7), pp. 1146-63.

Chau, A.Y. (2006). *Miraculous Response: Doing Popular Religion in Contemporary China*, Stanford: Stanford University Press.

Cheng, N. (1988). *Life and Death in Shanghai*, Penguin Books.

Conservation International (2007). *Biodiversity Hotspots*, http://www.biodiversityhotspots.org/xp/Hotspots/china/Pages/default.aspx.

Costa, D.L. and Kahn, M.E. (2003). 'Cowards and heroes: group loyalty in the American civil war', *Quarterly Journal of Economics*, vol. **118**(2), pp. 519-548.

Cramb, R.A. (2005). 'Social capital and soil conservation: evidence from the Philippines', *Australian Journal of Agricultural and Resource Economics*, **vol**. **49**(2), pp. 211-26.

Dayton-Johnson, J. (2000). 'Determinants of collective action on the local commons: a model with evidence from Mexico', *Journal of Development Economics*, vol. **62**(1), pp. 181-208.

De Weerdt, J. and Dercon, S. (2006). 'Risk-sharing networks and insurance against illness', *Journal of Development Economics*, vol. **81**(2), pp. 337-56.

Deng, Z. and Treiman, D.J. (1997). 'The impact of the Cultural Revolution on trends in educational attainment in the People's Republic of China', *American Journal of Sociology*, vol. **103**(2), pp. 391-428.

Durlauf, S.N. and Fafchamps, M. (2005). 'Social capital', in (P. Aghion and S.N. Durlauf, eds), *Handbook of Economic Growth*, pp.1639-99, Amsterdam: Elsevier.

Durante, R. (2010). 'Risk, cooperation and the economic origins of social trust: an empirical investigation', Unpublished.

Easterly, W. and Levine, R. (1997). 'Africa's growth tragedy: policies and ethnic divisions', *Quarterly Journal of Economics*, vol. **112**(4), pp. 1203-50.

Fafchamps, M and Minten, B. (2002), 'Returns to social network capital among traders', *Oxford Economics Papers*, vol. **54**(2), pp. 173-206.

Feránndez, R. and Fogli, A. (2009). 'Culture: an empirical investigation of beliefs, work, and fertility', *American Economic Journal: Macroeconomics*, vol. **1**(1), pp. 146-77.

Fernández, R., Fogli, A. and Olivetti, C. (2004). 'Mothers and sons: preference formation and female labor force dynamics', *Quarterly Journal of Economics*, vol. **119**(4), pp. 1249-99.

Francois, P. and Zabojnik, J. (2005). 'Trust, social capital, and economic development', *Journal of the European Economic Association*, vol. **3**(1), pp. 51-94.

Giles, J., Park, A., and Wang, M. (2008). 'The great proletarian Cultural Revolution, disruptions to education, and returns to schooling in urban China', World Bank Policy Research Working Paper No. 4729.

Giuliano, P. (2007). 'Living arrangements in western Europe: does cultural origin matter?' *Journal of the European Economic Association*, vol. **5**(5), pp. 927-52.

Gong, Y., Baylis, K., Xu, J., and Bull, G. (2010). 'Individual social interactions, village Institutions and rural villagers' mutual trust: survey and field experimental evidence from western rural China', Unpublished.

Guiso, L., Sapienza, P. and Zingales, L. (2004). 'The role of social capital in financial development', *American Economic Review*, vol. **94**(3), pp. 526-56.

—— (2008a). 'Social capital as good culture', *Journal of the European Economic Association*, vol. **6**(2-3), pp. 295-320.

—— (2008b). 'Long-term persistence', Chicago GSB Research Paper No. 08-11.

Guiso, L., and Sapienze, P. (2006). 'Does culture affect economic outcomes?' *Journal of Economic Perspectives*, vol. **20**(2), pp. 23-48.

Gustafsson, B., Li, S. and Sicular, T., eds., (2008). *Inequality and Public Policy in China*, New York: Cambridge University Press.

Hardin, G. (1968). 'The tragedy of the commons', *Science*, vol. **162**(13), pp. 1243-48.

