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Intersectoral Migration of Agricultural Labor Force and Business Cycles in Developing Countries

by

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INTERSECTORAL MIGRATION OF AGRICULTURAL LABOR FORCE AND BUSINESS CYCLES IN DEVELOPING COUNTRIES

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Abstract

This paper establishes a framework for an analytical theory of short-run macroeconomic cycles with intersectoral migration of agricultural labor in a developing economy. It defines measurements for the migration and finds cyclical fluctuations in farmer migrations. Data show such fluctuations are much more important in some developing economy than fluctuations in unemployment. A model of the labor and commodity markets is set up to investigate adjustments of both markets in response to external shocks. It shows flexible wages and prices with labor mobility can lead to a new equilibrium, but the economy may experience a slowdown with farmer return migrations.

Keywords: Short-run macroeconomics of developing countries; measures of agricultural labor migration; facts of agricultural labor migration; business cycles with agricultural labor migration; China.

JEL Classification No.: E32, O11, O41.

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Contents

1. Introduction

In a popular textbook on development economics (Perkins, Radeler, Snodgrass, et al., 2001: 3-6), the authors introduce the reader to the discipline with a narrative of a young Malaysian girl named Rachmina. At the age of 17, she leaves her family in a beautiful, poor village and enters an electronics factory set up by a Japanese company, where she works hard and earns much more for her family and herself. Gradually she becomes skilled and is promoted to a supervisory position. Seven years later, as a recession hits the electronics industry and her factory reduces output, she leaves the company with her savings once more to live in her village, but happily this time. Rachmina is, as the authors emphasize, "a personification of the nearly 4 billion people in the developing countries whose lives have been profoundly affected, in many different ways, by economic changes in recent years", (item: 6) and particularly by rural-urban and/or intersectoral migration from agriculture to nonagricultural activity as in Rachmina's case. But unlike her, many emigrants from rural areas or agriculture remain or prefer to remain in urban nonfarm employment. For them, returning to their villages for an agricultural occupation would be an alternative of last resort to maintain their livelihoods, not a happy outcome at all. Why must many migrant "farmers" be confronted with this alternative after several years' employment in the nonfarm sector? There may be several microeconomic reasons (Vandercamp, 1971), but there are macroeconomic reasons also. For example, the external shock that led to a broad decline in industrial production in Malaysia certainly contributed to Rachmina's return decision.

This paper will argue that the economy-wide intersectoral migration of agricultural labor would take the typical form of waves or cyclical fluctuations. A wave of returning migrant farmers to agriculture follows a wave of their massive migration to nonfarm activity and so on. The well-known Kuznets styled fact (Clark, 1957; Kuznets, 1957; 1966) is that labor moves in the single direction from agriculture to nonagricultural sectors in the modern growth era. Taking for granted that the Kuznets fact describes a long-term phenomenon of economic development from a precapitalist to a modern capitalist economy, we will introduce cyclical fluctuations in this movement to show that in the short-run the transfer can occur in both directions -- either from agriculture to nonagriculture or vice verse -- during the development process. For example, Rachmina's migrations out of and back into agriculture could be understood as a personal experience of the cycles of agricultural labor migration. Furthermore, two-directional migration can be a response to short-run macroeconomic fluctuations that impact the developing countries. In fact, the return migration of agricultural labor becomes a serious challenge for economic policy in these countries just at present when the severe international economic crisis has compelled millions of migrant farmers to return to agriculture. It is reported in China, for example, that nearly 20 million migrated industrial workers lost their jobs at the beginning of 2009 and had to return to their remote villages (Caijing, 2009). While the major concern in the US and Western Europe is with unemployment, the wave of involuntary return migration of several million "farmers" draws most attentions in many developing countries, particularly in China. A few figures may help highlight the difference. During the Great Depression the unemployment in the United States reached 13 million in 1933 when total agricultural employment amounted to 10 million. After the current financial crisis burst in September 2008, unemployment increased to more than 10 million in the US in November, 2008, while only 2.2 million farmers work in agriculture (US Government, 2009: Table B35). But at the beginning of 2009, China's official unemployment which does not contain the migrant workers was only about half of those migrant workers who lost jobs in the 2008 crisis and less than a tenth of labor force still engaged in agriculture (Cai, 2009). In my opinion, these migrant workers who are forced to return to countryside may also bear the heaviest burden of such a severe economic downturn in China. The short-run macroeconomic analysis of business cycles has to integrate these migratory fluctuations into its framework and thereby help to explain them.

The long-term, single-directional transfer of agricultural labor to nonagricultural activity has been an enduring subject for academic research. After World War II, Lewis (1954) first tackles the issue, pointing out that surplus labor in precapitalist agriculture may be the cause of a constant wage at which capitalist nonfarm firms can employ labor from agriculture to the extent that their available capital allows, until all of the surplus labor is absorbed by the nonfarm sector and the precapitalist sector vanishes. Ranis and Fei (1961; 1964) name that wage the "constant institutional wage" and develop a model in Lewis's tradition. Jorgenson (1961) discards the concept of a constant wage, but studies the long-term transfer of agricultural labor, assuming inter alia that per capita consumption of the agricultural product is constant. The short-run fluctuations of migratory rural labor, however, have attracted little attention in development economics.[1] Two studies that are exceptions are Todaro (1969) and Harris and Todaro (1970), and a large stock of literature following their ideas. They also accept a constant institutional wage, and go further to introduce urban unemployment as the factor that determines the regular fluctuations of migration by farmers. But they fail to analyze the links between migration and fluctuations in aggregate output and price level, so disregard the issue of whether economic cycles are caused by or associated with fluctuations in the migrations of farmers.[2]

[1] The large volume *Development Macroeconomics* by Agenor and Montiel (1999) neglects migratory fluctuations associated with business cycles almost completely. The topic is not mentioned, either, in the newly published collection of papers on development macroeconomics (Ghathak and Levine, 2009).

[2] Academic efforts to combine business cycle with agriculture have a long history. The most known effort was probably made by Jevons (1878) who argues that fluctuations in agricultural production may cause the business cycles in United Kingdom. But the former is brought about by periodical explosions of the sunspots. In the United States, Sprague (1903, 1915), Andrew (1906) and Anderson (1927, 1931) find close combinations of business cycles with fluctuations in purchasing power of farmers in the United States, which, in turn, are dependent on harvest. To explain the Great Depression in 1930s Keynes (1936) determinately rejects this agricultural theory of business cycles. After the Keynesian revolution (Klein, 1966), this theory disappears wholly. Recently, however, there come new interests in it

The on-going global financial and economic crisis puts short-run macroeconomics again at the center of interest of academic research and public discussion. The present paper tries to sets up a short-run macroeconomic framework to analyze the business cycles occurring in some of the most important developing countries that experience mass migrations of their agricultural labor between farm und nonfarm occupations. Examples of these countries are Bangladesh, China, India, Vietnam, and even Turkey, where agriculture with its heavy population und low productivity effectively remains in a state of pre-capitalist production. The nonfarm sectors in these countries are assumed to be roughly capitalist, with businesses seeking profits using familiar inputs and technologies of the neoclassical kind. In this paper, only the labor transfer (re-allocation) between non-capitalist and capitalist sectors, i.e. between farm and nonfarm sectors, is investigated. Labor transfers between different nonfarm capitalist sectors as well as between agricultural sub-sectors will be ignored.

In the following second section, we will introduce some indicators to measure the intersectoral migration of agricultural labor. The third section describes, with the help of these indicators, some dimensions of the fluctuations in farmer migration and their magnitude worldwide and particularly in US and China. A comparison of importance of farmer migration and unemployment in the short-run macroeconomic performance is made with data of the United States and China in the fourth Section. The fifth Section first deals with the model of intersectoral labor market and shows how wage rates are determined, then introduces relative price affecting labor market equilibrium. Subsequently, a commodity market will be established to determined relative price, the interactions of wages and relative prices be studied, and simultaneous equilibrium of the both markets investigated. Finally, relations between migration of agricultural labor and business cycles, especially during the on-going economic crisis, will be explained.

2. Measures of Intersectoral Migration of Agricultural Labor Forces [3]

To analytically investigate the intersectoral migration of agricultural labor force and the associated short-run macroeconomic effects on wage, price level and aggregate output, we need new concepts or indicators to measure the quantity of migrant labor. [4] Below there are

for understanding the business cycles in the pre-Great Depression era. See e.g., Miron (1986), Davis, Rhode and Hanes (2009). But this theory does not address the role the intersectoral migration of agricultural labor forces may play in business cycles. One of the reasons for it can be that labor statistics of that era are not available to both the contemporary and today's researchers.

[3] Parts of contents in this section are excerpted from Hu (2008a; 2008b).

[4] Foster and Rosenzweig (2008) recently complain the lack of data on migration of agricultural labor and find it is the basic restriction to its researches. While recognizing this difficulty, appropriate indicators seem more important to me. In fact, only with them can available relevant data, though often scarce and ambiguous, be processed for researchers and policy makers. In statistical or economic studies

some possible measures.

H:[5] True quantity of out-migrated agricultural labor which could be derived from changes in agricultural labor as follows

$$(2.1)\qquad \mathbf{H} = L_1^{t*} - L_1^{t} = (1 + n_1^{t})L_1^{t-1} - L_1^{t} = (L_1^{t-1} - L_1^{t}) + n_1^{t}L_1^{t-1}$$

where L stands for labor force and n for its growth rate, while sub- and superscripts represent sectors (1 for agriculture and 2 for nonagriculture) and time periods, respectively. It is assumed that agricultural population will become labor force automatically when they happen to be in the certain range of ages, normally from 16 to 65, and agricultural labor force is quantitatively the same to agricultural employment. Hence, L_1^{t*} stands for demographically determined quantity of agricultural labor force at a certain point of time t, without consideration of in- and out-migration from and to nonagriculture, and n_1^t for the "natural", that is, dependent only on the demographic factors in a closed agricultural sector, growth rate for L_1 in the period of time t. Therefore, $L_1^{t*} = (1 + n_1^{t})L_1^{t-1}$. L_1^t is the factual agricultural labor at point of time t. There is net labor out-migration out of agriculture if $\mathbf{H} > 0$ and net in-migration if $\mathbf{H} < 0$. In order to get L_1^{t*}, however, we must have knowledge on n_1^t. But the data of n_1 are not available in the accessible statistical publications. Consequently, L_1^{t*} and then **H** are statistically unobservable. We are forced to find some substitutions for **H** with regard to the availability of statistical data. Two of the possible substitutions are $\mathcal{H}$ and H explained below.

$\mathcal{H}$: Quantity of out-migrated agricultural labor when $n_1 = n$, that is, when the natural growth rate of agricultural labor would be as large as that of the total labor force in the economy concerned. $\mathcal{H}$ could be defined as product of total labor force and difference in

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of the long-run decline in agricultural share of employment, $l_1 = \frac{L_1}{L}$ (L_1 and L stand for agricultural and total employment, respectively) is often used in e.g., Lewis (1954); Clark (1957); Kuznets (1966); Jorgenson (1961); Denison (1962); Fei and Ranis (1964); Kongsamut, Rebelo and Xie (2001); Restuccia, Yang and Zhu (2008). Sjaastad（1962）may belong to the first economists who use the conceptions of rate of labor migration. Todaro (1969) defines a quantity of rural-urban migration and utilizes the rate of this quantity to urban labor force. Mundlak (1979) discusses detailedly the rate of out-migrated to total agricultural labor. In their empirical researches, however, they do not compute quantities of migrated farmers and instead continue to use data of l_1, see e.g., Mundlak (1979); Larson and Mundlak (1997).

[5] Todaro (1969) uses $\dot{S}$ to express the quantity of farmer migration, but M is used for the same quantity by Mundlak (1979) and the most other authors. However, all these authors do not relate farmer migration with total labor force and aggregate output immediately, as made in the present paper. In the short-run macroeconomics, M usually stands for money supplied to the economy. In consideration of it and of the fact that the most Latin letters are already used for some special meanings, we select H for migration.

agricultural share of labor force:

(2.2) $\mathcal{H} = -\Delta l_1 L$

where $l_1 = L_1/L$ and $\Delta l_1^t = l_1^t - l_1^{t-1}$, and L stands for total labor force. We divide the economy into only two sectors, hence $l_1 + l_2 = 1$ ($l_i > 0$). For computation of Δl_1 and $\mathcal{H}$, only data on L and L_1 are needed, but they are well available in the official statistics in the most countries and in some cases even for the whole world. $\mathcal{H}$ is, therefore, an observable quantity. (2.2) is derived from the following logic. Firstly, we know that

$$\Delta l_1^t = l_1^t - l_1^{t-1} = \frac{L_1^t}{L^t} - \frac{L_1^{t-1}}{L^{t-1}}$$

Then, because of $L^t = (1 + n^t)L^{t-1}$, we get

$$\Delta l_1^t = \frac{L_1^t}{L^t} - \frac{L_1^{t-1}}{\frac{L^t}{1+n^t}} = \frac{1}{L^t}[L_1^t - L_1^{t-1}(1+n^t)]$$

that is

$$\Delta l_1^t L^t = L_1^t - L_1^{t-1}(1+n^t)$$

therefore

(2.2) $$\mathcal{H}^t = (1+n^t)L_1^{t-1} - L_1^t = -\Delta l_1^t L^t$$

$(1+n^t)L_1^{t-1}$ expresses quantity of stock in agricultural labor force at the end of the *t*th period under the assumption of $n_1^t = n^t$, that is, if L_1 would grow at the rate same to that of growth of L during the same period. $\mathcal{H}^t = (1+n^t)L_1^{t-1} - L_1^t$ stands for the out-migrated agricultural labor if the growth rates of both agricultural and total labor are equal. $\mathcal{H} > 0$ indicates net out-migration and $\mathcal{H} < 0$ net in-migration.

