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RISK AVERSION, RURAL-URBAN WAGE DIFFERENTIATION AND MIGRATION

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ABSTRACT

In this paper I first present evidence to show that there is a labor shortage problem caused by insufficient rural-urban migration in Chinese urban/sub-urban areas. Moreover, people in poor rural areas migrate less than people in rich rural areas to cities. These phenomena cannot be explained by existing theories.

A theory is provided to explain those puzzling phenomena. In my theory, migration is regarded as an instrument of the income portfolio of a household: facing high risks of food price fluctuation, a geographically extended cooperative household which has land and has out-migrants regards city jobs as high-risk high-income opportunities, and regards agricultural production on its own land as low-risk low-income opportunities. In order to insure themselves, risk averse rural households would keep more labor input in agriculture (i.e. reduce the number of rural-urban migrants) compared with risk neutral households. Therefore, the "excess" labor input in agriculture and the resulting lower marginal labor productivity in agricultural production is virtually the payment for the insurance of rural households. If poorer households are more risk averse than rich households, then concerning their insurance, a poor rural household will have fewer rural-urban migrants than a richer rural household. An important implication of this result is that the gap between the poor and the rich is widened when there are opportunities for rural laborers to migrate to cities, and migration provides better chances to earn higher incomes.

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1. INTRODUCTION

Two related important classical phenomena in most developing economies are the following: the coexistence of a high city wage (in terms of an inability to clear the labor market) and a low wage in rural areas; and the coexistence of urban unemployment and the continuation of rural-urban migration.

In contrast, during the period of reform to transform the economy from a bureaucratically controlled to a market economy in China, the following interesting phenomena are observed: (i) in urban-suburban areas with higher incomes than in rural areas, instead of the problem of unemployment and too much migration, firms in these areas suffer from insufficient migration[1]; (ii) compared with poor rural areas, more people in rich rural areas migrate to urban-suburban areas where wages

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[1] In this paper I refer to all the areas where rural industry is concentrated as urban-suburban areas. In fact, about 70 percent of rural industrial enterprises are located in officially defined suburban areas (Perkins, 1987). Rural industry here is an official definition of industries run by rural residents. Actually, so-called rural industry includes the electronics, machine-building and mining industries etc. Moreover, more than one quarter of rural laborers are full-time workers in rural industrial enterprises.

are higher; (iii) people in poor rural areas migrate more to rich rural areas, where wages are higher than in the poor rural areas but lower than in the urban areas, than migrate to urban areas, while many rich rural area people migrate to urban areas. These phenomena cannot be explained by existing theories.

To explain the classical paradoxical phenomena, many theories have been developed. The Leibenstein-Mirrlees-Stiglitz nutrition-based efficiency wage theory explains the rural-urban wage differential by linking of food consumption and productivity. According to this theory, labor productivity is determined by the level of food consumption, which depends on the income of the laborers. Thus, low incomes in poor rural areas results in low productivity and thus low income per se. And high income in urban areas is necessary for maintaining high productivity in manufactural industry (Leibenstein, 1957, Mirrlees, 1975 and Stiglitz, 1976). However, no strong evidence for the effect of food consumption on productivity exists to support this theory (Bliss and Stern, 1978, and Strauss, 1986). Moreover, it was found in poor rural areas of India that real wages vary considerably across regions (Bliss and Stern, 1978, and Rosenzweig, 1984). Evidence also shows wage variations across Chinese rural areas (Xu, 1992). This wage variation contradicts the nutrition-wage theory which bases rural wages on a stable biological need.

The celebrated Harris-Todaro model and its variations (Corden and Findlay 1975, Cole and Sanders 1985, Harris and Todaro 1970, Stiglitz 1974, and Todaro 1969) explain the wage differentiation and rural-urban migration based on the hypothesis that rural people migrate to cities until the expected urban income equals that of the rural income. With the existence of unemployment in urban areas, in equilibrium

expected wages should be the same in both rural and in urban areas.[2] According to the logic of this model, the poorer a rural area is, the more rural-urban migrantion will occur. However, in China the number of rural-urban migrants from poor rural areas are less than those from rich rural areas (Geng, 1989). Moreover, there is a general trend, observed in most Less Developed Countries (LDCs), that rural-urban migrants tend not to be from the poorest families in the original rural area (Rosenzweig, 1988, p.745).

Stark and Katz analyze the roles of risk aversion and imperfect capital markets in rural-urban migration (Katz and Stark, 1986, or Stark, 1991). They argue that with fragmented capital markets, the rate of return on assets may be an increasing function of investment, which may result in a non-convex acceptable gamble set even when individual's utility function is strictly concave. Regarding migration as an investment, with a non-convex acceptable gamble set, a risk averse individual may take the risk of migration. This theory predicts that "the rural rich will not migrate." It contradicts the obervation that rural-urban migrants tend not to be from poorer rural areas. Moreover, Stark's theory cannot explain insufficient rural-urban migration.

According to Lewis (1954) and Ranis and Fei (1961), the immobility of agricultural labor, which is responsible for the low income in rural areas, results from the discrepancy of private and social costs of rural-urban migration. In rural areas, individuals get average agricultural products in the sense that they share agricultural

[2] However, evidence shows that the nominal urban wage in developing countries is usually 50-100 percent higher than nominal agricultural wage, and the unemployment rate is often lower than 10 percent, i.e. the expected urban wage is higher than the expected rural wage (Rosenzweig, 1988, p.748).

products with their family members. However, with a labor surplus, each rural laborer's marginal labor productivity is much lower than average labor productivity (they assume it as zero or negative). Therefore, the private cost of moving out of agriculture for an agricultural laborer, i.e. his/her average product in agriculture, is significantly higher than the social costs, which is his/her marginal product of labor in agriculture. The problems with these theories are the following: if household members are cooperative in the sense that they share the total income of the household such that the marginal utility of every member in the household is the same, a rational household should send laborers to urban areas to the point that the marginal products of labor in cities and in agriculture are the same. By doing so, the phenomenon of dual economies should disappear. If household members are not cooperative, the discrepancy of private and social costs of rural-urban migration should vanish.

Like in other developing countries, in Chinese rural areas, labor is the most abundant resource: both the marginal product of labor and labor income in agriculture are much lower than those of manufacturing and other industries in cities. However, during the period of economic reform, the insufficient migration phenomenon is observed in many urban-suburban areas where "rural industrial enterprises" are heavily concentrated: (i) in many suburban areas industrial enterprises have exhausted the local labor force and there are insufficient immigrants to meet labor demand, even though wages in these enterprises are higher than agricultural incomes in most areas (Byrd and Lin, 1990, Chen, 1987); (ii) in many sample surveys, managers of enterprises complained about labor shortage problems (Lin, 1987); (iii) an econometric study finds that the marginal product of labor of the

enterprises in many urban-suburban areas is significantly higher than their wages (Xu, 1992). This suggests that insufficient labor supply may result in the inefficient operation of these enterprises. Other interesting but not well understood features of China's rural-urban migration are the following: (i) migration from poorer rural areas (e.g. West China) is lower than the migration from richer rural areas (e.g. East China) (Geng, 1989); (ii) almost all "private immigrants"[3] migrate either alone or with some of their family members, i.e. it is rare that "private immigrants" migrate to urban areas together with their whole family.

The puzzling questions are: In rural areas, where decreasing returns to scale and too many laborers result in low marginal labor productivities, why are there not a sufficient number of people who migrate to the suburbs where they can earn higher expected incomes? Why do people in poor rural areas migrate less than people in rich rural areas to cities? Why do so many people in poor rural areas migrate to rich rural areas where wages are lower than urban wages, while many rich rural area people migrate to urban areas?

There are several plausible explanations for these puzzling questions. The first one is the high cost of migration (e.g. transportation costs and adjustment costs). If people are risk neutral and without liquidity constraints, rural residents should migrate to cities if in the long run the accumulated rural income is lower than the accumulated urban income minus the fixed cost of migration[4]. High unemployment

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[3] By official definition, "private immigrants" are those who migrate from rural areas to urban areas on their own without being permanently hired by any state-owned enterprise (usually city residents are permanently hired by state-owned units), or without being organized by any government agency, and who do not have official urban registrations.

[4] In most cases, after subtracting the cost of migration, urban income is still significantly higher than rural income.

in cities and too much rural-urban migration would be the result. Concerning the liquidity constraints, in general Chinese rural people are not poorer than the rural people in many other LDCs. If liquidity constraints were the major factor which restricted rural-urban migration in China, why is this not the case in other LDCs, where too many migrants and unemployment in cities is a serious problem? Furthermore, this explanation obviously does not help in explaining the phenomenon that many people in poor rural areas migrate to rich rural areas instead of urban areas, while numerous people in these rich rural areas migrate to cities.

The second explanation concerns administrative restrictions on rural-urban migration. There were abundant harsh administrative restrictions on rural-urban migration before the reforms. However, after the reforms, most of the administrative restrictions were substantially loosened. For out-migration, in many circumastances administrative restrictions have been replaced by economic measures: fixed fees are charged to the people who wished to migrate. In fact, the fixed fees can simply be regarded as part of migration costs.[5] The restrictions on immigration have also been loosened or even lifted.[6] Furthermore, administrative restrictions on immigration cannot explain the phenomenon that fewer poor rural laborers migrate to cities and more of them migrate to rich rural areas.

The third plausible explanation is based on the psychology of the rural populace: rural people do not enjoy overcrowded city life, thus they prefer to stay in the countryside. However, in China the living standard gap between the cities and

[5] The fee is usually lower than transportation costs and adjustment costs.

[6] In 1988, the Chinese government officially lifted administrative restrictions on rural-urban immigration as long as migrants were able to provide their own food in cities (Forbes and Linge, 1990).

the countryside is grave (the major source of income inequality in China is that between the city and the countryside). Therefore, most rural residents prefer to move to the cities if they are hired by a state owned-enterprise.[7]

This paper provides a theory to explain these phenomena. The theory is based on the feature of the risks faced by out-migrants and their families - regarding rural households as geographically extended cooperative families.

Facing high risks of food price fluctuation, a geographically extended cooperative household which has land and has out-migrants regards city jobs as high-risk high-income opportunities, and regards agricultural production on its own land as low-risk low-income opportunities. Because agricultural outputs from their land are not affected to the fluctuation of prices, agricultural production serves as insurance for rural households: in a bad year, the household will be able to survive by relying on their agricultural output. In order to insure themselves, risk averse rural households would keep more labor input in agriculture (i.e. reduce the number of rural-urban migrants) compared with risk neutral households. Therefore, the "excess" labor input in agriculture and the resulting lower marginal labor productivity in agricultural production is virtually the payment for the insurance of rural households.