Helliwell, J. (1996). 'Economic growth and social capital in Asia', in (R.G. Harris, eds), *The Asia Pacific Region in the Global Economy: A Canadian Perspective*, pp. 21-42, Calgary: University of Calgary Press.

Isham, J. and Kähkönen, S. (2002a). 'How do participation and social capital affect community-based water projects? Evidence from Central Java, Indonesia' in (C. Grootaert and T. van Bastelaer, eds), *The Role of Social Capital in Development: An Empirical Assessment*, pp. 155-87, New York: Cambridge University Press.

—— (2002b). 'Institutional determinants of the impact of community-based water services: evidence from Sri Lanka and India', *Economic Development and Cultural Change*, vol. **50**(3), pp. 667-91.

Jensen, R. and Oster, E. (2008). 'The power of TV: cable television and women's status in India', *Quarterly Journal of Economics*, vol. **124**(3), pp. 1057-94.

Kähkönen, S. (1999). 'Does social capital matter in water and sanitation delivery? A review of literature', SCI Working Paper No. 9, Washington: World Bank.

Knack, S. and Keefer, P. (1997). "Does social capital have an economic payoff? A cross-country investigation', *Quarterly Journal of Economics*, vol. **112**(4), pp. 1251-88.

Kleibergen, F. and Paap, R. (2006). 'Generalized reduced rank tests using the singular value decomposition', *Journal of Econometrics*, vol. **133**(1), pp. 97-126.

Krishna, A. and Uphoff, N. (2002). 'Mapping and measuring social capital: a conceptual and empirical study of collective action for conserving and developing watersheds in Rajasthan, India', in (C. Grootaert and T. van Bastelaer, eds), *The Role of Social Capital in Development: An Empirical Assessment*, pp. 85-124, New York: Cambridge University Press.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A. and Vishny, R. (1997). 'Legal Determinants of External Finance', *Journal of Finance*, vol. **52**(3), pp. 1113-55.

Lee, C.K. and Selden, M. (2007). *Durable Inequality: Legacies of China's Revolutions and the Pitfalls of Reform*, in (J. Foran, D. Lane and A. Zivkovic, eds), *Revolution in the Making of the Modern World: Social Identities, Globalization and Modernity*, Routledge.

Li, C. (2006). 'Socio-political changes and inequality of educational opportunity - the

impact of family background and institutions on educational attainment (1940-2001)', *Chinese Sociology & Anthropology*, vol. **38**(4), pp. 6-36.

Li, H., Meng, L., Wang, Q. and Zhou, L. (2008). 'Political connections, financing and firm performance: evidence from Chinese private firms', *Journal of Development Economics*, vol. **87**(2), pp. 283-99.

Li, H., Meng, L. and Zhang, J. (2006). 'Why do entrepreneurs enter politics? Evidence from China', *Economic Inquiry*, vol. **44**(3), pp. 559-78.

Li, H., Rosenzweig, M. and Zhang J. (2010). 'Altruism, favoritism, and guilt in the allocation of family resources: Sophie's choice in Mao's mass send-down movement', *Journal of Political Economy*, vol. **118**(1), pp. 1-38.

Lin, S. and Lu, D. (2004). 'Characteristics of precipitation in Gansu province in recent 40 years', *Plateau Meteorology*, vol. **23**(6), pp. 898-904.

Liu, Z. (2003). 'The economic impact and determinants of investment in human and political capital in China', *Economic Development and Cultural Change*, vol. **51**(4), pp. 823-49.

Macfarquhar, R. and Schoenhals, M. (2006). *Mao's Last Revolution*, Cambridge and London: The Belknap Press of Harvard University Press.

McCarthy, N., Sadoulet, E. and Janvry, A. (2001). 'Common pool resource appropriation under costly cooperation', *Journal of Environmental Economics and Management*, vol. **42**(3), pp. 297-309.

Meinzen-Dick, R., Raju, K.V. and Gulati, A. (2002). 'What affects organization and collective action for managing resources? Evidence from canal irrigation systems in India', *World Development*, vol. **30**(4), pp. 649-66.