Comparing (2.2) with (2.1) we get

$$\mathbf{H}^t - \mathcal{H}^t = L_1^{t-1}(n_1^t - n^t)$$

It points out that $\mathbf{H} > \mathcal{H}$ if $n_1 > n$ and $\mathbf{H} < \mathcal{H}$ if $n_1 < n$. Only when $n_1 = n$ there could be $\mathbf{H} =$

$\mathcal{H}$. But $n = n_1$ does not exist generally. Hence the both quantities are not equal generally, either. With data from labor statistics, we are able to get information on n, but not on n_1. Thus, we generally cannot know to what extent n_1 may deviate from n and $\mathcal{H}$ from **H**.[6] If taking business cycles and unemployment into account and allowing for changes in n_1 and n during the business cycles, deviations between n and n_1 will be more complicated. Therefore, $\mathcal{H}$ is at most a rough estimate of **H**, although $\mathcal{H}$ can be computed with statistics certainly.

H: Reduction in stock of agricultural labor force, defined by:

$$\text{(2.3)} \qquad H^t = -\Delta L_1^t = -(L_1^t - L_1^{t-1}) = L_1^{t-1} - L_1^t$$

In comparison to that of $\mathcal{H}$, the implications of H are straightforward. Data series of L_1 are available in the most countries and H is also statistically observable.

We compare (2.1), (2.2) with (2.3) to get

$$\text{(2.4)} \qquad \mathbf{H}^t - H^t = n_1^t L_1^{t-1}$$
$$\text{(2.5)} \qquad \mathcal{H}^t - H^t = n^t L_1^{t-1}$$

$\mathbf{H}^t > H^t$ because of $n_1^t > 0$ and $L_1^{t-1} > 0$ while $\mathcal{H}^t > H^t$ because of $n^t > 0$ as well. Take an example. There were in a county of a populous developing country L_1^{2004} =520 000 at the end of the year of 2004 and L_1^{2005} = 500 000 at the end of 2005. During the year of 2005 there were net 6240 entrants into labor force in agriculture, that is, n_1^{2005} = 6240/520000=1.2%. Assuming n^{2005} =1.0%, then we have

$$\mathbf{H} = [520\,000 \cdot (1+1.2\%)] - 500\,000 = 26\,240$$
$$\mathcal{H} = [520\,000 \cdot (1+1.0\%)] - 500\,000 = 25\,200$$
$$H = (520\,000 - 500\,000) = 20\,000$$

In this example, $\mathbf{H}^t > \mathcal{H}^t > H^t$. Generally speaking, $\mathcal{H}$ may represent **H** better than H when $n_1 > 0$, $n > 0$ and both growth rates lie in the neighborhood of each other. Only if $n_1 \rightarrow 0$ while n not being close to zero can H approach to **H** more closely than $\mathcal{H}$ does.

Now we go over to measures of labor migration relative to other indicators. The first measure we already saw is Δl_1. From (2.2), we get

$$\text{(2.6)} \qquad -\Delta l_1^t = \mathcal{H}^t / L^t \qquad (1 > \Delta l_1^t > -1)$$

The difference in agricultural shares of labor can measure how large the migrated agricultural labor is relative to the total labor when $n_1 = n$. Another measure would be the

6 Kuznets (1966) estimates that growth rate of rural population is three times higher than that of urban population.

rate of reduction in agricultural labor to total labor, symbolized as *h*. *h* is defined as follows

$$(2.7) \quad h = \frac{H}{L} = \frac{-\Delta L_1}{L} = \frac{\Delta L_2 - \Delta L}{L}$$

Because of $\Delta L = \Delta L_1 + \Delta L_2$, we have the third equal sign of Equation (2.7). If $\Delta L = 0$ in the short run, we get $-\Delta L_1 = \Delta L_2$ and

$$h = \frac{-\Delta L_1}{L} = \frac{\Delta L_2}{L}$$

h measures how large the reduction ($h > 0$) or augmentation ($h < 0$) in stock of agricultural labor in relation to total labor when demographically determined new entrants into agricultural labor are not taken into account. The relation between *h* and Δl_1 is expressed in (2.8) [7]:

$$(2.8) \quad h^t = -\Delta l_1^t - \frac{n^t}{1+n^t} l_1^{t-1}$$

$$= -\Delta l_1^t - C^t$$

where $C^t = \frac{n^t}{1+n^t} l_1^{t-1}$ is difference between *h* and Δl_1. Because of $l_1 > 0$ and $n^t > 0$, we have $C^t > 0$. C^t can be seen as given since l_1^{t-1} is known in the t*th* period and n^t is dependent on other factors than intersectoral transfer of labor and may be regarded as exogenous. It means that difference between *h* and Δl_1 may be a constant. In the short run with $n = 0$, there are $C = 0$ and $h = -\Delta l_1$. In the long run, however, $n > 0$ and then $C > 0$, we get $h + C = -\Delta l_1$, that is $h < -\Delta l_1$.[8]

[7] (2.8) can be derived as follows:

$$\Delta l_1^t = l_1^t - l_1^{t-1} = \frac{L_1^t}{L^t} - \frac{L_1^{t-1}}{L^{t-1}} = \frac{L_1^t}{L^t} - (1+n^t)\frac{L_1^{t-1}}{L^t} = \frac{L_1^t - L_1^{t-1}}{L^t} - n^t \frac{L_1^{t-1}}{L^t} = -h^t - \frac{n^t L_1^{t-1}}{(1+n^t)L^{t-1}}$$

$$= -h^t - \frac{n^t}{1+n^t} l_1^{t-1}.$$

[8] Naturally, $\mathcal{H}$ and H can be used to compare with other measures, e.g., $\mathcal{H}/L_1$ or $H/(L-L_1)$. Todaro (1969) constructs H/L_U, where L_U represents urban labor. In cases where data of **H** are possible to be collected in small regions, **H**/L or **H**/L_1 may be available. Province of Zhejiang Bureau of Statistics (2008) and Bureau of Statistics of Autonomous Region of Inner Mongolia (2008), e.g., use **H**/L_1 for migration rate of agricultural labor.

3. Cyclical Fluctuations in Agricultural Labor Migration: Some Facts

3.1 Worldwide

Before modeling the cyclical fluctuations of intersectoral migration of farmers, this section first looks at migration in reality with the measures set up in the last section. Recognizing that intersectoral migration of farmers has received insufficient attention in the literature, we will present some facts from available statistics that reveal the extraordinary magnitude of this migration. In fact, the extensive out-migration of agricultural labor is observed in almost all countries, particularly the developing ones, in recent years. We illustrate this mass movement for the whole world and for China, respectively. In order to make comparison, we will take the United States as a reference in this section. As to the whole world, we collect some statistics of the International Labor Organization (ILO) in Table 3.1. The data show several important phenomena in the period between 1997 and 2007: (1) Agricultural share of employment (l_1) [9] declined in the world as a whole as well as in all of the regions the ILO defines, including the developed countries, which implies that farmers migrated out of agriculture all over the world during this period. (2) The decline in l_1 occurred much more quickly in the developing countries than the developed ones. (3) Within the developing countries, three regions of South Asia, Sub-Saharan Africa and East Asia, which belonged to the poorest regions of the world, experienced the quickest decline in l_1, reduced around a percentage point yearly on average. They were followed by the region of Central and South-Eastern Europe and CIS, of which the most were the former central-commanding economies. North Africa decreased its l_1 most slowly. (4) The world's share of agricultural employment fell 7 percentage points from 41.4% in 1997 to 34.4% in 2007, and fell even around 1 percentage point in each of two consecutive years of 2007 and 2008. These must be astonishing. As analyzed before, $\Delta l_1 = \frac{H}{L} = -0.07$ implies that there may be 7 out of 100 employed workforces transferring from farm to nonfarm activity during the period from 1997 to 2007 if the growth rates of both L_1 and L were equal. Furthermore, $\Delta l_1 = -0.07$ implies more than 200 million farmers transferred into nonfarm jobs when the world employment totaled to 3 000 million in the year of 2007. The scale of $\Delta l_1 = -0.07$ can be imagined with an arithmetical example. l_1 would decline 70 percentage

[9] Agricultural shares of both employment and total labor force are quantitatively two indicators as soon as unemployment is taken into account. Let $\mathcal{L}$ represent employment and $\ell_1 = \frac{\mathcal{L}_1}{\mathcal{L}}$ stand for employment share. Assuming all agricultural labor forces are employed agriculturally, that is, $\mathcal{L}_1 = L_1$, we get $\ell_1 = \frac{\mathcal{L}_1}{\mathcal{L}} = \frac{L_1}{(1-u)L} = \frac{l_1}{1-u}$ and rearrange to $l_1 = (1-u)\ell_1$, where u is unemployment rate. Keeping it in mind, we will use l_1 for both shares in the texts when confusions may not occur.

points in a century if it did the same as from 1997 to 2007. The 20th century clearly did not reach this speed because l_1 was still 34.4% for the whole world in 2007. Therefore, the period from 1997 to 2007 should be one of the decades of the most massive out-migration of agricultural labor forces in the modern economic history.

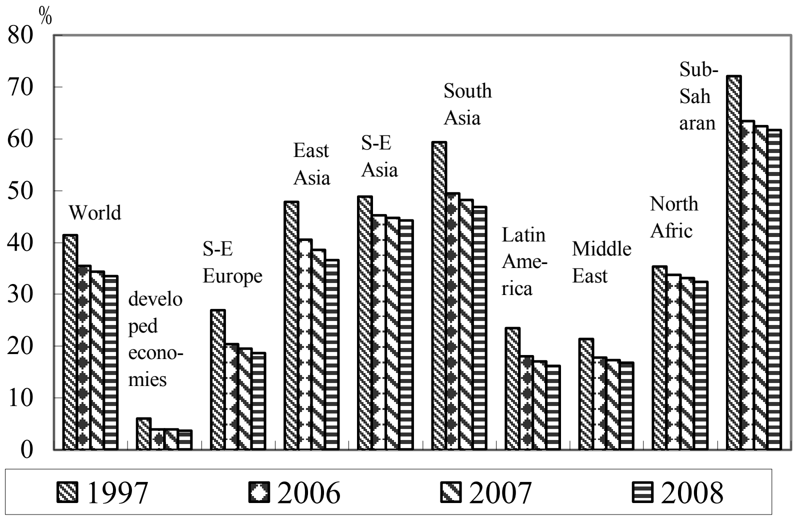
Table 3.1 Reduction in agricultural share of total employment, 1997-2007

(%)

	l_1				Δl_1		
Year	1997	2006	2007	2008	1997-2007	2006-2007	2007-2008
World	41.4	35.5	34.4	33.5	-7.0	-1.1	-0.9
Developed Economies and European Union	6.1	4.0	3.9	3.7	-2.2	-0.1	-0.2
Central and South-Eastern Europe (non-EU) & CIS	27.0	20.4	19.5	18.7	-7.5	-0.9	-0.8
East Asia	47.9	40.6	38.6	36.6	-9.3	-2.0	-2.0
South-East Asia and the Pacific	48.8	45.3	44.8	44.3	-4.0	-0.5	-0.5
South Asia	59.4	49.5	48.2	46.9	-11.2	-1.3	-1.3
Latin America and the Caribbean	23.5	18.0	17.1	16.2	-6.4	-0.9	-0.9
Middle East	21.4	17.8	17.3	16.8	-4.1	-0.5	-0.5
North Africa	35.4	33.8	33.1	32.4	-2.3	-0.7	-0.7
Sub-Saharan Africa	72.1	63.4	62.5	61.7	-9.6	-0.9	-0.8

Source: ILO, 2009, Global Employment Trends 2009, Appendix 1, Table 6; ILO, 2008, Global Employment Trends 2008, Appendix 1, Table 4. Data for 2008 are preliminary estimates. If different figures are assigned to the same measure in the same year in the series of the same statistical publications, the figure in the last publication will be taken into the Table. Calculations of Δl_1 were done by author.

Fig. 3.1 Reductions in agricultural share of employment, world and regions 1997-2008



Source: see Table 3.1.

The National Bureau of Statistics of China (NBSC) issues data of the share of employment in primary industry for selected countries, cited from the source of, it says, the World Bank database. We reproduce them in Table 3.2. It shows the most countries displayed in the table reduced their agricultural employment share from 2000 to 2005. The reduction is particularly impressive in Bangladesh (-10.4 from 2000 to 2003), Mongolia (-8.7), Vietnam (-7.4 from 2000 to 2004), Turkey (-6.5), Thailand (-6.2), Pakistan (-5.4) and two former communist countries Bulgaria (-17.3) and Romania (-10.7), all of which had an average annual reduction of more than 1 percentage point. In Table 3.2 there are also 5 countries (Sri Lanka, Egypt and three selected Latin American nations) increasing the share in the first years of the new century. These facts indicate that changes in the agricultural employment share could occur in both directions in the short term despite the share's long-term declining trend.

