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Tradeoff between Farm Profitability and the Desire for Market Work: An Empirical Analysis of Chinese Farm Households

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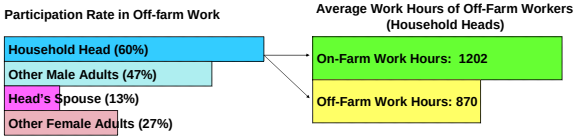
Introduction

● Income growth of Chinese farm households is slow partly because their reallocation between on-farm and off-farm work hours is slow.

Evidence from Chinese Household Income Project survey (Li, 2002))



● How can we explain such slow labor reallocation?

Standard way: Full reduced form (Tobit) regression of off-farm hours on relevant factors including variables related to farm production.

Alternative way: Simultaneous equations of the desire M^* for off-farm work and farm profitability R (Goodwin and Mishra, 2004)

Highlight of the model: Tradeoff between M^* and R

Higher M^* ⇒ Lower attention to farm production ⇒ **Lower R**

Higher R ⇒ Lower incentive for off-farm work ⇒ **Lower M^***

Advantage of "alternative way" in labor supply analysis of farmers in developing countries

- Advantage in modeling: Farmers in developing countries depend strongly on farm incomes. Therefore, related production variables should be determined jointly with off-farm labor supply. Farm profitability seems the most suitable variable which can be compared with the desire for off-farm work in the context of labor reallocation.
- Advantage in interpretations (policy implications of the tradeoff):
  - **(a)** Farmers will refrain from working off farm if their farm profitability is raised by, e.g., supported output prices.
    ⇒ Policies raising farm profitability might slow labor reallocation from agricultural to non-agricultural sectors and therefore slow economic development.
  - **(b)** Farm income might be reduced if farmers without off-farm jobs start searching for a job but cannot find one.
    ⇒ Policies increasing off-farm jobs are needed to promote migration to non-agricultural sector and to increase poor farmers' income.

● Objectives of this study

This study proposes theoretical and empirical methods to examine tradeoff between farm profitability R and the desire M^* for market (off-farm) work, both of which were not adequately addressed by Goodwin and Mishra (2004). Specifically,

- **Theoretical analysis**: Derive necessary conditions for the tradeoff using a simple agricultural household model
- **Empirical analysis:**

a) Derive simultaneous equations of R and M^* which differ from the model of Goodwin and Mishra.

b) Propose how to estimate these equations and check whether the tradeoff arises or not for Chinese farmers.

c) Examine advantage of the present model over the "globally (non-)separable model" of Goodwin and Mishra.

It also shows a strikingly negative effect of farm profitability on market labor supply for Chinese farmers.

Theoretical Analysis

● A simple agricultural household model

A farm household is assumed to maximize its utility function $u(C, t; s)$ (C: total household consumption, t: the head's leisure hours, s: household characteristics) subject to the following constraints.
(Time of other members than the head is assumed heterogeneous and fixed for simplicity.)

Budget constraint: $C = pX - qF + wM + V$
(C: Total household consumption; pX: Revenue from farming; qF: Costs of other variable inputs than labor; wM: Wage income; V: Nonlabor income)

Time constraint of the head: $T = L + M + t$
(T: Endowed time; L: Farm work hours; M: Market work hours; t: Leisure hours)

Farm production function: $X = f(L, F; K)$
(X: Farm output; L: Farm work hours; F: Other variable inputs; K: Fixed inputs)

Three types of exogenous variables

Production-side variables $\boldsymbol{K}$ include
- K: Fixed inputs
- p: price of output
- q: price of other variable inputs

Consumption-side variables $\boldsymbol{S}$ include
- s: Household characteristics
- T: Endowed time of the head
- V: Nonlabor income

$\boldsymbol{w}$: Effective wage rate

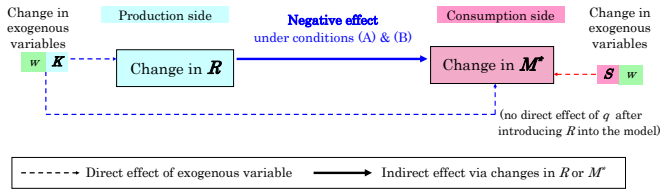
● Definition of major variables and results of the theoretical analysis

