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Impacts of loan availability on farmers' productive assets in China: Evidence from a household survey

Yang Zou^a, Jingwen Xu^a, Qingbin Wang^b, Yingying Pei^a, Yi Yuan^a and Licheng Qiu^c

(^aNankai University, ^bUniversity of Vermont, ^cYanshan University)

Outline

Introduction

A theoretical framework

Data source and variable definitions

Estimation results

Conclusions and policy recommendations

➔ Introduction

- ◆ Increasing farmers' productive assets is very important strategy for sustainable rural development and steady increase in rural income.
- ◆ One important source of farmers' productive assets is loans from banks and other financial institutions.
- ◆ The lack of access to loans has been identified as a significant barrier for many farmers to expand their production and increase their income.

➔ Introduction

- ◆ Since fixed productive assets are one of the most important collaterals, commercial banks are more willing to lend to companies or individuals with more fixed productive assets to reduce their risk.
- ◆ Due to the small scale of agricultural production and the low level of farmers' fixed assets in China, farmer households are less likely to obtain loans to increase their productive assets.

➔ Introduction

- ◆ While some studies have reported that China has made significant progress in enhancing fair financing for small businesses, many researchers believe that, at the present stage, farmers and small and medium-sized enterprises still face restrictions for meeting their demand for loans.
- ◆ In recent years, the Chinese government has made efforts to promote the development of inclusive finance, especially for the agricultural sector and farmers. For example, the balance of agricultural loans increased from 23.6 trillion yuan at the end of 2014 to 69.19 trillion yuan at the end of the first quarter in 2024, and the share of farmers' loans increased from 23% to 30% over the same period.

➔ Introduction

◆ Objectives:

- (1) To develop a theoretical framework for analyzing the impacts of loan availability on farmers' productive assets in China,
- (2) To empirically estimate and test such impacts using data from a national survey conducted in 2014, and
- (3) To derive policy recommendations

➔ A theoretical framework

◆ The final level of productive assets held by a farmer household (A):

$$A = A\{\theta(1 + s)[M_1 + \alpha(M_1, G)M_2]\} \quad (1)$$

where M_1 = self-owned funds

M_2 = loaned funds

s = government subsidy rate ($0 \leq s < 1$)

G = asset mortgage or guaranteed credit level

θ = The proportion of productive assets formed by various funds ($0 \leq \theta < 1$, $\theta = 0$ means that all of the funds obtained are used for non-productive purposes. For some human expenses will occur in the process of forming productive assets, not all of the funds will form productive assets, thus $\theta < 1$)

➔ A theoretical framework

- ◆ $\alpha(M_1, G)$ = The probability of obtaining credit loans M_2 $\left(0 \leq \alpha \leq 1, \frac{\partial \alpha}{\partial M_1} > 0, \frac{\partial \alpha}{\partial G} > 0\right)$
- ◆ α is an increasing function of self-owned funds M_1 and asset mortgage or guaranteed credit level G . The smaller the self-owned funds M_1 , the lower the loan availability α will be; the more collateral or higher internal and external credit level G , the higher loan availability α will be. When $\alpha = 0$, it means that farmer households have not obtained any loans; when $\alpha = 1$, it means that loan requirements are fully met; in other cases, loan requirements are partially satisfied.

➔ A theoretical framework

◆ The net income of productive assets:

$$\pi = \sum_{i=1}^n \tau_i (1 - \delta_i) A \{ \theta (1 + s) [M_1 + \alpha(M_1, G) M_2] \} - (1 + r) \alpha(M_1, G) M_2 \quad (2)$$

➔ A theoretical framework

◆ Sort out $\frac{\partial \pi}{\partial M_1}=0$ and $\frac{\partial \pi}{\partial M_2}=0$ respectively to obtain :

$$A'\{\theta(1+s)[M_1 + \alpha(M_1, G)M_2]\} = \frac{(1+r)\frac{\partial \alpha(M_1, G)}{\partial M_1}M_2}{\sum_{i=1}^n \tau_i(1-\delta_i)[\theta(1+s) + \frac{\partial \alpha(M_1, G)}{\partial M_1}M_2]} \quad (3)$$

$$A'\{\theta(1+s)[M_1 + \alpha(M_1, G)M_2]\} = \frac{(1+r)}{\sum_{i=1}^n \tau_i(1-\delta_i)\theta(1+s)} \quad (4)$$

The longer the service life of productive assets n , the less depreciation rate of each period δ_i , the more yield of each period before loan interest payment τ_i , the higher the proportion of productive assets formed by various funds θ , the higher government subsidy ratio s , the lower the interest rate r , the productive assets of farmer households are easier to form.

