University of Nevada, Reno
Statewide • Worldwide

UNR Joint Economics Working Paper Series
Working Paper No. 08-006

Industrial Upgrade, Employment Shock and Land Centralization in China

Shunfeng Song, Chengsi Wang and Jianghuai Zheng

Department of Economics /030
University of Nevada, Reno
Reno, NV 89557-0207
(775) 784-6850│ Fax (775) 784-4728
email: song@unr.nevada.edu

September, 2008

Abstract

This paper investigates the relationships among industrial upgrading, mid-aged peasants' non-farm employment, and land conversion systems. We prove that China's efforts to upgrade its industries generate a negative employment shock on mid-aged peasant workers, forcing some of them to return to their home villages. The current lump-sum land acquisition system, however, will neither help peasant workers deal with the adverse employment shock nor promote land centralization for industrial and urban uses. On contrary, land cooperation, an emerging land centralization system, will help peasant workers mitigate the adverse employment shock and centralize rural land for nonagricultural purposes.

JEL Classification: Q15, J43

Keywords: Peasant workers; Industrial upgrade; Employment; Land centralization

Industrial Upgrade, Employment Shock

and Land Centralization in China

Shunfeng Song
Department of Economics
University of Nevada
Reno, NV 89557-0207
USA
E-mail: song@unr.edu
Tel: (775) 784-6860
Fax: (775) 784-4728

Chengsi Wang
Department of Economics
Australia School of Business
University of New South Wales
Sydney NSW 2052
Australia
E-mail: chengsi.wang@student.unsw.edu.au
Tel: 0403658092
Fax: (+612) 9313 6337

Jianghuai Zheng
Department of Economics
Nanjing University
Nanjing, Jiangsu 210093
P. R. China
E-mail: zhengjh@nju.edu.cn
Tel: (+86) 13337811016
Fax: (+86) 25-83595262

Industrial Upgrade, Employment Shock and Land Centralization in China

This paper investigates the relationships among industrial upgrading, mid-aged peasants' non-farm employment, and land conversion systems. We prove that China's efforts to upgrade its industries generate a negative employment shock on mid-aged peasant workers, forcing some of them to return to their home villages. The current lump-sum land acquisition system, however, will neither help peasant workers deal with the adverse employment shock nor promote land centralization for industrial and urban uses. On contrary, land cooperation, an emerging land centralization system, will help peasant workers mitigate the adverse employment shock and centralize rural land for nonagricultural purposes.

JEL classification: Q15; J43

Keywords: Peasant workers; industrial upgrade; employment; land centralization

1. Introduction

Traditional development economics considers the transfer of rural labor into the industrial sector the only way to balance the economic development in urban and rural areas. Chang (1949) mentioned that rural labor will not always stand in a static state on farms but part of it will transfer into factories to engage in industrial production. Lewis (1954) established a dual-sector model and argued that the transfer of rural surplus labor from traditional sectors into modern industries is imperative. Later, Harris and Todaro (1970) changed the term of the industrial sector into urban sector by assuming the former mainly exists in the cities. Since then, the dual-sector model has become a classical approach used in economic development research.

A closer look of coastal China, however, shows a more complex picture that the one predicted by a simple transfer of rural labor into the urban sector. In recent years, facing international competition, China makes great efforts to upgrade its industries, and such efforts generate an adverse employment shock on peasant workers because industrial upgrading leads to a higher demand for skilled workers but a lower demand for unskilled workers. Peasant workers, especially those mid-aged workers, often find themselves lack of adequate skills to keep or find jobs in the industrial sector. Many of them have to flow back to their villages and become farmers again. Worse than this, some returned peasant workers found little land left in their home villages due to the vast amount of land converted for urbanization and industrial uses (Zheng et al., 2007). For these land-lost peasants, survival becomes a challenge.

A new land conversion system, called land cooperation, seems to help peasant workers better deal with the adverse employment shock caused by China's industrial upgrading. Under the conventional land conversion system, local governments get land from peasants with one-time lump-sum compensations, which are often significantly lower than the fair market values. Once land is transferred to local governments, peasants lose both their land ownership and use rights. Under the new system, i.e., the land cooperation system, peasants in the same village pool land together, invest land cooperatively into industrial and urban uses, and share returns jointly. Such land cooperation could mitigate the negative impact of employment shock because it not only allows peasants to keep their land ownership but also generates income flows for them. At the same time, the system could help local government centralize land due to better investment returns on land for urban and industrial uses.

A number of studies have examined why farmers migrate into cities and become industrial workers (e.g., Zhao, 1999; Zhang and Song, 2003; Lu and Song, 2006). They concluded that pushing factors include loss of land and high burden of taxes and fees in the countryside and pulling factors include higher income, better opportunities, better quality of life, and better education in cities. Much less research has been done about the backflow of rural migrants. Hare (1999) and Zhao (2002) are the exceptions. Hare (1999) believed that the urban admittance system and immature factor market are two key factors of labor backflow in China. Zhao (2002) examined causes and consequences of return migration. Using the 1999 data of rural families from six provinces in China, she concluded that the factors influencing migration decisions include the unstable condition of land ownership, urban admittance system, spouse leaving to work in other big cities, the proportion of adult labor in a family, and the development of none-agriculture sections in rural areas. We do not see any theoretical analysis on the relationship between backflow of peasant workers, the recent promotion of industrial upgrade, and rural land conversion systems.