It is desirable and useful to get the magnitude of labor migration out of agriculture through absolute numbers. Because Δl_1 is the ratio of migrated farmers to total employment if the growth rates of both L_1 and L are equal, the data on Δl_1 in Table 3.2 already indicate the scale of the migration. For example, that Δl_1 = -5.2 for China implies a migration of 39 million agricultural workers during the 5 years in China if its total employment were 750 million. [10] Table 3.3 presents ILO data of $\mathcal{H}$ and H for several recent years. The data demonstrate a clear deficiency of consistency. For example, growth rate of total employment, $n_{\mathfrak{L}}$, is unusually high in 2007, which leads to an abnormally large difference between $\mathcal{H}$ and

[10] China's total employment amounts to 770 million in 2007 (NBSC, 2008, Table 4-2).

Table 3.2 Changes in share of employment in primary industry in selected countries 2000-2005

%

Country	l_1		Δl_1	Country	l_1		Δl_1
	2000	2005			2000	2005	
China 1)	50.0	44.8	-5.2	United States	2.6	1.6	-1.0
Bangladesh 2)	62.1	51.7	-10.4	Argentina	0.7	1.1	0.4
Indonesia	45.1	44.0	-1.1	Brazil 5)	20.6	21.0	0.4
Israel	2.2	2.0	-0.2	Venezuela 2)	10.2	10.7	0.5
Japan	5.1	4.4	-0.7	Bulgaria	26.2	8.9	-17.3
Kazakhstan 3)	35.5	32.4	-3.1	Czech Republic	5.1	4.0	-1.1
Korea, Rep.	10.6	7.9	-2.7	Germany	2.7	2.4	-0.3
Malaysia 4)	18.4	14.8	-3.6	Italy	5.3	4.2	-1.1
Mongolia	48.6	39.9	-8.7	Netherlands	3.1	3.0	-0.1
Pakistan	48.4	43.0	-5.4	Poland	18.8	17.4	-1.4
Philippines	37.4	37.0	-0.4	Romania	42.8	32.1	-10.7
Sri Lanka 5)	24.2	33.5	9.3	Russian Fed.	14.5	10.2	-4.3
Thailand	48.8	42.6	-6.2	Spain	6.6	5.3	-1.3
Vietnam 4)	65.3	57.9	-7.4	Turkey	36.0	29.5	-6.5
Egypt 2)	29.6	29.9	0.3	Ukraine	23.4	19.4	-4.0
South Africa 2)	14.5	10.3	-4.2	United Kingdom	1.5	1.4	-0.1
Canada	3.3	2.7	-0.6	Australia	5.0	3.6	-1.4
Mexico	17.6	15.1	-2.5	New Zealand	8.7	7.1	-1.6

Note 1: 1) Data from Chinese sources, not from the World Bank database. 2) Data of 2003 instead of 2005. 3) Data of 2001 instead of 2000. 4) Data of 2004 instead of 2005. 5) Date of 2001 instead of 2000 and of 2004 instead of 2005.

Note 2: Data for China refer to agriculture only. Data for other countries may contain employment in the mining sector.

Source: NBSC, 2008, Appendix Table 2-2. Calculations of Δl_1 were done by author.

H because the difference is affected mainly by $n_{\mathcal{L}}$, as explained in the last section. Keeping this and other irregularities in mind, these data provide some rough estimates of $\mathcal{H}$ and H, which may approximate a scale of 10 to 30 million in the most years for which data are available. As mentioned above, H is inferior to $\mathcal{H}$ in representing **H** if $n>0$ and $n_1>0$ and $\mathcal{H}$ may be the lowest limit of possible ranges of **H** if $n<n_1$. Hence, we are concerned only about $\mathcal{H}$ in Table 3.3. In the 5 years from 2004 to 2008, $\mathcal{H}$ still remains over 25 million annually, sometimes even exceeding 30 millions. Based on $\mathcal{H}$, we may imagine the true out-migration of farmers, **H**, could lie in the range from around 30 million and above in each of those years.

Table 3.3 Quantity of labor migration out of agriculture around the world 1994-2008

Year	L	$\mathcal{L}$	L_1	$n_{\mathcal{L}}$	l_1	Δl_1	$\mathcal{H}$	H
	m	m	m	%	%	%	m	m
1994	1711.0	1570.7						
1995	2621.7	2464.4	1084.3		44.0			
1996	2645.9	2484.5	1070.8	0.8	43.1	-0.9	22.4	13.5
1997	2701.6	2536.8	1050.3	2.1	41.4	-1.7	43.1	20.6
1998	2719.7	2553.8	1041.9	0.7	40.8	-0.6	15.3	8.3
1999	2771.0	2599.2		1.8				
2000	2793.4	2623.0		0.9				
2001	2831.1	2658.4		1.3				
2002	2880.3	2704.6		1.7				
2003	2939.7	2754.5	1066.0	1.8	38.7			
2004	2984.1	2796.1	1048.5	1.5	37.5	-1.2	33.6	17.4
2005	3027.4	2839.7	1036.5	1.6	36.5	-1.0	28.4	12.1
2006	3063.3	2879.5	1022.2	1.4	35.5	-1.0	28.8	14.3
2007	3149.1	2969.6	1021.6	3.1	34.4	-1.1	32.7	0.7
2008	3170.0	2979.8	998.2	0.3	33.5	-0.9	26.8	23.3

Note: m means million, also in following tables and figures. L stands for total labor force and $\mathcal{L}$ for total employment, while n for growth rate. Denominator of l_1 is total employment. $\mathcal{H}=-\Delta l_1 \mathcal{L}$ and $H= L_1^{t-1}-L_1^{t}$.

Sources: ILO, Global employment trends, 2005, 2006, 2007, 2008 and 2009. Data for 2008 are preliminary estimates. If different figures are assigned to the same measure in the same year in the series of the same statistical publications, the figure in the last publication will be taken into the Table. Calculations of L_1, $n_{\mathcal{L}}$, Δl_1, $\mathcal{H}$ and H were done by author.

The indication is that there might be no fewer than 150 million farmers who have transferred into the nonfarm sector in that period of merely 5 years. Such a scale of farmer out-migration must be an event of historical importance for the mankind!

The data on L_1 and l_1 in Table 3.3 clearly validate the long-term trend of labor force transfer from agriculture to nonagriculture in the period from 1995 to 2008. At the same time, these data also show the presence of short-run fluctuations along the long-term trend. However, the data do not allow for a regular cycle of fluctuations because the number of years with data is too small and the quality of data is too doubtful. But the data may suggest that the agricultural employment might have increased worldwide between 1998 and 2003 if the figures for L_1 in both years would be plausible. The implication is that there might have been a phase of return migration of farmers between 1998 and 2003 or between two phases of their out-migration. The Chinese experience with intersectoral migration of farmers that will be described below in this section will support the interpretation.

The economic meanings of the farmer migration can be highlighted through its comparisons with unemployment. These comparisons are presented in Table 3.4 for the whole world. In spite of the poor quality of data, Table 3.4 would admit the conjecture that all of the world's 190 million unemployed persons in 2008 could find jobs in the nonfarm sector had there been no migrant farmers who became involved in nonfarm activity between 2004 and 2008. Net new unemployment in the past 5 years reached only 5 millions, while net farmer outmigration exceeded 150 millions in the same period. Farmer outmigration apparently was 30 times larger than new unemployment! Common sense suggests that it is not the stock of unemployment (U), but the fluctuations in unemployment, ΔU, that is operationally more relevant for output growth and macroeconomic performance. Obviously, $|\Delta U|$ is quantitatively much lower than $\mathcal{H}$ in all years with data; its ratio to $\mathcal{H}$ is around 10% in the most years. This quantitative relation highlights the macroeconomic importance of farmer migration and makes Todaro/Harris' ideas that $\mathcal{H}$ depends on ΔU less compelling.

Table 3.4 Comparison between world unemployment and farmers' migration 1994-2008

Year	$\mathcal{H}$	U	ΔU	$\mathcal{H} - \lvert\Delta U\rvert$	$\Delta U/\mathcal{H}$
	m	m	m	m	%
1993		140.5			
1994		140.3	-0.2		
1995		157.3	17.0		
1996	22.4	161.4	4.1	18.3	18.3
1997	43.1	164.8	3.4	39.7	7.9
1998	15.3	165.9	1.1	14.2	7.2
1999		171.8	5.9		
2000		170.4	-1.4		
2001		172.7	2.3		
2002		175.7	3.0		
2003		185.2	9.5		
2004	33.6	188.0	2.8	30.8	8.3
2005	28.4	187.7	-0.3	28.1	-1.1
2006	28.8	183.8	-3.9	24.9	-13.5

2007	32.7	179.5	-4.3	28.4	-13.2
2008	26.8	190.2	10.7	16.1	39.9
Sum (2004- 2008)	150.2	-	5.0	-	

Sources: see Table 3.3. Computations of ΔU, $\mathcal{H} - |\Delta U|$ and $\Delta U/\mathcal{H}$ were done by author.

3.2 United States

Labor and employment statistics in the United States, and in China in the next subsection, are much more consistent than the world data of ILO. We look at intersectoral migration of agricultural labor in the US only in the post-war era because of the serious changes in the US labor statistics made in 1947.[11] With the US data from 1947 to 2007 we compute Δl_1, $\mathcal{H}$, H and *h*. Note the denominators of Δl_1 and *h* now are total labor force (L), not total employment ($\mathcal{L}$), hence $\mathcal{H}$ is computed with $\Delta l_1 L$. Figure 3.2 shows scattered graphs of $\mathcal{H}$ and H as well as L_1. $\mathcal{H} > 0$ and $H > 0$ represent net out-migration out of agriculture and $\mathcal{H} < 0$ and $H < 0$ net in-migration into agriculture. We see in Figure 3.2 the well-known trends of absolute decline in L_1 clearly in the US in the post-war era. Although there were already less than 8 million farmers in 1947, they still transferred into nonfarm sector during the period of 6 decades until 2007, because $\mathcal{H}$ and H were positive in most of the years and, if they were negative, often near to zero. As a result of long-run out-migration trends, US had only 2.1 million farmers in 2007. At the same time, the long-run trend was full of short-run fluctuations and did not show any continuity or stability at all. The consecutive years of increase or decrease in H did not exceed 3 and in $\mathcal{H}$ reached 4 only one time. In other words, $\mathcal{H}$ and H would be decreasing for some 2 to 3 years after increasing for 2 to 3 years and so on. In this sense, the long-run trend and the short-run fluctuations of decline in L_1 in the US after the World War II may possess very different characteristics. [12]

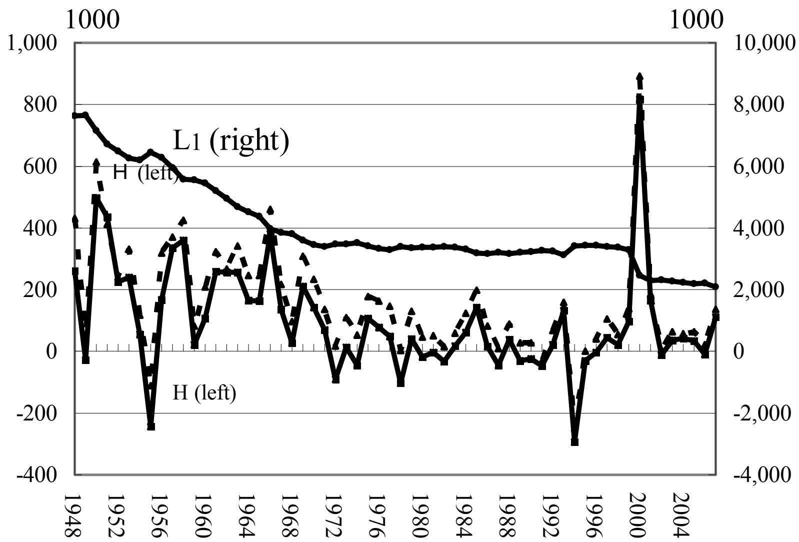
We further look at characteristics of the trend and the fluctuation of the migration revealed in Figure 3.3. Note positive Δl_1 represents decrease in l_1 and negative ones indicate increase. Figure 3.3 shows more robust long-run trend of decline in l_1 than in L_1 during the period because of two factors in work. One is the decline in L_1 and the other the growth in total labor, L. l_1 declined in US from 13.8% in 1947 to tiny 1.4% in 2007. But the

[11] One of the most important changes in US labor statistics in 1947 was the raising of labor age from 14 to 16. As results of this change, the agricultural employment of 1947 decreased 4.6%, while total labor reduced only 1.4% (Data from US Government, 2009, Table B-35).

