

Transfer of Land Use Rights and Agricultural Productivity in China

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Introduction

- *Land Rights in China*
 - *Property Rights are collectively owned.*
 - *Farmers only have the use rights*
- *Equally distributed but fragmented Land Size*
 - *Politically, the last line for protecting smallholders from hunger*
 - *Economically, inefficient for production*
- *Transfer of use rights*
 - *Solution to legal conflicts in land rights*
 - *Urbanization*
 - *Weakly protect farmers*
 - *Changes in product efficiency*

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Questions

- Causalities between transfer of land use rights and product efficiency
 - Difference in product efficiency induce transfer of land use rights
 - Transfer of land use rights may change product efficiency
- Specific hypothesis:
 - Farmers with higher technical efficiency are more likely to rent in more land to enjoy the scale effect
 - More land will induce farmers to adopt advanced technologies, which in turn alters the technical efficiency.

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Theoretical Framework

Land Rent Function

$$L = b_0 + \delta E \quad (1.a)$$

where L and E respectively are rent-in land area and technical efficiency representing the productivity. We assume $0 < E \leq 1$, $b_0 < 0$, and $\delta > 0$.

Product Efficiency Function

$$E = \rho_0 + \rho_1 L + \rho_2 L^2 \quad (1.b)$$

a relatively small size of rent-in land can have scale effect and incentivize farmers to work harder and improve technical efficiency; and a large size land may rapidly increase the costs of management and supervision beyond the farmers' ability which makes farms less efficient. That is, $\rho_2 < 0$.

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Equilibria

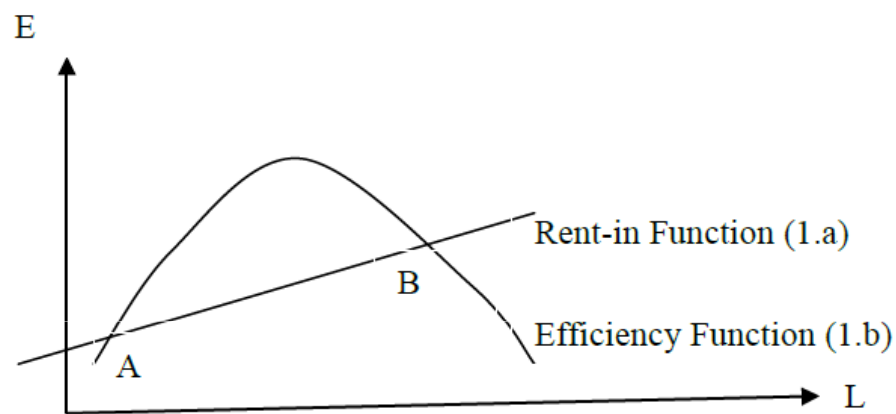


Figure 1 Equilibrium of Rent-in Activity and Technical Efficiency

Equilibrium

$$E' = \frac{-(\rho_1\delta + 2\rho_2b_0\delta - 1) - \sqrt{(\rho_1\delta + 2\rho_2b_0\delta - 1)^2 - 4\rho_2\delta^2(\rho_0 + \rho_1b_0 + \rho_2b_0^2)}}{2\rho_2\delta^2} \quad (2.a)$$

$$L' = b_0 + \frac{-(\rho_1\delta + 2\rho_2b_0\delta - 1) - \sqrt{(\rho_1\delta + 2\rho_2b_0\delta - 1)^2 - 4\rho_2\delta^2(\rho_0 + \rho_1b_0 + \rho_2b_0^2)}}{2\rho_2\delta} \quad (2.b)$$

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Econometric Models

1. Modeling Production

- Panel Stochastically Frontier Model (Battese and Coelli 1992)

$$y_{it} = X_{it}\beta + \lambda t + \alpha_i + v_{it} - u_{it} \quad (3)$$

$$u_{it} = \exp\{-\eta(t - T_i)\}u_i \quad (4)$$

Then, technical efficiency

$$E_{it} = \exp(-u_{it})$$

2. Modeling Rent-in Behavior

- Tobit Model with Endogeneity

$$L_{it}^* = \delta E_{it} + Z_{it}b + \varepsilon_{it} \quad (5.a)$$

$$L_{it} = \begin{cases} L_{it}^* & \text{if } L_{it}^* > 0; \\ 0 & \text{if } L_{it}^* \leq 0. \end{cases}$$

3. Modeling Technical Efficiency

- Instrumental Fixed-Effects Model

$$E_{it} = \rho_1 L_{it} + \rho_2 L_{it}^2 + \tilde{Z}_{it} \tilde{b} + \tilde{\alpha}_i + \tilde{\varepsilon}_{it} \quad (5.b)$$

