



ADB Working Paper Series

**INFRASTRUCTURE, URBANIZATION,
AND DEMAND FOR BANK AND NON-BANK
LOANS OF HOUSEHOLDS IN THE
PEOPLE'S REPUBLIC OF CHINA**

Angela C. Lyons, John E. Grable,
and Ting Zeng

No. 767
July 2017

Asian Development Bank Institute

Angela C. Lyons is an associate professor at the University of Illinois at Urbana-Champaign. John E. Grable is a professor at the University of Georgia. Ting Zeng is an assistant professor at the Southwestern University of Finance and Economics.

The views expressed in this paper are the views of the author and do not necessarily reflect the views or policies of ADBI, ADB, its Board of Directors, or the governments they represent. ADBI does not guarantee the accuracy of the data included in this paper and accepts no responsibility for any consequences of their use. Terminology used may not necessarily be consistent with ADB official terms.

Working papers are subject to formal revision and correction before they are finalized and considered published.

The Working Paper series is a continuation of the formerly named Discussion Paper series; the numbering of the papers continued without interruption or change. ADBI's working papers reflect initial ideas on a topic and are posted online for discussion. ADBI encourages readers to post their comments on the main page for each working paper (given in the citation below). Some working papers may develop into other forms of publication.

ADB recognizes "China" as the People's Republic of China; "Hong Kong" as Hong Kong, China; and "Korea" as the Republic of Korea.

Suggested citation:

Lyons, A. C., J. E. Grable, and T. Zeng. 2017. Infrastructure, Urbanization, and Demand for Bank and Non-Bank Loans of Households in the People's Republic of China. ADBI Working Paper 767. Tokyo: Asian Development Bank Institute. Available: <https://www.adb.org/publications/infrastructure-urbanization-and-demand-bank-and-non-bank-loans-households-prc>

Please contact the authors for information about this paper.

Email: anglyons@illinois.edu, grable@uga.edu, zengting@swufe@edu.cn

This paper was presented at the 5th Seminar on Asia and the Pacific Economies hosted by Xi'an Jiaotong-Liverpool University and the Asian Development Bank Institute (ADBI) in Suzhou, People's Republic of China (PRC), the ADBI workshop on "Urbanization in Asia: Economics and Social Consequences" hosted by Sogang University in Seoul, Republic of Korea, and the 2017 Chinese Economists Society Annual Conference in Nanjing, PRC. We are grateful to Peter Morgan, Paulo Regis, Bihong Huang, Chi-Chur Chao, Guanghua Wan, Almas Heshmati, and Sweety Pandey for helpful comments.

Asian Development Bank Institute
Kasumigaseki Building, 8th Floor
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500
Fax: +81-3-3593-5571
URL: www.adbi.org
E-mail: info@adbi.org

© 2017 Asian Development Bank Institute

Abstract

Financial inclusion plays an important role in giving households greater access to borrowing opportunities, which in turn can be used to improve human capital accumulation, socioeconomic status, and long-run economic development. One way to enhance households' access to and usage of the financial system, especially the formal banking system, is to ensure that an adequate infrastructure exists within their community. This study uses data from the *2013 Chinese Household Finance Survey* to investigate how the infrastructure affects the usage of formal bank loans for both urban and rural households in the People's Republic of China (PRC). The analysis is extended to investigate the impacts of the infrastructure on non-bank loans. The results suggest that the infrastructure, in a variety of forms (e.g., physical, financial, technological, social, and informational), is significantly associated with the loan demand—most notably for urban households using formal bank loans. Further, those living in more urbanized areas and megacities are less likely to demand bank and non-bank loans even after controlling for other factors, suggesting that there may be an “urbanization effect” that is dampening credit access and usage. The potential endogeneity between the infrastructure and the loan demand is taken into consideration. The results show that decisions related to the loan demand and infrastructure mostly appear to be made independently. The findings from this research have important implications for the PRC and other countries working on national strategies aimed at improving financial inclusion, especially the expansion of bank credit in rapidly growing urbanized areas, where the infrastructure may be reaching capacity.

Keywords: infrastructure, urbanization, financial inclusion, microfinance, credit, PRC

JEL Classification: D1, G2, O1, I3, J1

Contents

1.	INTRODUCTION	1
2.	DATA.....	3
2.1	Measuring Urbanization	4
2.2	Measuring the Infrastructure	4
2.3	Measuring Financial Inclusion	6
3.	DESCRIPTIVE STATISTICS.....	7
3.1	Usage of Bank and Non-bank Loans	10
3.2	The Influence of the Infrastructure on Bank and Non-bank Loans	12
3.3	A Closer Look at the Role of the Infrastructure	14
4.	METHODOLOGY	16
5.	RESULTS.....	18
5.1	Simultaneous Probit Estimates for Bank Loans and Infrastructure	18
5.2	Simultaneous Probit Estimates for Non-bank Loans and the Infrastructure ..	22
5.3	Results for Urban and Rural Households	22
5.4	Robustness Checks	25
6.	CONCLUSIONS	26
	REFERENCES	29

1. INTRODUCTION

Previous research has found that strong, stable financial systems are critical to providing individuals and families with the opportunities and skills needed to secure their own long-term economic and financial security. Well-functioning financial systems lead to long-run economic growth, financial stability, and overall gains in social welfare (Čihák et al. 2015; Čihák, Mare, and Melecký 2016; Dabla-Norris et al. 2015; Demirgüç-Kunt and Levine 2009; Fungacova and Weill 2015; Glomm and Ravikumar 1997; Hannig and Jansen 2010; Lyons, Roa, and Kunovskaya 2014; Lyons et al. 2016; United Nations 2015a; Xinhuanet 2013). Financial inclusion (as traditionally defined by access to and usage of formal financial services) can play an important role in providing households with opportunities to improve their skills and overall quality of life (Basel Committee on Banking Supervision 2015; CGAP 2011; Frazier 2013; G20 Financial Inclusion Experts Group 2010; Lyons et al. 2016; Mehrotra and Yetman 2015; Sahay et al. 2015; World Bank 2012, 2015). This might occur via investments in their education, the launching of a new business, or achieving other economic aspirations (Allen et al. 2016; Beck, Demirgüç-Kunt, and Levine 2007; Lagarde 2014; Li, Gan, and Hu 2011; Lyons and Contreras 2017; Lyons, Roa, and Kunovskaya 2014; Lyons et al. 2016; Rajan and Zingales 1998; World Bank 2014a, 2014b).

One way to improve households' access to and usage of the formal financial system is to develop a community's basic infrastructure. Infrastructure can be defined in a number of ways. First, there is the financial infrastructure, such as physical bank branches, ATMs, point-of-sale devices (POSs), payment associations, credit bureaus, and so on, where consumers can engage in the marketplace and conduct financial transactions. This can also include access to financial technologies, such as mobile and smart phones, to conduct electronic payments and digital banking (Anderson n.d.; Asian Development Bank Institute 2014; Chan and Jia 2011; China Financial Standardization Technical Committee 2012; Shrader and Duflos 2014; United Nations 2015b). Second, there is the physical infrastructure related to the overall material conditions of the community in which the household lives, such as the quality of roads, proximity of financial institutions, and availability of public transportation to facilitate access to the services. Third, the social and informational infrastructures can affect the usage of the formal financial system, especially due to some households' lack of trust in formal institutions (Allen et al. 2016; Amuendo-Dorantes and Mundra 2007; Li 2006a, 2006b; Shrader and Duflos 2014). Households with larger social or familial networks may not need (or even want) to turn to the formal sector to meet their financial needs. Instead, they may choose to rely on informal networks. Finally, households' access to financial information—in terms of quantity, quality, and frequency, especially with the rise of social media—can reduce the informational asymmetries in the marketplace, allowing households to make more informed financial decisions.

To date, very little research has empirically examined the actual impacts that various types of infrastructure can have on financial inclusion, especially access to and usage of formal banking institutions. They have occasionally been referenced within government reports and the media (e.g., CBRC 2013a, 2013b; Collard 2007; China Financial Standardization Technical Committee 2012; Schrader and Duflos 2014). They have also sometimes been presented within the context of how financial development can lead to reductions in income and wealth inequalities and poverty (e.g., Asian Development Bank Institute 2014; Beck et al. 2007; Celerier and Matray 2017; Demirgüç-Kunt and Levine 2009; Park and Mercado 2015; Frazier 2013). Most recently, Celerier and Matray (2017) investigated the links between the bank branch supply and the share of bank account holders in the United States. They found that an

exogenous increase in the density of bank branches decreases the share of unbanked households. The impacts are largest for those traditionally excluded from the financial markets—low-income, minority, and rural households. The work of researchers such as Celerier and Matray (2017) provides a useful starting place for investigating the relationship between infrastructure and financial inclusion. However, the research on the topic is still considerably limited in scope.

In fact, much of the literature related to financial inclusion focuses on three dimensions: the usage of bank accounts, savings in bank accounts, and the usage of bank credit at formal financial institutions (e.g., Allen et al. 2016; Ayyagari, Demirgüç-Kunt, and Maksimovic 2010; Demirgüç-Kunt and Klapper 2013; Demirgüç-Kunt et al. 2014; Duwal and Sun 2013; Fungacova and Weill 2015; Li, Gan, and Hu 2011; Li et al. 2010; Lyons, Grable, and Joo 2017; Peng, Zhao, and Wang 2014; Sparreboom and Duflos 2012; Sun and Huang 2010; Yin, Song, and Wu 2014). Very few of these studies have examined financial inclusion from the perspective of both formal and informal markets. Further, it is difficult to find studies that have specifically attempted to estimate the effect of the infrastructure on financial inclusion in countries such as the People's Republic of China (PRC) (Lyons et al. 2016). On the one hand, this is perhaps not surprising given the limited availability of data at both the household and the community level on financial inclusion and infrastructure for the PRC as well as other developing countries. On the other hand, it is a little startling, since the PRC has made significant progress in recent years in expanding its infrastructure and households' access to the formal financial markets.

Why is it important to investigate the relationship between financial inclusion and infrastructure for the PRC? There are a number of reasons, but at the forefront are the following. The PRC has the world's second-largest, soon-to-be largest, economy in the world and is positioned to have the most concentrated spending power globally. In addition, the PRC's financial markets and economic development are among some of the world's fastest growing. Since the 1978 economic reforms, the PRC has lifted more people out of poverty than any other country, especially in the urban coastal areas (Eckart 2016). Further, it has become one of the leading countries on the international stage in terms of its commitment to financial inclusion. In 2016 the PRC announced its G20 Financial Inclusion Action Plan and G20 Global Partnerships Financial Inclusion (GPMI) priorities, which focused on reducing poverty and income inequality for rural areas, the poor, the youth, and the elderly. The PRC's commitment to these initiatives is evidenced by its hosting of at least four key international meetings on financial inclusion last year, including the G20 Summit in Hangzhou in September 2016.¹

As the PRC continues to formulate its national agenda and strategies for financial inclusion, it is important for it to take into consideration the role of the infrastructure, especially as it pertains to the PRC's urbanization program. The PRC's recent urbanization policies and reforms have been fundamental in driving economic growth. However, they have also created additional stress for urban areas, as they have encouraged rapid migration from rural to urban areas (Bloomberg 2012; Xinhuanet 2013). According to the National Bureau of Statistics of China, the urban population density almost tripled between 2005 and 2014, and it does not appear to be slowing down (Hsu 2016). Many rural migrants now live in large cities, putting growing pressure on local governments and the availability and affordability of urban social services. Included are services related to health care, education, and housing as well as the

¹ Other key meetings hosted by the PRC in 2016 included: (1) the G20 GPMI meeting with the theme of "New Development and Indicators Update" in Shanghai in March; (2) the G20 GPMI workshop hosted by the People's Bank of China with the theme "Financial Consumer Protection and Financial Literacy" in May; and (3) the G20 GPMI Forum and GPMI Plenary in Chengdu in July.

formal financial sector. It should not be surprising that many of these stressors are infrastructural in nature.

In terms of the infrastructural issues related to the financial sector, the PRC still faces considerable challenges on the supply side, especially with regard to the supply of credit from formal financial institutions. These include finding efficient and viable mechanisms for distributing the existing credit (Peng, Zhao, and Wang 2014). Given the recent policies and reforms related to urbanization, it is plausible to hypothesize that the infrastructure is likely to affect financial inclusion efforts differently for those living in urban versus rural areas, especially in the metropolitan areas with the highest rates of urbanization. Nevertheless, very little attention has been paid to investigating the additional link between urbanization and its relationship to infrastructure and financial inclusion.