[12] Larson and Mundlak (1997) study intersectoral migration of agricultural labor with the data on l_1 of the years of 1950, 1960, 1970, 1980 and 1990 for almost all FAO member countries. But this data set cannot reveal the short-run properties of such the migration.

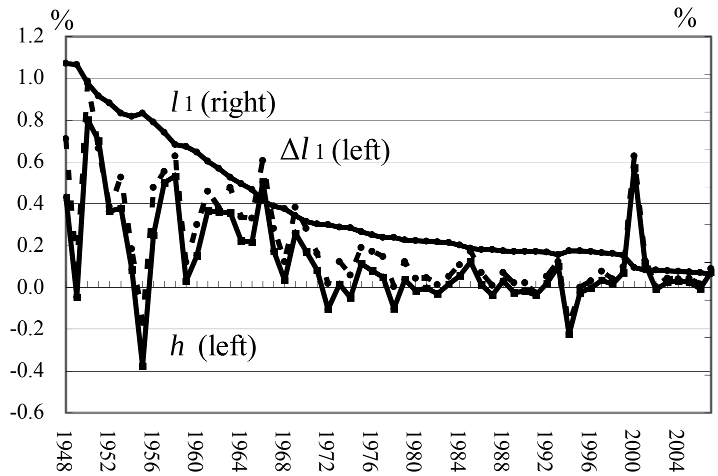
"instantaneous velocity" of the decline, measured with each of Δl_1 and h, changed continuously and frequently. On the one hand, no consecutive two years witnessed Δl_1 or h remaining unchanged. On the other, their continuous increase or decrease never surpasses 4 years. Besides these periodical characteristics, the amplitudes of their fluctuations were moderate in the most years, particularly after the middle of 1950s. Finally, there exits a diminishing trend of amplitude of fluctuations during the 6 decades we are studying. The absolute values of Δl_1 and h may converge to zero in the long run.

Figure 3.2 L_1, ℋ and H in US, 1948-2007



Source: US Government 2009, Table B-35. Because of the changes in the statistical definitions of agricultural employment in 2000, the data from 2000 cannot be compared with that before 2000 simply. Computations of ℋ and H were done by author.

Figure 3.3 l_1, Δl_1 and h in US, 1948-2007



Source: see Figure 3.2. Denominators of l_1, Δl_1 and h are total labor. Computations of l_1, Δl_1 and h were done by author.

3.3 China [13]

Unlike US, China was an agricultural country at the end of the World War II with its high l_1 of 84% in 1952. [14] China is the most populous country in the world and may still have a larger agricultural labor force than any other country (the possible exception being India). As elsewhere, China also experienced massive labor migration out of agriculture in recent decades. In China, there are time series of data on employment and its allocation to agriculture and other sectors from 1952.[15] These data appear, collected and rearranged, in Table A1 in the Appendix at the end of this paper. With these data we compute China's l_1, Δl_1, $\mathcal{H}$, h and H and illustrate them and L_1 in Figures 3.4-3.5 to show aspects of the labor migration from agriculture in China. Note the unit used in Figure 3.4 is million while it was thousand in Figure 3.2 above for the US. Figure 3.4 shows the absolute increase in L_1 from 190 million to 310 million in China during the period from 1953 to 2007. However, the period could be divided in two phases. The first one consists of 39 years from 1953 to 1991 when L_1 mainly increased and reached its peak of 390 million in 1991. The second phase runs from 1992 to 2007 when the decline in L_1 surpassed its increase and the net decrease in L_1 exceeded 80 million. China may enter from 1990s on the epoch of diminishing agricultural labor as US did around 80 years earlier.[16] $\mathcal{H}$ and H which had been negative in many or most years in the first phase turned to be overwhelmingly positive in the second phase in which $\mathcal{H}$ and H exceeded the threshold of 10 million annually in 7 or 8 years. Since n>0 and $n_1 > 0$ are true in China for the whole period under review, $\mathcal{H}$ approximates to **H** more closely than H does, we use data on $\mathcal{H}$ and find that there were annually more than 13 million farmers transferring to the nonfarm sectors in China in recent years: 17 million in 2004, 16 million in 2005, 17 million in 2006 and 13 millions in 2007. Alone in these four years, nearly 62.5 million farmers found employment in the nonfarm sectors in China, accounting for slightly more than half of the global migrated farmers (123.4 million in Table 3.3) in the same period.

If the graphs in Figure 3.4 do not demonstrate the long-term decreasing trend of L_1 unambiguously, Figure 3.5 shows this trend for l_1 unequivocally in China over the whole

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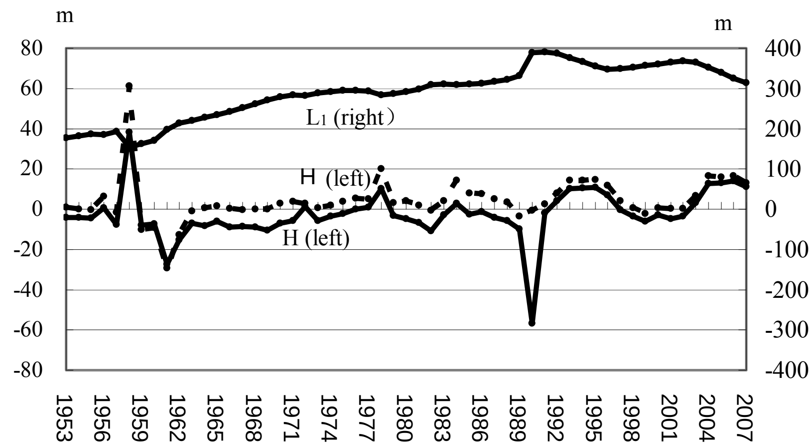
[13] Parts of contents in this subsection are excerpted from Hu (2008b).

[14] In Lebergott (1984: 66) and Weiss (1992: 22), l_1 was estimated for the United States 83.7% in 1810 and 74.4% in 1800, respectively, and might decrease thereafter.

[15] Reliability of Chinese official statistics is problematic. A most systematic recent study on it may be Holz (2005). To Problems on Chinese population and labor statistics and their adjustments, see Nan and Xue (2002). For our analysis has no alternatives but to use Chinese official statistics because only they offer sources of continuous and systematic data on Chinese economy. But our analysis and conclusions which mainly pertain to basic trends and economic logic do not depend on high reliability of these data. Reader is strongly recommended to be cautious about Chinese data presented here.

[16] The peak of agricultural labor force in US may appear between 1900 and 1910. The earliest report on yearly farm employment gives the highest number: 12.2 million in 1909 (SAUS 1946, Table 223). It exceeds estimates, mainly based on decennial censuses, for all earlier years. See Carter, Gartner, Haines, et al, 2006: Table Ba652 and the following tables).

Figure 3.4 L_1, $\mathcal{H}$ and H in China, 1953-2007



Source: Data from 1952-1977: NBSC, 2005, Table 4; data for 1978-2007: NBSC, Table 4-3. Data of 1990 to 2000 were be revised according to the 2000 census. Computations of $\mathcal{H}$ and H were done by author.

period 1952-2007. And the decrease seemed to accelerate as time proceeded. l_1 fell 13 percentage points over 26 years -- half a point a year, on average -- between 1952 and 1978, and 30 points in the later 29 years, or an annual average exceeding one percentage point, from 1978 to 2007. Alone in the most recent 4 years from 2004 to 2007 l_1 fell more than 8 percentage points. So l_1 reduced from 83.5% in 1952 to 40.5% in 2007 in China. During this successful process, however, there were appalling tragedies that were connected with farmers' out-migration, which was sometimes forcibly generated through totalitarian-administrative means. The sharpest decrease in l_1, a decrease of 23 percentage points in a single year of 1958 as displayed in Figure 3.5 may have been the biggest such fall in human history. It was followed, in turn, by a terrible famine, which may also be judged the saddest of its kind in human history: at least 20 million people starved in the three following years.[17] And l_1 increased 24 percentage points again immediately after 1958. For l_1 to fall again to its level in 1958 took 35 years until 1993.[18]

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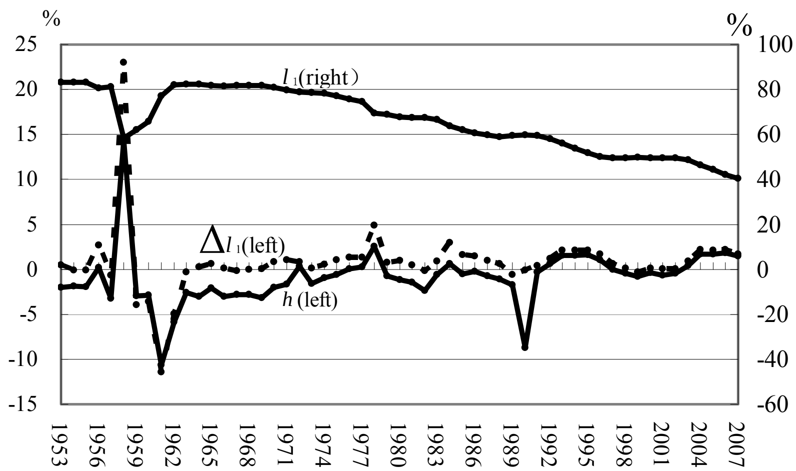
[17] According to Chinese official statistics, the net reduction in China's population reached 13.48 million in two years of 1960 and 1961. If adding the new born in these two years, the number of starvation must become much larger because China increased its population by net 13.41 millions alone in the year of 1958. See NBSC, 2005, Table 3. The same table also offers data on China's population growth rates. But the rates of these famine years show a clear incompatibility with the parallel displayed population numbers. To the famine see also Coale (1984), Li (1997) and Yang (2008) .

[18] Another big irregularity in China's employment statistics is found in 1990. It is said (Tan, 2006: 13) that the changes of data collection procedures contribute to it. The published data on employment until 1989 were collected through the so called "establishment approach", that is, based on reports from enterprises and agricultural production collectives as well as self-employment. It is replaced by the "population approach" after 2000. It is noted by the NBSC that the employment data between 1990 and 1999 were adjusted with results from China's 5th census in 2000. The data until 1989 and that from 1990

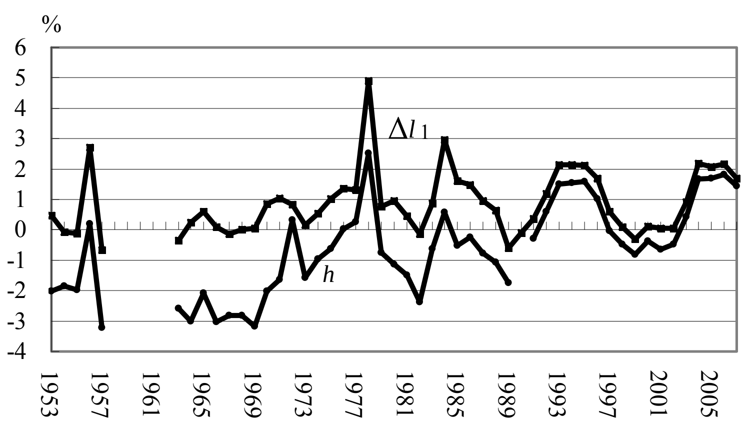
Another striking feature in Figure 3.4 and 3.5 is the cyclical fluctuations of farmer out-migration in China during the 55-year period under review. The cycles have become especially clear, regular and even robust since the end of the 1970s when China started steadily to transform its central-command economic system to a market-oriented one. Figure 3.4 indicates that $\mathcal{H}$ and H tend to expand for some 5 years after about 5 years of decline. Figure 3.5 and Figure 3.6 without the extreme years shed more light on this proposition. The "instantaneous velocity" of the decline in l_1 changed as frequently and

Figure 3.5 l_1, Δl_1 and h in China, 1953-2007



Source: see Figure 3.4.

Figure 3.6 Δl_1 and h in China without extreme years, 1953-2007



Source: See Figure 3.4. Δl_1 and h without 5 years from 1958 to 1962 and h also without 1990.

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could not be compared in a simple and linear manner.

strongly in China as in the US, but more regularly than in the US. Amplitudes of fluctuations in Δl_1 and h were much bigger in China as well. The ratio of $(h^{t+1}-h^t)/h^t$ exceeded 100% in 21 years. And the fluctuations in the first phase of 39 years were much stronger than in the second phase of 16 years. Cycles of the fluctuations became more regular in the second phase with some 3 to 5 years increase, followed by a decrease also for 3 to 5 years. There was even a flat area at the peak or bottom of cycles for around 3 years during this phase. In comparison of fluctuations in farmer outmigration between US and China in the post-war era, three differences should be mentioned briefly. Firstly, the absolute value of Δl_1 and h in China was much larger than in US. As Figure 3.3 shows, h's peak was 0.8% in 1951 and did not reach |0.2%| in the most years in US. However, China's h exceeded 1% in 8 years in the second phase of only 16 years, in which h fluctuated even regularly. Secondly, the amplitude of h's fluctuations in China was much wider than in US. The difference between the maximum and minimum value of h in the period under review was only 1.2% in US, but 5.7% in China even excluding extreme years of 1958, 1961 and 1990. Even in China's second phase with regular fluctuations, the difference still reached 2.8%. Thirdly, Δl_1 and h show the upward trend in China while the opposite occurs in US. Δl_1 in China would be increasing with the slope of 0.056 of its linear trend if excluding the abnormal year of 1958. h shows a slowly increasing trend in any cases, but the trend would become more robust without two extreme years of 1958 and 1990. These differences imply that intersectoral migration of agricultural labor force may play a very different role in economic growth and business cycles in China than in US.