This paper attempts to fill the above gap. Inspired by a recent case study in Suzhou, China, about challenges faced by peasant workers in the era of industrial upgrading, done by Zheng et al. (2007), we develop a theoretical model to investigate how industrial upgrading generates adverse employment shocks on mid-aged blue-collar workers and make them return to the countryside. We also show that one-time compensation of land conversion is inferior because of the low compensation and the risk of backflow caused by adverse employment shocks. Consequently, such land compensation system would slow down the pace of land conversion and hinder industrial upgrading in China. One possible solution, as theoretically proved in this paper, is to have a land cooperation system in rural areas. Under this system, local governments do not acquire land from farmers with low compensations. Instead, farmers keep their land ownership by investing land into urban-sector uses. Through such land investment, rural land is centralized for industrial purposes; it also generates incomes for rural laborers, helping them face employment shocks brought by industrial upgrading.

Next section elaborates how industrial upgrading causes adverse employment shocks on mid-aged peasant workers. The third section will first discuss the influence of adverse shock on mid-aged peasant workers under the one-time lump-sum compensation system and then examine how a land cooperation system could reduce the impact of adverse shock and help land centralization for industrial uses. The last section concludes.

2. Industrial Upgrading and Adverse Employment Shock on Peasant Workers

In recent year, in order to raise its international competitiveness, China has made great efforts to promote industrial upgrading, either through government direct investment or by providing enterprises with subsidies and tax breaks. Many development zones have switched their emphases from low-value-added processing and assembling activities to high-value-added and more sustainable industries. No doubt, these changes will cause not only sectorial shifts but employment shocks on workers as well, especially on low-skilled peasant workers.

This study theoretically investigates how the promotion of industrial upgrading affects a firm's hiring decisions. For this purpose, we classify workers into two general groups, blue-collar and white-collar workers. For the former, we further divide them into young workers of ages 40 or below and mid-aged workers of ages above 40. Because the legal retirement ages for blue-collar workers in China are 50 for female workers and 55 for male workers, we do not include workers older than 55. Throughout this paper, we will use a firm-level employment model, which assumes (a) the difference in age determines the difference in physical labor supplied and (b) the industrial upgrading within a company is driven by endogenous reasons such as profit maximization and exogenous reasons including government subsidies and tax breaks.

Specifically, we assume that a company uses three inputs in production, namely blue-collar-labor input as $n_1 l$, white-collar-worker input as $n_2 t$, and capital input as K, with n_1 representing the number of blue-collar workers hired , l the amount of labor provided per blue-collar worker , n_2 the number of white-collar workers hired , t the amount of labor input provided per white-collar worker, and $\bar{K}$ the fixed amount of capital. For simplicity, blue-collar workers are all from rural areas, due to migrants' lack of education and job-training. We further assume that l is a function of worker's age, *b*, with l_1 for young workers (40-year-old or younger) and l_2 for mid-aged workers (above 40-year-old). Because young workers offer more physical labor input than mid-aged workers, we have $l_1 > l_2$. Therefore, the firm's production function becomes $f(n_1 l(b), n_2 t, \bar{K})$, which satisfies $f_1, f_2 \geq 0,. f_{11}, \quad f_{22} \leq 0, f_{12} \geq 0$.

We also assume that product price, *P*, depends on a, the value-added of production, with $P^{'}(*) \geq 0, P^{''}(*) \leq 0$. In this paper, we let a be a function of white-collar labor input, i.e., $a = a(n_2 t)$, with $a^{'} \geq 0$ and $a^{''} = 0$, meaning that the white-collar labor input by industrial rank is degree of one.

Currently, the movement of industrial upgrading is largely directed by local governments. Such movement, as many policy-makers believe, will help local governments increase fiscal revenues through enhancing the profits of local enterprises and their international competitiveness. Industrial upgrading also is a very important measure for the upper-level government to assess the local government officials. Therefore, local governments have strong incentives to promote industrial upgrading through various programs, such as by providing enterprises with R&D subsidy of s per white-collar worker.