Desire for market work: $M^* \equiv \gamma(w - w_0^*)$, w_0^*: Reservation wage rate of the head ($\gamma > 0$)

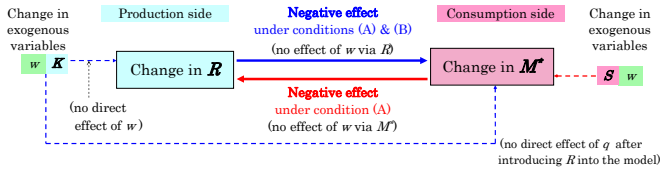
⇒ Market work hours: $M = M^*$ if $M^* > 0$, $M = 0$ if $M^* \le 0$

Farm profitability: $R = pX / qF$ = (Production revenue) / (Costs of other variable inputs)

Result 1: No tradeoff arises when $M > 0$ (one way effect from R to M^*)



Result 2: Tradeoff arises when $M = 0$ (interactions between R to M^*)



Condition (A): The household increases its supply of output less than its demand for other variable inputs when the household head's reservation wage rate falls.

Condition (B): 1) Leisure is a normal good. 2) Substitution between L and F is inelastic. 3) $\partial^2 X / \partial L \partial F > 0$. 4) $\partial \ln F / \partial \ln p < 1$ if R is greater than 1 and large enough.

Empirical Analysis

● Simultaneous equations of farm profitability and the desire for market work

Equation of farm profitability

$$\ln R = \alpha_0 + \alpha_1 w + \alpha_2 \boldsymbol{K} + u_1 \quad \text{for } M > 0 \quad (1)$$

$$= \beta_0 + \beta_1 \{M^* - E(M^* \mid w)\} + \beta_2 \boldsymbol{K} + u_0 \quad \text{for } M = 0 \quad (2)$$

Equation of the desire for market work

$$M^* = \delta_0 + \delta_1 \ln R + \delta_2 w + \delta_3 \tilde{\boldsymbol{K}} + \delta_4 \boldsymbol{S} + v \quad \text{for } M > 0 \ \& \ M = 0 \quad (3)$$

($\tilde{\boldsymbol{K}}$ excludes q from $\boldsymbol{K}$. $E(M^* \mid w)$ denotes portion of M^* explained by wage rate w. u_1, u_0, v are error terms.)

Feature of the empirical model: Switching equations of farm profitability

Equation (1) for $M > 0$ does not include M^*, whereas equation (2) for $M = 0$ does.

⇒ They show "local separability" of agricultural household model (Carter and Yao, 2002).

[i.e., separability of the model depends on the household's decision.]

● Estimation procedures

(Step 1) Run a Probit regression of a reduced form of M^* and compute sample correction terms for $M > 0$ and $M = 0$.

(Step 2) Run OLS regressions of reduced forms of $\ln R$ separately for $M > 0$ and $M = 0$ to compute fitted values of $\ln R$.

(Step 3) Use the fitted values of $\ln R$ to run a Tobit regression of eq. (3) and compute fitted values of $M^* - E(M^* \mid w)$.

(Step 4) Use the fitted values of $M^* - E(M^* \mid w)$ to run an OLS regression of eq. (2) after adding the correction term.

● Data

Main data source:
Chinese Household Income Project in 2002 (Li, 2002)
Sample size:
6566 households with married male heads
Regions:
22 provinces are covered and are classified into the Western, Central, and Eastern regions.

Mean of some variables in the sample	West	Center	East
Number of observations	2033	2513	2020
Income per capita (yuan = 0.16 US dollars)	1564	2198	3553
Participation rate of the head in market work (%)	52	56	60
Wage work hours of market workers (hours)	1003	1134	1515
Farm profitability R	2.87	3.98	3.89
Cultivated land areas (mu = 1/15 ha)	7.47	8.50	6.14

● Main empirical results

		West		Center		East	
Effect of M^* on $\ln R$	$M > 0$	0.000		0.000		0.000	
	$M = 0$	-0.029	(2.4)	-0.003	(0.3)	0.004	(0.4)
Effect of $\ln R$ on M^*		-34.83	(3.1)	-8.37	(0.6)	-25.04	(1.4)

Absolute values of the t statistic are shown in parentheses. Market work hours are divided by 100 in the estimation.