This paper addresses several of the critical gaps in the literature mentioned above. We used data from the *2013 Chinese Household Finance Survey* to investigate first how a village/community's infrastructure affects the usage of formal bank loans by both urban and rural households in the PRC. The analysis was then extended to investigate the impacts on non-bank loans. The results show that the infrastructure, in a variety of forms (i.e., physical, financial, technological, social, and informational), significantly affects the loan demand—most notably for urban households using formal bank loans. Further, those living in more urbanized areas and megacities are less likely to demand bank and non-bank loans even after controlling for other factors. The findings suggest that there may in fact be an “urbanization effect” that is dampening credit access and usage. In this research we also took into consideration the potential endogeneity between the infrastructure and the loan demand. While there is some evidence to suggest that dual endogeneity may exist for PRC households using bank loans, the results show that decisions related to the loan demand and infrastructure mainly appear to be made independently, especially when considering urban and rural households separately. The findings from this research have important implications for the PRC and other countries around the world working on national policies aimed at improving financial inclusion, especially the expansion of bank credit in rapidly growing urbanized areas, where the infrastructure may be reaching capacity.

The remainder of this paper is structured as follows. In the next sections, we describe the data and present the descriptive statistics. We then present the empirical framework and the model to be estimated. The methodology is followed by the presentation of the results. The final section summarizes the key findings and the implications for policy and future research.

2. DATA

This paper uses data taken from the *2013 Chinese Household Finance Survey (2013 CHFS)*, a nationally representative survey of PRC households administered by the Survey and Research Center for China Household Finance at Southwestern University of Financial and Economics (SWUFE).² The first wave of the survey started in 2011 and collected data from 8,438 households and 29,500 individuals in 80 counties and 320 communities across 25 provinces in the PRC (see Gan et al. (2014) for more details). The second wave of the survey was conducted in 2013. It expanded the 2011

² The CHFS is similar to the US Survey of Consumer Finances (SCF) sponsored by the US Board of Governors of the Federal Reserve System (Bricker et al. 2011, 2012).

sample by including 28,142 households from 262 counties in 1,084 communities across 29 provinces.

The 2013 survey questionnaire also included a much larger and more detailed set of questions. Information was collected on PRC households' asset and debt holdings, income and expenditures, social insurance and welfare, and a wide range of individual- and household-level demographics. Information was also collected at the village/community level related to the population, employment, standard of living, public security, and infrastructure. For the purposes of this study, we used the 2013 CHFS data and merge the community-level data with the individual- and household-level data to investigate how infrastructure affects the financial inclusion of households in urban and rural areas of the PRC.³

2.1 Measuring Urbanization

The CHFS defines rural and urban households by both the place of residence and the *hukou* (户口), the record in the government household registration system that determines where citizens are allowed to live. For the purposes of this paper, we distinguished urban and rural households by their current place of residence.⁴ Besides controlling for the urban–rural classification, we accounted for urbanization using two other measures. One measure controlled for whether the respondent lives in a “megacity,” defined as a metropolitan area with a population of over 10 million people.⁵ The other measure used data from the provincial statistical yearbooks in the PRC to construct an urbanization ratio for each household, defined as the ratio of the urban population to the total population. The availability of county-level urban, rural, and total population data by residence and/or by *hukou* registration differs across provinces. Whenever possible, we constructed the urbanization ratio based on residence. We used *hukou* registration as a close proxy only when the residential population data were unavailable. In addition, urbanization ratios were constructed at the county level. If urban population data were unavailable at the county level, we imputed the urbanization ratios using data from higher jurisdiction levels, that is, cities.

2.2 Measuring the Infrastructure

Using the merged CHFS data set, we first constructed a general measure of the overall quality of the community/village's physical infrastructure along five dimensions: the cleanliness of the roads, condition of the building structures, level of crowding, level of environmental friendliness, and economic conditions. The respondents were asked to rank on a scale from 1 to 10 the condition of their community/village along these five dimensions, with higher numbers indicating better conditions. A general physical infrastructure index was then created by summing the scores across the five

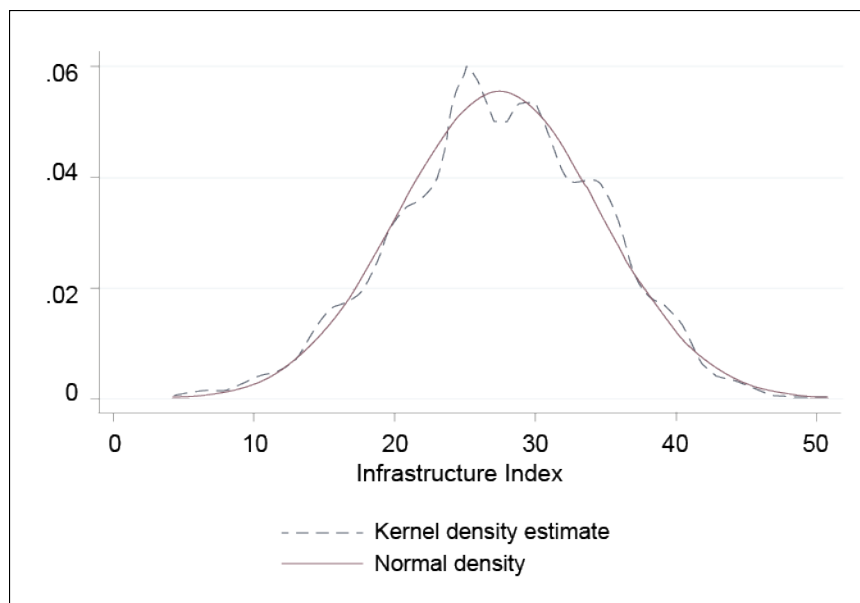
³ The CHFS data are regularly updated by SWUFE. To construct the sample, we merged the following four data files available at the time of this study: *chfs2013_hh_20161215.dta* (household-level data); *chfs2013_ind_20161215.dta* (individual-level data); *chfs2013_community_20161215.dta* (community-level data); and *chfs2013_master_20161215.dta* (master-level data). SWUFE used the available raw data to impute financial information for missing values. We used SWUFE's imputed values for household net worth and income. A review of SWUFE's imputation methods suggested that the financial information may be underreported. Still, the values appear to provide reasonable estimates of the financial earnings and wealth holdings of PRC households.

⁴ In modeling not included in this paper, urban and rural households were also defined by their *hukou*. The findings were fairly consistent with those obtained using households' place of residence.

⁵ We identified nine megacities in the data set with populations of over 10 million people in the PRC: Shanghai, Guangzhou, Beijing, Shenzhen, Tianjin, Chongqing, Chengdu, Wuhan, and Harbin.

dimensions. The scores ranged from 5 to 50 and followed a normal distribution (see Figure 1).

Figure 1: Kernel Density Estimates for the Infrastructure Index at the Community/Village Level for Households in the People's Republic of China



To test the index, a factor analysis was conducted using the principal component method. The factor loadings from both varimax and promax rotations revealed that the five items were in fact measuring one underlying latent concept, which is referred to as the physical infrastructure in this paper. A Cronbach's alpha test further revealed that the measure for the infrastructure index was reliable ($\alpha = 0.87$).

The level of physical infrastructure within a respondent's community is related to many other factors. The data contained additional information on community/village accessibility and crime. Specifically, we were able to identify whether a respondent's community/village was accessible by road and whether the community/village had experienced more than five incidents of larceny or robbery in the past year.

At the village/community level, information was also collected on the financial infrastructure. Village/community leaders were asked: "By the end of last year, how many bank branches were in your community/village (including rural credit cooperatives, postal savings, etc.)? Bank branches refers to locations where bank staff are present and conducting business. They are not ATM terminals only." We used this information to control for the number of bank branches and especially whether the village/community had at least one bank branch. The number of bank branches ranged from 0 to 50, with most locations reporting fewer than five (90.0%) and approximately 40.0% reporting no bank branches.

Using information on bank branches helps to account for potential access to financial services and products via the "financial infrastructure" in the village/community. However, it does not account for the quality and actual availability of the services. For this reason an additional measure was used to gauge the respondents' access to bank loans (i.e., formal credit). Respondents who reported that they had applied for a bank loan but were denied or needed a bank loan but had not yet applied were classified as having "limited access to bank loans." With the rapid movement in recent years

towards digital finance and mobile banking, additional variables were included to account for the access to and usage of electronic technologies (Anderson n.d.; Klapper and Singer 2014; Manyika et al. 2016; Shrader and Duflos 2014; Villasenor, West, and Lewis 2015, 2016). Respondents were classified as having access to electronic technologies if they reported using a mobile/cellular phone or a computer and/or engaged in online shopping.

In addition to the physical and financial infrastructure, the social infrastructure is likely to be a key determinant of the demand for bank and non-bank loans (Amuedo-Dorantes and Mundra 2007; Lakey 2013; Li 2006a, 2006b; Liang and Yuan 2013; Lyons et al. 2016; Thaler and Sunstein 2008). In the CHFS the respondents were asked: “How important to you is family?” The responses were based on a five-point Likert scale ranging from one = “very important” to five = “very unimportant.” Information was also collected on the respondents’ local familial network. They were asked to report how many blood relatives were living in their city or village; the responses ranged from zero to more than six. With these measures it is difficult to isolate the effects related to the strength of the respondents’ network. Accordingly, we included a third measure to account for this *guanxi* (关系). In the survey the respondents were asked to report how much money (i.e., “*guanxi* income”) they had received from people other than family members with whom they were living.⁶ This could be money given to them for festivals, weddings, funerals, education, medical services, living expenses, or other reasons. Using all three of these measures, we were able to test whether a respondent’s familial and social networks significantly affected their decision to take out a bank or non-bank loan and how they affected the decision in terms of the directional effect.

Individuals’ informational infrastructure (as related to their search habits and acquisition of knowledge) is also likely to affect their financial decisions, especially with regard to participation in the formal or informal markets (Lusardi, Michaud, and Mitchell 2013; Lusardi and Mitchell 2013; Lyons, Chang, and Scherpf 2006; Lyons and Scherpf 2004; Lyons et al. 2016; Van Rooij, Lusardi, and Alessie 2011; Yin, Song, and Wu 2014). The respondents were asked: “To what degree do you pay attention to economic and financial information?” The responses were based on a five-point Likert scale, ranging from one = “pay extreme attention to” to five = “pay no attention to.” This question is similar to queries used by other researchers investigating the source of their information and where they seek financial information. However, few studies have asked respondents about the “degree” to which they pay attention to this information.

2.3 Measuring Financial Inclusion

Within the literature there has been considerable debate concerning how financial inclusion should be defined and measured. Financial inclusion is commonly defined according to three dimensions: the access to, usage of, and quality of formal financial services (Allen et al. 2016; Demirgüç-Kunt and Klapper 2013; Demirgüç-Kunt et al. 2014; World Bank, n.d.). However, along these dimensions few data sources provide a clear and direct measure of actual “financial inclusion.” Instead, researchers often make assumptions and infer financial inclusion using proxies and indirect measurements of the “access,” “usage,” and “quality” of various financial services.

⁶ Note that because “*guanxi* income” was included in the models, we subtracted this income from the measure that controls for total household income.

Most commonly, financial inclusion is measured on the asset side with households' usage of bank deposit accounts. For the purposes of this paper, we focused on the liability side of a household's situation and defined financial inclusion in terms of the usage of bank and non-bank loans. This definition includes the process of providing all the households that want to use these financial services with access to them in a way that is optimal on both the supply and the demand side. On the supply side, optimality occurs when the supply conditions for these products and services are deemed to be profitable for financial institutions. On the demand side, optimality occurs when individuals can take out a loan at the minimum cost to maximize their utility given their preferences and constraints. When the supply of the services and the effective use of the services differ, it is possible to observe the existence of barriers to demand, hence *financial exclusion*.⁷ In this case some groups of households find themselves turning to the informal markets for access to alternative types of loans outside of the formal banking system.

The CHFS data include information on households' access to and usage of formal bank and informal non-bank loans for purposes related to: (1) home, (2) business, (3) agriculture, and/or (4) education. The respondents were asked whether they had a bank loan and if so for what purpose, from which bank, for how much, and the terms and conditions. The respondents were also asked whether they had a loan from a non-bank source (i.e., parents, children, siblings, other relatives, friends/colleagues, and non-government financial institutions). If so, they were asked more detailed questions about their non-bank loans. We used this information to examine how the infrastructure affects both urban and rural PRC households' probability of having a bank or non-bank loan.

In the end a working sample of 26,024 respondents was constructed from the data using key information on urbanization, bank and non-bank loans, and various forms of physical, financial, technological, social, and informational infrastructure. Observations not included in this sample were dropped due to missing information for key variables.