4. Comparative Importance of Agricultural Labor Migration and Unemployment

4.1 Theory

Data in the last section suggest that intersectoral transfer of farmers may be of importance for the short-run macroeconomic performance in the developing countries. This section will contribute to find a criterion with which the comparative macroeconomic importance of unemployment and migration could be determined in a specific case. In the short run, with capital and its sectoral allocation as well as total labor being given and institutions and technology being constant, changes in the labor force alone could affect aggregate output. The pathways by which labor influences growth and prices are fluctuations in unemployment or intersectoral migration (sectoral reallocation) or both together. In reality, both unemployment and migration always occur simultaneously in the real market economies we experience. But we start from pure theory. Assuming an aggregate production function for a two-sector economy in the short-run as follows

$$(4.1) \quad Y = pf_1(l_1) + f_2(l_2) \qquad (l_1 + l_2 = 1)$$

where Y stands for aggregate output or income and f for sectoral product in kind, p represents the relative price of the agricultural product, and f_1 and f_2 satisfy the Inada conditions. We let nonfarm product be the numeraire, $p_2 = 1$, $p = p_1/p_2$. Because the sectoral allocation of capital is assumed to be invariant, capital shares do not occur in (4.1). The fixed total labor is normalized at unity and its allocation expressed by $1 = l_1 + l_2$ $(1 > l_i > 0)$.

As a general practice in the developing countries, unemployment usually refers to workers who are out of work but are searching for jobs and remain in the nonfarm sector or urban areas. Unemployment statistics do not encompass farmers in agriculture or elsewhere in rural areas even when they are idle. Therefore, we suppose that unemployment is a subtraction of labor inputted in the nonfarm sector. Furthermore, we assume that labor transfer between sectors does not take time and unemployment is independent of farmer migration and vice versa. Let L, U and H stand for total labor, unemployment and migration out of agriculture and u=U/L and h=H/L for unemployment rate and migration rate, respectively. Introducing u and h simultaneously into (4.1), we get

$$(4.2)\quad Y^* = pf_1(l_1^*) + f_2(l_2^*) = pf_1(l_1-h) + f_2(l_2+h-u) \qquad (l_1^*+l_2^*+u=1)$$

where $1 > u > 0$ and $1 > h > 0$.[19] We look for the conditions under which $Y^*=Y$ exists with concurrence of both u and h. Without regard to changes in p, we differentiate (4.2) with respect to l_1 and l_2 and get [20]

$$pf'_1(l_1)\cdot(-h) + f'_2(l_2)\cdot(h-u) = 0$$

where $dY^*=0$. Rearranging it to

$$(4.3)\qquad [f'_2(l_2)\cdot h - f'_2(l_2)\cdot u] - pf'_1(l_1)\cdot h = 0$$

The first term on the left-hand side of (4.3) is the change in nonfarm product caused jointly by in-migration and unemployment and the second term is the change in farm product caused by out-migration of farmers if $h > 0$. The two changes must offset to each other for (4.3) to be valid. But the second term is obviously negative, while the first term becomes zero if $h = u$. Hence, the first condition for validity of (4.3) should be $h > u$ to ensure that the first term is positive. In addition, the second term is an expression of pdf_1, the incremental change

[19] The case of $-1 < h < 0$ can be studied in similar manner. It may be particularly useful to help determine the comparative effects of unemployment and (return) migration on output downturns during economic recessions.

[20] To differentiate (4.2) with respect to u and h will get similar results, but their economic meanings are difficult to be explained. If considering p, we get in (4.3) two additional terms of $(dp/dl_1)f_1$ and $(dp/dl_2)f_1$ with their sum $f_1(dp/dl_1 + dp/dl_2)$. The sum must be very small because $dp/dl_1<0$ and $dp/dl_2>0$ and is not taken into account further in order to make economic meanings of (4.3) clearer.

(reduction) in pf_1 that a change in agricultural labor from l_1 to (l_1 - h) brings about, while the first term is the increment of f_2, df_2, that the incremental change (augmentation) in nonfarm labor input from l_2 to ($l_2 + h - u$) causes. Therefore, the second condition for validity of (4.3) is $|p\mathrm{d}f_1| = \mathrm{d}f_2$.

We rewrite (4.3) to get

$$(4.4) \qquad f'_2(l_2)\cdot h = pf'_1(l_1)\cdot h + f'_2(l_2)\cdot u$$

Equation (4.4) expresses clearly that, if aggregate output remains the same before and after concurrent migration and unemployment, the increase in nonfarm product related to the in-migration must be equal to the sum of both decreases in farm and nonfarm product caused by outmigration and unemployment separately. Dividing by the left-hand term and rearranging the terms will give

$$(4.5) \quad 1 = \frac{u}{h} + \frac{pf'_1(l_1)}{f'_2(l_2)} = \frac{u}{h} + r$$

where

$$(4.6) \qquad r = \frac{pf'_1(l_1)}{f'_2(l_2)}$$

The term, r, is the ratio of the marginal products between the agricultural and nonfarm sectors when the labor increments are equal in both sectors. According to the Inada conditions, $f'_1(l_1) > 0$, $f'_2(l_2) > 0$, there must be $r > 0$. The productivity of farm sector is generally lower than that of nonfarm sector,[21] that is, $f'_1(l_1) < f'_2(l_2)$, and we take that $r < 1$. The term of $\frac{u}{h}$ is the ratio between unemployment rate and migration rate. It is also the ratio of unemployment and migration since $\frac{u}{h} = \frac{U/L}{H/L} = \frac{U}{H}$. Because of $u>0$, $h>0$, it holds $\frac{u}{h}>0$. The main messages conveyed by (4.5) are that the sum of the ratio of unemployment and migration and the ratio of marginal products must be unity if $Y^* = Y$. The migration of agricultural workers is of at least equal importance for macroeconomic performance as is unemployment if (4.5) holds because the effects of simultaneous changes in both unemployment and migration could offset to such an extent that aggregate output remains unchanged. Similarly, the effects of migration might exceed those of unemployment if

$$(4.7) \qquad 1 > \frac{u}{h} + r : \text{Lewisian Economy}$$

[21] Restuccia, Yang and Zhu (2008) find clearly lower productivity of labor in agriculture than nonagriculture in all country groups of different income levels in 1985.

What (4.7) expresses is that the extra product produced by the in-migrated farmers in nonfarm activity exceeds what is needed to compensate for both the reductions in farm production caused by these farmers' out-migration and in nonfarm production affected by unemployment. Thus, the aggregate output must rise, due to labor transfer from the less to the more productive sector. A necessary condition for (4.7) being valid is $\frac{u}{h}<1$, when $r<1$ is already given. That means $u<h$ and U<H, that is, unemployment is smaller than migration. We name, according to Lewis (1954), economies satisfying (4.7) the Lewisian ones where intersectoral migration of farmers is larger than unemployment and effects of the former on aggregate output are bigger than that of the latter. Therefore, macroeconomic analysis with these economies as the background may concentrate, at least to certain extent, on migration and its relations with economic growth and business cycles.

Alternatively, unemployment will exert the larger macroeconomic effect if

$$(4.8) \qquad 1 < \frac{u}{h} + r$$

The expression (4.8) implies that the negative effect of unemployment on total production could not be offset by the positive effect of labor transfer between sectors and unemployment must lead to a fall in aggregate output. (4.8) is valid when

$$(4.9) \qquad r = 1$$

$$(4.10) \qquad \frac{u}{h} \geq 1$$

$$(4.11) \qquad r < 1,\ \frac{u}{h} < 1,\ \frac{u}{h} + r > 1$$

(4.9) is true because of $\frac{u}{h}>0$, thus (4.9) must lead to (4.8). Note the case of $r>1$ is already excluded. (4.10) holds because there must be $r>0$ when Inada conditions apply. (4.11) is a partial repeat of (4.8). The standard neoclassical economy satisfies the condition of (4.9). In the neoclassical economy with $r = 1$, labor productivity is the same in all sectors; the transfer of a worker from one sector to another can change outputs of sectors he leaves and enters, but not aggregate one of both the sectors. Therefore, unemployment will cause Y to fall, no matter how small it might be. [22]

There may be some economies that satisfy (4.10). In these economies, productivity gap persists between agriculture and nonagriculture, but the farmer migration is less than unemployment. In this case, migration into nonfarm activity cannot, no matter how big it

[22] In order to ensure full employment in the neoclassical economy, unemployment can be seen as reduction in total labor force. Someone may exit from labor forces if current wage is too low to him and enter again if wage is high enough for him. (Ehrenberg/Smith, 1991)

may be, compensate nonfarm output loss from unemployment, not to say that migration out of agriculture affects farm output negatively. Unemployment is hence more important for aggregate output than migration. We divide these economies in two groups:

(4.12) $1>r,\ \frac{u}{h}\geq 1,\ \frac{u}{l_1}\geq 1$: quasi-neoclassical economies

(4.13) $1>r,\ \frac{u}{h}\geq 1,\ \frac{u}{l_1}<1$: Todaro economies

where $\frac{u}{l_1}=\frac{U/L}{L_1/L}=\frac{U}{L_1}$ is at the same time the ratio of unemployment and agricultural employment. There must be $u>h$ when $u\geq l_1$ or U> L_1 since H composes only a part of L_1 and $h<l_1$ always exits. Hence, Equation (4.12) defines a quasi-neoclassical economy where more importance of unemployment is identified with U>L_1. The present developed economies are categorized into this group. For example, as mentioned above, U and L_1 were 13 million and 10 million in the US in 1933, respectively, when the nation experienced the Great Depression. Today, as the financial crisis broke out in September, 2008 and led the US economy to downturn, U and L_1 amounted to 10 million and 2 million at the end of November, 2008 (US Government, 2009, Table B-35). Obviously, L_1 and then H were essentially too small and their effects on aggregate out and business cycles could not compete with unemployment during the two big recessions in the US economic history. Macroeconomics of these economies can and should, hence, exclude farmer intersectoral migration and concentrate itself on unemployment, as economists in this field have done. Keynes (1936) knew this, denied firmly the importance of agriculture for his macroeconomic analysis and did not at all mention intersectoral transfer of agricultural labor in his *General Theory*.

(4.13) defines another group of economies where U > H despite L_1 > U. It may be that large urban unemployment combined with sluggish economic growth could hinder or stop the migration of agricultural workers, as the Todaro (1969) and Todaro/Harris (1970) models predict. we name them Todaro economies accordingly. To conclude, it is a question for empirical research to determine if $\frac{u}{h}$ or $\frac{u}{h}+r$ are greater, smaller than or equal to unity for a specific real economy. Hence, we shall return to data issues subsequently.

4.2 United States

Unemployment and migration of farmers out of agriculture appear in all economies around the world we observe in reality. Comparative importance of unemployment and migration in every economy is hence an empirical question. We shall investigate two countries to highlight the various macroeconomic importance of farmers' intersectoral migration in different national economies. They are the United States, the world's most developed nation, and China, a nation with the world's most labor force. This subsection will deal with the US in the post-war era. It is known that (1) L_1 and l_1 still keep their long-run declining trends in the US after the World War II, as described in the last section. (2) Agriculture in US as a whole remains the sector essentially composed of family farms with labor forces mainly from within the family of the farm owners or managers who rent in farm from the owners, although there is a small fraction of farms which are very big according to land size or farm output [23] (Suits, 1995; Allen and Lueck, 2003). (3) Marginal productivity of labor even in US agriculture, the world's most advanced one, is not high enough to support the annual labor income as high as, or similar to, that in other economic sectors. This is mainly because of the seasonality of farm work, so that hiring wage labor all the year is reasonable neither to job-searchers who look for permanent employment nor to farmers who cannot pay competitive wages (Friedmann, 1978). (4) There may still be excessive labor force in US agriculture that should be transferred into nonfarm sector (Johnson, 1960: Denison, 1962). Therefore, the assumption of $r < 1$ could still apply to the US economy if it is divided into farm and nonfarm sector. But we will first investigate $\frac{u}{h}$ in US.

Here comes a question of stocks and flows to clarify. L_1 and U in this paper are stocks measured at a given point in time, whereas H and ΔU, the increment in L_1 and U, are flows measured per unit of time. There are certain quantities of L_1 and U at both the beginning and the end of the period t, while labor migrates between sectors and unemployment changes during the period t. Therefore, H represents the net changes in migration out of agriculture and ΔU the net changes in unemployment. u was introduced into Equation (4.2) for the first time in the present paper must be understand as ΔU/L instead of U/L.[24] Below we let u^*=ΔU/L and keep u=U/L according to the literature. What we must do now is to find if

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[23] According to Suits (1995) based on US Department of Agriculture (1992), there were 2.1 million farms and 2.9 million farm employment in the United States in 1990. The average acreage per farm amounted to 461. Although only about 5% of all farms contained 1 000 or more acres each, they used more than 40% of all farm acreage. And only 2% of all farms were incorporated, but they owned 12% of all land in farms and marketed 22% of the total value of all farm crops (Suits, 1995: 5-6). The similar structure is found in Europe as well. Hill (1993) finds from agricultural statistics of the European Union that farms whose more than half labor was done by non-family members amounted to only less than 7% of all farms in 1989. Alone in UK and Spain, such farms reached more than 15%.