In order to control the wage race[8], which is an important phenomenon in the reformed Chinese economy, the Chinese government sets ceiling wages for all firms

[7] In an opinion survey conducted in 1985, most rural residents regarded farming as the worst occupation in the society in terms of income, and all the subjects regarded farming as the worst occupation in the society in terms of social status. Among the ten occupations which they were asked to compare with in the sample survey, all occupations except farming are concentrated in urban areas (Institute of Economic System Reform (IESR), 1988).

[8] The wage race here refers to the fact that state-owned firms raise their wages to match higher standards of wages observed in other firms. When this race is prevailing, there will be run-away wage increases and run-away inflation. Further explanation on the wage-race is beyond the scope of this paper.

regardless of whether they are state-owned enterprises or TVEs (Township Village Enterprises). Ceilings on wages, together with high risks faced by rural-urban migrants, result in insufficient migration or urban labor shortage.

Concerning the influence of taxation on urban-rural migration, I show that a real land tax virtually reduces the insurance of a rural household, and thus reduces rural-urban migration. The higher the tax is the fewer the migrants will be. With high real land taxes in China, rural-urban migration is further restricted.

Regarding migration as an instrument of the income portfolio of a household, in an economy where most rural households have land, if poorer households are more risk averse than rich households, then concerning their insurance, a poor rural household will have fewer rural-urban migrants than a richer rural household. With safer real incomes in agricultural jobs, many members of households in poor rural areas migrate to rich rural areas, up to the point that the marginal labor productivities in the poor areas equal those in the rich areas. An important implication of this result is that the gap between the poor and the rich is widened when there are opportunities for rural laborers to migrate to cities, and migration provides better chances to earn higher incomes.

For the migration problem of landless rural households, I show that under some conditions all members of a landless household migrate to cities. This result may provide some clues on the explanation of the differences between a reformed Chinese economy and some other developing economies: in China, almost all of the rural households have land, rural-urban migrants face big uncertainties in the free markets, and insufficient rural-urban migration is observed; in other developing countries, a notable number of rural households are landless, rural-urban migrants

are not as clearly differentiated from other urban residents in the markets as they are in China, and migration-related unemployment is a distinguishing feature. When there are many landless rural households and marginal labor productivity in agriculture is very low, the Harris-Todaro model is a good approximation to the rural-urban migration phenomenon. However, it is not a proper model for the case where most rural households have crop land regardless of the marginal labor productivity level in agriculture.

The rest of the paper is organized as follows. Section 2 motivates the analysis by providing evidence. Section 3 discusses the basic model and Section 4 extends the model to the economy where there are poor rural areas and rich rural areas.

2. INSUFFICIENT RURAL-URBAN MIGRATION: EVIDENCE

(a) Insufficient Immigrants in China's Urban-Suburban Areas

An econometric study finds that the marginal product of labor in the TVEs[9] is significantly higher than their wages (Xu, 1992). This suggests that TVEs do not earn the profits which they could earn if they were to hire sufficient laborers. Given the fact that urban wages are higher than average agricultural incomes, this finding contradicts the Harris-Todaro model.

Insufficient migration is one of the major reasons why TVEs do not hire sufficient laborers. Several case studies and sample surveys in more than one dozen counties (e.g., Jiangyin County in Jiangsu and Zhongshan County in Guangdong, etc.)

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[9] Township village enterprises are non-agricultural enterprises run by officially defined rural residents. In fact, over 70 percent of the TVEs are located in urban-suburban areas. The officially defined rural resident has nothing to do with the location where he/she works and also has nothing to do with the nature of his/her job. Rural residents are restricted by the grain supply - they are not eligible to buy grain in the state stores.

find that in many newly industrialized areas the local labor force is exhausted, and insufficient migration has been a serious problem for further development. Under this situation, many firms have begun to adopt capital intensive technologies (He, 1990).

In an opinion survey conducted in Shanxi Province, 47.4 percent of the TVE managers complain about the labor shortage problem. According to their responses, the local labor force has been exhausted with the development of the local TVEs and this has caused labor shortage (Lin, 1987).

In the suburbs of Suzhou, Wuxi and Changshu, 59.27 percent of the rural labor force is working in nonagricultural sectors. In these areas, almost all of the younger labor force is already working in nonagricultural sectors. "The labor shortage is a prevailing phenomenon in these areas." Most employees of the TVEs live less than twenty km away, because they would like to go home regularly to take care of their land (Chen, 1987).

(b) High Risks in Urban Areas Faced by Rural Immigrants; Most TVE Employees Keep Crop Land at Home

In China, the government differentiates immigrants with rural origins from city residents through the so-called household registration system: only city residents are eligible to buy grain products in state-owned food stores.[10] Immigrants with rural origins have to rely on free markets for their grain consumption, although they can earn a higher nominal income compared to rural laborers and even compared to some urban laborers.

[10] With an extremely limited supply of other foodstuffs, grain is the major source of calories for the Chinese. In fact, a serious shortage of grain results in famine in China.

Every year, through administrative measures, the government procures a large fixed quantity of grain at fixed low official prices from rural areas for urban consumption (tax in kind). By doing so, the government in effect provides full insurance to all city residents for their grain consumption and leaves all the risks of agriculture production to the rural residents. To reduce the risk of famine, rural households horde large quantities of grains, even when the price of grain in the free markets is high.[11] In fact, in the free markets, the supply of grain is just the residual output each year; the prices of grain can be much higher than the official prices and they fluctuate widely. For example, in 1988, the price index of grain in the nationwide free markets was almost 100 percent higher than the price in the state stores. This was the highest free market vs official price ratio among all consumer goods. Moreover, the situation is even worse in some urban-suburban areas. In the period of 1987-1988, in Shanghai, the largest city in China, the grain price was increased by 63.9 percent; in Guangdong, one of the provinces with the highest concentration of TVEs, the grain price increased by 43.9 percent; in contrast, the grain price increased by 24.2 percent nationwide. (Urban Social and Economic Investigation Team (USEIT) of the State Statistical Bureau (SSB), 1989, p.129).[12] As a result, for rural households who migrate to urban areas and do not have crop land

[11] Rural household sample surveys show that when the price of grain in the free markets is high, rural households keep more grain in their inventories. However, when the price of grain in the free markets is low, rural households keep lower grain inventories (Rural Area Investigation Team (RAIT) of the SSB, 1987).

[12] In order to lessen the risks of their own food consumption, Chinese rural households which produce grain keep more grain inventory when prices of grain in the free markets go up. When the price of grain in the free markets comes down, they sell more for their cash income and keep less grain inventory (RAIT, 1987).

in their original rural area, the risk they are facing is higher than that of rural residents who have land.

Because of the risks of food consumption in urban areas, rural-urban migration may be restricted, especially in poor rural areas. In order to reduce the dependency on the unstable free market for food consumption, rural households with TVE employees may want to keep their crop land as insurance. However, the land may become a burden for out-migration. Sample surveys show that 96.2 percent of TVE employees keep crop land at home. (See Table 1.)

An opinion survey shows that rural households did regard crop land as insurance. In the survey, 86 percent of the TVE employees said that they would like to keep the land in their household for safety reasons; all of them said that with crop land in their households, losing their current non-agricultural job would not affect the basic life of their families. Among the sample of rural laborers who are doing agricultural work, 45 percent of them do not want to migrate to cities, since they do not feel safe to leave their land; 80 percent of them would like to find a non-agricultural job in the local area without leaving their land; and among the people who want to find a nonagricultural job in the local area, 91 percent want to keep their land even after they got a nonagricultural job (Ho et al., 1988).

(c) In Poor Rural Areas there are more Rural-Rural Migrants but less Rural-Urban Migrants than in Rich Rural Areas

A sample survey conducted in seven counties in Henan Province shows that the number of rural-urban migrants is positively correlated to per-capita grain production (Hou et al, 1988).

The data in Table 2 comes from a survey sampled from more than two hundred villages in 49 counties of ten provinces[13]. The table shows that rural-urban labor migration is positively correlated with per-capita agricultural income, and that net rural-rural labor migration is negatively correlated with per-capita agricultural income (it is interesting to note from the table that in regions with a per-capita agricultural income higher than 600 yuan there is a net immigration from other rural areas. But in regions with a per-capita agricultural income lower than 500 yuan, there is a net rural-rural out-migration).

Chen (1987) estimated that by the mid-1980s some six million laborers each year were leaving poor rural areas for rich rural areas, and that up to 1987 in some poor villages close to 20 percent of the laborers had departed. One example is the rural-rural migration from poor rural areas to Baoan county of Guangdong Province which is a rich rural area. Close to Shenzhen Special Economic Zone, most rural laborers in Baoan have taken nonagricultural work in the city. They rent out their lands to immigrant laborers. According to official report, by April 1986 the number of temporary immigrant laborers accounted for 60 percent of the resident population in that area (Wu and Xu, 1990).

3. RURAL-URBAN MIGRATION: THE BASIC MODEL

The basic features of the model are the following: (i) the decision-making unit is the household. A household in this paper is regarded as a geographically extended

[13] To better investigate rural households' rural-urban and rural-rural migration behavior, I have eliminated the data from Shanghai which is a large city in the sample. Moreover, unfortunately, the only data available to the public is the aggregated data which has only ten independent observations. Therefore, a rigorous econometric study based on the data available is not feasible.

family which can be quite large. Members in a household are perfectly cooperative in the sense that they share the total real income and risks in a egalitarian way such that everybody's marginal utility is the same; (ii) households are risk averse; (iii) there are random shocks to food prices.

Suppose that there are two states of nature in food price σ: good states and bad states.[14] Prices in the economy are expressed as $\mathbf{P}=\{P_a,P_m\}$. Here, P_a is the price of the agricultural good and P_m is the price of the manufactured good. The prices in different states are expressed as follows:

(1) prices in good state $\mathbf{P}(\sigma=g) = \mathbf{P}^* = \{p^*,p_m^*\}$ with $Pr.(\sigma=g) = q$,

prices in bad state $\mathbf{P}(\sigma=b) = \underline{\mathbf{P}} = \{\underline{p},\underline{p}_m\}$, with $Pr.(\sigma=b) = 1-q$.

In this paper, I assume that there is an exogenously given urban wage ceiling and it is binding.[15] To simplify the analysis, assume urban wage w remains constant in both states[16], and two par cases in a bad state are analyzed: (i) both prices increase by the same factor $\beta>1$; and (ii) the manufactural good price does not change, i.e. $p_m^*=\underline{p}_m=1$.

[14] To simplify the model, I assume away the random shock in agricultural production. It is easy to show that with the random shock in agricultural production in the model, the results of the model would not be changed provided that agricultural production is less risky than the city wages.