3. DESCRIPTIVE STATISTICS

Table 1 provides a descriptive summary of the sample, comparing those living in urban areas (60.1%) with those living in rural areas (39.9%). The urbanization ratio was 53.5% for all households, with 21.7% living in a megacity. Significant differences were found between urban and rural households for almost all of the variables. On average 13.1% of all households had a bank loan (13.2% for urban and 12.9% for rural). Urban households were statistically more likely to use bank loans for home and business purposes, whereas rural households were more likely to use them for agricultural and educational needs. Compared with urban households, rural households were also more likely to use non-bank loans (38.0% compared with 23.3%, respectively) and for purposes related to home, agriculture, and education. Urban households, on the other hand, were somewhat more likely to use non-bank loans for business purposes.

⁷ Financial exclusion, on the supply side, can be due to factors such as market failures (e.g., asymmetrical information, monopoly, or oligopoly in the financial market) or entry barriers to new competitors and/or products. These factors create barriers for some populations that are financially excluded for reasons such as price, risk, and/or reduced supply (Claessens 2006). On the demand side, Beck and De la Torre (2006) noted that the price of the financial service and income are the main determinants of the demand for payment and saving services.

Table 1: Descriptive Statistics for Urban and Rural Households in the People’s Republic of China (N=24,024)

Variables (%)	All Households	Urban Households	Rural Households	p-Value
<i>Urbanization</i>				
Urban resident	60.10	100.00	0.00	-.----
Ratio of urban population	53.49	65.98	34.64	0.0000***
Living in a megacity	21.67	30.48	8.37	0.0000***
<i>Has a bank loan</i>				
Bank loan: home	13.09	13.22	12.89	0.7152
Bank loan: business	8.02	10.30	4.60	0.0000
Bank loan: agriculture	1.63	1.90	1.23	0.0002***
Bank loan: education	2.62	0.53	5.77	0.0000***
<i>Has a non-bank loan</i>				
Non-bank loan: home	1.84	1.14	2.89	0.0000***
Non-bank loan: business	29.08	23.18	37.97	0.0000***
Non-bank loan: agriculture	19.74	17.07	23.76	0.0000***
Non-bank loan: education	3.30	3.86	2.45	0.0000***
Non-bank loan: agriculture	6.27	1.53	13.42	0.0000***
Non-bank loan: education	5.80	3.84	8.75	0.0000***
<i>Physical infrastructure</i>				
Infrastructure index (#)	27.30	27.73	26.66	0.0000***
Infra.: cleanliness of roads	5.41	5.66	5.04	0.0000***
Infra.: condition of building structures	5.40	5.66	5.01	0.0000***
Infra.: level of crowding	5.62	5.52	5.77	0.0000***
Infra.: environmental friendliness	5.70	5.31	6.28	0.0000***
Infra.: economic conditions	5.17	5.58	4.56	0.0000***
Accessible by road	90.54	89.29	92.43	0.0000***
Crime in the community	23.60	34.25	7.55	0.0000***
<i>Financial infrastructure</i>				
Has a bank branch	58.10	74.15	33.88	0.0000***
Number of bank branches (#)	1.76	2.51	0.62	0.0000***
Limited access to bank loans	14.55	10.20	21.13	0.0000***
<i>Technology infrastructure</i>				
Mobile phone	89.23	90.81	86.85	0.0000***
Computer	43.83	59.97	19.46	0.0000***
Online shopping	24.04	35.68	6.49	0.0000***
<i>Social infrastructure</i>				
Family very important	65.46	68.25	61.25	0.0000***
Local family network > 6	39.11	40.79	36.56	0.0000***
Guanxi income (RMB)	2,214.03	2,704.80	1,473.55	0.0000***
<i>Informational Infrastructure</i>				
Fin. info.: pay extreme attention	4.23	4.37	4.01	0.1962
Fin. info.: pay a lot of attention	7.88	8.32	7.23	0.0000***
Fin. info.: pay general attention	24.39	27.96	19.01	0.0000***
Fin. info.: pay a little attention	26.55	28.46	23.66	0.0000***
Fin. info.: pay no attention	36.95	30.89	46.09	0.0000***

continued on next page

Table 1 continued

Variables (%)	All Households	Urban Households	Rural Households	p-Value
<i>Risk management</i>				
Risk: high risk, high return	6.31	6.07	6.68	0.0267**
Risk: slightly above-average risk, slightly above-average return	4.76	6.06	2.79	0.0000***
Risk: average risk, average return	20.42	22.73	16.92	0.0000***
Risk: slightly below-average risk, slightly below-average return	15.27	16.30	13.71	0.0000***
Risk: unwilling to take any risk	53.25	48.84	59.90	0.0000***
<i>Respondent characteristics</i>				
Age (#)	50.71	49.05	53.21	0.0000***
Educ.: no school	9.62	5.36	16.04	0.0000***
Educ.: primary school	25.53	16.08	39.79	0.0000***
Educ.: junior high	31.98	31.00	33.47	0.0000***
Educ.: high school	12.90	16.33	7.73	0.0000***
Educ.: some college	12.42	18.91	2.63	0.0000***
Educ.: college	7.55	12.33	0.33	0.0000***
Female	41.91	47.61	33.30	0.0000***
Married	84.64	82.03	88.57	0.0000***
Poor health	28.03	20.16	39.91	0.0000***
<i>Household characteristics</i>				
Net worth (RMB)	696,670.51	980,040.32	269,121.91	0.0000***
Household income (RMB)	60,823.84	77,049.27	36,342.88	0.0000***
Has private insurance	17.26	21.57	10.76	0.0000***
Family size (#)	2.07	1.94	2.27	0.0000***
Has children	42.63	39.92	46.71	0.0000***
Has elders	29.11	26.40	33.19	0.0000***
Number employed (#)	188.33	153.31	241.19	0.0000***
Self-employed	8.93	11.98	4.33	0.0000***
Retired	14.59	22.62	2.48	0.0000***
Homeowner	63.64	63.91	63.24	0.0000***
<i>Regional location</i>				
Region 1: east	27.43	28.66	25.58	0.0000***
Region 2: north	13.02	14.40	10.94	0.0000***
Region 3: center	14.00	13.20	15.20	0.0000***
Region 4: south	9.46	10.21	8.32	0.0058**
Region 5: southwest	15.53	13.91	17.97	0.0000***
Region 6: northwest	9.92	8.81	11.59	0.0000***
Region 7: northeast	10.65	10.82	10.39	0.2835
Observations	24,046	16,545	7,501	

Note: All the statistics have been weighted and are reported as percentages unless otherwise indicated. Dollar values are in RMB. As of 28 November 2016, 1 RMB = 0.14 USD. Statistically significant differences in mean values for urban and rural households are reported using p-values. *** p < 0.01, ** p < 0.05, * p < 0.10.

With regard to the infrastructure, the mean value for the infrastructure index was 27.3 for all households (27.7 for urban and 26.7 for rural). While the index scores were similar for urban and rural households, urban households reported cleaner roads, better building structure conditions, and better economic conditions. Rural households reported less crowding and more environmental friendliness. Furthermore, in urban communities there was slightly less accessibility by road and considerably more incidents of crime. In terms of the financial infrastructure, urban households reported having greater access to bank branches and bank loans. Urban households also reported greater access to and usage of electronic technologies, including mobile phones, computers, and online shopping. Differences in the social infrastructure were also noted. Urban respondents were more likely to report that family was very important to them and that they had a local family network of more than six persons. They also reported higher levels of guanxi income. In terms of the informational infrastructure, urban households were found to pay more attention to financial information than rural households. In fact, almost half of rural households (46.1%) reported paying no attention to financial information.

Differences were also found for the other respondent- and household-level characteristics. In terms of risk management behavior, rural respondents were slightly more likely to prefer high-risk and high-return alternatives and at the same more likely to be unwilling to take any risk at all. Compared with those living in urban areas, rural respondents also tended to be older, less educated, male, married, and in worse physical health. In terms of household differences, rural households reported lower levels of household income and net worth. Rural households were also less likely to have any type of private insurance and to report lower frequencies of self-employment. Further, rural households were larger in terms of both children and elders in the home. Additionally, they reported more people working outside of the home. Urban households were more likely to report being retired and owning their own home. Finally, regional differences were identified. As shown in Table 1, respondents from eastern PRC represented the largest share of the sample. There were more urban households from eastern, northern, and southern PRC due to the greater urbanization of the coastal provinces in these regions.

3.1 Usage of Bank and Non-bank Loans

Tables 2A and 2B provide information on the differences between urban and rural households in terms of the relationship between the infrastructure and the likelihood of having a bank or non-bank loan. Table 2A presents the findings for bank loans; Table 2B presents the results for non-bank loans. Compared with those without bank loans, those with banks loans were more likely to be living in megacities but less likely to be living in urbanized areas in general. Those with non-bank loans were less likely than those without non-bank loans to be living in megacities and in urbanized areas. Among all those who reported having a bank loan, most borrowed to purchase a home (61.3%), followed by purposes related to agriculture, education, and business, respectively. Compared with rural households, urban households were significantly more likely to borrow for home (77.9% versus 35.6%) and business (14.4% versus 9.5%) purposes, whereas rural households were considerably more likely to borrow for agricultural (44.7% versus 4.0%) and education (22.4% versus 8.6%) purposes. Among those with non-bank loans, 67.9% reported borrowing for a home purchase, 11.3% for business purposes, 21.6% for agricultural purposes, and 19.9% for educational purposes. Similar to the findings for bank loans, urban households were more likely to borrow for home and business purposes, whereas rural households were more likely to borrow for agricultural and educational purposes. The reasons for taking

out a formal bank loan were quite similar regardless of the respondents' location. The top three reasons reported for taking out a bank loan, for both urban and rural respondents, were: cooperation between a developer and a bank; convenience of the bank's hours and location; and low interest rates. The sources of non-bank loans, however, differed significantly between urban and rural respondents. In general urban respondents were more likely than rural respondents to report the following as their primary source of non-bank loans: brothers and sisters, other relatives, friends and colleagues, and parents and parents-in-laws. While these sources were also important for rural respondents, those living in rural areas were more likely to report using children and persons/institutes with whom they had a prior relationship. The usage of small loan companies was relatively low among all the households, although urban respondents reported slightly higher usage of private financial institutions.

Table 2A: Relationship between Infrastructure and Bank Loans for Urban and Rural Households in the People's Republic of China (N=24,046)

Variables (%)	Bank Loans					
	All		Urban		Rural	
	Loan	No Loan	Loan	No Loan	Loan	No Loan
<i>Urbanization</i>						
Ratio of urban population	50.6	53.9	63.6	66.3	30.5	35.2
Living in a megacity	23.2	21.4	34.3	29.9	5.9	8.7
<i>Has a bank loan</i>						
Bank loan: home	100.0	0.0	100.0	0.0	100.0	0.0
Bank loan: business	61.3	0.0	77.9	0.0	35.6	0.0
Bank loan: agriculture	12.5	0.0	14.4	0.0	9.5	0.0
Bank loan: education	20.0	0.0	4.0	0.0	44.7	0.0
Bank loan: education	14.0	0.0	8.6	0.0	22.4	0.0
<i>Reasons for choosing the bank</i>						
Cooperation b/w developer and bank	22.3	0.0	30.9	0.0	8.9	0.0
Convenient hours and location	16.2	0.0	10.8	0.0	24.5	0.0
Low interest rates	11.0	0.0	11.2	0.0	10.7	0.0
Past experience in transactions	7.8	0.0	9.1	0.0	5.9	0.0
Personal relationships	6.5	0.0	7.4	0.0	5.2	0.1
Easy to gain approval	5.3	0.0	4.5	0.0	6.5	0.0
Flexible loan terms	5.3	0.0	5.6	0.0	4.8	0.0
Good service	5.2	0.0	4.6	0.0	6.3	0.0
Good reputation	4.1	0.0	4.4	0.0	3.6	0.0
Low fees	2.0	0.0	1.5	0.0	2.8	0.0
Market position	1.8	0.0	2.3	0.0	0.9	0.0
No choice	20.6	0.1	18.4	0.1	24.1	0.1
<i>Physical infrastructure</i>						
Infrastructure index (#)	28.6	27.1	29.5	27.4	27.2	26.6
Accessible by road	92.1	90.3	91.6	88.9	92.9	92.4
Crime in the community	26.7	23.1	40.2	33.3	5.9	7.8
<i>Financial infrastructure</i>						
Has a bank branch	65.4	57.0	80.9	73.1	41.6	32.7
Number of bank branches (#)	2.0	1.7	2.7	2.5	0.9	0.6
Limited access to bank loans	11.1	15.1	7.6	10.6	16.5	21.8

continued on next page

Table 2B *continued*

Variables (%)	Bank Loans					
	All		Urban		Rural	
	Loan	No Loan	Loan	No Loan	Loan	No Loan
<i>Technology infrastructure</i>						
Mobile phone	94.2	88.5	94.7	90.2	93.4	85.9
Computer	57.2	41.8	78.3	57.2	24.5	18.7
Online shopping	38.7	21.8	57.7	32.3	9.5	6.0
<i>Social/familial infrastructure</i>						
Family very important	72.4	64.4	75.0	67.2	68.3	60.2
Local family network > 6	40.4	38.9	38.6	41.1	43.1	35.6
Guanxi income (RMB)	3,318.9	2,047.6	4,447.9	2,439.7	1,571.6	1,459.0
<i>Informational infrastructure</i>						
Fin. info.: pay extreme attention	7.5	3.7	7.5	3.9	7.5	3.5
Fin. info.: pay a lot of attention	11.9	7.3	12.1	7.7	11.5	6.6
Fin. info.: pay general attention	29.3	23.7	32.4	27.3	24.5	18.2
Fin. info.: pay a little attention	25.1	26.8	28.4	28.5	20.2	24.2
Fin. info.: pay no attention	26.2	38.6	19.7	32.6	36.2	47.6
Observations	3,270	22,076	2,241	14,305	1,029	6,471

Note: All the statistics have been weighted and are reported as percentages unless otherwise indicated. Dollar values are in RMB. As of 28 November 2016, 1 RMB = 0.14 USD.