Assume that an enterprise receives an allowance of s per white-collar worker and has a budget constraint of $n_1\sigma w + n_2 w \le M$, where w is the wage rate received by white-collar workers and 0 < σ <1, meaning that blue-collar workers get a proportion of the wage rate received by white-collar workers. Then, the profit maximization of the enterprise becomes:

$$\underset{n_1,n_2}{Max}\,\pi = f(n_1 l(b), n_2 t, \bar{K}) * P[a(n_2 t)] + s n_2 t$$

$$s.t. \quad n_1\sigma w + n_2 w \le M \;;\; n_1, n_2 \ge 0 \tag{1}$$

The first-order conditions are:

$$f_1^{'} l(b) P[a(n_2 t)] - \lambda \sigma w = 0 \tag{2}$$

$$f_2^{'} t P[a(n_2 t)] + f\mathrm{P}^{'}(\cdot)\mathrm{a}^{'}(\cdot)\mathrm{t}+\mathrm{st}-\lambda\mathrm{w} = 0 \tag{3}$$

Combine (3) and (4) and simplify them, we have

$$\sigma^{-1} f_1^{'} l(b) - f_2^{'} t - \frac{f(\cdot) p^{'}[a(n_2 t)] a^{'}(\cdot) t + st}{P[a(n_2 t)]} = 0 \tag{4}$$

We want to examine the impact of industrial upgrading on the employment of mid-aged peasant workers. For this, we investigate two relationships. The first one is between a and $n_1 l$, assuming that industrial upgrading will increase the level of value-added in production and thus the demand for blue-collar workers. The second relationship is between the government efforts to promote industrial upgrading and the demand for blue-collar workers.

Taking the derivative of $\Omega = n_1 l(b)$ with respect to $a(\cdot)$ on equation (4), we get,

$$\frac{\partial \Omega}{\partial a} \geq 0 \tag{5}$$

(Please see Appendix 1 for the proof). Formula (5) suggests that the amount of blue-collar labor input, $n_1 l$, would increase with industrial upgrading. In turn, the demand for l will increase if n_1 is fixed. This implies that the enterprise will replace part or even all of l_2 with l_1. Accordingly, the enterprise would lay off some mid-aged workers and replace them with young employees. Therefore, we have proved the following proposition：

Proposition 1: When enterprises are in the process of industrial upgrading and if the number of blue-collar workers is fixed, they replace part or all of the mid-aged workers with young workers, creating an adverse employment shock on mid-aged peasant workers.

Similarly, by providing subsidies to enterprises, government's efforts to promote industrial upgrading also creates an adverse employment shock on mid-aged peasant workers. Taking the derivative of $\Omega = n_1 l(b)$ with respect to s on equation (4), we get,

$$\frac{\partial \Omega}{\partial s} \geq 0 \qquad (6)$$

The above formula demonstrates that the demand for blue-collar labor input, $n_1 l$, would increase with government subsidy on industrial upgrading. If the number of blue-collar workers is fixed, formula (6) suggests that l will increase, forcing enterprises to replace mid-age workers with young workers. In turn, we have derived the following proposition：

Proposition 2: If the number of blue-collar workers is fixed, local government subsidy on industrial upgrading would make enterprises substitute more young workers for mid-aged workers, causing an adverse employment shock on mid-aged peasant workers.

Several points are worth mentioning. First, the above propositions have different emphases. Proposition 1, through the impacts of industrial upgrading on the level of value-added in production and thus the price of industrial products, shows how industrial upgrading creates an adverse employment shock on mid-age blue-collar workers. It tells how the market force determines the demands for various types of workers. Proposition 2, by relating government's subsidy to the amount of blue-collar labor input, shows how government efforts to promote industrial upgrading causes an adverse employment shock on mid-age blue-collar workers. It shows the direct impact of government policy on enterprises' demand for various types of workers. Second, in the above analysis, we treated peasant workers as pure physical workers in a static state. In reality, however, some migrant workers could be white-collar workers and more will become white-collar workers through education and job-training. But this should not change our general conclusions, especially because enterprises may make more efforts to train young workers than to train mid-aged workers. Third, in above analysis, we only considered the impact of industrial upgrading on the value-added of product. However, industrial upgrading also improves production efficiency. Yet, our general conclusions remain the same because our production function is in its general form, which already captures the efficiency improvement through changes of various labor inputs. Last, in proving Proposition 1 and Proposition 2, we assumed that the number of blue-collar workers is fixed. This assumption should be considered as a necessary condition but not a sufficient condition for the two propositions, because increasing $n_1 l$ could also suggest an increase in n_1 or both n_1 and l. Increasing both n_1 and l will not change our general conclusions in Proposition 1 and Proposition 2.

3. Land Centralization and Mitigation of Adverse Employment Shock

In many Chinese cities, a vast amount of rural land is centralized and used for industrialization and urbanization, through either government expropriation, land leasehold, or land cooperation. In this paper, inspired by Yao (1999), we develop a model to analyze how a peasant household arranges production factors when it faces an adverse employment shock. Specifically, in Section 3.1, we assume that local governments acquire land from peasants with lump-sum compensations but they cannot force peasants to sell their land. In Section 3.2, we will generalize our analysis by including the option of land cooperation in rural areas.