[15] The Chinese government has set ceiling wages for all firms regardless of whether they are state-owned enterprises or TVEs to control the wage race, which is an important phenomenon in reformed Chinese economy. The wage race here refers to the fact that state-owned firms raise their wages to match higher standards of wages observed in other firms. When this race is prevailing, there will be run-away wage increases and run-away inflation. Further explanation on the wage-race is beyond the scope of this paper.

Evidence does suggests that ceilings on wages are binding: (i) TVE wages are not correlated to the marginal labor productivities; (ii) they are correlated with nearby state-owned enterprise wages (Xu, 1991).

[16] When the ceiling wage is binding both in the good state and in the bad state, and the government does not change the ceiling wage in a bad state, the wage remains constant in both states.

The economy consists of a large number of identical households each with a population M. In this economy, all of the population are laborers. Here, M is quite large since a household is regarded as an extended family. Each household is endowed with the same amount of land and capital. The only choice variable of a household is labor: the allocation of labor endowment in agriculture and in the cities. The agriculture production function of every household is the same and is expressed as f(N). Here, N is the labor input of agricultural production. Assume that land is limited such that changing the labor input will not change the area of land cultivated, i.e. there is a labor surplus in agricultural production, therefore $L=\underline{L}=$constant. Agricultural production technology f() satisfies the following properties: $f'> 0$ and $f''<0$ (decreasing return to scale).

In general, there are μ members of a household who migrate to cities. Members of a household are perfectly cooperative, that is they share the total income and they share the risks. The incomes of a household with μ members migrating to cities in different states are the following:

(2) in a good state: $I(\mu,\mathbf{P}^*)=p^*f(M-\mu)+\mu w$;

in a bad state: $I(\mu,\underline{\mathbf{P}})=\underline{p}f(M-\mu)+\mu w$.

where w is the exogenously given nominal urban wage.

For one household, μ is an integer. However, when the total number of households in the model is very large, regarding μ as an average number of migrants for each household, then μ is a real number.

The expected indirect utility of a household is the following:

(3) $U(\mu;\sigma) = qU(\mathbf{P}^*,I(\mu,\mathbf{P}^*)) + (1-q)U(\underline{\mathbf{P}},I(\mu,\underline{\mathbf{P}}))$.

The indirect utility function is defined as follows:

$$(4)\quad U(\mathbf{P},I(\mu,\mathbf{P})) = V(X(\mathbf{P},I(\mu,\mathbf{P})) = \max.\ V(X_a, X_m)$$
$$\text{s.t. } P_a(\sigma)X_a+P_m(\sigma)X_m = I.$$

Here, X_m and X_a are the consumptions of the manufactural good and the agricultural good respectively, $P_a(\sigma)$ is the price of the agricultural good in state σ, and $P_m(\sigma)$ is the price of the manufacture good in state σ. To facilitate the analysis, assume that the utility function is differentiable and strictly concave, and satisfies the following conditions: $\partial U/\partial p_a<0$, $\partial^2U/\partial p_a{}^2\geq 0$, $\partial U/\partial I>0$, $\partial^2U/\partial I^2\leq 0$, $\partial^2U/\partial I\partial P_i(\sigma)\leq 0$.

<u>Assumptions on parameters:</u>

(a) $w/p^*>f'(0)$ (in a good state, the real city wage is higher than the highest possible marginal agricultural income)[17];

(b) $w/\underline{p}<f'(M)$ (in a bad state, the real city wage is lower than the lowest possible marginal agricultural income)[18].

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[17] Compared with urban occupations, an opinion survey shows that most rural residents regarded farming as the worst occupation in the society in terms of income (IESR, 1988). Interpreting the good state in the model as a normal year, using rural incomes to approximate the marginal products of labor of agriculture, it is easy to find evidence that rural nominal incomes are significantly lower than urban nominal wages. For example, in 1988, average Chinese rural per capita annual income was 545 yuan and average Chinese urban per capita annual income was 1192 yuan (SSB, 1989, pp. 729-743). Suppose rural-urban migrants' annual income is the same as urban residence, in a normal year, if the food price in the free markets is 200 percent of the official price, and two third of migrants' expenditure is for food consumption, then the real income of rural-urban migrants is still higher than rural laborers.

[18] Even in a normal year, food consumption accounted for more than half of the total consumptions for both rural and urban residents in China. In a bad state, when the price of food in the free markets increases greatly (e.g. in the early 1960s the food price increased several hundred percent in the free markets), the real income of rural-urban migrants, who rely completely on the free markets for food consumption, can be significantly lower than that of rural laborers, since rural laborers' food consumption largely depends on their own agricultural products. According to official sample surveys, from 1978 to 1988, by average about two thirds of rural households' food consumption was made up of their own products (SSB, 1989, p.744). For urban resident households, who enjoy government subsidies and de facto insurance in food supplies, the share of food consumption was larger than 50 percent (SSB, 1989, pp.727-733). For rural-urban immigrants their share of the food consumption in their total expenditure must be significantly larger.

The household migration problem can be expressed as follows:

$$(5)\quad \underset{\mu}{\text{Max.}}\ qU(\mathbf{P}^*,p^*f(M-\mu)+\mu w) + (1-q)U(\underline{\mathbf{P}},\underline{p}f(M-\mu)+\mu w).$$

The FOC of problem (5) is that

$$(6)\quad \Phi=qU_I(\mathbf{P}^*,I(\mu^*,\mathbf{P}^*))(w-p^*f'(M-\mu^*)+(1-q)U_I(\underline{\mathbf{P}},I(\mu^*,\underline{\mathbf{P}}))(w-\underline{p}f'(M-\mu^*)=0.$$

Here, $U_I(\mathbf{P},I(\mathbf{P}))=\partial U(\mathbf{P},I(\mathbf{P}))/\partial I(\mathbf{P})$.

<u>Proposition 1</u>: For a risk averse household with an agricultural technology which is a decreasing return, the household migration problem (5) has a unique solution μ^*.

<u>Proof</u>: see Appendix.

<u>Lemma 1</u>: When all the parameters are fixed,

(i) in the case of $\underline{p}_m=\beta p_m$, $\underline{p}=\beta p$, and w=const, the FOC (6) can be approximated in the neighborhood of the given parameters as follows:

$$\Phi \approx U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))\{-r(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))q\mu w(1-p^*/\underline{p})$$
$$+[q(w-p^*f')+(1-q)(p^*/\underline{p})(w-\underline{p}f')]\}.$$

Here, r(.) is the ARA (absolute risk aversion) evaluated with given parameters;

(ii) in the case of $p_m=\underline{p}_m=1$, the FOC (6) can be approximated in the neighborhood of the given parameters as follows:

$$\Phi \approx U_I(\underline{p},I(\underline{p}))\{-r(\underline{p},I(\underline{p}))q(w-p^*f')(\underline{p}-p)f$$
$$+[q(w-p^*f')+(1-q)(w-\underline{p}f')]\}+qU_{Ip}(\underline{p},I(\underline{p}))[\underline{p}-p](w-p^*f').$$

Here, r(.) is the ARA (absolute risk aversion) evaluated with given parameters;

(iii) if $\underline{p}_m=\beta p_m$ and $\underline{p}=\beta p$, any interior solution μ^* must satisfy the following condition:

$$[w-p^*f'(M-\mu^*)]>[(1-q)/q](p^*/\underline{p})[\underline{p}f'(M-\mu^*)-w];$$

if $p_m=\underline{p}_m=1$, any interior solution μ^* must satisfy the following condition:

$$(w-p^*f'(M-\mu^*))>[(1-q)/q](\underline{p}f'(M-\mu^*)-w);$$

(iv) if r(.) goes to infinity, there is no interior solution.

Proof: see the Appendix.

Proposition 2: (i) In the $\underline{p}_m=\beta p_m$, $\underline{p}=\beta p$, and w=const case, a risk neutral rural household will allocate its laborers in such a way that its expected marginal product of labor equals to the expected urban wage;

(ii) in the $p_m=\underline{p}_m=1$ case, a risk neutral rural household will allocate its laborers in such a way that its expected marginal product of labor is lower than the expected urban wage;

(iii) everything being equal, a household with a higher degree of risk aversion will have fewer rural-urban migrants, i.e. $d\mu/dr<0$.

Proof: see the Appendix.

Proposition 2 implies that the number of rural-urban migrants from risk-averse households will be less than the number from risk-neutral households. Moreover, the number of agricultural laborers in risk-averse households will be more than the

number in risk-neutral households so that its expected marginal product of labor in agriculture will be lower than the expected city wage.

The result of Proposition 2(i) coincides with the Harris-Todaro model's basic assumption: at equilibrium the expected income in cities should be the same as in agriculture. Proposition 2 shows that in general for risk-averse households, i.e. for $r > 0$, rural-urban migration will be lower than that predicted by the Harris-Todaro model, and expected city income will be higher than the expected agricultural income. That is because risk-averse households care more about risks than risk-neutral households. Under this condition in order to ease the negative effect of random shocks, they would allocate more laborers to agriculture than risk-neutral households. This result is consistent with the following important phenomenon which cannot be explained by the Harris-Todaro model and its variations: rural-urban migration is not sufficient in the sense that the expected city wage is higher than expected agricultural income.

Compared with the result from the Harris-Todaro model, this model predicts that there is a labor surplus in agriculture in the sense that the expected marginal product of labor is lower than that in the Harris-Todaro model. Here, the excess labor input in agriculture is an insurance arrangement for rural households. Even though there are city jobs with high wages, rural households rationally choose to limit their out-migrants. This limitation of rural-urban migration results in an expected-wage differentiation between rural areas and urban areas.

This explanation of rural-urban migration and rural-urban wage differentiation is based on the features of risks faced by rural households and the risk-averse preferences of rural households. This theory is different from the popular explanations of the rural-urban migration and wage differentiation in developing economies (for other popular explanations, see Harris and Todaro, 1970, Jorgenson, 1967, Leibenstein, 1957, Lewis, 1954, Mirrlees, 1975, Ranis and Fei, 1961, Sen, 1966 and Stiglitz, 1976 etc.).

It is a common observation that the influence of a random shock may be larger on a poor household than on a rich household. This is because survival is more serious for a poor household when there is a random shock. For a rich household, surviving per se may not be a problem. As a result, a poor household may be more risk-averse than a rich household. Denoting poor and rich by subscript p and r respectively, this phenomenon can be described as $r_p(.)>r_r(.)$. Under this assumption, Proposition 2 predicts that for whatever reasons, if a household is poorer than others, then the number of rural-urban migrants from this household will be fewer than from those other households.

Corollary: If $r_p(.)>r_r(.)$, then a poorer household has fewer rural-urban migrants than a richer household.[19]

This corollary is consistent with the empirical evidence found in China, where there are fewer rural-urban migrants from poor provinces than there are from rich provinces (Geng, 1989). An important implication of this result is that the poor become poorer and the rich become richer when there are opportunities for rural laborers to migrate to cities, and migration provides better chances to earn higher incomes.