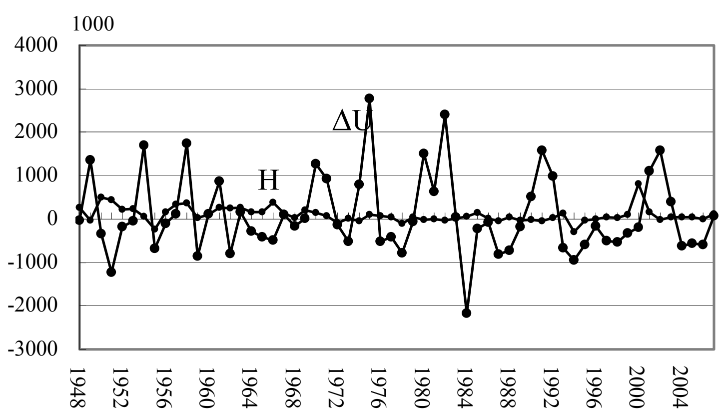
[24] The definition range is $l_1+l_2=1$ for (4.1), while $l_1^*+l_2^*+u=1$ for (4.2) with $l_1^*=l_1-h$ and $l_2^*=l_2+h-u$. The difference makes clear that u in (4.2) is the ratio of new unemployment to total labor.

$\frac{u^*}{h}>1$ for the United States. For convenience, we now consider only H and h defined in section 2, not ℋ and Δl_1, since there are systematic and stable relations between H and ℋ or h and Δl_1, as Equation (2.5) and (2.8) indicate, when growth rate of total labor force remains stable, which is just the case of the United States.

Although Figure 3.2 and 3.3 show evident cyclical fluctuations in the migration of the agricultural labor force in the US, that migration cannot compare quantitatively with changes in the US unemployment. As illustrated in Figure 4.1, fluctuations of H which were very strong and frequent in Figure 3.2 become now very calm in relation to ΔU, and the latter plays the leading role in macroeconomic cyclical fluctuations. In particular, the amplitude of fluctuations in ΔU is much wider than that of H, with ΔU frequently exceeding a million workers in both directions. But H approached that magnitude only once in 60 years. In the most years, H remained far below 0.2 million, while ΔU exceeded 0.2 million in almost every year. Dividing ΔU and H by the total labor yields Figure 4.2, where the shapes of curves $u^*=\Delta U/L$ and h=H/L are almost the same as ΔU and H in Figure 4.1. Figure 4.2 demonstrates much larger fluctuations in u^* compared with that of h in US.

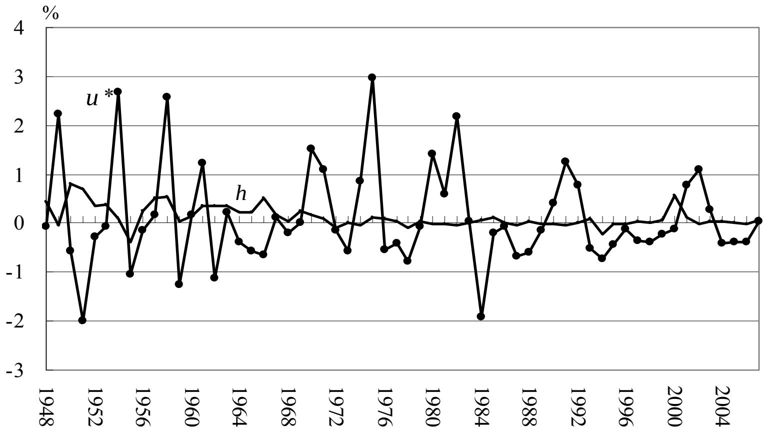
Since $\frac{u^*}{h}=\frac{\Delta U}{H}$, Figure 4.1 and 4.2 imply there may be |ΔU|>|H| and $|u^*|>|h|$ in US in most years during the post-war era. We look at quantitative relations of u and l_1 depicted in Figure 4.3 further. The relations developed clearly in two phases. The first phase lasts from 1947 to 1969 when $u<l_1$ ($U<L_1$) and the second from 1970 to 2007 when $u>l_1$ ($U>L_1$). As shown in Table 4.1, $|u^*|<|h|$ happened in 11 years during the whole post-war era, but the most of them were in the first phase with $u<l_1$, while only two years occurred in the second phase with $u>l_1$. The frequency of occurrence of $|u^*|<|h|$ exceeded the threshold of 5% only a little during this phase, although it reached 40% in the first phase.

Figure 4.1 ΔU and H in US, 1948-2007



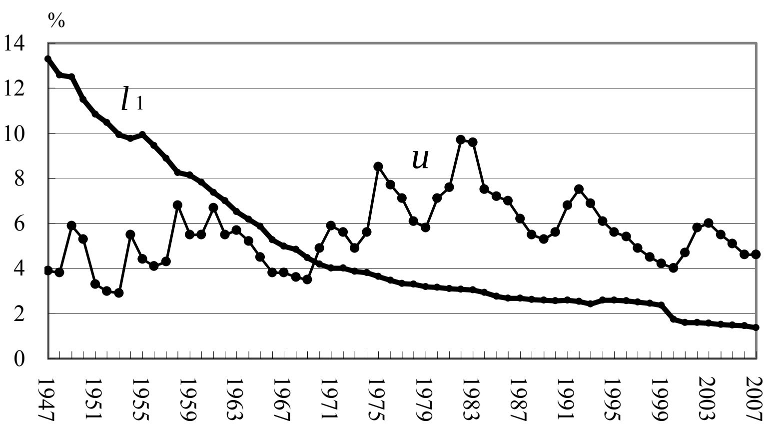
Source: see Figure 3.2. Computations of ΔU were done by author.

Figure 4.2 u^* and h in US, 1948-2007



Source: see Figure 3.2. Computations of u^* were done by author.

Figure 4.3 u and l_1 in US, 1947-2007



Source: see Figure 3.2. Note the denominator of l_1 is total labor force, not total employment being usually used for this measure. Computation of u was done by author.

Finally the averages and standard deviations of ΔU and H in 1948-2007 are shown in Table 4.2. Both statistics for ΔU reach 0.68 million and 0.62 million, respectively; for H, both fall far below 0.2 million. The average of ΔU is 5 times greater than that of H. The average of data series |ΔU/H| (=$|u^*/h|$) appears even to 1929%. It can conclude that $|u^*|$ is substantially bigger than $|h|$. In the meantime, range of deviation of |ΔU| or $|u^*|$, measured by standard deviation, is many time greater than that of |H| or $|h|$ as well. A t-test also validates the hypothesis of $\frac{|u^*|}{|h|}>1$. Therefore, Equation (4.10) of $\frac{u^*}{h}\geq 1$ and then (4.8) of $\frac{u}{h}+r>1$ apply to the post-war US economy. Effects of changes in unemployment on aggregate output must be more significant than that of farmer out-migration in US after 1947. Because of $\frac{u}{l_1}>1$ in the US after 1970, Equation (4.12) applies to the US as well. The US economy belongs to the quasi-neoclassical economies at least since 1970.[25]

Table 4.1 Frequency of Occurrence of $|u^*|<|h|$ in US, 1948-2007

Period	1948-2007	1948-1969	1970-2007
	Whole period	First phase	Second phase
		$u<l_1$	$u>l_1$
Total years	60	22	38
Years of $\|u^*\|<\|h\|$	11	9	2
Frequency (%)	18.33	40.91	5.26

Source: see Figure 3.2. Computation was done by author.

Table 4.2 Average and Standard Deviation of ΔU and H in US, 1948-2007

	|ΔU|	|H|	|ΔU/H|
	1 000		%
Average	678	132	1929.05
Standard deviation	620	149	3078.51

Source: see Figure 3.2. Computation was done by author.

4.3 China [26]

4.3.1 Value of $\frac{u^*}{h}$

Turning now to the value of $\frac{u^*}{h}+r$ in China, we note that, different from in the United States,

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[25] This judgment is made alone from our definitions of (4.12) of quasi-neoclassical economy. In reality, years of particular importance should be taken into account. As mentioned before, $U>L_1$ or $u>l_1$ already occurred in the US in 1933, It lasted to 1939 when L_1 amounted to 9.6 million, while 9.5 million people are reported unemployed. Only after the World War II broke out unemployment reduced strongly and the relation of $U<L_1$ arose in the US again.

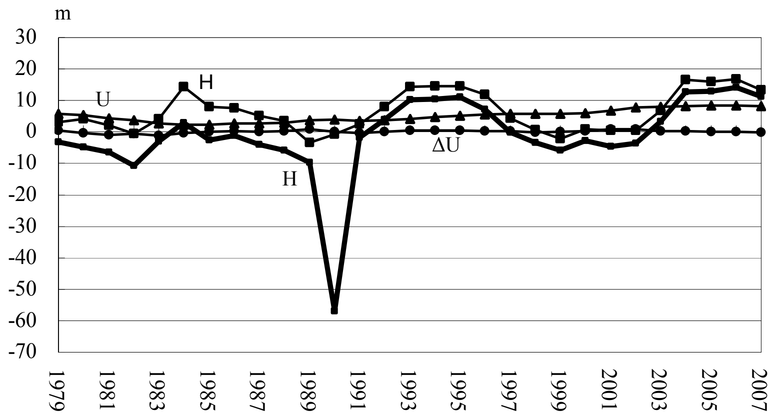
[26] Parts of contents in this section are excerpted from Hu (2008b)

the value of $\frac{u^*}{h}$ or r alone does not seem to be able to determine the comparative macroeconomic importance of farmer outmigration or unemployment in China. We discuss $\frac{u^*}{h}$ first. China has published unemployment statistics only from 1978, that is, the initial year of its on-going economic reforms.[27] We reproduce the data in Table A2 in the Appendix with those on farmer migration. The annual changes in China's unemployment (column ΔU in Table A2) are around 0.5 million for the whole period of 29 years, during which ΔU exceeds 1 million in only two years -- 1981 and 1983. In contrast, there are 10 years when farmer migration surpasses 10 millions each year, measured by H as well as $\mathcal{H}$, and few years witness migration of less than one million. The migration should be quantitatively even more significant than changes in unemployment allowing for the fact that H and $\mathcal{H}$ could be the lowest estimates of **H**, the true quantity of migration. The absolute scale of ΔU exceeds that of migration only in 1 year for H and in 3 years for $\mathcal{H}$, while being much smaller than both in the other 28 or 26 years, respectively. In 15 years, that is, more than half of the whole period concerned, |ΔU|/|H| as well as $|\Delta U|/|\mathcal{H}|$ is below $\frac{1}{20}$. This suggests that, in quantitative relation to migration, changes in unemployment would be too small to be of real macroeconomic relevance.

With figures from Table A2, we get Fig. 4.4 and 4.5 without the extreme year of 1990 for H. It illustrates not only the quantitative comparisons between migration and unemployment, but also their fluctuations. The cycles of fluctuations in both H and $\mathcal{H}$ are obvious and robust; their amplitude is much wider than that of ΔU. Even U itself can not compete with H and $\mathcal{H}$ for strength and regularity of cyclical fluctuations. In any cases, the scale of the fluctuations in ΔU, even if it does fluctuate, is still too small to convey any macroeconomic importance. Here again, size is decisive. In the short run, a change of 10 million persons must be a much more serious concern for economic policy makers than one of only several 100 thousand.

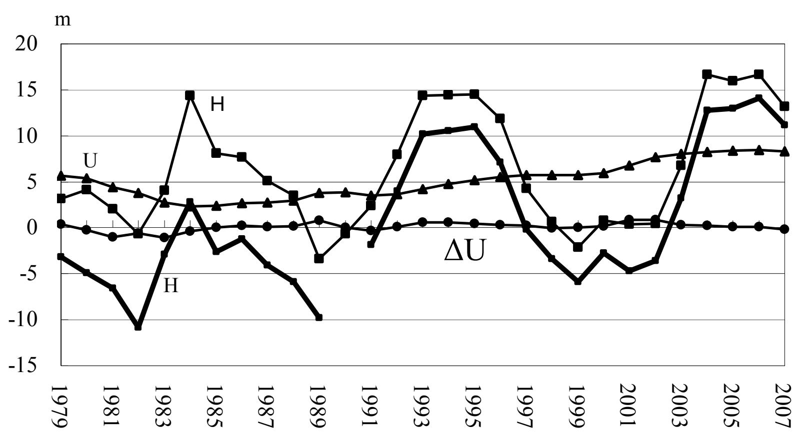
[27] Different from almost all other countries, China's unemployment statistics encompass only unemployed persons in urban areas who are assigned urban residence status. Assignment of this prestige status in China depends mainly on the status of parents or earlier ancestors. The status was assigned in the first years after the communists came to power in 1949 and established the status system, known as the Hukou system in the Western literature. Even a farmer who has worked and lived in urban areas for more than 10 years cannot change his status to that of urban resident and must remain a farmer. Therefore he does not qualify to register as unemployed if he lost his job, e.g., due to effects of a macroeconomic recession on the factory where he has been working in for many years. In recent years, this rigid and apartheid-like system has become looser to some extent in different regions, but remains essentially in place for the China as a whole. This particular institutional arrangement should be kept in mind when dealing with China's economic statistics, especially on labor and unemployment. Naughton (2007: 113) names this Hukou system "two different form of *citizenship*: one rural and one urban" (Italics is in original). See also Fan (2008).