3.1 One-time Lump-sum Land Compensation

Assume peasant workers face a two-stage life-cycle decision process. At the first stage, in ages below or equal to 40 and with an employment level $\bar{L}_1^w$, peasant workers arrange their initial resources. Between stage one and stage two, they face an adverse employment shock caused by industrial upgrading, as discussed in Section 2. At the second stage, peasant workers are in mid-ages and the adverse employment shock has taken place. The employment becomes $\bar{L}_2^w = \bar{L}_1^w - \theta$, where θ is a non-negative random variable representing the adverse employment shock on peasant workers. Over $[0, \bar{L}_1^w]$, θ is distributed with a probability density function $\phi(\theta \mid \varepsilon)$ and a cumulative distribution function Φ, with a conditional parameter ε

representing the level of industrial upgrading and thus $\partial\Phi(\theta \mid \varepsilon)/\partial\varepsilon \leq 0$.

Let $\bar{L}$ and $\bar{T}$ be the initial peasant's endowments of labor and land, respectively. Under the one-time lump-sum compensation system, peasant workers have three income sources. One is the agricultural income, with an agricultural production function $F(T,L)$, where T is the land input and L is the labor input. In the following analysis, we let the unit price of agricultural product equal to 1 and all other prices be relative to this price. The second source is the wage income from the industrial sector, with an exogenous wage rate w. The third source is a one-time lump-sum compensation from a local government in a land transaction, $T^b(r^b - c^b)$, with T^b, r^b and c^b being the amount of land transferred, unit land price, and unit transaction cost, respectively.

We use a Cobb-Douglas production function $F(T,L) = T^{\alpha}L^{\beta}$ to describe the agricultural production. Later in Section 3.2, we will add the commonly-used term A into the production function for efficiency improvement. To ensure the concavity of function and based on empirical finding of decreasing return to scale in agricultural production, we assume that $\alpha < 1, \beta < 1$, and $\alpha + \beta < 1$. Therefore, in the first stage, a peasant worker is to：

$$\underset{L_1^f, T_1^f, T_1^b, L_1^w}{Max} \ \pi = (T_1^f)^{\alpha}(L_1^f)^{\beta} + wL_1^w + T_1^b(r^b - c^b) + \mu E[\pi_2^*(T_1^b)]$$

$$\text{s.t} \quad L_1^f + L_1^w = \bar{L} \ ; \quad T_1^f + T_1^b = \bar{T} \ ; \ L_1^w \leq \bar{L_1^w} \ ; \ L_1^f, L_1^w, T_1^f, T_1^b \geq 0 \qquad (7)$$

where $L_1^f, L_1^w, T_1^f, T_1^b$ represent respectively the labor input used in the agriculture production, labor input supplied to the industrial production, the land used in the agricultural production, and the land transferred to the local government. μ is the discount factor with $\mu < 1$. π_2^* is the optimal value of peasant income in the second stage. Assume an optimal interior solution exist, we get the following first-order conditions：

$$\beta(T_1^f)^\alpha (L_1^f)^{\beta-1} - w = 0 \qquad (8)$$

$$-\alpha(\bar{T} - T_1^b)^{\alpha-1}(L_1^f)^\beta + (r^b - c^b) + \mu \frac{\partial E[\pi_2^*(T_1^b)]}{\partial T_1^b} = 0 \qquad (9)$$

Equation (8) shows that peasant's marginal benefit from agricultural production equals to the wage rate working in an enterprise. Equation (9) demonstrates that the current and expected losses in agricultural production be compensated by the one-time lump-sum compensation. This condition suggests that a peasant worker make land transfer decision by considering both current and future agricultural profits. We regard the third term of equation (9) as the shadow price of land transfer, P_2, which depends on peasant's expected income from the second stage and affects positively the amount of land transferred in the first stage, i.e.,

$$\frac{\partial T_1^b}{\partial P_2} > 0 \qquad (10)$$

In the second stage, facing the adverse employment shock caused by industrial upgrading, a peasant worker is to:

$$\underset{L_2^f, L_2^w}{Max}\ \pi_2 = (\bar{T} - T_1^b)^\alpha (L_2^f)^\beta + wL_2^w \tag{11}$$

$$\text{s.t. } L_2^f + L_2^w = \bar{L} \quad ; \; L_2^w \le \bar{L}_2^w \quad ; \; L_2^f, L_2^w \ge 0 \tag{12}$$

Accordingly, we get Kuhn-Tucker conditions:

$$-\beta(\bar{T} - T_1^b)^\alpha (\bar{L} - L_2^w)^{\beta-1} + w - \lambda = 0 \; ; \; \lambda(\bar{L}_2^w - L_2^w) \ge 0 . \tag{13}$$