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Description of data

RCRE data from 10 villages in Zhejiang province



Description of data

- Sample:
 - panel data
 - yearly data from 1995-2002
 - approx. 50 households per village; 10 villages
- Contents:
 - land rental activities
 - other household + farm characteristics
 - also village characteristics from community survey

Changes in Land Lease Activities

Table 1 Changes in Incidents of Land Rental Activities in Zhejiang Province

	1995	1996	1997	1998	1999	2000	2001	2002	Overall
No. of Observed Farms (A)	347	337	325	232	311	286	246	236	2320
No. of Rent-In Farms (B)	51	67	58	46	55	64	57	64	462
Rent-In Rate (B/A)	0.147	0.199	0.178	0.198	0.177	0.224	0.232	0.271	0.199
Average Rent-in Size (mu)	1.280	1.334	1.453	2.062	2.498	2.109	1.809	2.609	1.901
Land Per Farm (mu)	2.912	2.732	2.731	2.775	2.843	2.749	2.548	2.550	2.741

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Results (1)

Table 2. Estimation Results of the Production Function

	Fixed-Effects Model						Fixed-Effects Stochastic Frontier Model					
	Full Sample		Non-Lease		Lease		Full Sample		Non-Lease		Lease	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t
Ln (Land)	0.3550	1.80*	0.1193	0.55	0.8433	1.29	0.7946	4.68***	0.6036	3.30***	1.6039	3.47***
Ln(Labor)	0.2255	1.07	0.0543	0.23	0.1582	0.20	-0.1779	-1.04	-0.2515	-1.36	-0.8019	-1.75*
Ln(Capital)	0.0698	0.58	0.0876	0.65	0.1058	0.27	0.0412	0.51	0.0443	0.50	0.2046	0.95
Ln (Intermediate)	-0.4014	-1.98**	-0.2474	-1.11	-1.2471	-1.83*	-0.5229	-2.96***	-0.3944	-2.07**	-1.3294	-2.59***
Ln (Land) ²	-0.0084	-0.45	-0.0387	-1.83*	0.1296	2.00**	0.0280	1.69*	-0.0007	-0.04	0.2172	5.66***
Ln(Labor) ²	-0.0228	-0.95	-0.0003	-0.01	0.0207	0.24	0.0387	1.88*	0.0400	1.83*	0.1779	3.35***
Ln(Capital) ²	-0.0024	-0.38	-0.0037	-0.55	0.0187	0.87	0.0053	1.33	0.0047	1.11	0.0094	0.86
Ln (Intermediate) ²	0.0705	3.22***	0.0524	2.11**	0.2109	3.18***	0.0885	4.67***	0.0742	3.58***	0.1817	4.04***
Ln (Land)*Ln(Labor)	0.0116	0.32	-0.0221	-0.55	0.1426	1.12	-0.0830	-2.70***	-0.0888	-2.71***	-0.0899	-1.22
Ln (Land)*Ln(Capital)	0.0200	1.35	0.0240	1.44	0.0264	0.55	0.0306	2.46**	0.0294	2.16**	0.0116	0.43
Ln (Land)*Ln (Intermediate)	-0.0632	-1.90*	-0.0001	0.00	-0.2854	-3.09***	-0.0891	-3.03***	-0.0460	-1.43	-0.2642	-4.14***
Ln(Labor)*Ln(Capital)	0.0183	1.20	0.0199	1.17	-0.0192	-0.38	0.0030	0.26	0.0073	0.58	-0.0477	-1.67*
Ln(Labor)*Ln (Intermediate)	0.0233	0.59	0.0274	0.62	-0.0331	-0.28	0.0346	1.02	0.0427	1.16	-0.0095	-0.12
Ln(Capital)*Ln (Intermediate)	-0.0214	-1.38	-0.0225	-1.30	-0.0661	-1.34	-0.0318	-2.46***	-0.0340	-2.42**	-0.0268	-0.92
Time Trend	-0.0427	-7.81***	-0.0474	-7.21***	-0.0193	-1.42	-0.0121	-1.35	-0.0263	-2.89***	0.0084	0.78
Intercept	6.4440	7.27***	6.3556	6.43***	9.1014	2.97***	8.1267	11.57***	7.9365	10.57***	10.3193	5.23***
							0.0497	[0.0086]	0.0493	[0.0095]	41.1793	[63.0194]
							0.2351	[0.0076]	0.2359	[0.0087]	0.1415	[0.0108]
							0.1745	[0.0262]	0.1729	[0.0293]	0.9966	[0.0052]
Sample Size	2320		1858		462		2320		1858		462	
LR-Test	Chi 2(16) = 433.09***						LR chi2(12) = 147.43***					

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Table 3. Input Elasticities

	Non-Lease Farmers (A)		Lease Farmers (B)		Mean Difference	
	Mean	S.E.	Mean	S.E.	A-B	P-value
Land	0.179	0.003	0.258	0.011	-0.079	Pr(A > B) = 0.000***
Labor	0.298	0.002	0.277	0.011	0.021	Pr(A < B) = 0.028**
Capital	-0.020	0.001	-0.019	0.002	-0.001	Pr(A > B) = 0.597
Intermediate Inputs	0.363	0.003	0.339	0.010	0.024	Pr(A < B) = 0.015**
No. of observations	1931		474			

Note: *, ** and *** denote the 10%, 5% and 1% levels of significance, respectively.