1) Tradeoff between R and M^* in the Western region

- Higher M^* (i.e., lower "perceived cost of labor" w_0^*)
  - ⇒ Smaller increase in the supply X of output than increase in the demand F for variable inputs because of the head's lower attention to farm production while he searches for off-farm jobs.
  - ⇒ Lower R (additionally because of stronger dependence on livestock production in the Western region)
- Higher R
  - ⇒ Strong response of the reservation wage rate w_0^* because of strong dependence on farm production
  - ⇒ Lower M^* (lower incentive for market work)

2) No tradeoff between R and M^* in the Eastern and Central region

- Household heads can find off-farm jobs more easily, which can reduce loss in attention to farm production.
- Less dependence on farm production weakens response of the reservation wage rate to a rise in farm profitability.

3) Strikingly negative effect of R on M^* in the Western region

- For market workers, 10% increase in farm profitability reduces 348 hours of market work.
  - ⇒ A moderate rise in R can seriously slow labor reallocation from agricultural to non-agricultural sectors.

● Comparison of the model with "globally (non-)separable model"

If we call the model given by eqs. (1) – (3) "locally separable (LS)", we can call the model of Goodwin and Mishra "globally (non-)separable (GS)". The estimation results of the GS model listed below show that it is separable for all the three regions and that R has a positive effect on M^* in the Eastern region, which is not easy to interpret.

GS model of Goodwin and Mishra

$$\ln R = \beta_0 + \beta_1 M^* + \beta_2 w + \beta_3 \boldsymbol{K} + u \quad \text{for } M > 0 \ \& \ M = 0$$

$$M^* = \delta_0 + \delta_1 \ln R + \delta_2 w + \delta_3 \tilde{\boldsymbol{K}} + \delta_4 \boldsymbol{S} + v \quad \text{for } M > 0 \ \& \ M = 0$$

	West		Center		East	
Effect of M^* on $\ln R$	-0.010	(1.3)	-0.011	(1.8)	0.003	(0.6)
Effect of $\ln R$ on M^*	5.15	(0.6)	-4.50	(0.4)	18.18	(2.4)

Absolute values of the t statistic are shown in parentheses. Market work hours are divided by 100 in the estimation.

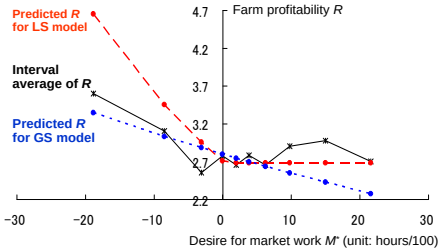
We can show an advantage of the LS model over the GS model by graphically comparing effects of M^* on R for the Western region. The figure below shows the LS model can trace the switching patterns of the "interval average" of farm profitability (see below for its definition), whereas the GS model cannot.

Using fitted values of M^*, we compute deciles $M^*(i)$ (i = 1, …,10) and the corresponding 10 internals of M^*.

For each interval, we compute

Interval average of R:
Average of actual farm profitability for the ith interval of M^*

Predicted R for LS (GS) model:
Fitted value of farm profitability computed by setting M^* at $M^*(i)$ and other exogenous variables at their means.



Conclusions

- In the simple agricultural household model, tradeoff between farm profitability and the desire for market work can arise only for households without a market worker. A key condition for the tradeoff requires that the household increase its supply of output less than its demand for other variable inputs when the head's reservation wage rate falls.
- Estimation equations of farm profitability have a switching structure depending on the head's participation in market work and exhibits "local separability", which differs from the "globally (non-)separable model" of Goodwin and Mishra.
- The tradeoff is actually found for the Western region of China in 2002, although it is not found for the other regions.
- The negative effect of farm profitability on off-farm labor supply is striking in the Western region, suggesting that agricultural domestic support policies in recent years (abolition of the agricultural tax, increased direct subsidies to grain production and purchased inputs, etc.) might explain the puzzle addressed by some researchers: coexistence of migrant labor shortage and rural labor surplus.
- The estimated model can trace changing effects of the desire for market work on farm profitability. The negative effect for households without a market worker, which is found in the Western region, arises probably because they lose their attention in farm production while their heads are searching for off-farm jobs. Such loss in attention might threaten stable domestic supply of food as China attains further economic development.

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