Denote $L_2^{w^*}$ to be the solution of the above equation. When $\lambda > 0$, we have $-\beta(\bar{T} - T_1^b)^\alpha (\bar{L} - L_2^w)^{\beta-1} + w > 0$ and possibly $\bar{L}_2^w - L_2^{w^*} = 0$, implying that enterprises are offering wages much higher than the agricultural income and thus virtually all peasants are eager to enter the industrial sector. In this case, we use $\bar{L}_2^w$ to substitute for $L_2^{w^*}$. Let $\bar{\theta}$ be the maximum of θ. We can rewrite the shadow price of land transfer as

$$P_2 = -\mu\int_0^{\bar{\theta}} \alpha(\bar{T} - T_1^b)^{\alpha-1} (\bar{L} - \bar{L}_2^w)^\beta \phi(\theta,\varepsilon) d\theta = -\mu \int_0^{\bar{\theta}} \alpha(\bar{T} - T_1^b)^{\alpha-1} (\bar{L} - \bar{L}_1^w + \theta) d\Phi(\theta,\varepsilon) \tag{14}$$

Integrating by parts of (14), we get,

$$P_2 = -\mu[\alpha(\bar{T} - T_1^b)^{\alpha-1} (\bar{L} - \bar{L}_1^w + \theta)\Phi(\theta,\varepsilon)]_0^{\bar{\theta}} + \alpha\mu\int_0^{\bar{\theta}} \Phi(\theta,\varepsilon) d(\bar{T} - T_1^b)^{\alpha-1} (\bar{L} - \bar{L}_1^w + \theta) \tag{15}$$

To investigate the impact of industrial upgrade scale ε on the shadow price of land transfer, we take the derivative of above function with respect to ε. We obtain,

$$\frac{\partial P_2}{\partial \varepsilon} = \alpha\mu \int_0^{\bar{\theta}} \frac{\partial \Phi(\theta, \varepsilon)}{\partial \varepsilon} d(\bar{T} - T_1^b)^{\alpha-1} (\bar{L} - \bar{L}_1^w + \theta) < 0 \qquad (16)$$

because of $\frac{\partial \Phi(\theta, \varepsilon)}{\partial \varepsilon} \leq 0$ and $d(\bar{T} - T_1^b)^{\alpha-1} (\bar{L} - \bar{L}_1^w + \theta) > 0$. Combining equations (10) and (16), we derive the following relationship between the amount of land transferred in the first period and the scale of industrial upgrading,

$$\frac{\partial T_1^b}{\partial \varepsilon} = \frac{\partial T_1^b}{\partial P_2} \frac{\partial P_2}{\partial \varepsilon} < 0 \qquad (17)$$

Therefore, we conclude that industrial upgrading (thus higher ε) will cause less land voluntarily transferred by peasant workers, leading to a slower pace of land centralization for industrial and urban uses.

The above conclusion, however, is not surprising. With industrial upgrading, an adverse employment shock exists for mid-age peasant workers, resulting in a higher possibility for peasant workers to return to home villages and lower incentives for them to sell their land. Put it differently, the relative marginal return of land would increase with peasant workers flowing back to villages. To balance the marginal land return of the two stages, peasant workers will reduce land transfer in the first stage.

One possible solution to help land centralization is to lower the unit land transaction cost by better defining rights of land for peasants. Mathematically, based on equation (9), we can prove that a lower land transaction cost will lead to more land transferred in the first period, because

$$\frac{\partial T_1^b}{\partial c^b} = \frac{-1}{(1+\mu)(\alpha^2-\alpha)(\bar{T}-T_1^b)^{\alpha-2}(L_1^f)^\beta} > 0 \qquad (18)$$

where $\alpha^2 - \alpha < 0$, given 0 < α < 1.

The above discussions allow us to state the following proposition:

Proposition 3: Facing an adverse employment shock caused by industrial upgrading, peasant workers have a higher possibility to return to the rural land and thus a lower motivation to sell their land under the one-time lump-sum compensation system. This slows down the pace of land centralization for industrial purposes. However, better defined land rights and lower transaction cost could promote land transfers and help land centralization.

3.2 Land Cooperation

In some Chinese cities such as Suzhou, an innovative approach to centralize rural land is through land cooperation (Zheng et al., 2007). Under this new system, rural land is centralized within a collective and managed jointly by peasants. The land cooperation system exhibits two main advantages. First, while peasants still keep their land ownership, they pool land together and rent bulk part of land for industrial and city uses. This will not only help peasant better plan for their land use but also enhance peasants' bargaining power in land transactions, thus better protecting peasants' welfare in both long and short terms. Second, by pooling land together and managing land jointly, the new system helps to promote large-scale agricultural production and improve efficiency.

How could the land cooperation system help to mitigate the adverse employment shock caused by industrial upgrading on mid-aged peasant workers? To answer this question, we add a term A into the agricultural production function to capture the efficiency gain generated by land cooperation and large-scale production, thus $A > 1$ relative to the production function used in Section 3.1. Denote N to be the number of peasants in a land cooperation. Assume other factors remain the same as those in Section 3.1, such as an individual peasant's labor and land endowments $\bar{L}$ and $\bar{T}$, the Cobb-Douglas form of production function, and the industrial wage rate w. Therefore, a land cooperation has a production function $G(T, L) = A(\sum_{i=1}^{N} T_i)^{\alpha} (\sum_{i=1}^{N} L_i)^{\beta}$.