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Results (2): Estimated Technical Efficiency

Table 4. Technical and Scale Efficiencies over the Observed Period

		1995	1996	1997	1998	1999	2000	2001	2002	Overall	t test for mean difference
Efficiency	No Lease (A)	0.538	0.535	0.526	0.515	0.513	0.503	0.503	0.489	0.518	P(A>B)=0.000***
	Lease (B)	0.877	0.869	0.870	0.808	0.826	0.807	0.800	0.779	0.829	
	Overall	0.588	0.601	0.587	0.573	0.568	0.571	0.572	0.567	0.580	
Scale	No Lease (C)	0.811	0.819	0.816	0.826	0.822	0.806	0.830	0.841	0.820	P(C>D)=0.000***
	Lease (D)	0.822	0.859	0.888	0.872	0.878	0.816	0.821	0.875	0.854	
	Overall	0.813	0.827	0.829	0.835	0.832	0.808	0.828	0.850	0.827	

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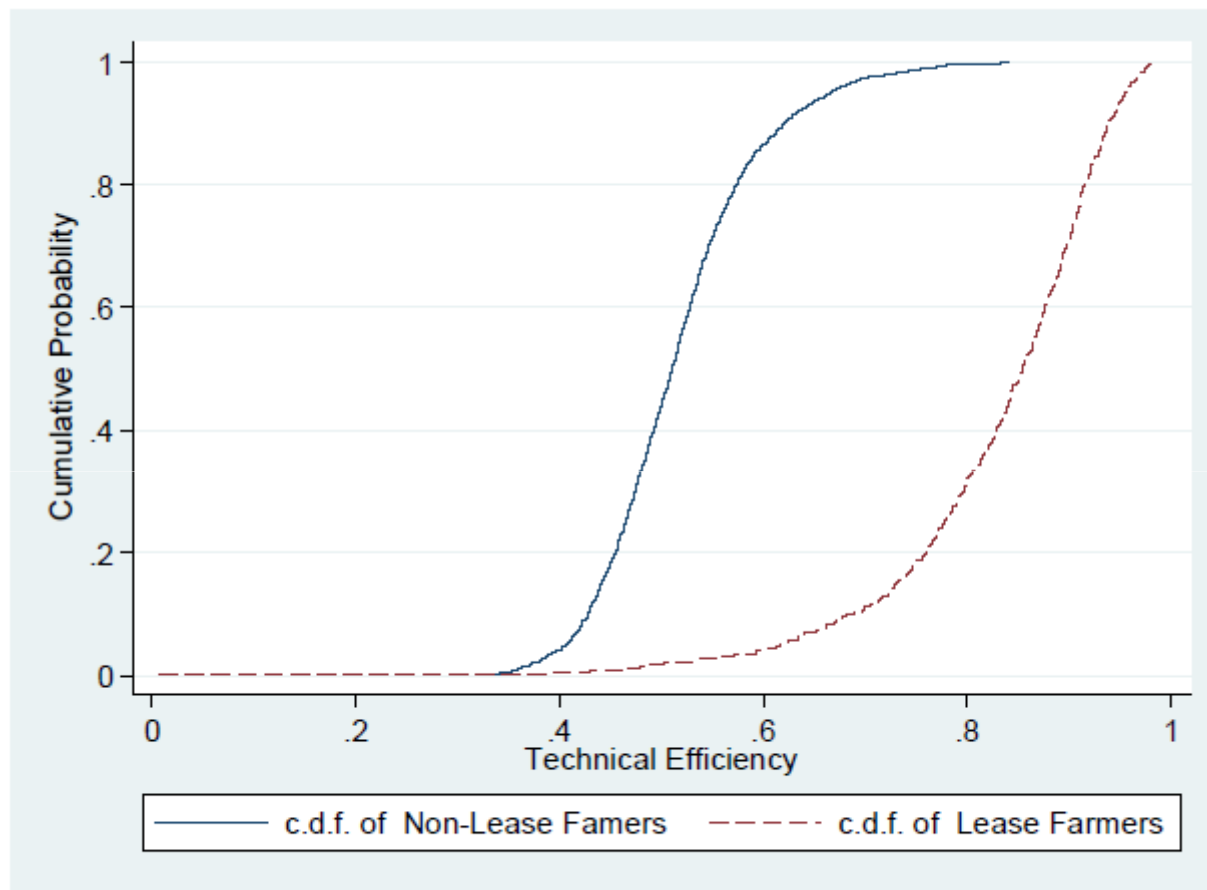