Meng, X. and Gregory, R.G. (2002). 'The impact of interrupted education on subsequent educational attainment: A cost of the Chinese Cultural Revolution', *Economic Development and Cultural Change*, vol. **50**(4), pp. 935-59.

Miguel, E., Satyanath, S. and Sergenti, E. (2004). 'Economic shocks and civil conflict: an instrumental variables approach', *Journal of Political Economy*, vol. **112**(4), pp. 725-53.

Morduch, J. and Sicular, T. (2000). 'Politics, growth, and inequality in rural China: does it pay to join the Party?' *Journal of Public Economics*, vol. **77**(3), pp. 331-56.

Narayan, D. (1999). 'Bonds and bridges: social capital and poverty', World Bank Policy Research Working Paper 2167. Washington, D.C.: World Bank.

Nunn, N. and Wantchekon, L. (2011). 'The slave trade and the origins of mistrust in Africa', *American Economic Review*, vol. **101**(7), pp. 3221-52.

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*, Cambridge: Cambridge University Press.

—— (1992). *Crafting Institutions for Self-Governing Irrigation Systems*, San Francisco, California: ICS Press.

—— (1999). 'Coping with tragedies of the commons', *Annual Review of Political Science*, vol. **2**, pp. 493-535.

Palloni, A., Massey, D., Ceballos, M., Espinosa, K. and Spittel, M. (2001). 'Social capital and internal migration: A test using information on family networks', *American Journal of Sociology*, vol. 1**06**(5), 1262-98.

Pargal, S., Huq, M. and Dilligan, D. (2002). 'Social capital in solid waste management: evidence from Dhaka, Bangladesh', in (C. Grootaert and T. van Bastelaer, eds), *The Role of Social Capital in Development: An Empirical Assessment*, pp. 188-212, New York: Cambridge University Press.

Pepper, S. (1996). *Radicalism and Education Reform in Twentieth-Century China*, Cambridge: Cambridge University Press.

Putnam, R.D. (2000). *Bowling Alone: The Collapse and Revival of American Community*, New York: Simon & Schuster.

Putnam, R.D., Leonardi, R. and Nanetti, R.Y. (1993). *Making Democracy Work: Civic Traditions in Modern Italy*, Princeton: Princeton University Press.

Ravallion, M. and Chen, S. (2007). 'China's (Uneven) Progress against Poverty', *Journal of Development Economics*, vol. **82**(1), pp. 1-42.

Sato H. and Li, S. (2007). 'Revolution and family in rural China: Influence of family background on current family wealth', IZA Discussion Paper No. 3223.

—— (2008). 'Class origin, family culture, and intergenerational correlation of education in rural China', *China Economic Quarterly*, vol. **7**(4), pp. 1105-30.

Schechter, L. (2007). 'Theft, gift-giving, and trustworthiness: honesty is its own reward in rural Paraguay', *American Economic Review*, vol. **97**(5), pp. 1560-82.

Staiger, D. and Stock, J.H. (1997). 'Instrumental variables regression with weak instruments', *Econometrica*, vol. **65**(3), pp. 557-86.

Stock, J.H. and Yogo, M. (2005). 'Testing for weak instruments in linear IV regression', in (J.H. Stock and D.W.K. Andrews, eds), *Identification and Inference for Econometric Models: Essays in Honor of Thomas J. Rothenberg*, pp. 80-108, New York: Cambridge University Press.

Su, Y., (2002). 'A case study from Yulong Village in Lijiang county's Baisha Township', in (Southwest China Forest Resources Conflict Management Case Study Research Group, eds), *Conflict and Conflict Management: A New Approach to Conflict Management in the Forests of Southwest China*, Beijing: People's Press.

Szelényi, I. (1988). *Socialist Entrepreneurs: Embourgeoisement in Rural Hungary*, Madison: University of Wisconsin Press.

Tabellini, G. (2010). 'Culture and institutions: economic development in the regions of Europe', *Journal of the European Economic Association*, vol. **8**(4), pp. 677-716.

Tsai, L. (2002). 'Cadres, temple and lineage institutions, and governance in rural China', *The China Journal*, vol. **48**, pp. 1-27.