➔ A theoretical framework

◆ Combine Formulas (3) and (4) to obtain:

$$M_2^* = \frac{1}{\frac{\partial \alpha(M_1, G)}{\partial M_1} \left(1 - \frac{1}{\theta(1+s)}\right)} \quad (5)$$

If M_1 increases, because $\frac{\partial \alpha(M_1, G)}{\partial M_1} > 0$, thus M_2^* will decrease with increase in M_1 , indicating that there is a certain substitution relationship between the household self-owned funds and the loan funds. At the same time, to ensure $M_2^* > 0$, $\theta(1 + s) > 1$ has to be met, which requires the loss of loan funds in the process of forming productive assets being less.

➔ A theoretical framework

◆ According to Formulas (1) and (5), the level of productive assets for farmer households:

$$A^* = \theta(1 + s) \left[M_1^* + \frac{\alpha(M_1, G)}{\frac{\partial \alpha(M_1, G)}{\partial M_1} \left(1 - \frac{1}{\theta(1+s)}\right)} \right] \quad (6)$$

The higher the proportion of various funds to form productive assets θ , the higher the government subsidy rate s , and the higher the loan availability α , the higher the level of productive assets of farmer households A^* will be.

➔ Data source and variable definitions

- ◆ This paper utilizes the data of CHIP 2013, conducted in 2014 by the Institute of Economic Research of the Chinese Academy of Social Sciences and the National Bureau of Statistics. It includes 11,013 rural households from 236 counties in 12 provinces, two municipalities, and one autonomous region. The observations with missing or invalid data on all variables used were excluded.
- ◆ Dependent variable (farmers' productive assets) : (1) How much is the estimated net present value of agricultural fixed productive assets at the end of 2013? (2) How much is the estimated net present value of non-agricultural fixed productive assets at the end of 2013? (3) How much is the estimated present value of net productive liquid at the end of 2013?

➔ Data source and variable definitions

- ◆ Independent variable (loan availability): (1) In the last three years, have you or any member of your household applied for or asked for a loan or other credit from a bank, rural credit cooperative, moneylender, or other business, financial institution, or formal lender? (2) Were any of these applications or requests for a loan or credit turned down, or approved fully and partially? (3) In the last three years, have you or any member of your household asked for a loan or borrowed from relatives or friends? (4) Were any of your households' requests to relatives or friends for a loan turned down or agreed fully and partially?

➔ Data source and variable definitions

Table1 Definitions of the main variables

Variables	Definition
<i>lnagrfixasset</i>	Logarithm of the estimated net value of agricultural fixed productive assets owned by farmer households at the end of 2013
<i>lnnagrfixasset</i>	Logarithm of the estimated net value of non-agricultural fixed productive assets owned by farmer households at the end of 2013
<i>lnliquidasset</i>	Logarithm of the estimated present value of net productive liquid assets [Deducting the debt (loans)] at the end of 2013
<i>formalloan</i> (Formal loans)	<i>formalloan</i> = 0 for one or more loan requests on bank, other financial institutions, were turned down, <i>formalloan</i> = 1 for loan requests on bank, other financial institutions were partially or fully satisfied
<i>informalloan</i> (Informal loans)	<i>informalloan</i> = 0 for one or more loan requests on relatives and friends were turned down, <i>informalloan</i> = 1 for loan requests on relatives and friends were partially or fully satisfied

➔ OLS estimation

- ◆ **The following regression model is constructed:**

$$\ln asset_i = \gamma_0 + \gamma_1 loan_i + \sum \sigma X + \varepsilon_i$$

- ◆ The OLS method is utilized, for the dependent variables are continuous variables. Considering that OLS regression results may be affected by sample selection bias, causing estimation distortion, to ensure the robustness of the research conclusions, PSM (Propensity Score Matching) estimation will be used in the following subsection to examine the impact of loan availability on farmers' productive assets.