3.2 The Influence of the Infrastructure on Bank and Non-bank Loans

Generally the findings for the infrastructure were similar across the entire sample regardless of the respondents' location. Compared with those without a bank loan, those with a bank loan reported living in areas with a better physical infrastructure, more bank branches, greater access to bank loans, and greater access to and usage of technology. These factors were slightly more important for those living in urban areas. Social and informational infrastructure factors were also important in shaping bank loan decisions. Those with bank loans were more likely to report family as being very important. Having a family network greater than six persons was also important but varied for urban and rural respondents. Those with bank loans living in urban areas were less likely to have a large local family network than those without bank loans. Rural respondents with bank loans were considerably more likely than rural respondents without bank loans to have a larger local family network. Compared with rural households, urban households with bank loans were more likely to report receiving higher levels of guanxi income than those without bank loans. For rural households the difference in guanxi income received by those with and without banks loans was negligible. Concerning the informational infrastructure, paying attention to financial information was also important. Those without bank loans reported paying little or no attention to financial information, whereas those with bank loans reported paying much more attention to financial information. This was true for both urban and rural respondents.

Table 2B: Relationship between Infrastructure and Non-bank Loans for Urban and Rural Households in the People's Republic of China (N=24,046)

Variables (%)	Non-bank Loans					
	All		Urban		Rural	
	Loan	No Loan	Loan	No Loan	Loan	No Loan
<i>Urbanization</i>						
Ratio of urban population	45.8	56.6	58.1	68.4	34.5	34.7
Living in a megacity	15.4	24.2	22.5	32.9	8.8	8.1
Has a non-bank loan	100.0	0.0	100.0	0.0	100.0	0.0
Non-bank loan: home	67.9	0.0	73.6	0.0	62.6	0.0
Non-bank loan: business	11.3	0.0	16.7	0.0	6.4	0.0
Non-bank loan: agriculture	21.6	0.0	6.6	0.0	35.4	0.0
Non-bank loan: education	19.9	0.0	16.6	0.0	23.0	0.0
<i>Source of non-bank loan</i>						
Parents/parents-in-law	19.0	0.0	34.8	0.0	8.4	0.0
Children	8.1	0.0	6.5	0.0	9.0	0.0
Brothers and sisters	69.4	0.0	74.6	0.0	65.5	0.0
Other relatives	62.6	0.0	68.2	0.0	58.6	0.0
Friends/colleagues	49.3	0.0	56.8	0.0	44.3	0.0
Person/institute with a prior partnership	6.4	0.0	4.4	0.0	7.4	0.0
Private financial institutions	2.4	0.0	3.1	0.0	2.1	0.0
Small loan companies	0.8	0.0	1.5	0.0	0.4	0.0
Other	3.6	0.0	4.4	0.0	3.1	0.0
<i>Physical infrastructure</i>						
Infrastructure index (#)	26.8	27.5	26.9	28.0	26.6	26.7
Accessible by road	90.6	90.5	88.5	89.5	92.6	92.3
Crime in the community	17.9	25.9	32.0	34.9	5.0	9.1
<i>Financial infrastructure</i>						
Has a bank branch	51.1	61.0	71.8	74.8	32.0	35.0
Number of bank branches (#)	1.4	1.9	2.3	2.6	0.6	0.6
Limited access to bank loans	33.8	6.7	30.4	4.1	37.0	11.4
<i>Technology infrastructure</i>						
Mobile phone	91.8	88.2	93.0	90.2	90.7	84.5
Computer	37.1	46.6	56.1	61.1	19.7	19.3
Online shopping	19.0	26.1	32.4	36.7	6.6	6.4
<i>Social/familial infrastructure</i>						
Family very important	65.8	65.3	69.6	67.9	62.4	60.5
Local family network > 6	39.6	38.9	40.8	40.8	38.4	35.4
Guanxi income (RMB)	2,060.9	2,276.8	2,767.6	2,685.8	1,409.9	1,512.5
<i>Informational infrastructure</i>						
Fin. info.: pay extreme attention	4.2	4.2	4.0	4.5	4.4	3.8
Fin. info.: pay a lot of attention	7.4	8.1	7.7	8.5	7.3	7.2
Fin. info.: pay general attention	24.4	24.4	27.9	28.0	21.1	17.7
Fin. info.: pay a little attention	26.1	26.8	28.6	28.4	23.7	23.7
Fin. info.: pay no attention	37.9	36.6	31.8	30.6	43.6	47.6
Observations	6,898	17,148	3,818	12,727	3,080	4,421

Note: All the statistics have been weighted and are reported as percentages unless otherwise indicated. Dollar values are in RMB. As of 28 November 2016, 1 RMB = 0.14 USD.

The infrastructure played a similar role in shaping non-bank loan decisions, with a few exceptions. Those with non-bank loans reported having more limited access to formal bank loans. This was true in general for all the respondents regardless of urban or rural status. In addition, the number of bank branches was similar regardless of whether the respondent had a non-bank loan. However, those with non-bank loans were slightly more likely to have access to mobile technology but less likely to have computers and to engage in online shopping. Social infrastructure factors were similar overall for both urban and rural respondents. In general those with a non-bank loan were more likely to report that family was very important to them, although the differences were small. Those living in a rural area with a non-bank loan were more likely to report having a larger family network nearby, while urban households reported receiving larger amounts of guanxi income. The results related to the level of attention paid to financial information were less consistent. Urban respondents with a non-bank loan reported paying somewhat less attention to financial information than those without a non-bank loan. Non-bank loan usage increased a little among rural respondents as their attention to financial information declined, except for those who paid no attention to information. In this case non-bank use was lower.

3.3 A Closer Look at the Role of the Infrastructure

Table 2C examines the infrastructure in greater depth and investigates how financial inclusion and other key factors vary for households living in communities/villages with an infrastructure index above the mean value of 27 and those living in communities with an infrastructure index below that value. Interestingly, those living in communities with a better infrastructure were less likely to be living in megacities and more likely to be living in areas with smaller urban populations. In terms of financial inclusion, those living in communities with a better infrastructure were found to be more likely to have a bank loan, especially urban households, and to borrow with the purpose of purchasing a home. They were also more likely to have greater access in their communities to bank branches and bank loans. Those with a better infrastructure were less likely to have a non-bank loan. These differences were most notable for urban households. There were few differences when comparing rural households living in communities with a better or worse infrastructure. As illustrated in Table 2C, there was a strong relationship not only between the physical and the financial infrastructure but also between technological factors. Those living in communities with a better infrastructure were more likely to have greater access to and usage of electronic technologies. The relationships between the physical infrastructure and the social and informational factors appeared to be weaker and somewhat negligible, especially with regard to family networks and the degree to which households pay attention to information.

Table 2C: Relationship between Infrastructure and Bank and Non-bank Loans for Urban and Rural Households in the People's Republic of China (N=24,046)

Variables (%)	Infrastructure Index Above/Below the Mean					
	All		Urban		Rural	
	Infra. Index > 27	Infra. Index ≤ 27	Infra. Index > 27	Infra. Index ≤ 27	Infra. Index > 27	Infra. Index ≤ 27
<i>Urbanization</i>						
Ratio of urban population	45.8	56.6	58.1	68.4	34.5	34.7
Living in a megacity	15.4	24.2	22.5	32.9	8.8	8.1
<i>Has a bank loan</i>	14.8	11.1	15.4	10.4	13.8	12.0
Bank loan: home	9.8	6.0	12.7	7.3	4.9	4.2
Bank loan: business	1.8	1.4	2.0	1.8	1.5	0.9
Bank loan: agriculture	2.6	2.7	0.6	0.5	5.9	5.7
Bank loan: education	1.7	2.0	0.9	1.4	3.0	2.7
<i>Has a non-bank loan</i>	27.6	30.8	21.5	25.4	37.9	38.0
Non-bank loan: home	19.2	20.4	16.2	18.2	24.1	23.4
Non-bank loan: business	3.3	3.3	3.6	4.2	2.8	2.0
Non-bank loan: agriculture	5.6	7.1	1.3	1.8	12.7	14.2
Non-bank loan: education	5.2	6.5	3.0	4.9	8.8	8.7
<i>Physical infrastructure</i>						
Infrastructure index (#)	32.5	21.3	33.0	21.1	31.7	21.5
Accessible by road	95.0	85.4	93.8	83.6	96.9	87.8
Crime in the community	24.2	22.9	33.5	35.1	8.8	6.3
<i>Financial infrastructure</i>						
Has a bank branch	60.3	55.6	75.6	72.3	34.7	33.0
Number of bank branches (#)	1.9	1.5	2.7	2.3	0.7	0.6
Limited access to bank loans	13.6	15.7	9.0	11.8	21.3	20.9
<i>Technology infrastructure</i>						
Mobile phone	90.6	87.7	91.7	89.7	88.7	85.0
Computer	50.2	36.4	66.3	51.9	23.4	15.4
Online shopping	28.9	18.4	41.6	28.2	7.8	5.2
<i>Social/familial infrastructure</i>						
Family very important	67.3	63.3	69.7	66.4	63.2	59.3
Local family network > 6	39.2	39.0	40.2	41.5	37.5	35.6
Guanxi income (RMB)	2,483.9	1,899.2	3,001.6	2,328.2	1,622.3	1,320.5
<i>Informational infrastructure</i>						
Fin. info.: pay extreme attention	5.0	3.4	5.0	3.5	4.9	3.1
Fin. info.: pay a lot of attention	8.7	6.9	9.4	6.9	7.6	6.9
Fin. info.: pay general attention	26.2	22.3	29.5	26.1	20.8	17.1
Fin. info.: pay a little attention	27.5	25.4	28.9	27.9	25.2	22.1
Fin. info.: pay no attention	32.6	42.0	27.2	35.5	41.5	50.8
Observations	13,175	10,871	9,312	7,233	3,861	3,640

Note: All the statistics have been weighted and are reported as percentages unless otherwise indicated. Dollar values are in RMB. As of 28 November 2016, 1 RMB = 0.14 USD.

4. METHODOLOGY

The main premise of this paper is that PRC households' decision to take out a bank or a non-bank loan is likely to be dependent on the existing infrastructure. Moreover, the effects of the infrastructure are likely to vary across the formal and informal markets, especially when comparing households living in more urbanized and developed regions with those living in more rural and underdeveloped regions. This assumes a direction of causality from infrastructure to loan access and usage, which in turn can lead to improvements in human capital development, socioeconomic status, and long-run economic well-being. However, it is possible that loan access and usage might also lead to new development and greater improvements in the infrastructure—in particular, a community's level of *physical* infrastructure. The descriptive findings presented in Tables 1 and 2 suggest that there may be potential dual endogeneity between infrastructure and financial inclusion. To account more formally for this potential endogeneity, we estimated a series of simultaneous bivariate probit models for formal and informal loans.