—— (2007). *Accountability Without Democracy: Solidary Groups and Public Goods Provision in Rural Chin*a, Cambridge University Press.

van den Brink, R. and Chavas, J. (1997). 'The microeconomics of an indigenous African institution: the rotating savings and credit association', *Economic Development and Cultural Change*, vol. **45**(4), pp. 745-72.

Wang, F. (2008). *Boundaries and Categories: Rising Inequality in Post-Socialist urban China*, Stanford: Stanford University Press.

Wang, N. (2009). *The Era of Big Turmoil: China in 1949-1976*, Henan: People's Press.

Wang, Y., Wang, R., Zhang, K., Wang, H. and Zhao, H. (2009). 'Review of arid climate disaster in Gansu province', *Journal of Catastrophology*, vol. **24**(1), pp. 47-52.

Watson, J., eds., (1984). *Class and Social Stratification in Post-Revolution China*, Cambridge: Cambridge University Press.

Weyerheauser, H., Kahrl, K. and Su, Y. (2006). 'Ensuring a future for collective forestry in China's southwest: adding human and social capital to policy reforms', *Forest Policy and Economics*, vol. **8**(4), pp. 375-85.

Woolcock, M., (1998). 'Social capital and economic development: Toward a theoretical synthesis and policy framework', *Theory and Society*, vol. **27**, pp. 151-208.

Worden R.L., Savada, A.M. and Dolan, R.E., eds., (1987). *China: A Country Study*. Washington: GPO for the Library of Congress.

Xie Y., Jiang Y. and Greenman, E. (2008). 'Did send-down experience benefit youth? A reevaluation of the social consequences of forced urban-rural migration during China's Cultural Revolution', *Social Science Research*, vol. **37**(2), pp. 686-700.

Xu, J. and Wilkes, A. (2004). 'Biodiversity impact analysis in northwest Yunnan, southwest China', *Biodiversity and Conservation*, vol. **13**(5), 959-83.

Yang, L., An, D. and Turner, J.A. (2005). *Handbook of Chinese Mythology*, ABC-Clio.

Yang, X. (2005). 'The characteristics and possible causes of change in precipitation in northwest China during the recent 50 years', MSc Thesis, Chinese Academy of Meteorological Sciences.

Yu, J. (2001). *The Politics in Yuecun: The Changes in Political Structure in Rural China during the Transition Periods*, Beijing: Shangwu Yinshu Guan (Commercial Press).

Zhang, W. (2010). 'How does a traumatic experience during youth affect later life?' Unpublished.

Zhao, X. and Bell, D. (2007). 'Miaohui, the temples meeting festival in north China', *China Information*, vol. **21**(3), pp. 457-79.

Zhou, X., Moen, P. and Tuma, N.B. (1998). 'Education stratification in urban China: 1949-94', *Sociology of Education*, vol. **71**(3), pp. 199-222.

Zhou, X. and Hou, L. (1999). 'Children of the Cultural Revolution: The state and the life course in the People's Republic of China', *American Sociological Review*, vol. **64**(1), pp.12-36.

Appendices

A Appendix to Chapter 2

A.1 Determinants of Villagers' Participation in ROLAs (Probit Models)

	(1)	(2)	(3)	(4)
	Dependent Variable: Participation in a ROLA			
Social capital	0.459***	0.448***	0.444***	0.438***
	(0.105)	(0.106)	(0.104)	(0.120)
Percent of household laborers conducting non-farm work	0.223	0.233	0.249	0.161
	(0.229)	(0.230)	(0.231)	(0.244)
Land area per laborer	0.018	0.015	0.012	0.013
	(0.024)	(0.025)	(0.025)	(0.026)
Labor contribution to maintenance of canals	0.068**	0.062**	0.062*	0.061*
	(0.030)	(0.029)	(0.032)	(0.034)
Individual controls	Yes	Yes	Yes	Yes
Household controls	No	Yes	Yes	Yes
Geographic controls	No	No	Yes	Yes
County dummies	Yes	Yes	Yes	Yes
Restricted sample	No	No	No	Yes
Number of obs.	668	656	656	581
Pseudo R-squared	0.159	0.168	0.180	0.189