➔ OLS estimation

- ◆ *lnasset*: The logarithm of different productive assets of farmer households at the end of 2013, which include agricultural fixed productive assets (*lnagrfixasset*), non-agricultural fixed productive assets (*lnnagrfixasset*) and productive liquid assets (*lnliquidasset*).
- ◆ *loan*: Dummy variable, if all or parts of loan applications are met, $loan = 1$, otherwise $loan = 0$, *loan* includes formal loans (*formalloan*) and informal loans (*informalloan*).
- ◆ **X**: Control variables vector, including gender, marriage, party affiliation, village cadres, years of education, health status, whether engaged in local wage earning work, whether engage in local non-agricultural production/business, whether migrate out for work/business, land area, working time in busy farming season.

➔ Descriptive statistics (1)

Table 2 Descriptive statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
<i>lnagrfixasset</i>	19271	8.236	1.482	3.401	15.895
<i>lnnagrfixasset</i>	6937	9.531	1.825	0.693	15.761
<i>lnliquidasset</i>	5339	8.973	1.551	2.079	13.816
<i>lnland</i>	32637	1.485	0.977	-2.303	5.418
<i>lnbusyhours</i>	14672	5.765	1.122	0	7.824
<i>leader</i>	38679	0.02	0.14	0	1
<i>marriage</i>	39001	0.688	0.463	0	1
<i>eduyear</i>	35750	7.417	3.504	0	21
<i>gender</i>	39063	0.521	0.5	0	1
<i>health</i>	38919	2.015	0.905	1	5
<i>outwork</i>	30222	0.243	0.429	0	1
<i>salary</i>	30287	0.254	0.435	0	1
<i>nonagr</i>	30045	0.086	0.281	0	1
<i>formalloan</i>	4854	0.85	0.357	0	1
<i>informalloan</i>	12580	0.866	0.34	0	1

➔ OLS estimation

Table 3 OLS Estimation

Variables	<i>lnagrfixasset</i>		<i>lnnagrfixasset</i>		<i>lnliquidasset</i>	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>formalloan</i>	0.26** (0.104)		-0.1963 (0.2599)		0.1868 (0.2108)	
<i>informalloan</i>		0.2528*** (0.0726)		0.2626 (0.2128)		0.1027 (0.1723)
cons	6.5262*** (0.3434)	6.4088*** (0.2231)	10.6494*** (0.8731)	10.3935*** (0.6495)	8.6362*** (0.691)	8.3166*** (0.5021)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	1320	3066	438	757	390	724
R-squared	0.206	0.2067	0.098	0.0873	0.1582	0.1412

- ◆ The availability of farmers' formal loans and informal loans is conducive to the increase of agricultural fixed productive assets.

➔ PSM estimation

- ◆ Due to the self-selection problem (the dependent variable loan availability of farmer households may be an endogenous variable), the general OLS estimation method may produce estimation bias.
- ◆ The PSM (method is often used to estimate the treatment effects for micro-data, especially for large sample sizes and more covariates).
- ◆ Abadie & Imbens (2012, 2016) developed an improved method for estimating the standard error for PSM that considered the propensity score before matching is obtained by estimation.