Fig. 4.4 Migration and unemployment in China, 1978-2007



Source: see Table A2.

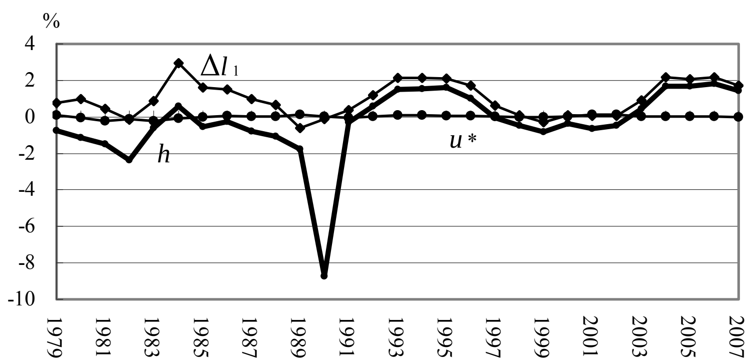
Fig. 4.5 Migration and unemployment in China, 1978-2007



Note: H without the extreme year of 1990
Source: see Table A2.

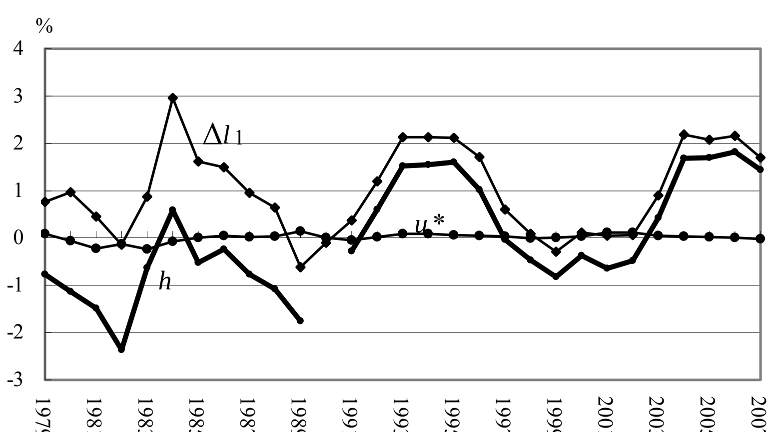
The comparative macroeconomic importance of migration and unemployment for economic policy could be clarified further with Figure 4.6 and 4.7 without data of 1990 for *h*. In both figure, *u** seems like a horizontal curve with only slight and irregular ripples in China from 1978 to 2007, while Δl_1 and *h* swing forcefully and cyclically. In fact, the fluctuation range of *u** was only (-0.23, 0.15), as shown in Figure 4.6, and the difference between its maximum and minimum value reached only 0.38. In the same period, however, the range of *h*'s fluctuations is (-8.73, 1.82) and the difference of *h*'s maximum and minimum is 10.55 with data of 1990, or (-2.37, 1.82) and 4.19 without 1990. It is obvious that *h* should be substantially larger than *u**. The averages and standard deviations of absolute values of H, H^* and ΔU in the period of 29 years are given in Table 4.3, where the year of 1990 is not considered in H^*. The averages of |H| and $|H^*|$ amount to about 8 million and 6.2 million, respectively, whereas that of |ΔU| falls even under 0.4 million. The ratio between averages of |ΔU| and |H| or $|H^*|$ reach only 4.6% or 5.9%, while the ratio between standard deviations of |ΔU| and |H| or $|H^*|$ come to be 3.0% or 7.6%. A comparison with the values of US: The ratio between averages of |ΔU| and |H| in the period under review is 517% in US and 4.6% in China and the ratio between standard deviations of the both is 417% in US and 3.0% in China. US and China may lie at the two extremes within the range of |ΔU|/|H|. Farmer out-migration may be more important for China, when unemployment play greater role in the US economy.

Figure 4.6 *u**, Δl_1 and *h* in China, 1978-2007



Source: see Table A2.

Figure 4.7 *u**, Δl_1 and *h* without 1990 in China, 1978-2007



Source: see Table A2.

The average of data series of |ΔU/H| (=|u^*/h|) amounts to 0.1211, as shown in the last column in Table 4.3. We compute frequencies of certain value ranges of |u^*|/|h| in Table 4.4 and find the frequency of |u^*/h|≥0.40 is under only 5%. In order to enhance robustness of our findings, we take |u^*/h|=0.4 for the further studies.

Table 4.3 Average and Standard Deviation of ΔU and H in China, 1979-2007

	|H|	|H^*|	|ΔU|	|ΔU/H|
	million			%
Average	7.97	6.22	0.37	12.11
Standard Deviation	10.21	4.04	0.31	22.47

Source: see Table A2. H^* without 1990. Computation was done by author.

Table 4.4 Frequency of occurrence of values of u^*/h in China, 1979-2007

|u^*/h|	<0.10	≥0.10	≥0.20	≥0.30	≥0.40
Number of years	20	9	4	2	1
Frequency (%)	68.97	31.03	13.79	6.90	3.45

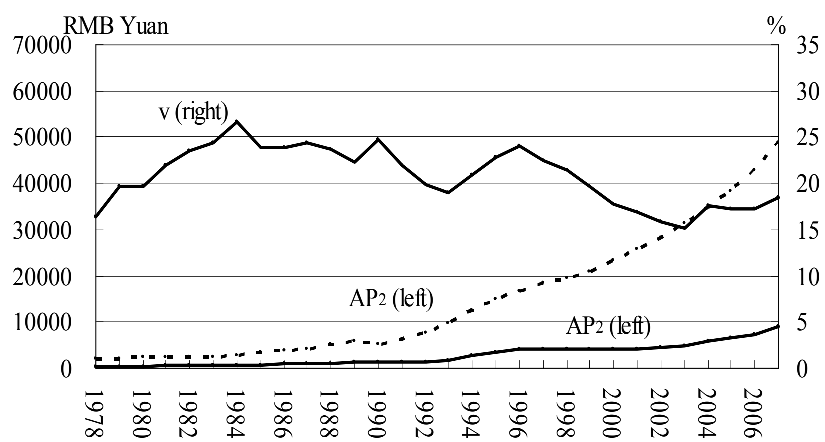
Source: see Table A2. Total years=29. Computation was done by author.

4.3.2 Value of *r*

Since |u^*/h| = 0.4 <1 in China, we have to investigate the other factor, r, to make sure to which group of economies China should belong according to 1 >=< $u^*/h + r$. r stands for ratio between marginal products of farm and nonfarm labor. Let MP and AP represent marginal and average product of labor, respectively, $r = \frac{MP_1}{MP_2}$ and let $v = \frac{AP_1}{AP_2}$. The strategy used to find r for China in this subsection is as follows: first we compute AP_1 and AP_2 and their ratio, v, with the data available, then we explain there should be $r \le v$ in order to get the value range of r. In the Chinese statistics, the economy is divided into 3 industries, of which the primary one contains only agriculture without mining sector that is categorized under the secondary industry in China. We combine the secondary and tertiary industry for nonagriculture and assume $AP_i = \frac{GDP_i}{L_i}$, i=1, 2 and L is employment. The data on sectoral GDP and employment in China from 1978 to 2007 are made use of to compute AP. The results of computation of AP_1, AP_2 and v are shown in Figure 4.8 where deflators are not used for the computations since we are interested mainly in v and a representative deflator for the whole nonagricultural sector is not available. Figure 4.8 reveals that AP_1 and AP_2 rise quickly and almost continuously during recent 3 decades. AP_1 is multiplied by 25 times and

AP_2 by 22 times when the GDP data are not deflated with constant prices. Unlike them, *v* experiences continual changes or fluctuations, but does not show distinct trends to rise or fall in the 30 years considered here. Both of the average and median of *v* is around 0.21 and its standard deviation is 0.03, which implies 0.21 may be a good representative of the true average of *v*. In fact, this value seems to be in line with Maddison's findings (1970). He compares average productivity of labor in agriculture and nonagriculture in two years of 1950 and 1965 for 22 countries, all of which were less developed at that time, and finds the ratios of the productivity between the two sectors be around 0.2 for the most countries in each of the two years under review, although productivity in each of the both sectors rose for the most countries from 1950 to 1965. Restuccia, Yang and Zhu (2008) also find $v<0.2$ in almost all developing countries in 1985. Our computation of frequency in Table 4.5 tells that the frequency of $v\geq 0.25$ is under 5% for the whole period under review. For robustness of the results we get, we take $v=0.25$ for further studies. In the meantime, $v=0.25$ implies that, when still remaining in term of average product and highlighting with an example, out of 4 million farmers who have transferred into nonfarm activity in a certain year, merely 1 million are needed to produce nonfarm output to compensate the loss of farm production made by out-migration of these 4 million farmers. Farmer out-migration should be more important for output growth than unemployment if there would be less than 3 million new unemployment occurring in the same year.

Figure 4.8 Average Product of Labor in China, 1978-2007



Sources: NBSC, 2007; 2008. Current prices. Computations of AP and *v* were done by Author.

Table 4.5 Frequency of occurrence of values of *v* in China, 1978-2007

v	<0.21	≥0.21	≥0.25	≥0.27
Number of years	15	15	1	0
Frequency (%)	50.0	50.00	3.33	0.00

Sources: see Figure 4.8. Current prices. Total years =30. Computation was done by Author.

Let α, α_1 and α_2 stand for MP/AP, MP_1/AP_1 and MP_2/AP_2, respectively, we get relations between *r* and *v* [28]

(4.14) $r = (\alpha_1/\alpha_2)v$ $(r、\alpha_1、\alpha_2、v > 0)$

and three possibilities resulting from (4.14)

(4.15) $r > v$, if $\alpha_1 > \alpha_2$
(4.16) $r = v$, if $\alpha_1 = \alpha_2$
(4.17) $r < v$, if $\alpha_1 < \alpha_2$

We will explain Equation (4.15), that is, $r > v$, would be very impossible and $r \leqslant v$ generally possible from economic logic and available empirical studies.
As to the logic, it is known that the relationship

(4.18) $\alpha'(L) < 0$

applies for production functions (4.1) and (4.2) satisfying the Inada conditions with constant capital and other inputs (Hu, 2008c). According to (4.18), α and L will change in opposite directions. It implies that, the smaller the labor is or the larger the ratio of constant capital to variable labor is in an economic sector comparative to that of other sectors, the larger α this sector will have. In our case, the relations

(4.19) $\alpha_1 > \alpha > \alpha_2$, if $K_1/L_1 > K_2/L_2$

should hold when $r > v$. But $K_1/L_1 > K_2/L_2$ is almost impossible in the developing countries with higher l_1 and lower average productivity of labor in agriculture, such as in China. Therefore, $\alpha_1 > \alpha_2$ and then $r > v$ are logically very impossible and $r \leq v$ should be more possible.

Regarding empirical studies, there are few researches on China's sectoral MP in the literature. Chow (1993) estimates values of MP in different sectors in China in 1978. They are RMB Yuan 63 for agriculture, Yuan 1027 for manufacturing, Yuan 452 for construction, Yuan 739 for transportation and Yuan 1809 for trade. The estimations by Wang (1997) of the ratio of MPs between China's nonfarm and farm sectors are 2.55 for the year of 1980, 2.29 for 1988 and 3.68 for 1992. Yang and Zhou (1996) divide the Chinese economy into three sectors of agriculture, rural and state-owned industries. They find that MP is among Yuan 450

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[28] (4.14) is obtained from $r = \frac{MP_1}{MP_2} = \frac{\frac{MP_1 AP_1}{AP_1}}{\frac{MP_2 AP_2}{AP_2}} = \frac{\frac{MP_1}{AP_1}}{\frac{MP_2}{AP_2}}\frac{AP_1}{AP_2} = \frac{\alpha_1}{\alpha_2}v$.

to 600 in Chinese agriculture from 1987 to 1992, among Yuan 600 to 900 in the rural industries from 1987 to 1991 and Yuan 9300 in 1992, and among Yuan 7700 to 9300 in the state-owned industries from 1987 to 1992. Comparing with v=0.25, most of these findings support $r \leqslant v$, while some support $r > v$. The biggest value of r from these findings is $r = \frac{1}{2.29}$ =0.44 > 0.25, which is found by Wang (1997) only for the year of 1988. Nevertheless, all these estimations are very rudimentary and could not be taken seriously. A descriptive statistical research by Li, Liu and Wang (2009) shows that more developed provinces had higher α than less developed ones in China. That is, the provinces with lower l_1 are more possible to have higher α, while provinces with higher l_1 have lower α generally. It probably implies that the case of $\alpha_1 > \alpha_2$ could not be very possible for the Chinese provinces. In contrast, there is much more possible for $\alpha_1 \leq \alpha_2$ and $r \leq v$.