A.2 Determinants of Villagers' Participation in ROLAs (IV-Probit Models)

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A	Dependent Variable: Participation in a ROLA					
Social capital	0.942***	0.905***	0.937***	0.909***	0.916***	0.857***
	(0.170)	(0.243)	(0.179)	(0.237)	(0.204)	(0.274)
Percent of household laborers conducting non-farm work	0.141	0.128	0.139	0.142	0.067	0.039
	(0.212)	(0.233)	(0.214)	(0.235)	(0.244)	(0.259)
Land area per laborer	-0.011	0.015	-0.014	0.014	-0.014	0.009
	(0.022)	(0.024)	(0.022)	(0.024)	(0.024)	(0.025)
Labor contribution to maintenance of canals	0.056*	0.050*	0.041	0.048	0.035	0.044
	(0.029)	(0.030)	(0.030)	(0.032)	(0.033)	(0.035)
Panel B	Dependent Variable: Social Capital					
Temple presence prior to 1949	0.597***	0.568***	0.586***	0.566***	0.620***	0.603***
	(0.121)	(0.120)	(0.119)	(0.120)	(0.129)	(0.132)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	No	No	Yes	Yes	Yes	Yes
County dummies	No	Yes	No	Yes	No	Yes
Restricted sample	No	No	No	No	Yes	Yes
Number of obs.	656	656	656	656	581	581

A.3 Reduced Form Regressions of Villagers' Participation in ROLAs

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A	Dependent Variable: Participation in a ROLA					
Temple presence prior to 1949	0.138***	0.096**	0.123***	0.095**	0.120**	0.086*
	(0.044)	(0.046)	(0.044)	(0.045)	(0.047)	(0.050)
Percent of household laborers conducting non-farm work	0.034	0.049	0.039	0.051	0.041	0.042
	(0.062)	(0.060)	(0.060)	(0.059)	(0.065)	(0.062)
Land area per laborer	0.001	0.005	-0.001	0.003	0.001	0.004
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
Labor contribution to maintenance of canals	0.024**	0.018	0.017	0.018	0.017	0.019
	(0.010)	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	No	No	Yes	Yes	Yes	Yes
County dummies	No	Yes	No	Yes	No	Yes
Restricted sample	No	No	No	No	Yes	Yes
Number of obs.	656	656	656	656	581	581
Adjusted R-squared	0.051	0.111	0.089	0.125	0.097	0.132

B Appendix to Chapter 3

B.1 Proof of Proposition 3.1

$$
\begin{aligned}
m_i &= \gamma\eta\sigma_\mu^2\left(1-M_i r_{iB}\right)\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right) r_A \\
&\quad -\frac{1}{2}\gamma\eta\sigma_\mu^2\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n \left(r_{nB}\right)^2+\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right)^2\right)\left(r_A\right)^2 \\
&> \gamma\eta\sigma_\mu^2\left(1-M_i r_{iB}\right)\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right) r_A-\gamma\eta\sigma_\mu^2\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right)^2\left(r_A\right)^2 \\
&= \gamma\eta\sigma_\mu^2\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right)\left(1-M_i r_{iB}-\left(N-1\right) r_A-\sum_{n\neq i}^{N} M_n r_A r_{nB}\right) r_A \\
&> 0.
\end{aligned}
$$

The first derivative of m_i with respect to A_i is:

$$
\begin{aligned}
\frac{\partial m_i}{\partial A_i} &= \gamma\eta\sigma_\mu^2\left(1-M_i r_{iB}\right)\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right)\frac{\partial r_A}{\partial A_i} \\
&\quad -\gamma\eta\sigma_\mu^2\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n \left(r_{nB}\right)^2+\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right)^2\right) r_A\frac{\partial r_A}{\partial A_i} \\
&> \gamma\eta\sigma_\mu^2\left(1-M_i r_{iB}\right)\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right)\frac{\partial r_A}{\partial A_i} \\
&\quad -\gamma\eta\sigma_\mu^2\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right)\left(1+\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right) r_A\frac{\partial r_A}{\partial A_i} \\
&= \gamma\eta\sigma_\mu^2\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right)\left(1-M_i r_{iB}-N r_A-\sum_{n\neq i}^{N} M_n r_A r_{nB}\right)\frac{\partial r_A}{\partial A_i} \\
&= \gamma\eta\sigma_\mu^2\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right)\left(\theta_i-r_A\right)\frac{\partial r_A}{\partial A_i}.
\end{aligned}
\tag{B.1}
$$

Since $\frac{\partial r_A}{\partial A_i}>0$ and $\theta_i \geq r_A$, we then have $\frac{\partial m_i}{\partial A_i}>0$.

