Determinants of Agricultural Investment: An Application to Rural China

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Background

China, a country developing at unprecedented levels, has experienced drastic changes throughout its recent economic history. Of primary interest is the continuing development and improvement of the rural agricultural sector. Estimates of rural households involved in agricultural production range from 65 to 70 percent (de Brauw & Rozelle, 2008; Rozelle, Taylor, & de Brauw, 1999). Improvements in agricultural production therefore have a direct impact on the livelihood of rural households in China. Of primary interest in this study are the factors influencing the smallholder farmers' agricultural investment strategies to improve agricultural yields.

Objectives

Households involved in agricultural production can primarily improve their yields through the use of agricultural improvements made available by ongoing agricultural research. Of utmost interest is the following question: **If the returns to agricultural technologies have had positive effects on agricultural yields, then what constrains households from applying them?** We are primarily interested in the following factors influencing the investment decision:

1. **Land tenure insecurity**
2. **Access to credit, from both formal and informal sources**
3. **Compulsory educational attainment**
4. **Migration of household members for work**

Model

Determinants of agricultural investment potential of agricultural households are estimated via a Heckman sample selection model due to the presence of sample selection bias. Sample selection bias is embedded in our study since households will face two decisions:

1. Whether to make agricultural investments
2. Proportion of income put toward agricultural investments

Given the two-stage decision process, factors that constrain the decision to invest may not constrain the intensity of investment. Use of the Heckman model thus offers more robust estimates of factors which act to hinder or promote agricultural investment potential. The model is structured as follows:

1. Decision to invest, given by:

$$E(e_i \mid X_i, Y_i > 0) = E(e_i \mid X_i, u_i > -X_i\beta)$$

where

$$E(Y_i \mid X_i) = X_i\beta + e_i$$

$$E(Y_i \mid X_i, Y_i > 0) = X_i\gamma + u_i > 0$$

$$u_i > -X_i\gamma$$

2. Investment intensity -- the proportion of income spent on agricultural investments -- conditional on investment occurring is then estimated through:

$$E(Y_i \mid X_i, Y_i > 0) = X_i\beta + E(e_i \mid u_i > -X_i\beta)$$

$$= X_i\beta + \frac{\sigma_{11}}{(\sigma_{22})^{1/2}}\lambda_i$$

where

$$\lambda_i = \frac{\phi(\omega_i)}{1-\Phi(\omega_i)}$$

is the Inverse Mills Ratio and $\omega_i = \frac{-X_i\gamma}{(\sigma_{22})^{1/2}}$

Data

Data in this analysis are cross-sectional, collected over a period of three years between 2006 and 2008 from rural villages within six provinces in China. This analysis is applied over Hunan, Yunnan, and Heilongjiang provinces to capture effects on the investment decision that may differ by region. Households surveyed over the three years total to 4,178, with a total of 3,718 used in this analysis. Of these households, 3,347 (90%) were registered under agricultural hukou, with 3,269 (87.9%) involved in agricultural production during the year of 2008.