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[19] Here, only rural-urban migration is analyzed. The possibility of migration from a poor area to a rich area will be discussed later.

Proposition 3: (i) When households are more optimistic about the state of nature, i.e. when q increases, rural-urban migration will increase, i.e. $d\mu/dq>0$;

(ii) when the agricultural-product price in good state p increases, rural-urban migration will decrease, i.e. $d\mu/dp<0$;

(iii) when the agricultural-product price in bad state $\underline{p}$ increases, if rural households are risk neutral or almost risk neutral (the ARA is very small), rural-urban migration will decrease, i.e. $d\mu/d\underline{p}<0$; if rural households are risk averse, when $\underline{p}$ increases, rural-urban migration may or may not decrease, i.e. $d\mu/d\underline{p}$ is indeterminate.

Proof: see the Appendix.

A policy implication of Propositions 2 and 3 is that stabilizing food prices in the free markets, or providing food insurance for rural-urban migrants, especially for those from poor rural households, is helpful in increasing labor mobility between rural and urban areas, reducing rural-urban wage differentiations, and preventing the widening of the gap between rich and poor areas.

In explaining urbanization or rural-urban migration, there have been two principal competing theories advanced in the literature: population push theory and urban pull theory (Williamson, 1988). The population push theory claims that population growth pressing on limited farm land pushes rural laborers into the cities (Ravenstein, 1889, and Lewis, 1954). The urban pull theory maintains that higher wages associated with the development of industries in urban areas pull migrants into cities (Engels, 1845, 1974). In the following, Proposition 4 analyzes the urban pull effect and Proposition 5 examines the population push effect on rural-urban migration.

Proposition 4: (i) If households are risk neutral or almost risk neutral (i.e. the ARA is very small), when the urban wage increases, rural-urban migration (8) increases, i.e. $d\mu/dw>0$;

(ii) if there are very few rural-urban migrants, when the urban wage increases, rural-urban migration increases regardless of the degree of risk aversion of the households, i.e. if μ is very small, $d\mu/dw>0$;

(iii) if households are risk averse and the number of rural-urban migrants is not too few, when the urban wage increases, the rural-urban migration may or may not increase, i.e. sign $(d\mu/dw)$ is ambiguous.

Proof: see the Appendix.

If there are very few rural-urban migrants, or if rural households are risk neutral or slightly risk averse, other things being equal, the urban pull effect will be significant: an increase of the urban wage pulls more migrants from rural areas. However, when there are already quite a few rural-urban migrants, and when rural households are risk averse, the urban pull effect may or may not exist. More specifically, under the condition that the real urban wage is much higher than agriculture marginal labor productivity in a good state and that the subjective probability of the state's being good is high, i.e. if q, r, μ, and $w-p^*f'$ are large, then when the city wage further increases, rural households would increase the number of laborers in agriculture to strengthen their insurance by reducing the number of migrants. This is because a very risk averse household may want to buy more insurance (increasing laborers in agricuture) when the household has a higher income (city wages increase and the household already has quite a few members in cities).

In most developing economies, or in early stages of industrialization, the number of rural-urban migrants is few compared with rural population. Thus, urban pull effect is significant. However, when there are many rural-urban migrants, the urban pull effect may not be significant.

Proposition 5: (i) For risk-neutral or almost risk-neutral households (i.e. the ARA is very small), when the population of these households increases, rural-urban migration also increases, i.e. $d\mu/dm>0$;

(ii) if agricultural technology exhibits strongly decreasing returns to scale and the marginal product of labor is very low, when the rural population increases, rural-urban migration also increases regardless of the degree of risk aversion of the rural households, i.e. if $f'' \ll 0$, and $f' \to 0$, then $d\mu/dm>0$;

(iii) if agricultural technology does not exhibit strongly decreasing returns to scale and the marginal product of labor is not low, when the population in risk-averse households increases, rural-urban migration may or may not increase, i.e. $d\mu/dm$ is indeterminate.

Proof: see the Appendix.

When the marginal product of labor in agriculture is almost zero[20], or rural households are risk neutral or slightly risk averse, other things being equal, the population push effect will be significant: a population increase in rural households

[20] This is the basic assumption in the classical theory of dual economies (Lewis, 1954 and Ranis and Fei, 1961).

pushes more migrants to urban areas. However, when rural households are risk averse and the marginal product of labor in agriculture is not too low, the population pull effect may or may not exist. More specifically, with high risk aversion and pessimistic households, under the condition that the urban wage is already much higher than the marginal product of labor in agriculture and the degree of decreasing returns in agricultural production is not high, i.e. if q, r, and $w-p^*f'$ are sufficiently large, and the absolute value of f" is not large, then when the population M increases, these households would increase the number of laborers in agriculture to strengthen their insurance by reducing migration. This is because with a low cost of insurance (low degree of decreasing returns in agricultural production) and a reasonably high income, when the endowment of a household increases, the risk averse and pessimistic household may want to buy more insurance.

4. RURAL-RURAL AND RURAL-URBAN MIGRATION

In addition to migrating to urban areas, when there are rich and poor rural areas there will be chances for rural-rural migration: people from a poor rural area may migrate to a rich rural area. Thus, households in poor rural areas have three portfolio instruments: stay on their own land, migrate to rich rural areas, and migrate to urban areas.

According to the Harris-Todaro model, if wages in a rich rural area are lower than in the urban areas, people in both rich and poor rural areas should migrate to urban areas. Moreover, people in poor rural areas should migrate more to urban areas than people in rich rural areas. However, casual evidence shows that in China

many more people in poor rural areas migrate to rich rural areas than to urban areas, while people in rich rural areas are migrating to urban areas. This phenomenon itself contributes to the insufficient rural-urban migration and needs to be explained. In this section, the basic model is extended to analyze this phenomenon.

To simplify the analysis, only one polar case is analyzed, i.e. the case that both prices π_a and π_m increase by the same factor $\beta>1$ in a bad state. Moreover, I assume that rural households in all rural areas are the same except that the technology in a poor area is less productive than the technology in a rich area. That is, the prosperity of rural areas is determined by exogenous factors (e.g. land quality or other technical factors). Agricultural production technologies with a labor input of N in rich and poor rural areas are described by the production functions $f_r(N)$ and $f_p(N)$ respectively. f_r and f_p satisfy the following properties: $f_r(N)>f_p(N)$, $f_r'(N)>f_p'(N)>0$, $f_r''(N)<0$ and $f_p''(N)<0$. Assumptions (a) and (b) on parameters in the Section 3 are the same.

The income of a rural-rural migrant is the marginal product of his/her labor on rented land.[21] Moreover, this agricultural income is real, as opposed to the the city wage which is nominal. The income of a rich rural household from its land is the total output of its land minus the payment to the hired migrants. The members of households both in rich rural areas and in poor areas may migrate to urban areas. Assume that the city wage level is exogenously given and is not indexed[22]. The

[21] To focus on my point, I ignore the uncertainties in agricultural production and the contractual problems between a rich household, which hires laborers and provides land and capital, and employees. I simply assume that an employee earns his marginal product of labor.

[22] If city firm managers are risk averse, wages will not be indexed. When the managers are also rural migrants, or when the firms are small, assuming managers' risk aversion is easily justifiable.

income of a poor household I_p is the summation of the agricultural income from its own land (total output) and the income from rural-rural migrants (marginal products of labor), as well as the income from rural-urban migrants (wages). The income of a rich household I_r is the summation of the agricultural income from its own land (total output minus the salary to migrants), and the income from rural-urban migrants (wages). Formally, I_p and I_r in different states are the following:

$$I_p(n,\mu_p,\mathbf{P}^*)=p[f_p(M-n-\mu_p)+nf_r'(n_r+M-\mu_r)]+\mu_p w;$$

$$I_p(n,\mu_p,\underline{\mathbf{P}})=\underline{p}[f_p(M-n-\mu_p)+nf_r'(n_r+M-\mu_r)]+\mu_p w;$$

$$I_r(\mu_r,\mathbf{P}^*)=p[f_r(n_r+M-\mu_r)-n_r f_r'(n_r+M-\mu_r)]+\mu_r w;$$

$$I_r(\mu_r,\underline{\mathbf{P}})=\underline{p}[f_r(n_r+M-\mu_r)-n_r f_r'(n_r+M-\mu_r)]+\mu_r w.$$

Here, μ_p and μ_r are the numbers of rural-urban migrants originally from poor areas and from rich areas respectively, n is the number of rural-rural migrants from poor rural households, n_r is the number of migrant laborers hired by a rich household. n_r is collectively determined by the labor market. For a single rich household, it is exogenously given.

The expected indirect utilities of a rich household and a poor household are the following respectively:

$$U^r(\mu_r) = qU(\mathbf{P}^*,I_r(\mu_r,\mathbf{P}^*)) + (1-q)U(\underline{\mathbf{P}},I_r(\mu_r,\underline{\mathbf{P}}));$$

$$U^p(n,\mu_p) = qU(\mathbf{P}^*,I_p(n,\mu_p,\mathbf{P}^*)) + (1-q)U(\underline{\mathbf{P}},I_p(n,\mu_p,\underline{\mathbf{P}})).$$

Here, the expected utility function is defined as follows:

$$U(p_a,I(\mu,p_a)) = V(X(p_a,I(\mu,p_a)).$$

U(.) satisfies the following properties: $\partial U/\partial p<0, \partial^2 U/\partial p^2\geq 0, \partial U/\partial I>0, \partial^2 U/\partial I^2\leq 0$, and $\partial^2 U/\partial I\partial\pi_i(\sigma)\leq 0$.

The rich rural household migration problem is basically the same as the basic model. In the following, I concentrate on the poor rural household migration problem.

A poor rural household chooses the number of rural-rural migrants and the number of rural-urban migrants to maximize its expected utility, given that a rural rich household chooses the number of rural-urban migrants to maximize its expected utility.

The migration problem for a household in poor areas is the following:

(7) $$\max_{n,\mu_p}\; qU(\mathbf{P}^*,p[f_p(M-n-\mu_p)+nf_r'(n_r+M-\mu_r)]+\mu_p w) + (1-q)U(\underline{\mathbf{P}},\underline{p}[f_p(M-n-\mu_p)+nf_r'(n_r+M-\mu_r)]+\mu_p w).$$

(8) $$\text{s.t. } \mu_r = \text{argmax. } U^r = qU(\mathbf{P}^*,p[f_r(n_r+M-\mu_r)-n_r f_r'(n_r+M-\mu_r)]+\mu_r w + (1-q)U(\underline{\mathbf{P}},\underline{p}[f_r(n_r+M-\mu_r)-n_r f_r'(n_r+M-\mu_r)]+\mu_r w).$$

(8) can be replaced by its First Order Condition as follows:

(8a) $$qU_I(w-p^*f_r'(n_r+M-\mu_r)+n_r p^* f_r''(n_r+M-\mu_r)) + (1-q)U_I(w-\underline{p}f_r'(n_r+M-\mu_r)+n_r\underline{p}f_r''(n_r+M-\mu_r))=0.$$

The FOCs of problem (7) are the following:

(9) $$\partial U/\partial n = [qU_I p+(1-q)U_I\underline{p}][f_r'(n_r+M-\mu_r)-f_p'(M-n^*-\mu_p^*)] = 0,$$

or

(9') $f_r'(n_r+M-\mu_r)=f_p'(M-n^*-\mu_p^*)$.