The first derivative of m_i with respect to B_i is:

$$
\frac{\partial m_i}{\partial B_i} = -\gamma\eta\sigma_\mu^2 M_i\left\{\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right\} r_A\frac{dr_{iB}}{dB_i}. \tag{B.2}
$$

Since $\frac{dr_{iB}}{dB_i}>0$, we then have $\frac{\partial m_i}{\partial B_i}<0$.

Taking the first derivative of $\frac{\partial m_i}{\partial A_i}$ with respect to B_i yields:

$$\frac{\partial^2 m_i}{\partial A_i \partial B_i} = -\gamma\eta\sigma_\mu^2 M_i \left\{ (N-1) + \sum_{n\neq i}^{N} M_n r_{nB} \right\} \frac{\partial r_A}{\partial A_i} \frac{dr_{iB}}{dB_i}. \tag{B.3}$$

Since $\frac{\partial r_A}{\partial A_i} > 0$ and $\frac{dr_{iB}}{dB_i} > 0$, we thus have $\frac{\partial^2 m_i}{\partial A_i \partial B_i} < 0$.

B.2 Proof of Proposition 3.2

Substituting (3.8) and (3.9) into the group objective function, we then have

$$\max_{\{\hat{c}_1,\hat{c}_2,\cdots,\hat{c}_N\}} \sum_{i=1}^{N} \left(\left(1+\frac{1}{\alpha m_i}\right) u\left(\hat{c}_i, \hat{c}_{-i}\right) - \frac{1}{\alpha m_i} u\left(c_i\left(\hat{c}_{-i}\right), \hat{c}_{-i}\right) \right)$$

$$= \max_{\{\hat{c}_1,\hat{c}_2,\cdots,\hat{c}_N\}} b\sum_{i=1}^{N} \left(\left(1+\frac{1}{\alpha m_i}\right)\hat{c}_i \left(\frac{a-d}{b} - \sum_{n=1}^{N}\hat{c}_n\right) - \frac{1}{4\alpha m_i}\left(\frac{a-d}{b} - \sum_{n\neq i}^{N}\hat{c}_n\right)^2 \right)$$

The first order condition for user $i = 1, 2, \cdots, N$ is given by:

$$\left(1+\frac{1}{2\alpha m_i} + \frac{1}{2\alpha}\sum_{n=1}^{N}\frac{1}{m_n}\right)\left(\frac{a-d}{b} - \sum_{n=1}^{N}\hat{c}_n\right) - \frac{1}{2\alpha}\sum_{n=1}^{N}\frac{\hat{c}_n}{m_n} - \sum_{n=1}^{N}\hat{c}_n - \frac{1}{2\alpha}\frac{\hat{c}_i}{m_i} = 0. \tag{B.4}$$

Summation of all the users' first order condition yields:

$$\frac{1}{2\alpha}\sum_{n=1}^{N}\frac{\hat{c}_n}{m_n} = -\left(\frac{2N}{N+1} + \frac{1}{2\alpha}\sum_{n=1}^{N}\frac{1}{m_n}\right)\sum_{n=1}^{N}\hat{c}_n + \left(\frac{N}{N+1} + \frac{1}{2\alpha}\sum_{n=1}^{N}\frac{1}{m_n}\right)\left(\frac{a-d}{b}\right). \tag{B.5}$$

Substituting (B.5) into (B.4) to eliminate $\sum_{k=1}^{N}\frac{\hat{c}_k}{m_k}$ and rearranging yields:

$$\hat{c}_i = -\left(\frac{4\alpha}{(N+1)}m_i + 1\right)\sum_{n=1}^{N}\hat{c}_n + \left(\frac{2\alpha}{(N+1)}m_i + 1\right)\frac{a-d}{b}. \tag{B.6}$$