Results

Table 1: Full Model Parameter Estimates

	All Provinces		Yunnan		Hunan		Heilongjiang	
	Likelihood	Intensity	Likelihood	Intensity	Likelihood	Intensity	Likelihood	Intensity
tot_land	-0.0268*	0.0305	-0.0541	0.0670	-0.0548	0.0265	-0.0258	0.0674*
	(-2.04)	(1.12)	(-1.32)	(0.59)	(-1.40)	(0.30)	(-1.49)	(2.00)
renter	0.152**	-0.0722	0.0855	0.0146	0.00714	-0.244	0.769***	-0.205*
	(3.11)	(-0.82)	(1.20)	(0.08)	(0.06)	(-1.26)	(10.10)	(-2.04)
owner	0.240***	-0.106	0.139**	-0.0564	0.207***	-0.0243	0.258***	-0.0720
	(8.93)	(-1.18)	(2.97)	(-0.29)	(3.49)	(-0.13)	(3.34)	(-0.68)
rent_own	0.137***	-0.0935	0.0683	-0.0599	0.183*	-0.0817	0.0666	0.0734
	(3.79)	(-1.18)	(1.14)	(-0.35)	(2.10)	(-0.43)	(0.62)	(0.68)
landlord_own	0.188***	-0.113	0.130*	-0.0553	0.119*	-0.0570	1.006***	-0.465***
	(5.92)	(-1.31)	(2.50)	(-0.27)	(2.09)	(-0.34)	(10.10)	(-4.19)
rent_land	0.0138	0.0463*	0.0333	0.0496	0.0323	0.0481	0.0342	0.0110
	(0.87)	(2.57)	(0.84)	(0.66)	(0.65)	(0.91)	(1.25)	(0.36)
own_land	0.0316	0.0294	0.109*	-0.0251	0.0544	0.0265	0.00141	0.0158
	(1.91)	(1.13)	(2.56)	(-0.21)	(1.26)	(0.32)	(0.04)	(0.46)
pct_informal	0.0590**	0.0697***	0.0119	0.00852	0.0519	0.0657*	0.0942**	0.116**
	(3.23)	(3.35)	(0.47)	(0.29)	(1.61)	(2.19)	(3.09)	(2.85)
savings	-0.00189	-0.00152	-0.00551	0.00371	0.00439	0.000676	-0.00467	-0.00716
	(-0.99)	(-0.71)	(-1.82)	(0.90)	(1.31)	(0.21)	(-1.32)	(-1.68)
grain	0.00756**	0.00145	0.00321	-0.00313	0.00866	-0.000824	0.00504	0.00551
	(2.67)	(0.49)	(0.83)	(-0.68)	(1.67)	(-0.16)	(0.93)	(1.03)
ag_inc	0.0850*	-0.115**	0.0128	-0.228**	0.123	0.0600	0.0830	-0.271***
	(2.29)	(-3.16)	(0.21)	(-3.21)	(1.69)	(0.96)	(1.38)	(-4.42)
ag_subs	-0.00701	0.00760	-0.00558	0.00791	0.00564	0.0248*	-0.00902	0.00118
	(-1.56)	(0.98)	(-0.61)	(0.60)	(0.84)	(2.35)	(-1.00)	(0.06)
ag_share	0.0419	0.267***	0.0122	0.273***	-0.0592	0.407***	0.0692	0.288***
	(1.44)	(9.96)	(0.37)	(7.57)	(-0.67)	(5.60)	(1.42)	(5.79)
wage_income	0.00143	-0.00902***	0.00109	-0.00417	0.00131	-0.00684	-0.00191	-0.0137**
	(0.65)	(-3.74)	(0.33)	(-1.11)	(0.34)	(-1.57)	(-0.52)	(-2.86)
other_income	-0.000495	-0.000413	0.00347	-0.00130	-0.00345	0.00331	-0.00193	0.00331
	(-0.23)	(-0.18)	(1.07)	(-0.35)	(-0.83)	(0.81)	(-0.54)	(0.71)
inc_subs	0.00623**	-0.00306	0.000818	-0.00347	0.00780*	-0.00888*	0.00858*	-0.00510
	(3.10)	(-0.93)	(0.23)	(-0.70)	(2.52)	(-2.01)	(2.08)	(-0.63)
prop_comp	-0.0572	-0.00780	-0.0622	-0.0262	-0.0751	-0.0627	0.0664	0.0527
	(-1.61)	(-0.20)	(-1.15)	(-0.39)	(-1.18)	(-0.93)	(1.05)	(0.72)
poor	0.0127	0.256***	-0.00856	0.243***	0.0279	0.148*	0.0323	0.251***
	(0.48)	(8.68)	(-0.26)	(6.33)	(0.48)	(2.25)	(0.71)	(3.66)
compulsory	0.00436	0.0114	0.0126	0.00205	0.0481	-0.0155	-0.0309	0.0827
	(0.19)	(0.45)	(0.39)	(0.05)	(1.23)	(-0.39)	(-0.71)	(1.58)
labor	0.0606*	0.0584	0.0699	0.00599	-0.100	0.0525	0.132***	0.00797
	(2.35)	(1.47)	(1.65)	(0.09)	(-1.81)	(0.66)	(3.47)	(0.12)
lab_ratio	0.00236	-0.126	0.0874	-0.246	-0.00750	-0.00997	-0.241	-0.0399
	(0.03)	(-1.60)	(0.86)	(-1.90)	(-0.07)	(-0.09)	(-1.42)	(-0.18)
mig	0.0191	0.0392	0.0648	0.0336	-0.00795	0.127**	-0.105	0.0375
	(0.72)	(1.39)	(1.60)	(0.78)	(-0.17)	(2.65)	(-1.96)	(0.55)
num_mig	0.0193	0.0328	0.0282	0.0317	-0.0236	0.0168	0.148	-0.0446
	(0.71)	(1.20)	(0.78)	(0.88)	(-0.55)	(0.38)	(1.88)	(-0.40)
remittance	-0.00417	-0.00978	-0.0125	-0.00642	0.00332	-0.0198*	-0.00741	0.00564
	(-0.77)	(-1.66)	(-1.66)	(-0.71)	(0.37)	(-2.13)	(-0.58)	(0.29)
Observations	1258	1258	452	452	372	372	434	434

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Key Findings

Land Tenure Insecurity

- Households with rented land accounting for at least 75% of total agricultural landholdings are less likely to make agricultural investments.
- Conditional on investing, there is no statistical difference in the intensity of investments for renters compared to other landholders.

Access to Credit

- The share of total borrowings from informal sources, including friends, family, and ROSCAs, is linked to statistically significant improvements in the likelihood and intensity of agricultural investments.

Education, Migration, and Labor Force Participation

- Labor force participation by the household head improves investment potential in some cases.
- Compulsory educational attainment has no statistical impact on investment potential.
- Migration and remittance income is not linked to consistent changes in investment potential.

Policy Implications

- Further development of rural land rental markets, including improvements to the terms of leases to improve land tenure security, can help improve investment outcomes on rented land.
- Evidence for informal credit suggests that improving access to informal credit, through the expansion of microcredit institutions and further development of ROSCAs, can help improve the investment potential across all types of landholdings.