And,

(10) $\partial U/\partial \mu_p = qu_I(w-p^* f_p'(M-n^*-\mu_p^*)) + (1-q)U_I(w-\underline{p}f_p'(M-n^*-\mu_p^*))=0$.

Proposition 6: For risk-averse households with decreasing return agricultural technologies, the household migration problem (7) has a unique solution $\{\mu_p^*, n^*\}$.

Proof: see the Appendix.

It is easy to see from the first order condition (9') that in equilibrium there is migration from poor rural areas to rich rural areas and urban areas such that the marginal product of labor in poor rural areas is equal to that in rich areas.

Proposition 7: For a rural household in a poor rural area where it has opportunities to migrate to rich rural areas and urban areas,

(i) when the rural household is risk neutral, it will allocate its laborers, which include rural-rural migrants, rural-urban migrants, and the laborers at home, in such a way that the expected marginal product of labor equals the expected urban wage;

(ii) as the household becomes more risk averse, the number of rural-urban migrants in this household will decrease, i.e. $d\mu_p/dr<0$;

(iii) when the household becomes more risk averse, the number of rural-rural migrants in this household will increase, i.e. $dn/dr>0$;

(iv) the number of rural-urban migrants from poor rural areas is less than the number from rich areas, i.e. $\mu_r>\mu_p$;

(v) compared with people from rich rural areas, people from poor rural areas are more likely work in agriculture, i.e. $m-\mu_r < m-\mu_p$.

Proof: see the Appendix.

Proposition 8: For a risk-averse rural household in a poor rural area where it has opportunities to migrate to rich rural areas and urban areas, we have the following results:

(i) when the agricultural-product price in a good state p increases, rural-rural migration increases and rural-urban migration decreases, i.e. $\partial n/\partial p > 0$ and $\partial \mu_p/\partial p < 0$;

(ii) when the agricultural-product price in a bad state $\underline{p}$ increases, rural-rural migration increases and rural-urban migration decreases, i.e. $\partial n/\partial \underline{p} > 0$ and $\partial \mu_p/\partial \underline{p} < 0$;

(iii) when the poor household is more optimistic about the state of nature, i.e. when the subjective probability q increases, rural-rural migration decreases and rural-urban migration increases, i.e. $\partial n/\partial q < 0$ and $\partial \mu_p/\partial q > 0$.

Proof: see the Appendix.

Proposition 9: (i) For a risk-neutral or almost risk-neutral poor rural household (i.e. the ARA is almost 0), when the city wage increases, rural-rural migration decreases and rural-urban migration increases, i.e. $dn/dw<0$ and $d\mu_p/w > 0$;

(ii) if there are very few rural-urban migrants, when the urban wage increases, rural-urban migration increases and rural-rural migration decreases regardless of the degree of risk aversion of the households, i.e. if μ_p is very small, $dn/dw<0$ and $d\mu_p/w > 0$;

(iii) for a risk-averse poor rural household, when the city wage increases, rural-rural migration may or may not decrease, i.e. dn/dw is ambiguous. Moreover, the change of rural-urban migration is in the opposite direction of dn/dw, i.e. sign $d\mu_p/dw$ = sign -dn/dw is also ambiguous.

Proof: see the Appendix.

Proposition 10: (i) For a risk-neutral or almost risk-neutral poor rural household, if production in a rich area shows stronger decreasing returns to scale than in a poor area, i.e. $f_r'' \leq f_p''$, then when the population of a household increases, rural-rural migration decreases and rural-urban migration increases, i.e. $\partial n/\partial m < 0$ and $\partial \mu_p/\partial m > 0$;

(ii) if the agricultural technology in a poor area exhibits strong decreasing returns to scale and the marginal product of labor is very low, and if production in a rich area shows a stronger decreasing return to scale than in a poor area, i.e. $f_r'' \leq f_p''$, when the rural population increases, rural-rural migration decreases and rural-urban migration increases regardless of the degree of risk aversion of the rural households, i.e. if $f_p'' << 0$, and $f_p' \to 0$, then $\partial n/\partial m < 0$ and $\partial \mu_p/\partial m > 0$;

(iii) in general, when the population of a household increases, rural-rural migration may or may not increase, i.e $\partial n/\partial m$ is ambiguous. Moreover, sign $\partial \mu_p/\partial m$ is also ambiguous.

Proof: see the Appendix.

5. APPLICATION OF THE MODEL: LAND TAX AND LANDLESS HOUSEHOLDS

Land Tax

Some taxation under certain circumstances may affect rural-urban migration. In the following, the model is employed to analyze the effect of land taxes on rural-urban migration. Land taxes in this model are taxes imposed on a rural household solely based on the area cultivated in agricultural production. Two kinds of land taxes are analyzed: a monetary land tax and a real land tax[23].

With a monetary or a nominal land tax, the incomes of a household in different states are the following:

$$I(\mathbf{P}^*)=p^*f(M-\mu)+\mu w-t;$$

$$I(\underline{\mathbf{P}})=\underline{p}f(M-\mu)+\mu w-t.$$

Proposition 11: With a nominal land tax t,

(i) if rural households are risk-neutral, or have a constant ARA, then the nominal tax has no effect on rural-urban migration, i.e. $d\mu/dt=0$;

(ii) if households are less risk averse in a good state than in a bad state, i.e. if $r(\mathbf{P}^*,I(\mathbf{P}^*))<r(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))$, then when the nominal tax increases, rural-urban migration will decrease, i.e. $d\mu/dt<0$.

Proof: see the Appendix.

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[23] The effect of many other lump sum taxes on rural-urban migration are virtually the same as the land taxes analyzed here.

A fixed nominal tax is lighter in a bad year (when nominal agricultural income is higher) than in a good year (when nominal agricultural income is lower). The effect of a nominal land tax on rural-urban migration does not depend on the level of risk aversion of rural households, but depends on the risk aversion gap between a bad state and a good state. The higher the degree of risk aversion in a bad state over that in a good state, the larger the effect of the tax on the migration. If risk aversion is independent of the states, a nominal land tax has no effect on rural-urban migration. However, with a real land tax or a land tax in kind, the effect of the tax on migration will be different. In this case, the incomes of a household in different states are the following:

$$I(\mathbf{P}^*)=p[f(M-\mu)-T]+\mu w;$$

$$I(\underline{\mathbf{P}})=\underline{p}[f(M-\mu)-T]+\mu w.$$

Proposition 12: With a real land tax T,

(i) if a household is risk neutral, then the real land tax has no effect on rural-urban migration, i.e. $d\mu/dT=0$;

(ii) for any risk-averse household, when the real land tax increases, rural-urban migration will decrease, i.e. $d\mu/dT<0$.

Proof: see the Appendix.

Proposition 12 shows that the effect of a real land tax on rural-urban migration depends on the degree of risk aversion. The larger risk aversion, the stronger the

effect of the tax on rural-urban migration. In fact, in China the most important tax in rural areas is the real land tax. A heavy real land tax in China further reduces rural-urban migration.

The Migration of Landless Rural Households

In the previous part of the paper, I have analyzed the cases where all of the rural households have crop land. Next, I extend this model to the case of landless rural households.

The migration problem for a landless household is the following:

$$(7^*)\quad \underset{\mu_L}{\text{Max.}}\ qU(\mathbf{P}^*, p^{*}*(M-\mu_L)f_r'(n_r+M-\mu_r)+\mu_L w) + (1-q)U(\underline{\mathbf{P}}, \underline{p}(M-\mu_L)f_r'(n_r+M-\mu_r)+\mu_L w).$$

$$(8)\quad \text{s.t. } \mu_r = \text{argmax. } U^r = qU(\mathbf{P}^*, p[f_r(n_r+M-\mu_r)-n_r f_r'(n_r+M-\mu_r)] + \mu_r w + (1-q)U(\underline{\mathbf{P}}, \underline{p}[f_r(n_r+M-\mu_r) - n_r f_r'(n_r+M-\mu_r)]+\mu_r w).$$

Here, μ_L is the number of rural-urban migrants from a landless rural household.

(8) can be replaced by its FOC as follows:

$$(8a)\quad qU_I(w-p^* f_r'(n_r+M-\mu_r)+n_r p^* f_r''(n_r+M-\mu_r)) + (1-q)U_I(w-\underline{p}f_r'(n_r+M-\mu_r)+n_r\underline{p}f_r''(n_r+M-\mu_r))=0.$$

The FOC of problem (7*) is the following:

$$(10^*)\quad \partial U/\partial\mu_L = qu_I(w-p^* f_r') + (1-q)U_I(w-\underline{p}f_r').$$

Here, f_r' is the marginal labor productivity of a rich household farm, and is independent of μ_L.

In general, $\partial U/\partial \mu_L$ does not equal zero, i.e. there is no interior solution for the landless households. If the gap between the real urban wage and the agricultural income in a good state is wide and the landless rural households are optimistic about the state of nature, such that the expected marginal utility of migrating to the city is positive, i.e. $\partial U/\partial \mu_L>0$, or $qu_I(w-p^*f_r') > (1-q)U_I(\underline{p}f_r'-w)$, then all of the landless laborers migrate to cities. Obviously, if the marginal labor productivity in agriculture is very low, then we must have $qu_I(w-p^*f_r') > (1-q)U_I(\underline{p}f_r'-w)$. However, if landless rural households are pessimistic about the state of nature, and agricultural income is significantly higher than the real urban wage in a bad state, such that the expected marginal utility of migrating to the city is negative, i.e. $\partial U/\partial \mu_L<0$, or $qu_I(w-p^*f_r') < (1-q)U_I(\underline{p}f_r'-w)$, then none of the landless laborers would migrate to cities; instead, they would take agricultural jobs either by migrating to other rural areas or by renting crop land in their home villages. Similarly, if the marginal labor productivity in agriculture is quite high, say $f_r'=w/p^*$, then we must have $qu_I(w-p^*f_r') < (1-q)U_I(\underline{p}f_r'-w)$.