Summation over i on both sides and rearranging solves the total cooperative consumption:

$$\sum_{n=1}^{N}\hat{c}_n = \frac{2\alpha\sum_{n=1}^{N}m_n + N(N+1)}{4\alpha\sum_{n=1}^{N}m_n + (N+1)^2}\frac{a-d}{b}. \tag{B.7}$$

Substituting (B.7) into (B.6) solves user *i*'s optimal consumption under cooperative strategy:

$$\hat{c}_i = \frac{2\alpha\left(\sum_{n=1}^{N} m_n - (N-1)m_i\right) + (N+1)}{4\alpha\sum_{n=1}^{N} m_n + (N+1)^2}\frac{a-d}{b}. \tag{B.8}$$

Now we need to show whether condition in (3.15) is satisfied. Substituting $\sum_{n=1}^{N}\hat{c}_n$ in (B.7) and $\hat{c}_i$ in (A8) into $\hat{U}_i = \frac{b(1+\alpha m_i)}{\alpha m_i}\hat{c}_i\left(\frac{a-d}{b} - \sum_{n=1}^{N}\hat{c}_n\right) - \frac{b}{4\alpha m_i}\left(\frac{a-d}{b} - \sum_{n\neq i}^{N}\hat{c}_n\right)^2$ and rearranging yields the user *i*'s utility of consuming the CPR under cooperative strategy:

$$\hat{U}_i = \frac{\left(2\alpha\sum_{n=1}^{N} m_n + (N+1)\right)^2 - \left(4\alpha\sum_{n=1}^{N} m_n + (3N-1)\right)(N-1)\alpha m_i}{\left(4\alpha\sum_{n=1}^{N} m_n + (N+1)^2\right)^2}\frac{(a-d)^2}{b}. \tag{B.9}$$

User *i*'s utility of consuming the CPR under non-cooperative strategy is given by (3.3) and (3.5):

$$\tilde{U}_i = \frac{1}{(N+1)^2}\frac{(a-d)^2}{b}. \tag{B.10}$$

To make the cooperative equilibrium enforceable, we must have $\hat{U}_i \geq \tilde{U}_i$ for each $i = 1,2,\cdots,N$. Using the expressions in (B.6) and (B.7) we then have:

$$m_i \leq \frac{N(N+3)}{(N+1)^2}\bar{m} + \frac{N(N-1)(3N+5)}{(N+1)^2\left(4N\alpha + (N+3)/\bar{m}\right)} \quad for\ \forall\ i = 1,2,\cdots,N \tag{B.11}$$

,

in which $\bar{m} = \frac{1}{N}\sum_{n=1}^{N} m_n$. (B.8) is equivalent to:

$$\max_{\{j=1,2,\cdots,N\}}\left(m_j\right) \leq f\left(\bar{m}\right), \tag{B.12}$$

in which $f(\bar{m}) \le \frac{N(N+3)}{(N+1)^2}\bar{m} + \frac{N(N-1)(3N+5)}{(N+1)^2(4N\alpha + (N+3)/\bar{m})}$.

Now we explore the relationship between the optimal consumption under cooperative strategy and the vulnerability to social sanction. Using the expression of $\hat{c}_i$ in (B.8), we can derive the first derivative of $\hat{c}_i$ with respect to m_i:

$$\frac{d\hat{c}_i}{dm_i} = -\frac{2(N-1)\left(4\sum_{n\neq i}^{N} m_n + N(N+1)\right)}{\left(4\sum_{n=1}^{N} m_n + (N+1)^2\right)^2}\frac{a-d}{b} < 0. \quad \text{(B.13)}$$

The second derivative of $\hat{c}_i$ with respect to m_i is:

$$\frac{d^2\hat{c}_i}{d(m_i)^2} = \frac{16(N-1)\left(4\sum_{n\neq i}^{N} m_n + N(N+1)\right)}{\left(4\sum_{n=1}^{N} m_n + (N+1)^2\right)^3}\frac{a-d}{b} > 0. \quad \text{(B.14)}$$

B.3 Proof of Proposition 3.3

Combining $\frac{d\hat{c}_i}{dm_i} < 0$ and $\frac{\partial m_i}{\partial A_i} > 0$, we then have $\frac{\partial \hat{c}_i}{\partial A_i} = \frac{d\hat{c}_i}{dm_i}\frac{\partial m_i}{\partial A_i} < 0$.