Consider the following system of equations:

$$L_{ijk}^* = \alpha_1 \text{Infra}_{ijk} + X_{1ijk}' \alpha_2 + \varepsilon_{1ijk}, \tag{1}$$

$$\text{Infra}_{ijk}^* = \beta_1 L_{ijk} + X_{2ijk}' \beta_2 + \varepsilon_{2ijk}.$$

In this model L_{ijk}^* and Infra_{ijk}^* are the continuous, latent random variables, where L_{ijk}^* is the actual amount of bank or non-bank loans held by the i^{th} household in the j^{th} community for the k^{th} loan. Infra_{ijk}^* is the actual level of physical infrastructure in the i^{th} household's j^{th} community. L_{ijk}^* and Infra_{ijk}^* are not observable. However, the discrete dependent variables, L_{ijk} and Infra_{ijk} , are observable such that

$$L_{ijk} = 1 \text{ iff } L_{ijk}^* > 0 \text{ and } 0 \text{ otherwise for } i=\{1, \dots, I\}, j=\{1, \dots, J\}, \text{ and } k=\{1, \dots, K\} \tag{2}$$

$$\text{Infra}_{ijk} = 1 \text{ iff } \text{Infra}_{ijk}^* > [\sum_i^I \text{Infra}_{ijk}] / I \text{ and } 0 \text{ otherwise for } i=\{1, \dots, I\}, j=\{1, \dots, J\}, \text{ and } k=\{1, \dots, K\}.$$

L_{ijk} is equal to one if the i^{th} household in the j^{th} community has a k^{th} bank or non-bank loan and zero otherwise. Infra_{ijk} is equal to one if the level of physical infrastructure in the j^{th} community where the i^{th} household resides is above the mean level of physical infrastructure for all the communities and zero otherwise.⁸

X_{1ijk} and X_{2ijk} include individual, household, and community characteristics that affect both the household's financial inclusion decisions and the level of physical infrastructure found within the household's community. This includes the controls for the other types of infrastructure: financial, technological, social, and informational. To account for urbanization, there are controls for the location of the household's residence as well as the ratio of urbanization. Socioeconomic and demographic controls at the individual level are included to account for age, education, gender, marital status, risk tolerance, and health status. Household-level controls are also included to account for private insurance coverage, family size, family structure (i.e., the number and presence of children and elders in the home), employment status (i.e.,

⁸ It is known from Table 1 that the mean value for the infrastructure index is 27.3 for all households. Therefore, we use 27 as the cutoff value in the models.

number of employed, self-employed, and retired), and homeownership.⁹ Two additional controls are included to account for the household's income and net worth. Households with greater income and wealth generally have more resources that can be leveraged for a bank loan in the mainstream financial markets. These factors have commonly been used as control variables in standard models of financial inclusion and are well supported and documented by the literature (e.g., Allen et al. 2016; Fungacova and Weill 2015; Li, Gan, and Hu 2011; Lyons et al. 2016).

To ensure the identification of the two equations, some variables were included in the financial inclusion equation but not in the infrastructure equation (and vice versa).¹⁰ In the equation for formal and informal loans, we included social/familial controls for whether the household had a large local family network and was receiving guanxi income. These social/familial factors can affect a household's decision to take out a loan but are unlikely to affect a community's level of physical infrastructure directly, since these decisions are made by local governments. The loan equations also include whether the household believed that it was liquidity constrained and had limited access to bank loans. A household's belief about access to credit was found to affect its current borrowing decisions. However, these beliefs should not directly affect a community's infrastructure except to the extent that these factors indirectly affect the current access to credit and a household's ability to contribute to the community infrastructure via the purchase of a new home, the starting of a new business, and so on. We tested the identifiers for the financial inclusion equation by running probit models for the infrastructure that included these instrumental variables. We found the instruments, in almost all cases, to be insignificant predictors of the physical infrastructure. One of the strongest instruments was the control for limited access to bank loans. In all cases having less access to bank loans was found to be a significant predictor of the loan demand but an insignificant predictor of the physical infrastructure.

To identify the equation for the physical infrastructure, we included a dummy for whether the community/village was accessible by road.¹¹ We also accounted for public security by including a control for whether the community/village had five or more incidents of crime in the past year. These factors are directly related to a community/village's overall physical infrastructure. They should not have a direct impact on a household's decision to take out a bank or non-bank loan. However, there could be an indirect effect. For example, if the crime rates are higher in a community, they could affect the condition of the buildings, the economic conditions of the community, and so on, which in turn might affect a financial institution's decision to grant fewer loans, which in turn could also affect a household's decision to take out a

⁹ Note that risk tolerance and private insurance coverage are included as controls for risk management. The PRC has a strong social insurance system such that most households have some type of coverage under the public system, and therefore it was not included in the modeling. Private insurance coverage is commercial and includes life, health, pension, and property as well as any other type of commercially purchased insurance.

¹⁰ The factors affecting the demand functions for formal and informal credit varied for all households and for urban and rural respondents. For this reason we needed to include more than one instrument in each equation. The models were tested for overidentification. The results are presented later in the paper.

¹¹ A village/community's accessibility by road is part of its physical infrastructure. However, this variable could not be included in the physical infrastructure index, so instead it was included as an instrumental variable. Our reasoning was as follows. First, the village/community leader was asked to report on the five dimensions used to construct the physical infrastructure index, whereas all the survey respondents were asked whether the village/community was accessible by road. Second, the factors used to construct the physical infrastructure index were based on factors that could be ranked using a 10-point scale. A village/community's accessibility by road was measured only as a discrete choice variable (1 = yes or 0 = no).

loan. We tested the identifiers for the infrastructure equation by including them in the loan equations. Again, these instruments were mostly found to be insignificant predictors of the loan demand. Additional robustness checks are presented in the next section.

The simultaneous probit model presented in Equation (2) was estimated using a two-stage approach (Maddala 1986; Fisher and Lyons 2006; Lyons and Contreras 2017). The error terms were assumed to be standard normally distributed with a mean of zero and variances equal to one. In the first stage, the probit method was used to estimate the following reduced-form equations:

$$L_{ijk}^* = \pi_1 X_{ijk} + u_{1ijk}, \quad (3)$$

$$Infra_{ijk}^* = \pi_2 X_{ijk} + u_{2ijk}.$$

X_{ijk} includes all of the exogenous variables from both equations including the instruments. The reduced-form estimates were then used to obtain predicted values for financial inclusion and infrastructure. The predicted values were then substituted into the right-hand side of Equation (3) such that:

$$L_{ijk}^* = \alpha_1 \widehat{Infra}_{ijk}^* + X_{1ijk}' \alpha_2 + \varepsilon_{1ijk}, \quad (4)$$

$$Infra_{ijk}^* = \beta_1 \widehat{L}_{ijk}^* + X_{2ijk}' \beta_2 + \varepsilon_{2ijk}.$$

In the final stage, Equation (4) was estimated simultaneously as a system of equations. Bootstrapping was used to obtain consistent standard errors. The joint distribution function of the errors terms, ε_{1ijk} and ε_{2ijk} , was defined by $F(\cdot, \cdot)$, the bivariate standard normal cumulative distribution function. The correlation between the error terms is denoted by ρ . Using this framework, we tested whether $\rho = 0$. The error terms were assumed to be correlated if $\rho \neq 0$, indicating dual endogeneity and the need for simultaneous estimation.

Using this methodology, we first estimated Equation (4) for all households and then separately for urban and rural households.

5. RESULTS

5.1 Simultaneous Probit Estimates for Bank Loans and Infrastructure

Table 3 presents the marginal effects and standard errors from the simultaneous bivariate probit regressions for bank loans and non-bank loans. With regard to bank loans, several findings are worth noting. First, the findings provide evidence of an urbanization effect, but the effect is opposite in direction for the loan demand and the infrastructure. Specifically, those living in more urbanized areas were found to be significantly less likely to have a bank loan, whereas they were more likely to be living in communities with a better infrastructure. These findings may suggest that urbanization in the PRC is in fact straining the formal financial sector and dampening credit access and usage.

Second, the results show that the infrastructure does in fact matter. The respondents living in areas with a better physical infrastructure were significantly more likely to have a bank loan. Having at least one bank branch in the village/community also increased the probability of having a bank loan.¹² Not surprisingly, those with limited access to bank loans were significantly less likely to have a bank loan. In terms of the technological infrastructure, having access to a mobile phone and computer did not significantly affect the demand for bank loans; however, engaging in online shopping did, and the effect was significantly positive.¹³ The results for the social infrastructure were also significant. The respondents who reported that family was “very important” were significantly more likely to have a bank loan. Those receiving guanxi income were also significantly more likely, but the amount needed to be fairly large to exert any real impact on a household’s decision to take out a bank loan. Those who had a local family network of more than six family members were significantly less likely. It may be that those with a larger social/familial network may not feel the need to turn to a formal bank to meet their credit needs. Finally, the informational infrastructure was also found to be an important factor. With regard to informational searches, those who reported paying more attention to financial information were significantly more likely to have a bank loan.

In general other socioeconomic factors that significantly increased a respondent’s probability of having a bank loan included the following: being married, being more risk tolerant, having poor health, having a type of private insurance, being self-employed, and owning a home. Not surprisingly, those with more education, income, and wealth were also more likely to have a bank loan. Those who were older, had elders present in the home, and were retired were less likely. The effect of gender was found to be negative but insignificant.

The results for the simultaneous model for bank loans also indicated that the correlation (ρ) between the error terms and the two equations was positive and statistically significant. This suggests that unobserved variables are likely to be influencing both the likelihood of having a bank loan and the likelihood of living in a community with a better infrastructure. However, the most notable finding from the infrastructure equation indicates that the demand for bank loans is not a significant predictor of a community’s infrastructure. Nevertheless, a strong urbanization effect remains. Those living in more urbanized areas and megacities were significantly more likely to live in communities with a better infrastructure. Not surprisingly, accessibility by road increases the probability of living in communities with a better infrastructure, while the incidence of crime decreases the likelihood.

¹² In models not presented in this paper, the number of bank branches was also found to increase the probability of having a bank loan significantly for all households.

¹³ Note that these technological measures only controlled for whether the respondent had an electronic device. Future research should take into consideration more robust measures that control better for technological access and usage, especially making digital payments and carrying out banking transactions (Lyons et al. 2016).

Table 3: Simultaneous Probit Results for the Loan Demand and Infrastructure

Variables	Simultaneous Model for Bank Loans		Simultaneous Model for Non-bank Loans	
	Has a Bank Loan	Infrastructure Index > 27	Has a Non- bank Loan	Infrastructure Index > 27
Ratio of urbanization	-0.0752*** (0.0066)	0.0572*** (0.0140)	-0.0784*** (0.0102)	0.0606*** (0.0142)
Living in a megacity	0.0042 (0.0052)	0.0230** (0.0093)	-0.0495*** (0.0101)	0.0226** (0.0100)
Predicted value: infrastructure index > 27	0.0738*** (0.0216)	-.---	0.0007 (0.0384)	-.---
Predicted value: has a bank/ non-bank loan	-.---	-0.0435 (0.0774)	-.---	0.0024 (0.0279)
Fin. infra.: has a bank branch	0.0223*** (0.0040)	-0.0007 (0.0066)	0.0065 (0.0068)	-0.0019 (0.0067)
Limited access to bank loans	-0.0541*** (0.0039)	-.---	0.3548*** (0.0086)	-.---
Accessible by road	-.---	0.2830*** (0.0110)	-.---	0.2821*** (0.0098)
Crime	-.---	-0.0347*** (0.0085)	-.---	-0.0348*** (0.0078)
Mobile phone	0.0011 (0.0087)	0.0173 (0.0125)	0.0241*** (0.0091)	0.0176 (0.0115)
Computer	0.0076 (0.0049)	0.0404*** (0.0091)	-0.0350*** (0.0063)	0.0401*** (0.0090)
Online shopping	0.0198*** (0.0053)	0.0318*** (0.0098)	-0.0303*** (0.0092)	0.0304*** (0.0103)
Family very important	0.0099** (0.0040)	0.0179** (0.0074)	0.0132** (0.0063)	0.0174*** (0.0054)
Local family network > 6	-0.0104*** (0.0039)	-.---	-0.0034 (0.0039)	-.---
Guanxi income (100,000 RMB)	0.0325** (0.0153)	-.---	0.0129 (0.0128)	-.---
Fin. info.: pay extreme attention	0.0615*** (0.0119)	0.0745*** (0.0213)	-0.0064 (0.0066)	0.0712*** (0.0161)
Fin. info.: pay a lot of attention	0.0337*** (0.0098)	0.0548*** (0.0134)	0.0159 (0.0201)	0.0533*** (0.0151)
Fin. info.: pay general attention	0.0140** (0.0060)	0.0305*** (0.0111)	0.0177** (0.0090)	0.0300*** (0.0091)
Fin. info.: pay a little attention	-0.0001 (0.0060)	0.0432*** (0.0076)	0.0046 (0.0086)	0.0432*** (0.0083)
Risk: high risk, high return	0.0313*** (0.0097)	0.0130 (0.0158)	-0.0053 (0.0124)	0.0119 (0.0137)
Risk: slightly above-average risk, slightly above-average return	0.0154* (0.0094)	0.0094 (0.0156)	0.0098 (0.0187)	0.0085 (0.0175)
Risk: average risk, average return	0.0217*** (0.0059)	0.0053 (0.0088)	-0.0074 (0.0074)	0.0042 (0.0092)
Risk: slightly below-average risk, slightly below-average return	0.0118 (0.0075)	-0.0131 (0.0087)	-0.0001 (0.0083)	-0.0135 (0.0092)
Net worth (100,000 RMB)	0.0003*** (0.0001)	0.0015*** (0.0003)	-0.0010*** (0.0004)	0.0014*** (0.0003)
Household income (100,000 RMB)	0.0041*** (0.0015)	0.0032 (0.0023)	-0.0004 (0.0021)	0.0028 (0.0025)
Age	-0.0018*** (0.0002)	0.0005 (0.0004)	-0.0031*** (0.0004)	0.0006 (0.0004)