PSM estimation

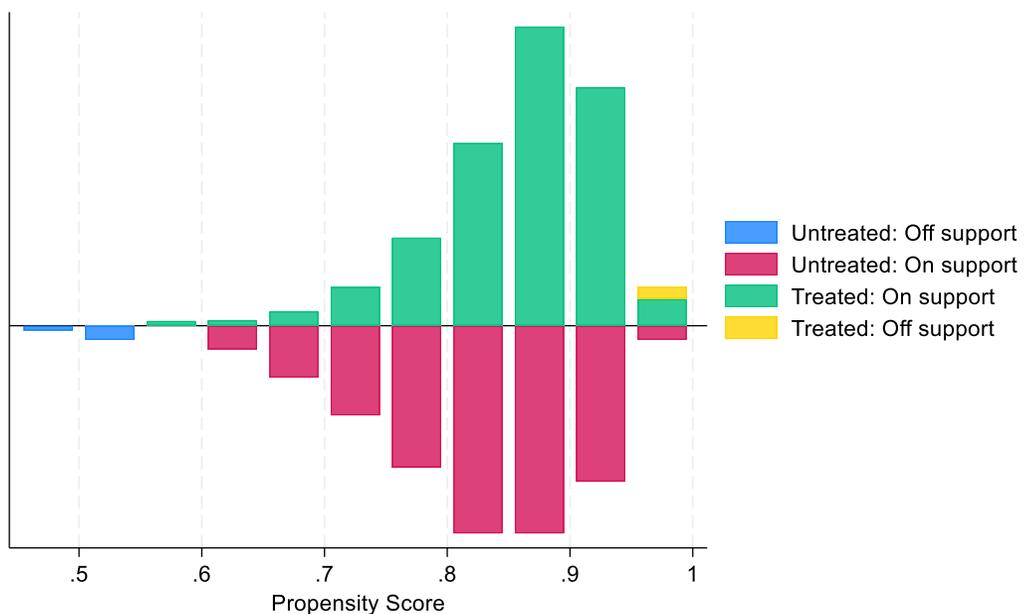


Figure 1 PSM common support areas

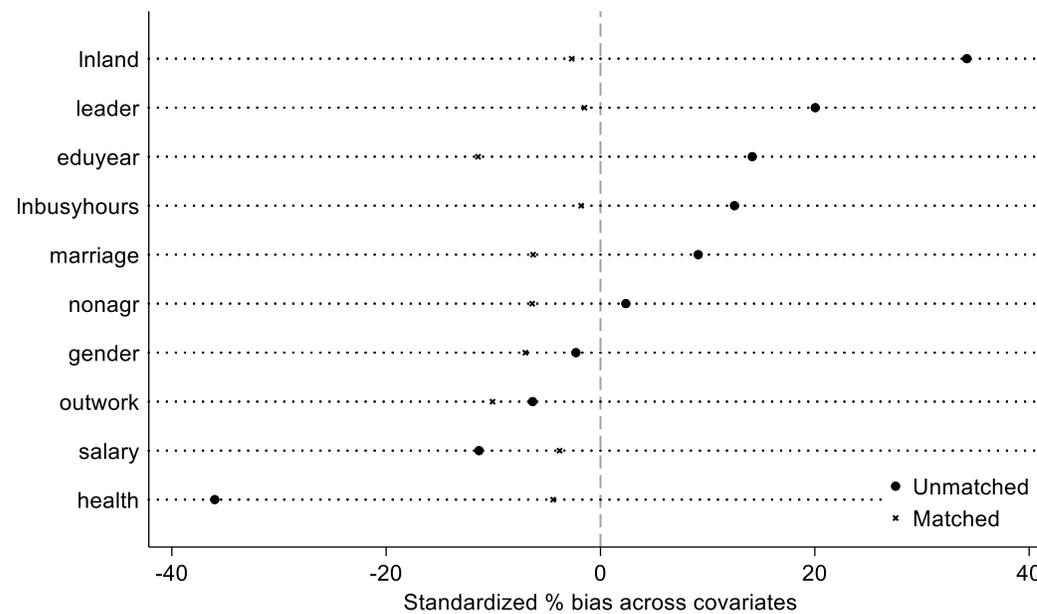


Figure 2 Standardized % bias across covariates

➔ PSM estimation

Table 4 PSM estimation

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Variable	<i>lnagrfixasset</i>		<i>lnnagrfixasset</i>		<i>lnliquidasset</i>	
Indep. Variable	<i>formalloan</i>	<i>informalloan</i>	<i>formalloan</i>	<i>informalloan</i>	<i>formalloan</i>	<i>informalloan</i>
1:1 nearest matching	0.3376*** (0.1228)	0.2230** (0.0960)	-0.1868 (0.2272)	0.4599*** (0.1623)	1.0098*** (0.2482)	0.0739 (0.3337)
1:4 nearest matching	0.3076*** (0.1046)	0.2459*** (0.0825)	-0.2408 (0.3162)	0.4950*** (0.1302)	0.4221 (0.2791)	0.1889 (0.2086)
Obs.	1,320	3,066	438	757	390	725

◆ The estimated results of PSM are the same by utilizing different matching methods.

➔ Further empirical estimation

- ◆ In the CHIP questionnaire, there is one question about employment status at current job, the answers can be given as: ①Employer, ②Employee, ③Self-employed, and ④Family worker. Rural entrepreneurial households are identified by the respondents who selected ① Employer and ③Self-employed. The following questions are further asked for these entrepreneurial households: (1) How much did you invest in this business when you started it (2) Among which, how much did you borrow? (3) Among which, how much did you borrow from a formal bank or credit cooperatives (4) Among which, how much did you borrow from private lending organizations or private lenders ?
- ◆ The variables for the above questions denoted by: *employmentstatus*, *employer*, *self-employment*, *totalinvestment* (total investment), *totalinvloan* (total loan for investment), *invforloan* (formal loan for investment) and *invinforloan* (informal loan for investment).