For an individual peasant i, we denote T^g and L^g to be his land and labor inputs to the cooperation, respectively. For other peasants, $j \in N$ and $j \neq i$, we denote T^{g^*} and L^{g^*} to be the optimal land and labor inputs devoted by peasants j, respectively. Peasant's income from the cooperation is endogenous, with the wage w^g and land rent r^g depending on the marginal output of labor and land, as shown in the following equations:

$$w^g = \frac{\partial G}{\partial L^g} = A\beta[(N-1)T^{g^*} + T^g]^{\alpha}[(N-1)L^{g^*} + L^g]^{\beta-1} \quad (19)$$

$$r^g = \frac{\partial G}{\partial T^g} = A\alpha[(N-1)T^{g^*} + T^g]^{\alpha-1}[(N-1)L^{g^*} + L^g]^{\beta} \quad (20)$$

For a typical or the average peasant, because of $A > 1$ and $N > 1$, we have $AN^{\alpha+\beta-1} > 1$. Therefore, the marginal income of labor in the cooperation is always higher than that of self-cultivated land, suggesting that peasants are willing to put more labor into the cooperation. In turn, this will increase the marginal return of land used in the cooperation, as seen in equation (20), making peasants invest more land to the cooperation. In other words, land cooperation is able to absorb more workers and promote land centralization. Thus, it helps to mitigate the negative impact caused by exogenous adverse employment shock on peasant workers.

Under the land cooperation system, the optimization problem for a peasant becomes:

$$\underset{T^f, T^g, L^f, L^w, L^g}{Max} \pi = (T^f)^{\alpha}(L^f)^{\beta} + wL^w + T^g r^g + L^g w^g$$

$$\text{s.t} \quad T^f + T^g = \bar{T} \ ; \quad L^f + L^w + L^g = \bar{L} \qquad (21)$$

In Appendix 2, we list all five first-order conditions with equations (28)-(32). If all the peasants in the cooperation are assumed to be the same, we can use L^g, T^g to replace all the L^{g*}, T^{g*} in the first-order conditions and simplify these equations. Specifically, by combining equations of (28) and (30) and equations of (29) and (32), we get the following two results, respectively

$$\frac{\alpha L^f}{\beta T^f} = \frac{\lambda_1}{\lambda_2} \qquad (22)$$

$$\frac{\alpha L^g}{\beta T^g} = \frac{\lambda_1}{\lambda_2} \qquad (23)$$

From the above equations, we derive that,

$$\frac{L^f}{T^f} = \frac{L^g}{T^g} \tag{24}$$

indicating that the optimal labor-to-land ratio are the same for self-cultivation and cooperation production.

To examine how the land cooperation affects land centralization for industrial uses, we discuss the ratio of $\frac{T^g}{T^f}$ and investigate how this ratio changes with the scale of land cooperation. From equations (30) and (32) in Appendix 2, we obtain the following optimal ratio between land invested in cooperation and used for self-cultivation, Λ:

$$\Lambda = \frac{T^g}{T^f} = [\frac{1}{AN^{\alpha+\beta-2}(N+\alpha+\beta-1)}]^{\frac{1}{\alpha+\beta-1}} \tag{25}$$

(Please see Appendix 3 for derivation.) Given $N > 1$, the above ratio is strictly positive, meaning the amount of land invested in a cooperation from its peasants never equals to zero and thus our Lagrange solution is the overall optimal solution. The result also shows that the cooperation has enhanced the welfare of its peasants.

Based on formula (25), because of $0 < \alpha + \beta < 1$, it is not difficult to see that Λ increases along with the growth of A, because of

$$\frac{\partial \Lambda}{\partial A} = \frac{1}{1-\alpha-\beta} A^{\frac{\alpha+\beta}{1-\alpha-\beta}} \left[N^{\alpha+\beta-2}(N+\alpha+\beta-1) \right]^{\frac{1}{1-\alpha-\beta}} > 0 \tag{26}$$

This result suggests that peasants are more willing to invest land in a cooperation with better production efficiency brought by a large-scale production. Again, we have proved that land cooperation not only improves efficiency but helps land centralization as well.

Furthermore, we also prove that Λ grows with N for $N > 1$, a given condition for any land cooperation. See Appendix 4 for the proof. This result shows that proportionally the amount of land invested in a land cooperation increases with the number of peasants joining the cooperation. In turn, it shows that land cooperation promotes land centralization. However, it needs to be cautious to conclude that a larger cooperation is always better. Because many costs and problems could arise with the size of an organization, such as transaction cost and the free-ride problem, we expect that there exists an optimal level of N, which could vary from one cooperation to another. Generally, we consider village as a good size for land cooperation, as evidenced by the experiences in south Jiangsu Province (Zheng et al., 2007).