continued on next page

Table 3 *continued*

Variables	Simultaneous Model for Bank Loans		Simultaneous Model for Non-bank Loans	
	Has a Bank Loan	Infrastructure Index > 27	Has a Non- bank Loan	Infrastructure Index > 27
Female	-0.0043 (0.0041)	0.0056 (0.0069)	0.0070 (0.0067)	0.0057 (0.0067)
Educ.: no school	-0.0508*** (0.0078)	-0.1804*** (0.0177)	0.0524*** (0.0203)	-0.1765*** (0.0188)
Educ.: primary school	-0.0474*** (0.0071)	-0.1669*** (0.0162)	0.0822*** (0.0172)	-0.1629*** (0.0168)
Educ.: junior high	-0.0417*** (0.0067)	-0.1472*** (0.0158)	0.0726*** (0.0137)	-0.1436*** (0.0146)
Educ.: high school	-0.0349*** (0.0063)	-0.1339*** (0.0162)	0.0485*** (0.0150)	-0.1305*** (0.0173)
Educ.: some college	-0.0229*** (0.0068)	-0.0572*** (0.0158)	0.0031 (0.0132)	-0.0549*** (0.0156)
Married	0.0318*** (0.0049)	0.0328*** (0.0098)	0.0384*** (0.0102)	0.0315*** (0.0082)
Poor health	0.0260*** (0.0051)	-0.0135* (0.0076)	0.0572*** (0.0074)	-0.0143* (0.0079)
Has private insurance	0.0149*** (0.0048)	0.0209** (0.0101)	0.0001 (0.0076)	0.0200** (0.0090)
Family size	0.0020 (0.0021)	-0.0100*** (0.0027)	0.0142*** (0.0032)	-0.0100*** (0.0033)
Has children	0.0012 (0.0055)	0.0156** (0.0073)	-0.0119 (0.0087)	0.0152* (0.0090)
Has elders	-0.0263*** (0.0052)	0.0201** (0.0099)	-0.0359*** (0.0076)	0.0209*** (0.0075)
Number employed	0.0169*** (0.0019)	0.0142*** (0.0034)	0.0228*** (0.0031)	0.0134*** (0.0035)
Self-employed	0.0451*** (0.0075)	-0.0485*** (0.0113)	0.0351*** (0.0121)	-0.0508*** (0.0138)
Retired	-0.0300*** (0.0067)	0.0407*** (0.0114)	-0.0523*** (0.0112)	0.0415*** (0.0129)
Homeowner	0.0963*** (0.0035)	0.0350*** (0.0101)	0.1944*** (0.0054)	0.0300*** (0.0074)
Region 1: east	-0.0272*** (0.0055)	0.0082 (0.0123)	-0.0306*** (0.0112)	0.0094 (0.0114)
Region 2: north	-0.0168*** (0.0063)	-0.0557*** (0.0152)	0.0051 (0.0116)	-0.0547*** (0.0137)
Region 3: center	-0.0308*** (0.0068)	-0.1171*** (0.0129)	0.0222** (0.0112)	-0.1154*** (0.0128)
Region 4: south	-0.0245*** (0.0070)	-0.1056*** (0.0166)	0.0139 (0.0140)	-0.1041*** (0.0117)
Region 5: southwest	0.0306*** (0.0082)	-0.0561*** (0.0160)	-0.0148 (0.0137)	-0.0577*** (0.0127)
Region 6: northwest	0.0203** (0.0091)	-0.0392** (0.0158)	0.0338*** (0.0125)	-0.0402*** (0.0134)
ρ	0.0655	(0.0149)***	-0.0077	(0.0107)
Observations	24,046		24,046	
No. of positive observations	3,270	13,175	6,898	13,175

Note: Marginal effects are reported. Consistent standard errors are in parentheses and were generated using bootstrapping. Omitted categories include: fin. info.: pay no attention; risk: unwilling to take any risk; educ.: college; and region 7: northeast. All dollar values are in 100,000 RMB. *** p < 0.01, ** p < 0.05, * p < 0.1

5.2 Simultaneous Probit Estimates for Non-bank Loans and the Infrastructure

Recall that Table 3 also presents the results for non-bank loans. Again, an effect for urbanization was present and moved in opposite directions. As shown in Table 3, those living in more urbanized areas and megacities were significantly less likely to have a non-bank loan and more likely to be living in communities with a better infrastructure. These results support the findings associated with formal bank loans and provide additional support for the suggestion that urbanization may be putting stress on both the formal and the informal financial sector in terms of the system's capacity to meet the credit demand.

However, contrary to the previous findings, the infrastructure may not matter as much regarding non-bank loans. The physical infrastructure was not a significant predictor of non-bank loans. This finding may simply reflect the fact that, when conditions are better, people do not have as great a need for non-bank loans or any type of loans in general. It could also pick up latent effects related to the negative impacts of urbanization and maybe even the crowding out of informal credit.

Only a few other infrastructural factors were found to be significant. Not surprisingly, those with limited access to bank loans were significantly more likely to have a non-bank loan. Interestingly, the most significant effects were found for the technological infrastructure. Having access to a mobile phone and a computer significantly increased the likelihood of having a non-bank loan, as did engaging in online shopping. The marginal effects were quite large. For the reasons previously discussed, future research may explore the use of more robust measures to account for the movement away from traditional brick and mortar financial service locations to electronic payments and digital banking. The effects of the financial, social, and informational infrastructure on the likelihood of having a non-bank loan were largely statistically insignificant.

With regard to the infrastructure equation, having a non-bank loan did not significantly affect the probability of living in a community with a better infrastructure. This finding was similar to that found for bank loans. Thus, there does not appear to be a strong relationship between the infrastructure and the demand for non-bank loans. Further, there is little evidence to suggest a joint relationship between these two factors, especially since the correlation (ρ) between the error terms was found to be negative and statistically insignificant.

5.3 Results for Urban and Rural Households

To examine more closely the effects that urbanization might have on the relationship between the infrastructure and the demand for formal and informal credit of households, the models were estimated separately for urban and rural households. Table 4 presents the findings from the simultaneous models for bank and non-bank loans for urban and rural households. For ease of exposition, the results for the key infrastructure variables are included in the table. The results from the fully estimated models, which include the other socio-economic controls, are available on request.

Table 4: Simultaneous Probit Results for the Loan Demand and Infrastructure for Urban and Rural Households in the PRC

Variables	Simultaneous Model for Bank Loans			
	Urban		Rural	
	Has a Bank Loan	Infrastructure Index > 27	Has a Bank Loan	Infrastructure Index > 27
Ratio of urbanization	-0.0588*** (0.0084)	0.0745*** (0.0152)	-0.1098*** (0.0200)	0.1082*** (0.0345)
Living in a megacity	0.0087 (0.0061)	0.0387*** (0.0103)	-0.0519*** (0.0112)	-0.0021 (0.0301)
Predicted value: infrastructure index > 27	0.0838*** (0.0237)	-.--- -.---	0.0495 (0.0460)	-.--- -.---
Predicted value: had a bank/non-bank loan	-.--- -.---	0.0411 (0.0765)	-.--- -.---	0.0017 (0.1276)
Fin. infra.: has a bank branch	0.0245*** (0.0050)	0.0145 (0.0096)	0.0188*** (0.0072)	0.0126 (0.0152)
Limited access to bank loans	-0.0488*** (0.0052)	-.--- -.---	-0.0574*** (0.0078)	-.--- -.---
Mobile phone	-0.0136 (0.0091)	0.0107 (0.0140)	0.0205* (0.0108)	0.0251 (0.0197)
Computer	0.0142** (0.0067)	0.0490*** (0.0098)	0.0064 (0.0106)	0.0477*** (0.0153)
Online shopping	0.0233*** (0.0064)	0.0442*** (0.0097)	-0.0011 (0.0151)	0.0206 (0.0225)
Family very important	0.0079 (0.0050)	0.0107 (0.0088)	0.0118 (0.0072)	0.0276** (0.0133)
Local family network > 6	-0.0148*** (0.0053)	-.--- -.---	0.0029 (0.0075)	-.--- -.---
Guanxi income (100,000 RMB)	0.0317** (0.0131)	-.--- -.---	0.0213 (0.0607)	-.--- -.---
Fin. info.: pay extreme attention	0.0660*** (0.0172)	0.0463** (0.0227)	0.0416* (0.0228)	0.1089*** (0.0325)
Fin. info.: pay a lot of attention	0.0280*** (0.0093)	0.0443*** (0.0157)	0.0392** (0.0172)	0.0574** (0.0244)
Fin. info.: pay general attention	0.0123* (0.0069)	0.0156 (0.0127)	0.0213 (0.0131)	0.0616*** (0.0174)
Fin. info.: pay a little attention	0.0080 (0.0071)	0.0353*** (0.0102)	-0.0199** (0.0097)	0.0547*** (0.0162)
Control variables included	YES	YES	YES	YES
Instruments included	YES	YES	YES	YES
ρ	0.0878	(0.0179)***	0.0135	(0.0270)
Observations	16,545		7,501	

continued on next page

Table 4 *continued*

Variables	Simultaneous Model for Non-bank Loans			
	Urban		Rural	
	Has a Non-bank Loan	Infrastructure Index > 27	Has a Non-bank Loan	Infrastructure Index > 27
Ratio of urbanization	-0.0556*** (0.0133)	0.0687*** (0.0147)	-0.0477 (0.0400)	0.1099*** (0.0400)
Living in a megacity	-0.0417*** (0.0074)	0.0379*** (0.0125)	-0.0296 (0.0221)	-0.0022 (0.0237)
Predicted value: infrastructure index > 27	-0.0373 (0.0362)	-. -. (0.0362)	0.0420 (0.1008)	-. -. (0.0362)
Predicted value: had a bank/non-bank loan	-. -. (0.0363)	-0.0351 (0.0363)	-. -. (0.0363)	0.0543 (0.0427)
Fin. infra.: has a bank branch	0.0147** (0.0067)	0.0158** (0.0077)	0.0098 (0.0128)	0.0124 (0.0141)
Limited access to bank loans	0.0212** (0.0107)	-. -. (0.0107)	0.3105*** (0.0119)	-. -. (0.0107)
Mobile phone	-0.0237*** (0.0086)	0.0104 (0.0155)	0.0251* (0.0138)	0.0243 (0.0216)
Computer	-0.0197** (0.0088)	0.0485*** (0.0123)	-0.0345* (0.0183)	0.0495*** (0.0166)
Online shopping	0.0178** (0.0079)	0.0447*** (0.0109)	-0.0186 (0.0289)	0.0219 (0.0246)
Family very important	-0.0062 (0.0063)	0.0115 (0.0086)	0.0009 (0.0118)	0.0277*** (0.0095)
Local family network > 6	0.0187 (0.0209)	-. -. (0.0209)	-0.0036 (0.0120)	-. -. (0.0209)
Guanxi income (100,000 RMB)	0.0143 (0.0169)	-. -. (0.0169)	-0.0524 (0.1363)	-. -. (0.0169)
Fin. info.: pay extreme attention	0.0070 (0.0143)	0.0496** (0.0205)	0.0267 (0.0360)	0.1078*** (0.0281)
Fin. info.: pay a lot of attention	0.0152 (0.0105)	0.0460*** (0.0165)	-0.0041 (0.0259)	0.0575*** (0.0223)
Fin. info.: pay general attention	0.0132 (0.0090)	0.0166 (0.0133)	0.0254 (0.0183)	0.0600*** (0.0187)
Fin. info.: pay a little attention	0.0212** (0.0107)	0.0359*** (0.0111)	-0.0164 (0.0178)	0.0550*** (0.0151)
Control variables included	YES	YES	YES	YES
Instruments included	YES	YES	YES	YES
ρ	-0.0118	(0.0178)	-0.0036	(0.0219)
Observations	16,545		7,501	

Note: Marginal effects are reported. Consistent standard errors are in parentheses and were generated using bootstrapping. The control variables were included in each regression, and the omitted categories were consistent with the previous estimations. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The results for the key variables of interest were as follows. First, a negative urbanization effect was again noted for those with a bank or a non-bank loan, except for rural households using informal markets. This should not be surprising, since rural households using informal markets are likely to be living in the least urbanized areas.¹⁴ Second, the effects of the infrastructure were most significant for those with bank loans and in particular urban households with bank loans. Specifically, urban households living in communities with a better infrastructure were significantly more likely to have a bank loan, as were those that reported having at least one bank branch and greater access to bank loans. The factors related to the technological, social, and informational infrastructure also tended to be more significant for urban households with bank loans. A particularly interesting finding was that urban households with larger local family networks were significantly less likely to have a bank loan. It may be the case that urban respondents with a larger social/familial network may not feel the need to turn to a formal bank to meet their credit needs. Rural respondents in the PRC may still rely primarily on their social/familial network(s) to begin with and turn to bank loans independently and only as needed. In this context a social/familial network would not have a significant effect on bank loans for those living in rural areas. Higher amounts of guanxi income increased the probability of having a bank loan—again, this finding was only significant for urban households. The results also suggest that a respondent's informational search habits may play a more critical role in the decision to take out a bank loan than in the decision to take out a non-bank loan. For those with a non-bank loan, the driving factor was access to bank loans. Limited access to bank loans resulted in a significant increase in the likelihood of having a non-bank loan, regardless of urban or rural status. Comparing the results for the two groups, there was little empirical evidence to support dual endogeneity between financial inclusion and infrastructure except in relation to bank loans for urban households.