<u>Proposition 13</u>: For landless rural households,

(i) there is no interior solution for their migration problem;

(i) all landless rural household members migrate to cities if marginal labor productivity in agriculture is very low, i.e. if $f_r'\rightarrow 0$;

(ii) all landless rural household members stay in agriculture if marginal labor productivity in agriculture is high, i.e. if $f_r'\rightarrow w/p^*$.

These results provide some clues as to the explanation of the differences between the reformed Chinese economy and some other developing economies. In China and in other developing countries, rural households face a similar problem: marginal labor productivity in agriculture is very low. However, in China, almost all of the rural households have land, and rural-urban migrants face big uncertainties in the free markets. According to the results above, under these conditions migration will be limited to a low level. In contrast, in most developing countries (similarly in the early stages of British industrial revolutions) a considerable number of rural households are landless, and rural-urban migrants are not as clearly differentiated from other urban residents in the markets as they are in China. When the real urban wage is sufficiently higher than agricultural income in a good state, such that the expected marginal utility of migrating to cities is positive, more landless people will migrate to cities. "Too much" migration and migration-related unemployment may be the result.

APPENDIX

Proof of Proposition 1:

Problem (5) is strictly concave which can be shown by the following Second Order Condition:

$$(7)\qquad d\Phi/d\mu = q[U_I(P^*,Ip^*(^*f''+U_{II}(\mathbf{P}^*,I)(w-p^*f')^2] +(1-q)[U_{II}(\mathbf{P}^*,I)(w-\underline{p}f')^2+U_I(\underline{\mathbf{P}},I)f''] < 0.$$

Here, $U_{II}(\mathbf{P}^*,I(\mathbf{P}^*))=\partial^2U(\mathbf{P}^*,I(\mathbf{P}^*))/\partial I^2(\mathbf{P}^*)$ and $U_{II}(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))=\partial^2U(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))/\partial I^2(\underline{\mathbf{P}})$. Moreover, μ is confined to a closed interval [0,m]. Therefore, problem (5) has a unique solution.■

Proof of Lemma 1:

(i) $\underline{p}_m=\beta p_m$ and $\underline{p}=\beta p$ case. The indirect utility is homogeneous degree of zero[24], that is,

$$U(\mathbf{P}^*,I) = U(\alpha\mathbf{P}^*,\alpha I) \text{ or } U_I(\mathbf{P}^*,I) = \alpha U_I(\alpha\mathbf{P}^*,\alpha I).$$

Therefore, let $\beta=\underline{p}/p^*$,

$$U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}})) = U_I(\beta p,\beta(1/\beta)I(\underline{\mathbf{P}})) = (1/\beta)U_I(\mathbf{P}^*,(1/\beta)I(\underline{\mathbf{P}})) = (p^*/\underline{p})U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}})).$$

Moreover,

$$(p^*/\underline{p})I(\underline{\mathbf{P}}) = p^*f+(p^*/\underline{p})\mu w < p^*f+\mu w = I(\mathbf{P}^*),\ U(\mathbf{P}^*,I(\mathbf{P}^*)) > U(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))$$

for any $p<\underline{p}$.

Thus, $U_I(\mathbf{P}^*,I(\mathbf{P}^*)) < U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))$.

[24] To avoid the complications caused by $\partial^2U/\partial I\partial p$, in the following the homogeneous property of the indirect utility function is employed.

Given p, $\underline{p}$ and other parameters, $U_I(\mathbf{P}^*,I(\mathbf{P}^*))$ can be approximated in the neighbor of $U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))$:

$$U_I(\mathbf{P}^*,I(\mathbf{P}^*)) \approx U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}})) + U_{II}(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))[I(\mathbf{P}^*)-(p^*/\underline{p})I(\underline{\mathbf{P}})]$$
$$= U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}})) + U_{II}(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))\mu w(1-p^*/\underline{p}).$$

Using the above results to rearrange (6),

$$(6')\qquad \Phi= qU_I(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')+(1-q)U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')$$
$$= q[U_I(\mathbf{P}^*,I(\mathbf{P}^*))-(\underline{p}/p^*)U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))](w-p^*f') +U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))[q(\underline{p}/p^*)(w-p^*f')+(1-q)(w-\underline{p}f')]$$
$$= q[U_I(\mathbf{P}^*,I(\mathbf{P}^*))-U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))](w-p^*f') +U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{p}))[q(w-p^*f')+(1-q)(p^*/\underline{p})(w-\underline{p}f')]$$
$$\approx qU_{II}(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))[I(\mathbf{P}^*)-(p^*/\underline{p})I(\underline{\mathbf{P}})](w-p^*f') +U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))[q(w-p^*f')+(1-q)(p^*/\underline{p})(w-\underline{p}f')]$$
$$= U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))\{-r(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))q\mu w(1-p^*/\underline{p}) +[q(w-p^*f')+(1-q)(p^*/\underline{p})(w-\underline{p}f')]\}.$$

Here, $r(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}})) = -U_{II}(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))/U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))$ is the ARA evaluated with the given parameters. Assuming that all parameters are fixed, then r(.) can be treated as a parameter r.

(ii) $p_m=\underline{p}_m=1$ case. Given p, $\underline{p}$ and other parameters, $U_I(p,I(p))$ can be approximated in the neighbor of $U_I(\underline{p},I(\underline{p}))$:

$$U_I(p,I(p)) \approx U_I(\underline{p},I(\underline{p}))+U_{II}(\underline{p},I(\underline{p}))[I(\underline{p})-I(p)]+U_{Ip}(\underline{p},I(\underline{p}))[\underline{p}-p]$$
$$= U_I(\underline{p},I(\underline{p}))+U_{II}(\underline{p},I(\underline{p}))(\underline{p}-p)f+U_{Ip}(\underline{p},I(\underline{p}))[\underline{p}-p].$$

Using the above results to rearrange (6), (6") $\Phi = qU_I(p,I(p))(w-p^*f')+(1-q)U_I(\underline{p},I(\underline{p}))(w-\underline{p}f')$

$= q[U_I(p,I(p))-U_I(\underline{p},I(\underline{p}))](w-p^*f')$

$+U_I(\underline{p},I(\underline{p}))[q(w-p^*f')+(1-q)(w-\underline{p}f')]$

$\approx q\{U_{II}(\underline{p},I(\underline{p}))[I(\underline{p})-I(p)]+U_{Ip}(\underline{p},I(\underline{p}))[\underline{p}-p]\}(w-p^*f')$

$+U_I(\underline{p},I(\underline{p}))[q(w-p^*f')+(1-q)(w-\underline{p}f')]$

$= U_I(\underline{p},I(\underline{p}))\{-r(\underline{p},I(\underline{p}))q(w-p^*f')(\underline{p}-p)f$

$+[q(w-p^*f')+(1-q)(w-\underline{p}f')]\}+qU_{Ip}(\underline{p},I(\underline{p}))[\underline{p}-p](w-p^*f')$.

Here, $r(\underline{p},I(\underline{p})) = -U_{II}(\underline{p},I(\underline{p}))/U_I(\underline{p},I(\underline{p}))$ is the ARA evaluated with the given parameters. Assuming that all parameters are fixed, then r(.) can be treated as a parameter r.

(iii) From (6′),

$\Phi \approx U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))\{-r(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))q\mu w(1-p^*/\underline{p})+[q(w-p^*f')$

$+(1-q)(p^*/\underline{p})(w-\underline{p}f')]\}=0$.

This implies

$q(w-p^*f')+(1-q)(p^*/\underline{p})(w-\underline{p}f')>0$ or $[w-p^*f']>[(1-q)/q][\underline{p}f'-w]$.

From (6"),

$\Phi \approx U_I(\underline{p},I(\underline{p}))\{-r(\underline{p},I(\underline{p}))q(w-p^*f')(\underline{p}-p)f$

$+[q(w-p^*f')+(1-q)(w-\underline{p}f')]\}+qU_{Ip}(\underline{p},I(\underline{p}))[\underline{p}-p](w-p^*f')=0$.

This implies

$q(w-p^*f')+(1-q)(w-\underline{p}f')>0$, or $(w-p^*f')>[(1-q)/q](\underline{p}f'-w)$.

(iv) It is obvious from (6′) and (6"). ■

Proof of Proposition 2:

(i) $\underline{p}_m=\beta p_m$ and $\underline{p}=\beta p$ case. If r(.) = 0, by Lemma 1, (6′) is reduced to the following: $\Phi = U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))[w-f'(qp+(1-q)\underline{p}] = 0$.

Or, $qw+(1-q)w = qp^*f'+(1-q)\underline{p}f'$.

This simply means:

Expected real city wage = Expected agricultural marginal income.

(ii) $p_m=\underline{p}_m=1$ case. If r(.) = 0, by Lemma 1, (6") is reduced to the following:

$\Phi = U_I(\underline{p},I(\underline{p}))[q(w-p^*f')+(1-q)(w-\underline{p}f')]+qU_{Ip}(\underline{p},I(\underline{p}))[\underline{p}-p](w-p^*f')=0$.

Since $qU_{Ip}(\underline{p},I(\underline{p}))[\underline{p}-p](w-p^*f')<0$, this implies

$q(w-p^*f')+(1-q)(w-\underline{p}f')>0$,

or $qw+(1-q)w > qp^*f'+(1-q)\underline{p}f'$.

(iii) By Lemma 1,

$d\Phi/dr = -U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))q\mu w(1-p^*/\underline{p})<0$.

$d\mu/dr = -\Phi_r/\Phi_\mu < 0$. ■

Proof of Proposition 3:

(i) By (6),

$\Phi = qU_I(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')+(1-q)U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')$.

Thus, $\Phi_q=U_I(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')-U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')$.

By assumptions (a) and (b),

$\Phi_q>0$, or $d\mu/dq>0$.