The above analyses allow us to give our last proposition:

Proposition 4: When an adverse employment shock on peasants exists during industrial upgrading, land cooperation helps to mitigate the negative impact on the process of land centralization and the welfare of peasant workers. Peasants are more *willing to invest their land in a land cooperation due to better efficiency and higher returns. Also, the amount of land invested in land cooperation increases proportionally with the number of peasants joining the cooperation, thus promoting land centralization.*

4．Conclusions

Facing international competition, China makes great efforts in recent years to upgrade its industries. These efforts, however, generate an adverse employment shock on peasant workers because of their lack of adequate skills to keep or find jobs in the industrial sector. Many of them have to flow back to their villages and become farmers again. Some returned peasant workers even found that survival in the countryside becomes a challenge due to the amount of land converted for urbanization and industrial uses.

Using a firm-level employment model, this paper has theoretically proved that firms would replace mid-aged peasant workers with younger workers, causing an adverse employment shock on peasant workers. This adverse employment shock would force some rural workers to return to their home villages, especially those mid-aged workers. The current lump-sum land acquisition system, however, is unable to help peasant workers mitigate the negative impact of the employment shock when they face a risk of backflow to home villages, because peasants found it uneconomical to sell their land if the compensation is way too low. Therefore, the current land acquisition system makes it more difficult to centralize rural land for industrial and urban uses.

This paper has also proved that land cooperation could help peasant workers better deal with the adverse employment shock and centralize rural land for nonagricultural purposes. Under the land cooperation, peasants in the same village pool land together, invest part of the land for industrial and urban uses, and share profits jointly. Because of the large-scale of production and higher returns from nonagricultural uses, land cooperation would not only improve agricultural efficiency but also increase peasants' incentive to invest their land for urban purposes. The former helps peasant workers mitigate the negative impact of employment shock, while the latter promotes land centralization for industrial and urban uses. Both improve peasant's welfare.

Based on our theoretical findings, we would propose two policy recommendations. First, to upgrade China's industries, it is important for the government to provide peasant workers with job-training and education opportunities. With the rapid pace of urbanization, more and more farmers will migrate into cities. Without adequate job-training and education, rural migrants, especially those mid-aged ones, would have a very low employability and thus many of them could become the urban poor. Second, China needs to further reform its rural land system. Under the current land expropriation system, local governments compensate farmers too little. It deprives peasants' interests and hinders land centralization. To better protect peasants' land rights and welfare, various land conversion systems could coexist, largely depending on peasants' choices rather than going with local governments' decisions. Given the huge rural population, China would not see a harmonious society if peasants are left behind and unable to benefit from the overall economic development.

References

Chang, Pei-Kang. 1949. *Agriculture and Industrialization*, Cambridge: Harvard University Press.

Hare, Denise. 1999. "'Push' versus 'pull' factors in migration outflows and returns: Determinants of Migration Status and Spell Duration among China's Rural Population." *Journal of Development Studies*, 35(3): 45-72.

Harris, John R. and Michael P. Todaro. 1970. "Migration, Unemployment and Development: A Two-Sector Analysis." *American Economic Review*, 60(1): 126-42.

Lewis, W. Arthur. 1954. "Economic Development with Unlimited Supplies of Labour." *Manchester School*, 28(2): 139-91.

Lu, Zhigang and Shunfeng Song. 2006. "Rural-Urban Migration and Wage Determination." *China Economic Review*, 17(3): 337-45.

Yao, Yang. 2004. *Land, Institution and Agricultural Development*, Beijing: Peking University Press.

Zhang, Kevin H. and Shunfeng Song. 2003. "Rural-Urban Migration and Urbanization in China: Evidence from Time-Series and Cross-Sectional Analyses." *China Economic Review*, 14(4): 386-400.

Zhao, Yaohui. 1999. “Leaving the Countryside: Rural to Urban Migration Decisions in China.” *American Economic Review*, 89(2): 281–86.

Zhao, Yaohui. 2002. “Causes and Consequences of Return Migration: Recent Evidence from China.” *Journal of Comparative Economics*, 30(2): 376-94.

Zheng, Jianghuai, Hua Zhao, Chengsi Wang, and Changjiang Chen. 2007. “Building up the Status of Peasants and Eliminating the Development Diversity.” *Journal of Northwest University*, 95(3): 2-18.

Appendix 1：

Using $\frac{\partial a'(n_2 t)}{\partial a(n_2 t)} = \frac{\partial a'(n_2 t)}{\partial n_2 t} * \frac{\partial n_2 t}{\partial a(n_2 t)} = \frac{a''(n_2 t)}{a'(n_2 t)}$ and the inverse function derivative, we get $\frac{\partial n_2 t}{\partial a(n_2 t)} = \frac{1}{a'(n_2 t)}$. Therefore,

$$\frac{\partial \Omega}{\partial a} = -\frac{\sigma^{-1}\left(\frac{f''_{12} l(b)}{a'(*)} - \frac{f''_{22} t}{a'(*)}\right) - \frac{P(*) f(*) t \left\{ P''[a(*)] a'(*) + P'[a(*)] \frac{a''(*)}{a'(*)} \right\} - f(*) t [P'(*)]^2 a'(*) - stp'(*)}{[P(a(*))]^2}}{\sigma^{-1}(f''_{11} l(b) - f''_{21} t) - \frac{tP'(*) a'(*)}{P(a)} f'_1} \quad (27)$$