Figure 2. Cumulative Distribution of Technical Efficiency

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Results (3): Land Lease Function

Table 5. Land Lease Function

Lease Area	IV Tobit Model		Tobit Model	
	Coef.	Z	Coef.	Z
Efficiency	15.470	4.44***	23.201	23.00***
Household Labor Share	-0.596	-0.96	-0.648	-1.06
Household Head Education	-0.627	-3.02***	-0.621	-3.05***
Household Head Age	0.001	0.12	-0.001	-0.10
Ln(Capital)	0.435	4.47***	0.389	4.18***
Share of Machinery in Capital	0.572	0.97	0.841	1.49
Off-Farm Wage	0.019	1.54	0.026	2.30**
Village Rent per mu	0.000	-1.47	0.000	-1.28
Own Land Size	-0.372	-3.31***	-0.304	-2.88***
Household Size	0.342	2.82***	0.320	2.70***
Ln(Levies)	0.302	2.47**	0.363	3.14***
Land Size per Parcel	0.442	1.49	0.555	2.02**
Average Household Education	0.352	0.53	0.395	0.60
Time trend	0.401	4.05***	0.432	4.51***
Intercept	-20.563	-7.79***	-25.605	-17.05***
Test of Exogeneity for Efficiency	chi2(1) = 5.19**			
Log Likelihood	-257.683		-1314.372	

Note: The cluster technical efficiency is used as an instrument for technical efficiency.
 *, ** and *** denote the 10%, 5% and 1% levels of significance, respectively.

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Results (3): Technical Efficiency Function

Table 6. Technique Efficiency Function

	Pooled Regression				Fixed-Effects Regression					
	IV Regression		OLS		IV Regression		OLS		IV Regression	
	Coef.	T	Coef.	T	Coef.	Z	Coef.	t	Coef.	t
Lease Area	0.064	7.28***	0.108	35.86***	0.039	4.20***	0.090	32.06***	0.003	0.30
(Lease Area) ²	-0.001	-5.68***	-0.002	-27.26***	-0.001	-3.82***	-0.002	-25.84***		
Land Size per Parcel	-0.022	-4.37***	-0.023	-4.76***	0.006	0.93	-0.008	-1.57	0.014	1.82*
Average Household Education	0.001	0.10	0.006	0.46	0.020	1.07	0.016	0.98	0.021	1.02
Household Head Education	0.003	0.62	0.003	0.69	0.006	0.72	0.013	1.84*	0.003	0.32
Household Head Age	0.000	1.27	0.000	1.30	0.000	-0.11	0.000	0.63	0.000	-0.34
Ln(Capital)	-0.002	-0.79	-0.003	-1.91*	0.002	0.70	0.000	-0.15	0.004	1.26
Share of Machinery in Capital	-0.048	-4.14***	-0.050	-4.66***	-0.003	-0.13	-0.046	-2.54**	0.016	0.65
Share of Grain Area in Land	0.017	1.26	0.032	2.64***	0.023	1.84*	0.025	2.18**	0.027	1.89*
Household Size	-0.002	-0.76	-0.003	-1.13	0.001	0.19	-0.003	-0.88	0.003	0.73
Village Rent Per mu	0.000	-0.17	0.000	0.31						
Own Land Size	-0.001	-0.76	0.001	0.66	-0.003	-1.84*	0.001	1.26	-0.005	-2.60***
Time Trend	-0.009	-4.31***	-0.010	-5.26***	-0.010	-6.54***	-0.012	-8.61***	-0.009	-5.22***
Intercept	0.624	29.24***	0.616	31.34***	0.557	16.61***	0.571	19.14***	0.538	13.72***
F-tests for Fixed-Effects					F(380,1797) = 6.15 ***		F(384, 1868) = 7.32 ***		F(380,1798) = 6.40 ***	
Hausman Tests for Exogeneity		chi2(12) = 49.96**				chi2(12) = 58.02***				

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Equilibrium

Table 7. Equilibrium of the size of the Leased Land Area and Technical Efficiency

	Full Lease Samples		2002 Lease Sample	
	Present value	Equilibrium	Present value	Equilibrium
Technical Efficiency	0.829	0.846	0.779	0.835
Leased Land Area (mu)	1.901	2.165	2.609	3.477

Note: Equilibria are computed based on Equations 6.a and 6.b.

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Conclusions

- Rent-in activity has been increasing
- Rent-in behavior and technical efficiency are endogenous
- Empirical Results match our theoretical results.
- Rent-in efficiency is higher than no rent-in.
- Both Rent-in behavior and efficiency can increase to the long-run equilibrium
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Thanks for your attention!

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