(ii) Similarly,

$$\Phi_p=q[U_{Ip}(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')-U_I(\mathbf{P}^*,I(\mathbf{P}^*))f'$$

$$+U_{II}(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')f]<0, \text{ i.e. } d\mu/dp<0.$$

(iii) $$\Phi_{\underline{p}}=(1-q)[U_{I\underline{p}}(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))-U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))f'+U_{II}(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')f]$$

$$=(1-q)\{U_{I\underline{p}}(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))-U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))[f'+r(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')f]\}$$

$$\lim_{r\to 0} \Phi_{\underline{p}}<0, \text{ i.e. } \lim_{r\to 0} d\mu/d\underline{p}<0.$$ ■

Proof of Proposition 4:

$$\Phi =qU_I(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')+(1-q)U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')$$

$$\Phi_w=q[U_I(\mathbf{P}^*,I(\mathbf{P}^*))+U_{II}(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')\mu]$$

$$+(1-q)[U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))+U_{II}(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')\mu]$$

$$=qU_I(\mathbf{P}^*,I(\mathbf{P}^*))[1-r(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')\mu]$$

$$+(1-q)U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))[1-r(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')\mu]$$

(i) $$\lim_{r\to 0} \Phi_w = qU_I(\mathbf{P}^*,I(\mathbf{P}^*))+(1-q)U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}})) > 0.$$

(ii) $$\lim_{\mu\to 0} \Phi_w = qU_I(\mathbf{P}^*,I(\mathbf{P}^*))+(1-q)U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}})) > 0.1$$

(iii) In general, for $r(.)>0$, sign Φ_w is ambiguous. Thus, $d\mu/dw$ is indeterminate.■

Proof of Proposition 5:

$$\Phi_m=q[U_I(\mathbf{P}^*,I)(-p^*f'')+U_{II}(\mathbf{P}^*,Ip^*(^*f'(w-p^*f')]$$

$$+(1-q)[U_I(\underline{\mathbf{P}},I)(-\underline{p}f'')+U_{II}(\underline{\mathbf{P}},I)(w-\underline{p}f')\underline{p}f']$$

$$=qU_I(\mathbf{P}^*,I)[-p^*f''-r(\mathbf{P}^*,I)p^*f'(w-p^*f')]$$

$$+(1-q)U_I(\underline{\mathbf{P}},I)[-\underline{p}f''-r(\underline{\mathbf{P}},I)(w-\underline{p}f')\underline{p}f'].$$

(i) $$\lim_{r\to 0} \Phi_m = qU_I(\mathbf{P}^*,I)[-p^*f'']+(1-q)U_I(\underline{\mathbf{P}},I)[-\underline{p}f''] > 0.$$

(ii) $$\lim_{f'\to 0} \Phi_m = qU_I(\mathbf{P}^*,I)[-p^*f'']+(1-q)U_I(\underline{\mathbf{P}},I)[-\underline{p}f''] > 0.$$

(iii) In general, when $r(.)>0$, sign Φ_m is ambiguous.■

Proof of Proposition 6:

Problem (7) is strictly concave which can be shown by the following SOCs:

(11) $$U_{nn}= qp[U_{II}(f_r'(n_r+M-\mu_r)-f_p'(M-n-\mu_p))^2+U_If_p''(M-n-\mu_p)]$$

$$+ (1-q)\underline{p}[U_{II}(f_r'(n_r+M-\mu_r)-f_p'(M-n-\mu_p))^2+U_If_p''(M-n-\mu_p)]$$

$$= qpU_I[-r(.)(f_r'(n_r+M-\mu_r)-f_p'(M-n-\mu_p))^2+f_p''(M-n-\mu_p)]$$

$$+ (1-q)\underline{p}U_I[-r(.)(f_r'(n_r+M-\mu_r)-f_p'(M-n-\mu_p))^2+f_p''(M-n-\mu_p)]$$

$$= [qpU_I(\mathbf{P}^*,I_p(\mathbf{P}^*)) + (1-q)\underline{p}(U_I(\underline{\mathbf{P}},I_p(\underline{\mathbf{P}}))]\ f_p''(M-n-\mu_p)$$

$$< 0$$

From (9),

(12) $$U_{n\mu}= qp[U_{II}(f_r'(n_r+M-\mu_r)-f_p'(M-n-\mu_p))(w-p^*f_p')+U_If_p''(M-n-\mu_p)]$$

$$+ (1-q)\underline{p}[U_{II}(f_r'(n+M-\mu_r)-f_p'(M-n-\mu_p))(w-\underline{p}f_p')+U_If_p''(M-n-\mu_p))]$$

$$= qpU_I[-r(.)(f_r'(n+M-\mu_r)-f_p'(M-n-\mu_p))(w-p^*f_p')+f_p''(M-n-\mu_p)]$$

$$+ (1-q)\underline{p}U_I[-r(.)(f_r'(n+M-\mu_r)-f_p'(M-n-\mu_p))(w-\underline{p}f_p')+f_p''(M-n-\mu_p))]$$

$$= qpU_I(\mathbf{P}^*,I_p(\mathbf{P}^*)) + (1-q)\underline{p}U_I(\underline{\mathbf{P}},I_p(\underline{\mathbf{P}}))]f_p''(M-n-\mu_p))$$

$$< 0$$

From (10),

(13) $$U_{\mu\mu} = q[U_{II}(w-p^*f_p')^2 + U_I(p^*f_p'')] + (1-q)[U_{II}(w-\underline{p}f_p')^2+U_I(\underline{p}f_p'')]$$
$$= qU_I[-r(.)(w-p^*f_p')^2 + (p^*f_p'')] + (1-q)U_I[-r(.)(w-\underline{p}f_p')^2+(\underline{p}f_p'')]$$
$$< 0$$

(14) $$|J| = \begin{vmatrix} U_{nn} & U_{n\mu} \\ U_{n\mu} & U_{\mu\mu} \end{vmatrix}$$
$$= U_{nn}U_{\mu\mu} - U_{n\mu}{}^2$$
$$= [qpU_I(g) + (1-q)\underline{p}(U_I(b)]\, f_p''(M-n-\mu_p)$$
$$\{qU_I(g)[-r(.)(w-p^*f_p')^2 + (p^*f_p'')] + (1-q)U_I(b)[-r(.)(w-\underline{p}f_p')^2+(\underline{p}f_p'')]\}$$
$$- [qpU_I(g) + (1-q)\underline{p}U_I(b)]^2\, [f_p''(M-n-\mu_p))]^2$$
$$= [qpU_I(g) + (1-q)\underline{p}U_I(b)]\, f_p''\, [qU_I(gp^*(^*f_p'' + (1-q)U_I(b)\underline{p}f_p'']$$
$$- [qpU_I(g) + (1-q)\underline{p}U_I(b)]^2\, [f_p'']^2$$
$$+ [qpU_I(g)+(1-q)\underline{p}U_I(b)]\, f_p''\, [qU_I(g)r(.)(w-p^*f_p')^2$$
$$+(1-q)U_I(b)r(.)(w-\underline{p}f_p')^2]$$
$$= [qpU_I(g) + (1-q)\underline{p}U_I(b)]^2\, f_p''\, f_p''$$
$$- [qpU_I(g) + (1-q)\underline{p}U_I(b)]^2\, [f_p'']^2$$
$$+ [qpU_I(g)+(1-q)\underline{p}U_I(b)]\, f_p''\, [qU_I(g)r(.)(w-p^*f_p')^2$$
$$+ (1-q)U_I(b)r(.)(w-\underline{p}f_p')^2]$$
$$= qpU_I(g)+(1-q)\underline{p}(U_I(b)]\, f_p''\, [qU_I(g)r(.)(w-p^*f_p')^2+(1-q)U_I(b)r(.)(w-\underline{p}f_p')^2$$
$$> 0.$$

Moreover, both μ_p and n are confined to a closed interval [0,m]. Therefore, problem (7) has an unique maximum.■

Proof of Proposition 7:

The FOC (10) is the same as (6). Therefore, Lemma 1 is applicable to problem (7). By Lemma 1(i),

(10′) $$U_\mu \approx U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))\{-r(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))q\mu w(1-p^*/\underline{p})$$
$$+[q(w-p^*f')+(1-q)(p^*/\underline{p})(w-\underline{p}f')].$$

Here, $r(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}})) = -U_{II}(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))/U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))$ is the ARA evaluated with the given parameters. Assuming that all parameters are fixed, r(.) can be treated as a parameter.

(i) When r(.)=0,

(10″) $$U_\mu \approx U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))[q(w-p^*f')+(1-q)(p^*/\underline{p})(w-\underline{p}f')].$$

At equilibrium, when r(.)=0, n^* and $\mu_p{}^*$ are chosen such that (10″) and (9′) are satisfied. (10″) implies that

$$qw+(1-q)w = qp^*f_p'(M-n^*-\mu_p{}^*)+(1-q)\underline{p}f_p'(M-n^*-\mu_p{}^*).$$

To prove the remaining part of the proposition, totally differentiate the FOCs (9) and (10):

(15) $$U_{nn}dn+U_{n\mu}d\mu_p=-U_{np}dp-U_{n\underline{p}}d\underline{p}-U_{nq}dq-U_{nm}dm-U_{nw}dw-U_{nr}dr,$$

(16) $$U_{\mu n}dn+U_{\mu\mu}d\mu_p=-U_{\mu p}dp-U_{\mu\underline{p}}d\underline{p}-U_{\mu q}dq-U_{\mu m}dm-U_{\mu w}dw-U_{\mu r}dr.$$

Rearrange (15) and (16),

$$\begin{bmatrix} U_{nn} & U_{n\mu} \\ U_{\mu n} & U_{\mu\mu} \end{bmatrix} \begin{bmatrix} \partial n/\partial r \\ \partial\mu_p/\partial r \end{bmatrix} = \begin{bmatrix} -U_{nr} \\ -U_{\mu r} \end{bmatrix} = \begin{bmatrix} 0 \\ U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))q(\underline{p}-p)f_p'(w-p^*f_p')>0 \end{bmatrix}.$$

$$\partial n/\partial r = \frac{\begin{vmatrix} -U_{nr} & U_{n\mu} \\ -U_{\mu r} & U_{\mu\mu} \end{vmatrix}}{|J|}$$

$$\partial \mu_p/\partial r = \frac{\begin{vmatrix} U_{nn} & -U_{nr} \\ U_{\mu n} & -U_{\mu r} \end{vmatrix}}{|J|}$$

Since $|J|>0$,

(17) sign $\partial n/\partial r = U_{n\mu}U_{\mu r}$, and

(18) sign $\partial \mu_p/\partial r = -U_{nn}U_{\mu r}$.

Differentiate (10') with respect to r,

(19) $U_{\mu r}=-U_I(\mathbf{P}^*,(p^*/\underline{p})I(\underline{\mathbf{P}}))q\mu w(1-p^*/\underline{p}) < 0.$

(ii) By (18), (19) and (11), sign $\partial \mu_p/\partial r = -U_{nn}U_{\mu r} = U_{nn} < 0.$

(iii) By (17), (19) and (12), sign $\partial n/\partial r = U_{n\mu}U_{\mu r} > 0.$

(iv) Given $r_p>r_r$, $\partial \mu_p/\partial r < 0$ and $\partial \mu_r/\partial r < 0$, $\mu_r>\mu_p$.