According to the definition of f (*), the above denominator is non-positive. Since $a'' = 0$, the second term in the big bracket of numerator is 0, and we can rewrite the third term of the numerator as $\frac{f(*) t a'(*) \{P(*) P''(*) - [P'(*)]^2\}}{[P(a(*))]^2}$. According to the properties of function $P(*)$, i.e., the increment of marginal price is negative while the increment of price is positive, we have $[\frac{P'(*)}{P(*)}]' \le 0$ and thus $P(*) P''(*) - [P'(*)]^2 \le 0$. Along with the properties of function f, we proved

$$\frac{\partial \Omega}{\partial a} \ge 0 \cdot$$

Appendix 2：

Using Lagrange's theorem to formula (21), we get the following five first –order conditions:

$$\alpha(T^f)^{\alpha-1}(L^f)^\beta - \lambda_1 = 0 \tag{28}$$

$$\alpha A[(N-1)T^{g*}+T^g]^{\alpha-1}[(N-1)L^{g*}+L^g]^\beta + (\alpha^2-\alpha)AT^g[(N-1)T^{g*}+T^g]^{\alpha-2}[(N-1)L^{g*}+$$

$$L^g]^\beta + \alpha\beta AL^g[(N-1)T^{g*}+T^g]^{\alpha-1}[(N-1)L^{g*}+L^g]^{\beta-1} - \lambda_1 = 0 \tag{29}$$

$$\beta(T^f)^\alpha(L^f)^{\beta-1} - \lambda_2 = 0 \tag{30}$$

$$w - \lambda_2 = 0 \tag{31}$$

$$\alpha\beta AT^g[(N-1)T^{g*}+T^g]^{\alpha-1}[(N-1)L^{g*}+L^g]^{\beta-1} + (\beta^2-\beta)AL^g[(N-1)T^{g*}+T^g]^\alpha *$$

$$[(N-1)L^{g*}+L^g]^{\beta-2} + A\beta[(N-1)T^{g*}+T^g][(N-1)L^{g*}+L^g]^{\beta-1} - \lambda_2 = 0 \tag{32}$$

where λ_1, λ_2 are Lagrange multipliers.

Appendix 3：

Dividing formula (30) by the simplified formula (32), we get：

$$1 = \frac{\beta(T^f)^\alpha(L^f)^{\beta-1}}{A\beta T^g\alpha(NT^g)^{\alpha-1}(NL^g)^{\beta-1} + A(\beta^2-\beta)L^g(NT^g)^\alpha(NL^g)^{\beta-2} + A\beta(NT^g)^\alpha(NL^g)^{\beta-1}}$$

$$= \frac{1}{[\alpha AN^{\alpha+\beta-2} + A(\beta-1)N^{\alpha+\beta-2} + AN^{\alpha+\beta-1})}(\frac{L^f}{L^g})^{\beta-1}(\frac{T^f}{T^g})^\alpha \tag{33}$$

Because of $\frac{L^f}{T^f} = \frac{L^g}{T^g}$, we rewrite the right side of the above equation as:

$$1 = \frac{1}{AN^{\alpha+\beta-2}(N+\alpha+\beta-1)}(\frac{T^f}{T^g})^{\alpha+\beta-1}. \tag{34}$$

Solving the ratio of $\frac{T^g}{T^f}$, we obtain:

$$\Lambda = \frac{T^{g}}{T^{f}} = [\frac{1}{AN^{\alpha+\beta-2}(N+\alpha+\beta-1)}]^{\frac{1}{\alpha+\beta-1}} \quad . \tag{35}$$

Appendix 4：

Let $\alpha + \beta - 1 = x$ and thus $0 < x < 1$. Equation (34) becomes

$$\Lambda = N[\frac{1}{AN^{x-1}(N+x)}]^{\frac{1}{x}} \tag{36}$$

Taking the partial derivative of equation (35) with respect to *N*, we get:

$$\frac{\partial\Lambda}{\partial N} = [AN^{x-1}(N+x)]^{-\frac{1}{x}} - \frac{N}{x}[AN^{x-1}(N+x)]^{-\frac{1}{x}}\frac{AN^{x-2}(Nx+x^2-x)}{AN^{x-1}(N+x)}$$

$$= [AN^{x-1}(N+x)]^{-\frac{1}{x}}(1-\frac{N+x-1}{N+x}) > 0 \cdot \tag{37}$$

Therefore, Λ increases with *N*, proving that the ratio of land used in cooperation to land used for self-cultivation increases with the scale of land cooperation (i.e., the number of peasants belonging to the cooperation). In other words, land cooperation helps land centralization for industrial purposes.