Combining $\frac{d\hat{c}_i}{dm_i} < 0$ and $\frac{\partial m_i}{\partial B_i} < 0$, we then have $\frac{\partial \hat{c}_i}{\partial B_i} = \frac{d\hat{c}_i}{dm_i}\frac{\partial m_i}{\partial B_i} > 0$.

Taking partial derivative of $\frac{\partial \hat{c}_i}{\partial A_i}$ with respect to B_i yields:

$$\frac{\partial^2 \hat{c}_i}{\partial A_i \partial B_i} = \frac{d^2\hat{c}_i}{d(m_i)^2}\frac{\partial m_i}{\partial B_i}\frac{\partial m_i}{\partial A_i} + \frac{d\hat{c}_i}{dm_i}\frac{\partial^2 m_i}{\partial A_i \partial B_i}. \quad \text{(B.15)}$$

Substituting $\frac{d^2\hat{c}_i}{d(m_i)^2}$ in (B.14), $\frac{\partial m_i}{\partial B_i}$ in (B.2), $\frac{\partial m_i}{\partial A_i}$ in (B.1), $\frac{d\hat{c}_i}{dm_i}$ in (B.13), and $\frac{\partial^2 m_i}{\partial A_i \partial B_i}$ in (B.3) into (B.15) and rearranging yields:

$$\frac{\partial^2 \hat{c}_i}{\partial A_i \partial B_i} = 4\rho_i \sum_{n=1}^{N} m_n + \rho_i \left(N+1\right)^2$$

$$-8\rho_i \gamma\eta\sigma_\mu^2 r_A \left\{ \begin{array}{l} \left(1-M_i r_{iB}\right)\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right) \\ -\left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n \left(r_{nB}\right)^2 + \left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right)^2\right) r_A \end{array} \right\}$$

$$= 4\rho_i \left(\sum_{n=1}^{N} m_n - 2m_i\right) + \rho_i \left(N+1\right)^2$$

$$+ 4\rho_i \gamma\eta\sigma_\mu^2 \left(r_A\right)^2 \left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n \left(r_{nB}\right)^2 + \left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right)^2\right)$$

$$> 0,$$

where

$$\rho_i \equiv \frac{2\gamma\eta\sigma_\mu^2 \left(N-1\right) M_i \left(\left(N-1\right)+\sum_{n\neq i}^{N} M_n r_{nB}\right)\left(4\sum_{n\neq i}^{N} m_n + N\left(N+1\right)\right)\frac{a-d}{b}\frac{\partial r_A}{\partial A_i}\frac{dr_{iB}}{dB_i}}{\left(4\sum_{n=1}^{N} m_n + \left(N+1\right)^2\right)^3}.$$

B.4 Proof of Proposition 3.4

Taking the partial derivative of $\hat{c}_i$ in (20) with respect to A_i yields:

$$\frac{\partial \hat{c}_i}{\partial A_i} = \frac{1}{\beta}\left(\left(N-1\right)+\left(M-1\right)\sum_{n\neq i}^{N} r_{nB}\right)\hat{\mu}_i \frac{\partial r_A}{\partial A_i} < 0,$$

Taking the partial derivative of $\hat{c}_i$ in (20) with respect to B_i yields:

$$\frac{\partial \hat{c}_i}{\partial B_i} = \frac{1}{\beta}\left(M-1\right)\hat{\mu}_i \frac{dr_{iB}}{dB_i} < 0,$$

Taking the partial derivative of $\frac{\partial \hat{c}_i}{\partial A_i}$ with respect to B_i yields:

$$\frac{\partial^2 \hat{c}_i}{\partial A_i \partial B_i} = 0.$$