(v) Given $m_r=m_p=m$ and $\mu_r>\mu_p$, the result is obvious.■

Proof of Proposition 8:

(i) Rearrange (15) and (16),

$$\begin{bmatrix} U_{nn} & U_{n\mu} \\ U_{\mu n} & U_{\mu\mu} \end{bmatrix}\begin{bmatrix} \partial n/\partial p \\ \partial \mu_p/\partial p \end{bmatrix} = \begin{bmatrix} -U_{np} \\ -U_{\mu p} \end{bmatrix} = \begin{bmatrix} 0 \\ qU_I w f_p'>0 \end{bmatrix}.$$

$$\partial n/\partial p = \frac{\begin{vmatrix} -U_{np} & U_{n\mu} \\ -U_{\mu p} & U_{\mu\mu} \end{vmatrix}}{|J|}$$

$$\partial \mu_p/\partial p = \frac{\begin{vmatrix} U_{nn} & -U_{np} \\ U_{\mu n} & -U_{\mu p} \end{vmatrix}}{|J|}.$$

Since $|J|>0$,

sign $(\partial \mu_p/\partial p) = U_{nn} < 0$

sign $(\partial n/\partial p) = -U_{n\mu} > 0.$

(ii) and (iii) Similarly,

$U_{n\underline{p}}=0$ and $-U_{\mu\underline{p}}=(1-q)U_I f_p'>0$. Thus,

sign $(\partial n/\partial \underline{p}) = -U_{n\mu} > 0$ and

sign $(\partial \mu_p/\partial \underline{p}) = U_{nn} < 0.$

$U_{nq}=0$ and $-U_{\mu q}=-(U_I(w-p^*f_p') - U_I(w-\underline{p}f_p'))<0$. Thus,

sign $(\partial n/\partial q) = U_{n\mu} < 0$ and

sign $(\partial \mu_p/\partial q) = -U_{nn} > 0.$■

Proof of Proposition 9:

Let us proof part (iii) first. By (9), (10), (15) and (16),

(20) $$\partial n/\partial w = \frac{\begin{vmatrix} -U_{nw} & U_{n\mu} \\ -U_{\mu w} & U_{\mu\mu} \end{vmatrix}}{|J|}$$

(21) $$\partial \mu_p/\partial w = \frac{\begin{vmatrix} U_{nn} & -U_{nw} \\ U_{\mu n} & -U_{\mu w} \end{vmatrix}}{|J|}$$

$U_{nw}=0.$

$$-U_{\mu w}=-\{q[U_{II}(g)(w-p^*f_p')\mu_p + U_I(g)]+ (1-q)[U_{II}(b)(w-\underline{p}f_p')\mu_p + U_I(b)\}$$
$$=qU_I(g)[r(g)(w-p^*f_p')\mu_p - 1] + (1-q)U_I(b)[r(b)(w-\underline{p}f_p')\mu_p - 1]$$

(iii) In general, sign $(-U_{\mu w})$ is ambiguous. By (20) and (21),

$$\text{sign } \partial n/\partial w = \text{sign } U_{n\mu}U_{\mu w} = \text{sign } -U_{\mu w} \text{ and}$$

$$\text{sign } \partial \mu_p/\partial w = \text{sign } -U_{nn}U_{\mu w} = \text{sign } U_{\mu w}.$$

Therefore, sign $\partial n/\partial w$ and sign $\partial \mu_p/\partial w$=sign $-dn/dw$ are ambiguous.

(i) $\lim_{r\to 0} -U_{\mu w} < 0.$

$$\text{sign} \lim_{r\to 0} (\partial n/\partial w) = \text{sign } U_{n\mu} < 0$$

$$\text{sign} \lim_{r\to 0} (\partial \mu_p/\partial w) = \text{sign } -U_{nn} > 0.$$

(ii) $\lim_{\mu_p\to 0} -U_{\mu w} < 0.$

$$\text{sign} \lim_{\mu_p\to 0} (\partial n/\partial w) = \text{sign } U_{n\mu} < 0$$

$$\text{sign} \lim_{\mu_p\to 0} (\partial \mu_p/\partial w) = \text{sign } -U_{nn} > 0.$$ ■

Proof of Proposition 10:

Let us proof part (iii) first. Rearrange (15) and (16),

$$\partial n/\partial m = \frac{\begin{vmatrix} -U_{nm} & U_{n\mu} \\ -U_{\mu m} & U_{\mu\mu} \end{vmatrix}}{|J|}$$

$$\partial \mu_p/\partial m = \frac{\begin{vmatrix} U_{nn} & -U_{nm} \\ U_{\mu n} & -U_{\mu m} \end{vmatrix}}{|J|}$$

$$\text{sign } \partial n/\partial m = \text{sign } (-U_{nm}U_{\mu\mu}+U_{n\mu}U_{\mu m}), \text{ and}$$

$$\text{sign } \partial \mu_p/\partial m = \text{sign } (-U_{nn}U_{\mu m}+U_{nm}U_{\mu n}).$$

Here, sign $U_{nm}=f_r''-f_p''\le 0$, if $f_r''\le f_p''$; $U_{nm}>0$, otherwise.

$$U_{\mu m}=qp[U_{II}(w-p^*f_p')f_p'-U_If_p''] + (1-q)\underline{p}[U_{II}(w-\underline{p}f_p')f_p'-U_If_p'']$$
$$=qpU_I[-r(g)(w-p^*f_p')f_p'-f_p''] + (1-q)\underline{p}U_I[-r(b)(w-\underline{p}f_p')f_p'-f_p'']$$

(iii) In general, when $r(.)>0$, sign $U_{\mu m}$ is ambiguous.

(i) $\lim_{r\to 0} U_{\mu m} > 0,$

If $f_r''\le f_p''$,

$$\lim_{r\to 0} \text{sign } \partial n/\partial m < 0, \text{ and } \lim_{r\to 0} \text{sign } \partial \mu_p/\partial m > 0.$$

(ii) $\lim_{f_p'\to 0} U_{\mu m} > 0,$

If $f_r''\le f_p''$,

$$\lim_{f_p'\to 0} \text{sign } \partial n/\partial m < 0, \text{ and } \lim_{f_p'\to 0} \text{sign } \partial \mu_p/\partial m > 0.$$ ■

Proof of Proposition 11:

$$\Phi_t=-qU_{II}(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')-(1-q)U_{II}(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')$$
$$=qU_I(\mathbf{P}^*,I(\mathbf{P}^*))r(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')+(1-q)U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))r(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')$$

(i) If $r(\mathbf{P}^*,I(\mathbf{P}^*))=r(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))=r$, by the FOC,

$$\Phi_t=[qU_I(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')+(1-q)U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')]r=0, \quad \text{i.e. } d\mu/dt=0.$$

(ii) If $r(\mathbf{P}^*,I(\mathbf{P}^*))<r(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))$, by the FOC and assumptions (a) and (b), $d\mu/dt<0$.■

<u>Proof of Proposition 12:</u>

$$\Phi_T=-qU_{II}(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')p^*-(1-q)U_{II}(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')\underline{p}$$
$$=qU_I(\mathbf{P}^*,I(\mathbf{P}^*))[r(\mathbf{P}^*,I(\mathbf{P}^*))p^*](w-p^*f')+(1-q)U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))[r(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))\underline{p}](w-\underline{p}f')$$

(i) If $r(.)=0$, $\Phi_T=0$, i.e. $d\mu/dT=0$.

(ii) For any risk-averse household, since $p<\underline{p}$ and $r(\mathbf{P}^*)\leq r(\underline{\mathbf{P}})$, thus $pr(\mathbf{P}^*,I(\mathbf{P}^*))=A<\underline{p}r(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))=B$. By the FOC and assumptions (a) and (b),

$$\Phi_T=qU_I(\mathbf{P}^*,I(\mathbf{P}^*))(w-p^*f')A+(1-q)U_I(\underline{\mathbf{P}},I(\underline{\mathbf{P}}))(w-\underline{p}f')B<0.$$

Therefore, $d\mu/dT<0$.■

TABLE 1

<u>Land in the Households of TVE Employees (in percentage)</u>

0 mu	1-5 mu	6-10 mu	11 mu and more
3.8	27.8	31.6	36.8

<u>Source:</u> Lin (1987).

<u>Note:</u> A mu is a Chinese unit of measurement equivalent to about 1/15 hectare.

TABLE 2

Rural-urban and Rural-rural Migration and Agricultural Income

Areas	Agricultural Income per capita (yuan)	Rural-urban migration ratio (a) (1/10 000)	Rural-rural migration ratio (b) (1/10 000)
Zhejiang	809	1234	-869
Heilongjiang	789	704	-576
Inner Mongolia	743	352	-911
Jiangsu	590	717	-496
Fujian	567	1187	- 46.6
Hebei	546	380	116
Guangxi	500	819	107
Ningxia	439	393	- 72.9
Shanxi	357	316	334
Qinghai	295	338	1049

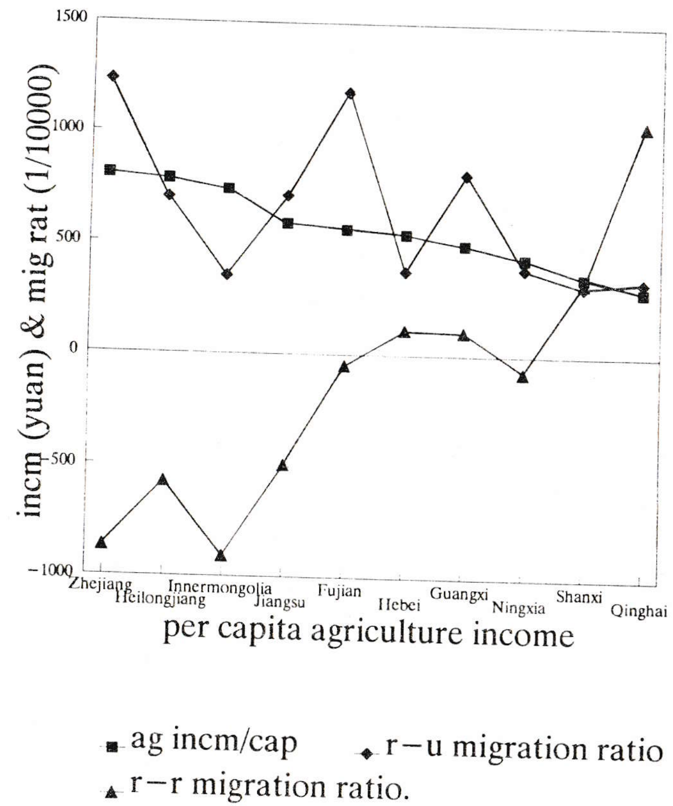
Source: Geng, 1989.

Notes: a) Rural-urban migration ratio: number of rural-urban migrants divided by the total number of the rural labor force. Urban areas here include township, county, mid-city, and large city.

b) Rural-rural migration ratio: number of net rural-rural migrants divided by the total number of the rural labor force. Here, net rural-rural migrants is calculated as follows: the total number of rural-rural migrants minus the number of immigrants. Thus, a negative rural-rural migration ratio means a net immigration into the area and a positive ratio means a net out-migration from the area.

FIGURE

Agricultural Income Per Capita



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