5.4 Robustness Checks

As with most models that attempt to control for endogeneity, concerns almost always arise with regard to the quality of the instruments. To address the potential concerns, we ran a series of robustness checks. First, we tested the sensitivity of the results by estimating the models using various combinations of the instruments. Using different combinations of the instruments did not significantly affect the results, especially for the key variables of interest related to the infrastructure, urbanization, and financial inclusion. Second, we found that, for most of the models, the error terms from the two equations were not significantly correlated. For this reason we also estimated the equations using a two-stage probit model instead of the simultaneous bivariate probit model. In the first stage, we again estimated the reduced-form equations, but in the second stage, we assumed that the error terms were uncorrelated and used the probit method to estimate the equations using the predicted values that were found for the loan demand and infrastructure. Again, we found that the results for the key variables did not change significantly.

¹⁴ Note that there was some measurement error related to the urbanization variable. Recall that, if urban population data were unavailable in the statistical yearbooks at the local level, the urbanization ratio was constructed using available data from a higher jurisdiction level.

We also ran statistical tests to assess the strength of the instruments. Weak instruments can affect standard errors, which in turn can affect the significance of the variables in the second stage of estimation. For this reason we first conducted a joint test of the instruments in each equation using the F-statistics from the first-stage estimations. The F-statistics were large, with p-values of less than 0.001, suggesting that the instruments have sufficient explanatory power. Given the number of instruments used in both equations, we also conducted a Hausman test to check for overidentification (see Hausman 1983, p. 444). The first-stage equations were estimated with and without the instruments from the other equation. The results from the likelihood ratio tests indicated that the addition of the instruments had little or no effect on the explanatory power of the results except in a few cases related to the infrastructure equation. However, even in these cases, the over-identifying restrictions did not appear to be violated considerably.

6. CONCLUSIONS

This study used data from the *2013 Chinese Household Finance Survey* to investigate how various forms of infrastructure affect the usage of bank and non-bank loans for both urban and rural households in the PRC. Several findings are worth noting. First, the infrastructure, in a variety of forms (i.e., physical, financial, technological, social, and informational), appears to influence significantly the demand for bank and non-bank loans. These effects seem to be more significant for bank loans, especially for urban households with bank loans. Further, the direction of the effects indicates that a better infrastructure (and not just the financial infrastructure) is related to an increased demand for bank loans for urban populations. The effect of the infrastructure on non-bank loans and for rural households was negligible.

Second, there also appears to be a strong “urbanization effect” such that those living in more urbanized areas are less likely to have a bank or non-bank loan even after controlling for other factors. Initially, one might expect the relationship to be positive, since it is reasonable to assume that households in more urbanized areas should have greater access to formal and informal credit as well as greater access to the infrastructure that facilitates that access. However, the negative relationship probably reflects the strain that rapid urbanization is putting on the financial sector, especially the credit markets in highly urbanized areas. Recall that the PRC’s recent urbanization policies have resulted in rapid migration of the population from rural to urban areas. Urban areas, especially larger metropolitan areas, are facing critical capacity issues concerning urban services and the infrastructure needed to support those services for larger populations. The financial sector is just one of many sectors facing these capacity constraints.

An alternative explanation could be that households living in more urban areas (i.e., megacities) are less likely to be financially constrained. For households living in megacities, the savings rate (defined as the total income less the total consumption divided by the total income) was found in general to be higher. Additionally, more households were found to have negative savings in non-megacities. Having said this, our models controlled for household income, net worth, and liquidity, returning to the notion that urbanization may be dampening credit access and usage.

Overall, the results presented in this paper are informative and among the first to shed light not only on the relationship between the infrastructure and the loan demand but also on the added impact of urbanization. Further, this work is unique, especially for the PRC, in that we have household-level data that can be linked to village–community-level infrastructure data. Even so, a few limitations need to be acknowledged.

At the onset of this research, a concern arose about the potential endogeneity between the infrastructure and the loan demand. While there is some evidence to suggest that dual endogeneity may exist for PRC households with bank loans, the findings mainly show that decisions related to the loan demand and infrastructure may in fact be made independently, especially for non-bank loans. One reason may be that the decision to take out a loan is made primarily at the household level, whereas decisions related to communities' infrastructure are made at the county or higher municipality levels in the PRC. While we ran several robustness checks, there may still be concerns about the potential endogeneity and the instruments used, especially given the complexities that appear to exist between infrastructure, loan demand, and urbanization.

Further, one might question the quality of the various infrastructure measures. Many of them are based on self-reported measures, which are dependent on the reliability of the respondent or the village/community leader. This paper particularly focused on the measure of the physical infrastructure, which was constructed as an index using the best available data in the survey. Statistical tests showed that this was a valid and reliable measure. As such, the index was used to distinguish communities with a better infrastructure from those with a worse infrastructure. However, as this paper points out, the infrastructure can be defined in a number of ways. We included other measures related to the financial, technological, social, and informational infrastructure, but they were assumed to be exogenous. Given the availability of data and the significance of the other measures in the models, we believe that this was a reasonable assumption to make.

It is also noticeable that the demand functions may be different for bank and non-bank loans as well as for urban and rural respondents. The results presented in this paper assumed the same demand function for all the models. However, a few additional demand models were estimated. The findings showed that generally the key results stayed the same regardless of the specification. It may be worth noting that it was easier to construct better demand specifications for bank loans than non-bank loans using the existing data. Along these same lines, one might question whether the results differ according to the type of loan (e.g., home, business, agriculture, and education). Additionally, the analysis revealed that the relationship between the infrastructure and the loan demand appears to be driven largely by home loans, which is not surprising, since home loans are the largest type of loans held by PRC households. Of those with a bank loan, 61.3% have a home loan compared with 67.9% of those with a non-bank loan.

Finally, we must acknowledge that, while we investigated the potential endogeneity between the infrastructure and the loan demand, we were unable to identify clearly the potential directions of causality. This can only be achieved using longitudinal data. This paper used data from the *2013 Chinese Household Finance Survey*. As additional survey data become available, there will be opportunities for future analysis to investigate this issue as well as the other issues mentioned above.

Until that time this work lays important groundwork for future policy and research. This study is among the first to provide empirical evidence that the infrastructure, especially non-financial types of infrastructure, is an important determinant of financial inclusion, perhaps more so for urbanized areas. The PRC, as well as several other developing countries, is working on national strategies aimed at improving financial inclusion, especially with regard to the expansion of bank credit. Governments are facing the challenge of expanding the formal financial services to mass populations using limited resources, including in many cases a limited infrastructure. This paper shows that future models of financial inclusion and economic development need to consider the potential impacts of various types of infrastructure more carefully. This will help to mitigate the potential adverse effects on households' consumption, savings, and human capital decisions, which in turn can have a direct impact on the long-run economic growth and financial stability of countries such as the PRC.

REFERENCES

- Allen, F., A. Demirgüç-Kunt, L. Klapper, and M.S.M. Peria. 2016. "The Foundations of Financial Inclusion: Understanding Ownership and Use of Formal Accounts." *Journal of Financial Intermediation* 27 (1): 1–30.
- Amuedo-Dorantes, C., and K. Mundra. 2007. "Social Networks and their Impact on the Earnings of Mexican Migrants." *Demography* 44 (4): 849–863.
- Anderson, B. n.d. "How Technology Drives Financial Inclusion." MasterCard Center for Inclusive Growth. <http://inclusionhub.mastercardcenter.org/backgrounds/5939/how-technology-drives-financial-inclusion/>.
- Asian Development Bank Institute (ADBI). 2014. *Financial Inclusion in Asia: Country Surveys*. Tokyo, Japan. <http://www.adb.org/sites/default/files/publication/159308/adbi-financial-inclusion-asia.pdf>.
- Ayyagari, M., A. Demirgüç-Kunt, and V. Maksimovic. 2010. "Formal versus Informal Finance: Evidence from China." *Review of Financial Studies* 23: 3048–3097.
- Basel Committee on Banking Supervision (BCBS). 2015. *Range of Practice in the Regulation and Supervision of Institutions Relevant to Financial Inclusion*. Basel: Bank for International Settlements.
- Beck, T., and A. De La Torre. 2006. "The Basic Analytics of Access to Financial Services." *Financial Markets, Institutions and Instruments* 16: 79–117.
- Beck, T., A. Demirgüç-Kunt, and R. Levine. 2007. "Finance, Inequality and the Poor." *Journal of Economic Growth* 12 (1): 27–49.
- Bloomberg. 2012. "China's Urban Population Exceeds Countryside for First Time." Bloomberg.com. <http://www.bloomberg.com/news/2012-01-17/china-urban-population-exceeds-rural.html>.
- Bricker, J., B. Bucks, A. Kennickell, T. Mach, and K. Moore. 2011. "Surveying the Aftermath of the Storm: Changes in Family Finances from 2007 to 2009." *Finance and Economics Discussion Series 2011–17*. Washington, DC: Board of Governors of the Federal Reserve System. <http://www.federalreserve.gov/pubs/feds/2011/201117/201117pap.pdf>.
- Bricker, J., A.B. Kennickell, K.B. Moore, and J. Sabelhaus. 2012. "Changes in U.S. Family Finances from 2007 to 2010: Evidence from the Survey of Consumer Finances." *Federal Reserve Bulletin* 98 (2), June: 1–80.
- CBRC. 2013a. *The 1000th Village and Township Bank Started Operation*. Beijing: CBRC. <http://www.cbrc.gov.cn/EngdocView.do?docID=3B6DF046CC5B43418CB26C88A445637159>.
- CBRC. 2013b. *The CBRC Issued Notice on Improving Financial Services for Migrant Workers*. Beijing: CBRC. <http://www.cbrc.gov.cn/EngdocView.do?docID=2E0B9748C5BA492293E2A796B588020D>.
- Celerier, C., and A. Matray. 2017. "Bank Branch Supply and the Unbanked Phenomenon." HEC Paris Research Paper No. FIN-2014-1039. SSRN. <https://ssrn.com/abstract=2392278>
- CGAP. 2011. *Global Standard-Setting Bodies and Financial Inclusion for the Poor: Toward Proportionate Standards and Guidance*. Washington, DC: CGAP.