➔ Descriptive statistics (2)

Table 5 Basic statistics of the variables for rural entrepreneurial households

Variables	Obs.	Mean	Std. Dev.	Min	Max
<i>employment status</i>	16566	2.1257	0.4452	1	4
<i>employer</i>	492	1	0	1	1
<i>self-employment</i>	2097	3	0	3	3
<i>totalinvestment</i>	2213	52455.64	124473.5	0	2100000
<i>totalinvloan</i>	1619	24904.14	99297.03	0	2000000
<i>invforloan</i>	1378	13158.2	70191.11	0	1680000
<i>invinforloan</i>	1456	12855.98	47367.11	0	800000

➔ Further empirical estimation

Table 6 Estimation on total investment and total loan for rural entrepreneurial households

Variables	<i>lnagrfixasset</i>		<i>lnnagrfixasset</i>		<i>lnliquidasset</i>	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Intotalinvestment</i>	0.0854** (0.0423)		0.6232*** (0.047)		0.3507*** (0.0477)	
<i>Intotalinvloan</i>		0.0656 (0.1066)		0.5138*** (0.1328)		0.3616*** (0.1134)
Cons	7.6514*** (0.8542)	11.694*** (1.8218)	4.5877*** (0.9295)	8.5717*** (2.3436)	5.9642*** (0.9186)	7.8549*** (1.7234)
Controls	YES	YES	YES	YES	YES	YES
Observations	494	150	517	153	363	106
R-squared	0.1738	0.2073	0.319	0.2244	0.2064	0.2856

◆ The positive impacts of total investment on different productive assets are all statistically significant.

◆ The positive impacts of total loan for investment are statistically significant only for non-agricultural productive asset and productive liquid asset.

➔ Further empirical estimation

Table 7 Estimation on formal and informal loans for rural entrepreneurial households

Variables	<i>lnagrfixasset</i>		<i>lnnagrfixasset</i>		<i>lnoperationasset</i>	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>lninvforloan</i>	0.0742 (0.2068)		0.8005*** (0.2026)		0.5868*** (0.2163)	
<i>lninvinforloan</i>		0.0671 (0.1413)		0.3362* (0.1996)		0.4027** (0.1878)
Cons	13.0135*** (2.8422)	10.7821*** (2.7909)	4.1768 (3.0422)	10.4998** (3.9843)	7.0162** (2.8825)	8.3843*** (2.7481)
Controls	YES	YES	YES	YES	YES	YES
Observations	60	101	65	95	50	62
R-squared	0.3588	0.228	0.37	0.2337	0.3012	0.3631

- ◆ The positive impacts of formal and informal loans for investment are statistically significant only for non-agricultural productive asset and productive liquid asset.
- ◆ The impact on agricultural productive assets is not statistically significant, and the impacts of formal loans are greater than those of informal loans.

➔ Conclusions

- ◆ The impacts of both formal loans and informal loans on agricultural fixed productive assets are positive and statistically significant, while for non-agricultural fixed productive assets, only the impact of informal loans is positive and statistically significant, and for productive liquid assets, only the impact of formal loans is positive and statistically significant.
- ◆ For rural entrepreneurial households, the impacts of both formal and informal loans on non-agricultural fixed productive assets and productive liquid assets are positive and statistically significant; the positive impacts on agricultural fixed productive assets are not statistically significant.

➔ Policy recommendations

- ◆ To actively promote formal inclusive finance, expand lending channels, promote the increase of agricultural and non-agricultural productive assets for farmer households, and finally ensure the sustainability of rural development and farmers' income.
- ◆ To encourage farmers to access formal and informal loans to form fixed productive assets and productive liquid assets, make the benefits through using the lending funds be higher than the interest payment to ensure that farmers can obtain gradually increased asset accumulation and continuous productive income.
- ◆ To actively explore the collateral and credit guarantee ways for farmers' lending, such as considering the transaction orders of products and services between farmers and cooperatives and supermarkets as guarantee, taking guarantee as an opportunity to improve the use of lending funds and reduce the default risk of repayment of lending funds.

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Thank you!

Please contact Professor Yang Zou at yzou33@163.com for more information about this study