- Chan, A., and T. Jia. 2011. *The Role of Mobile Banking in Facilitating Rural Finance: Reducing Inequality in Financial Services between Urban and Rural Areas*. Dublin, Ireland: Accenture Banking Services.
- China Financial Standardization Technical Committee. 2012. The People's Bank of China publishes the technical standards of China's financial mobile payment. Retrieved from <http://www.cfstc.org/publish/en/87/20130319100821779939420/index.html>
- Čihák, M., D. Mare, and M. Melecký. 2016. "The Nexus of Financial Inclusion and Financial Stability: A Study of Trade-Offs and Synergies." IMF Working Paper. Washington, DC: International Monetary Fund.
- Čihák, M., P. N'Diaye, A. Barajas, S. Mitra, A. Kyobe, Y.N. Mooi, and S.R. Yousefi. 2015. "Financial Inclusion: Can It Meet Multiple Macroeconomic Goals?" No. 15/17. Washington, DC: International Monetary Fund.
- Claessens, S. 2006. "Access to Financial Services: A Review of the Issues and Public Policy Objectives." *The World Bank Research Observer* 21: 207–240.
- Collard, S. 2007. "Toward Financial Inclusion in the UK: Progress and Challenges." *Public Money and Management* 27: 13–20.
- Dabla-Norris, E., Y. Ji, R. Townsend, and D.F. Unsal. 2015. "Identifying Constraints to Financial Inclusion and their Impact on GDP and Inequality: A Structural Framework for Policy." IMF Working Paper 15/22. Washington, DC: International Monetary Fund.
- Demirguc-Kunt, A., and L. Klapper. 2013. "Measuring Financial Inclusion: Explaining Variation in Use of Financial Services across and within Countries." *Brookings Papers on Economic Activity*: 279–340.
- Demirguc-Kunt, A., L. Klapper, D. Singer, and P.V. Oudheusden. 2014. "The Global Findex Database 2014: Measuring Financial Inclusion around the World." World Bank Policy Research Working Paper No. 7255. Washington DC: The World Bank.
- Demirguc-Kunt, A., and R. Levine. 2009. "Finance and Inequality: Theory and Evidence." No. w15275. Washington, DC: National Bureau of Economic Research.
- Duwal, B.R., and S.Y. Sun. 2013. "Research on Rural Financing in China with Reference to Village and Township Banks: An Overview." *International Journal of Business and Management* 8: 75–84.
- Eckart, J. 2016. "8 Things You Need To Know about China's Economy." World Economic Forum. <https://www.weforum.org/agenda/2016/06/8-facts-about-chinas-economy/>.
- Fisher, J.D., and A.C. Lyons. 2006. "Till Debt Do Us Part: A Model of Divorce and Personal Bankruptcy." *Review of Economics of the Household* 4 (1): 35–52.
- Frazier, M. (2013). "Narrowing the Gap: Rural–Urban Inequality in China." *World Policy Review*. <http://www.worldpoliticsreview.com/articles/13241/narrowing-the-gap-rural-urban-inequality-in-china>.
- Fungacova, Z., and L. Weill. 2015. "Understanding Financial Inclusion in China." *China Economic Review* 34: 196–206.

- G20 Financial Inclusion Experts Group. 2010. "ATISG Report. Innovative Financial Inclusion: Principles and Report on Innovative Financial Inclusion from the Access through Innovation Sub-group of the G20 Financial Inclusion Experts Group." <http://aid.dfat.gov.au/Publications/Documents/G20financialinclusion.pdf>.
- Gan, L., Z. Yin, N. Jia, S. Xu, S. Ma, and L. Zheng. 2014. *Data You Need To Know about China: Research Report of China Household Finance Survey 2012*. Berlin, Germany: Springer.
- Glomm, G., and B. Ravikumar. 1997. "Productive Government Expenditures and Long-Run Growth." *Journal of Economic Dynamics and Control* 21: 183–204.
- Hannig, A., and S. Jansen. 2010. *Financial Inclusion and Financial Stability: Current Policy Issues*. Tokyo, Japan: Asian Development Bank Institute (ADBI).
- Hausman, J.A. 1983. "Specification and Estimation of Simultaneous Equation Models." *Handbook of Econometrics* 1: 391–448.
- Hsu, S. 2016. "China's Urbanization Plans Need To Move Faster in 2017." *Forbes*. <http://www.forbes.com/sites/sarahsu/2016/12/28/chinas-urbanization-plans-need-to-move-faster-in-2017/#3cc55af33c3b>.
- Klapper, L., and D. Singer. 2014. *The Opportunities of Digitizing Payments: How Digitization of Payments, Transfers, and Remittances Contributes to the G20 Goals of Broad-Based Economic Growth, Financial Inclusion, and Women's Economic Empowerment. A Report by the World Bank Development Research Group, the Better than Cash Alliance, and the Bill and Melinda Gates Foundation to the G20 Global Partnership for Financial Inclusion*. Washington, DC: World Bank Group.
- Lagarde, C. 2014. "Empowerment through Financial Inclusion." Keynote address at the International Forum for Financial Inclusion, Mexico City. <https://www.imf.org/external/np/speeches/2014/062614a.htm>.
- Lakey, B. 2013. "Perceived Social Support and Happiness: The Role of Personality and Relationship Processes." In *Oxford Handbook of Happiness*, edited by I. Boniwell, S.A. David, and A.C. Ayers, 847–860. Oxford: Oxford University Press.
- Li, T. 2006a. "Social Interaction and Investment Choice." *Economic Research Journal* 8: 45–57.
- . 2006b. "Social Interaction, Trust and Stock Market Participation." *Economic Research Journal* 1: 34–45.
- Li, T., Z. Wang, H. Wang, and S. Tan. 2010. "A Study on Chinese Urban Residents' Financial Exclusion: Empirical Evidence Based on Micro-survey Data." *Economic Research Journal* 7: 15–30.
- Li, X., C. Gan, and B. Hu. 2011. "Accessibility to Microcredit by Chinese Rural Households." *Journal of Asian Economics* 22: 235–246.
- Liang, E., and S.D. Yuan. 2013. "Investors are Social Animals: Predicting Investor Behavior Using Social Network Features." Proceedings of the Workshop on Mining and Learning with Graphs (MLG-2013). http://snap.stanford.edu/mlg2013/submissions/mlg2013_submission_7.pdf.
- Lusardi, A., P.C. Michaud, and O.S. Mitchell. 2013. "Optimal Financial Knowledge and Wealth Inequality." National Bureau of Economic Research Working Paper 18669. Washington, DC: NBER.

- Lusardi, A., and O.S. Mitchell. 2013. "The Economic Importance of Financial Literacy: Theory and Evidence." National Bureau of Economic Research Working Paper w18952. Washington, DC: NBER.
- Lyons, A.C., Y. Chang, and E. Scherpf. 2006. "Translating Financial Education into Behavior Change for Low-Income Populations." *Journal of Financial Counseling and Planning* 17 (2): 27–45.
- Lyons, A.C., and S.A. Contreras. 2017. "A Simultaneous Equation of Youth Entrepreneurship and Financial Inclusion across Developing Countries." Working Paper. Urbana, IL: University of Illinois at Urbana-Champaign.
- Lyons, A.C., J.E. Grable, L. Chen, X. He, J.H. Liu, and T. Zeng. 2016. "Impacts of Financial Literacy, Familial Networks, and Financial Access on Demand for Bank and Non-bank Loans of Financially Excluded Households in China." The 11th Biennial Conference Proceedings of Asian Consumer and Family Economics Association, Hong Kong, China, 307–312.
- Lyons, A.C., J.E. Grable, and S.H. Joo. 2017. "A Cross-Country Evaluation of Population Aging and Financial Security." Working Paper. Urbana, IL: University of Illinois at Urbana-Champaign.
- Lyons, A.C., M. Roa, and I. Kunovskaya. 2014. "An International Framework for Advancing Economic Development, Financial Education, and Inclusion: The Launching of a Multi-phase Research Project." *The 10th Biennial Conference Proceedings of Asian Consumer and Family Economics Association*: 111–124.
- Lyons, A.C., and E. Scherpf. 2004. "Moving from Unbanked to Banked: Evidence from the Money Smart Program." *Financial Services Review* 13: 215–231.
- Maddala, G.S. 1986. *Limited-Dependent and Qualitative Variables in Econometrics* (No. 3). Cambridge, MA: Cambridge University Press.
- Manyika, J., S. Lund, M. Singer, O. White, and C. Berry. 2016. *Digital Finance for All: Powering Inclusive Growth in Emerging Economies*. San Francisco, CA: McKinsey Global Institute. <http://www.mckinsey.com/global-themes/employment-and-growth/how-digital-finance-could-boost-growth-in-emerging-economies>.
- Mehrotra, A., and J. Yetman. 2015. "Financial Inclusion – Issues for Central Banks." *BIS Quarterly Review*, March: 83-96. Basel, Switzerland: Bank for International Settlements.
- Park, C.Y., and R. Mercado Jr. 2015. "Financial Inclusion, Poverty, and Income Inequality in Developing Asia." Asian Development Bank Economics Working Paper Series, No. 426. Tokyo, Japan: Asian Development Bank Institute. <http://www.adb.org/sites/default/files/publication/153143/ewp-426.pdf>.
- Peng, R., M. Zhao, and L. Wang. 2014. "Financial Inclusion in the People's Republic of China: Achievements and Challenges." *Financial Inclusion in Asia*: 7.
- Rajan, R.G., and L. Zingales. 1998. "Financial Dependence and Growth." *American Economic Review* 88: 559–586.

- Sahay, R., M. Čihák, P. N'Diaye, A. Barajas, S. Mitra, A. Kyobe, Y.N. Mooi, and R. Yousefi. 2015. "Financial Inclusion: Can It Meet Multiple Macroeconomic Goals?" IMF Staff Discussion Note (SDN/15/17). Washington, DC: IMF. https://www.researchgate.net/profile/Srobona_Mitra/publication/281821048_Financial_Inclusion_Can_It_Meet_Multiple_Macroeconomic_Goals/links/55f97e7a08aec948c493e404.pdf.
- Shrader, L., and E. Duflos. 2014. "China: A New Paradigm in Branchless Banking?" CGAP Working Paper. Washington, DC: Consultative Group to Assist the Poor (CGAP).
- Sparreboom, P., and E. Duflos. 2012. "Financial Inclusion in the People's Republic of China: An Analysis of Existing Research and Public Data." China Papers on Inclusiveness No. 7. Geneva: CGAP and World Microfinance Forum Geneva.
- Sun, T., and S. Huang. 2010. "Chinese Households' Saving, Consumption and Intergenerational Support with the Influence of Informal Institution." *Economic Research Journal*: S1. http://en.cnki.com.cn/Article_en/CJFDTOTAL-JJYJ2010S1007.htm.
- Thaler, R.H., and C.R. Sunstein. 2008. *Nudge: Improving Decisions about Health, Wealth, and Happiness*. New Haven, Connecticut: Yale University Press.
- United Nations. 2015a. "Addis Ababa Action Agenda of the Third International Conference on Financing for Development (Addis Ababa Action Agenda)." Resolution adopted by the UN General Assembly at the Third International Conference on Financing for Development, Addis Ababa, Ethiopia. http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/69/313
- . 2015b. "Governments Leading the Way: Digitizing Payments and Advancing Inclusive Finance To Achieve the Sustainable Development Goals" [Video File]. <http://webtv.un.org/meetings-events/conferencessummits/3rd-international-conference-on-financing-for-development-addis-ababa-ethiopia-13%E2%80%9316-july-2015/press-conferences/watch/governments-leading-the-way-digitizing-payments-and-advancing-inclusive-finance-to-achieve-the-sustainable-development-goals/4511910526001>.
- Van Rooij, M., A. Lusardi, and R. Alessie. (2011). "Financial Literacy and Stock Market Participation." *Journal of Financial Economics* 101: 449–472.
- Villasenor, J.D., D.M. West, and R.J. Lewis. 2015. *The 2015 Brookings Financial and Digital Inclusion Project Report: Measuring Progress on Financial Access and Usage*. Washington, DC: Center for Technology Innovation at Brookings. <http://www.brookings.edu/~media/research/files/reports/2015/08/financial-digital-inclusion-2015-villasenor-west-lewis/fdip2015.pdf>
- . 2016. *The 2016 Brookings Financial and Digital Inclusion Project Report: Advancing Equitable Financial Ecosystems*. Washington, DC: Center for Technology Innovation at Brookings.
- World Bank. n.d.. *How To Measure Financial Inclusion*. Washington, DC: World Bank. <http://www.worldbank.org/en/topic/financialinclusion/brief/how-to-measure-financial-inclusion>.
- . 2012. *Financial Inclusion Strategy Reference Framework*. Washington, DC: World Bank. <http://siteresources.worldbank.org/EXTFINANCIALSECTOR/Resources/282884-1339624653091/>

- . 2014a. *Global Financial Development Report: Financial Inclusion*. Washington, DC: World Bank.
- . 2014b. “Financial Inclusion—A Foothold on the Ladder toward Prosperity? An IEG Evaluation of World Bank Group Support for Financial Inclusion for Low-Income Households and Microenterprises: Approach Paper.” Washington, DC: IEG World Bank Group. <http://documents.worldbank.org/curated/en/2014/06/23525662/financial-inclusion-foothold-ladder-toward-prosperity-ieg-evaluation-world-bank-group-support-financial-inclusion-low-income-households-microenterprises-approach-paper>.
- . 2015. “Overview: National Financial Inclusion Strategies.” Washington, DC: World Bank. <http://www.worldbank.org/en/topic/financialinclusion/brief/national-financial-inclusion-strategies>.
- Xinhuanet. 2013. “China To Balance Urban, Rural Development.” Third Plenary Session of the 18th CPC Central Committee. Beijing. http://news.xinhuanet.com/english/china/2013-11/15/c_132892185.htm.
- Yin, Z., Q. Song, and Y. Wu. 2014. “Financial Literacy, Trading Experience and Household Portfolio Choice.” *Economic Research Journal* 4: 62–75.