We take $r = v$ for the Chinese economy from 1979 to 2007 and get r =0.25. Since u^*/h=0.40, we have

$$(4.20) \quad u^*/h + r = 0.40 + 0.25 = 0.69 < 1$$

When the averages of u^*/h and v are taken into account, then u^*/h=0.12, r=0.21, we will get

$$(4.21) \quad u^*/h + r = 0.12 + 0.21 = 0.33 < 1$$

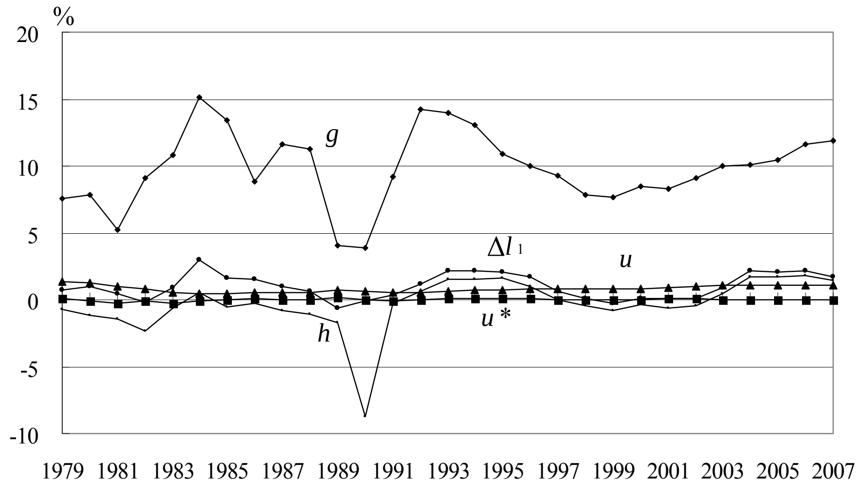
If for the whole period under review the biggest value of r we find in the literature is used, then r = 0.44. Taking u^*/h=0.40, we still get

$$(4.22) \quad u^*/h + r = 0.40 + 0.44 = 0.84 < 1$$

It can be concluded from (4.20) to (4.22) that the Chinese economy in the last 30 years may satisfy the condition of (4.7) and belong to the Lewisian economies where farmer out-migration has larger effects on aggregate output than unemployment. Therefore, it is necessary for understanding the Chinese economy to study immediate relations between intersectoral migrations of agriculture labor force on the one hand and output growth and macroeconomic stability on the other.

Finally, the comparative importance of migration in China can be highlighted with Figure 4.9 where the growth rate of China's GDP, g, is introduced. There is an apparent correlation in the cycles of fluctuations in g and Δl_1 as well as h. And the correlation is more closed than that between g and u or u^*. Therefore, researches on the short-run business cycles in the developing countries as China should take intersectoral migration of agricultural labor into account.

Figure 4.9 g, Δl_1, h, u or u^* in China, 1979-2007



Source: See Table A2. g from 1978-2003: National Bureau for Statistics, 2005, Table 8; from 2004 on: Chinese Statistical Yearbook 2008, Table 2-6. Computations of g by author.

5. Modeling Business Cycles with Agricultural Labor Migration [29]

5.1 Labor market

In this section we set up a short-run macroeconomic framework to analyze the massive intersectoral migration of agricultural labor described in the last two sections. Ideally, the framework should deal with labor migration and unemployment simultaneously. However, this paper is limited to studying only migration and business cycles and, therefore, we assume in this section that there is no unemployment in the economy concerned. And we accept the usual assumptions of the short-run, and some other specific assumptions:

1) A closed economy;
2) Complete competition;
3) No government;
4) Two sectors: non-capitalist agriculture and capitalist nonagriculture;
5) Nobody can be involved in both sectors at the same time in the short-run;
6) Migration takes no time;
7) Workers are homogeneous;
8) Each family consists of only one member who is a worker.

Hu (1994) assumes a family agricultural structure in which ownership of total arable land is allocated according to the population principle and every farm family cultivates its own land. No tenure exists. Farmers' incomes derive from their average product of labor. If this system results from a thorough and comprehensive land reform, which eliminates earlier tenure arrangements and re-distributes land to all farmers according to the population principle, then the average product may remain unchanged if agricultural techniques are the same and the quantity of land is constant.[30] However, a representative farmer will receive the average product of his labor, a higher income than before because now there are no rents to be paid for land use. If his income stands at the subsistence level before the land reform, it must surpass that level after the reform. Therefore, the subsistence wage is eliminated in the family farm agriculture set up by a land reform.[31] Family farm agriculture can also evolve from rural

[29] Parts of contents in this section are excerpted for Hu (2008a)

[30] It seems to be probable that the average product of labor will rise through land reforms favorable to small farmers. There are case studies on China's land reform at the end of the 1970s that support the hypothesis (Lin, 1992).

[31] Hu (1998) names the present Chinese family farm structure "Quasi-owner farming system", meanings that Chinese farmers does not possess land ownership individually, but get use-rights through the population principle and use the land "freely", that is, do not need to pay any economic rents, in an expected long time (30 years by law). He also argues subsistence wage does not exit in such a agriculture. According to Zhu (1995: 102) around 70 percent of all farmer collectives distributed land to individual family for use with population principle during the Chinese land reform at the end of 1970s and beginning of 1980s, while more than 21 percent used the double-principle considering population and labor force and 7.7 percent utilized the principle of labor force. Kisen (2006) offers an interesting case study of farm land distribution in a remote village in China where a most equal distribution is pursued and implemented. .

village communities with common land. The communities live at least at the subsistence level before their disintegration. It means the average product of labor cannot be lower than that for subsistence. The level will remain after the common property resources are distributed to community members averagely in favor of family farm. In both cases, however, the average product will increase if some farmers migrate out of agriculture and leave their land to be cultivated by remaining farmers freely.[32] Equating the average product with the agricultural wage rate, we recognize that the wage rate will rise along with out-migration of farmers. The well-known horizontal wage curve that Lewis (1954) proposed could not be valid here, irrespective of how low the marginal product of agricultural labor, provided that it is positive.[33] Based on this family structure, Hu's agriculture sector can be modeled as follows:

(5.1) $Y_1 = f_1(L_1, K_1)$

(5.2) $w_1 = f_1/L_1$

(5.3) $L_1 = L_1$

(5.4) $K_1 = K_1^{\sim}$ ($^{\sim}$ means a constant)

where w and K stand for wage rate and capital, respectively. Other symbols have the same meanings as before. We continue to assume that the Inada conditions apply to f_1, that is, besides others, $f_{1,i}'>0$, $f_{1,i}''<0$, $f_{1,i}(0)=0$, $f_{1,i}(\infty)= \infty$, $f_{1,i}'(0)=\infty$, $f_{1,i}'(\infty)=0$, i $=L_1, K_1$.

The system is solvable when L_1 is given. Equation (5.2) is the embodiment of the assumption of average product wage and all farm product will be evenly distributed to farmers who cultivate the land.[34,35] We differentiate (5.2) with respect to L_1 and get[36]

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[32] It is an assumption to make the model simpler. In a market economy with individual decision making, a migrant farmer hopes to get some rents from a remaining farmer who is ready to cultivate his land. But the remaining farmer rents in the land only when his annual income will rise thereby. The interactions of the both should lead to the result that the product of the remaining farmer on rented land will be divided between them, meaning that the average annual income of agricultural labor will increase.

[33] Hu (1994) finds that Lewis' horizontal wage curve should be valid only in the agricultural structure of tenure system where a group of landowners possesses all land available and rents it out to peasants who do not own any land for farming, but have to rent in. Because of too many peasants or surplus labor in Lewis' term, their competitions with each other for renting a piece of land lead land rents to be so high that the rest can suffice to subsistence only. The situation will remain as long as surplus labor still exists. The hypothesis of average product wage is not compatible with horizontal wage curve because average product cannot be constant along with changes in agricultural labor.

[34] Strictly speaking, each family or worker produces the same product with the same size of homogeneous land.

[35] Hu (2008d: 9, footnote 3) explains to this point: "The average product wage is a very strong assumption. It might describe the reality well to some extent when most of labor forces remain in the agriculture during the first phase of the economic development departed from the precapitalist society. However, effectiveness of this assumption will be diminishing in the development process as more and more labor force leave agriculture for nonfarm activity. In the owner-farmer agriculture, farmers who plan to leave will sell, rent or relinquish their land to remainders. As a result, land value or "rent" begins to appear. On the other hand, capital will be invested in agriculture along with agricultural labor leaving out. As capital individual farmers input into production is quantitatively not large, it is probable to be seen as a kind of current costs and be regained from the harvest value, as though it is embodied, in the

(5.5) $\frac{dw_1}{dL_1} < 0$

meaning that w_1 will rise when L_1 decreases along with out-migration of farmers.

The unique destination for farmers who leave agriculture is the nonfarm sector. The model with intersectoral labor migration consists of the following additional equations:

(5.6) $Y_2 = f_2(L_2, K_2)$

(5.7) $L_2 = L - L_1$

(5.8) $w_2 = \frac{df_2}{dL_2}$ [37]

(5.9) $pw_1 = w_2$

(5.10) $Y = pY_1 + Y_2$

(5.11) $L = L^{\sim}$

(5.12) $K_1 + K_2 = K$

(5.13) $K = K^{\sim}$

(5.14) $p = p^{\sim}$

All symbols used in the equations have been defined earlier in this paper. Inada conditions also apply for f_2. Without (5.3) and (5.5), the above equations from (5.1) to (5.14) comprise a complete model of 12 equations with 12 variables (Y, Y_1, Y_2, L, L_1, L_2, K, K_1, K_2, w_1, w_2 and p) for wage determination in the short run. Existence, uniqueness and stability of a mathematical solution is demonstrated in Hu (1994). The equilibrium equation (5.9) implies

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farmers'eyes, in a sickle which is easily damaged and must be repeatedly purchased in the country fairs. But, as more and more labor leaves and more and more capital is inputted into agriculture, "opportunity cost" of capital will appear and then become stronger and stronger in the farmers' thought, value or "profit" of capital begin and evolve gradually. Finally, a part of farmers may, as a great number of farmers migrate out, get much more land than they can cultivate individually. Even facilitated with big machines, they have to employ other workers, at least seasonally, for helps, so that "wage" in the proper sense of the word appears. Agricultural producers will begin to separate from agricultural workers. Therefore, the original ideologies of farmers that all their net land product corresponds to only that of their labor will diminish gradually. In considering if to migrate into nonfarm sector, they may begin to compare nonfarm wage rate with agricultural wage in the proper sense instead of all net agricultural product. All these changes can be understood as transformation of agricultural production from its precapitalist forms to the capitalist ones. In fact, even pertaining only to agricultural workers and producers, economic development necessarily means institutional transition and ideological conversion at the same time, means changes in the social framework in which agriculture functions, in the way farmers think and reason, and evolution of farmers as human beings."

[36] (5.5) comes from $\frac{dw_1}{dL_1} = \frac{f'_{1,L_1} L_1 - f_1}{L_1^2} = \frac{f_1}{L_1^2}(\frac{f'_{1,L_1} L_1}{f_1} - 1) = \frac{f_1}{L_1^2}(e-1)$. e is production elasticity of labor. There must be $\frac{dw_1}{dL_1}$<0 because of e<1.

[37] Since K_i (i =1, 2) is a constant, we substitute df_i for $df_{i,Li}$ when confusions may not happen.

that wage rates in both the sectors must be equalized by the allocation of total labor between the two sectors at equilibrium. Letting p=1 for convenience and combining (5.8) and (5.9), we get

$$(5.15) \quad w_1 = \frac{df_2}{dL_2}$$

and

$$(5.16) \quad L_2^D = L_2^D(w_1)$$

Since f_2''<0, we have $\frac{dw_1}{dL_2}$<0 and $\frac{dL_2^D}{dw_1}$<0. (5.16) can be illustrated as a decreasing demand curve of nonfarm sector for labor from agriculture. Introducing (5.7) into (5.2) to get

$$(5.17) \quad w_1 = \frac{f_1(L-L_2)}{L-L_2}$$

and

$$(5.18) \quad \mathrm{L}_2^S = \mathrm{L}_2^S(w_1)$$

where K_1 does not appear in f_1 because of its constancy. Since $\frac{dw_1}{d(L-L_2)} = \frac{dw_1}{dL_1}$<0, there must be $\frac{dw_1}{dL_2}$>0 for Equation (5.17). Therefore, we have $\frac{dL_2^S}{dw_1}$>0. (5.18) describes an increasing supply curve of farmers' labor for nonfarm activity. Both curves are depicted in Figure 5.1. They have one and only one point of intersection, E, in their common domains in Figure 5.1. As capital accumulates in the nonfarm sector, new labor from agriculture is demanded. But the average product of agricultural labor will rise when a new farmer leaves for nonfarm activity. This farmer will require a nonfarm wage rate that is at least not lower than the new farm wage rate, which is higher because of his leaving, or he will be reluctant to migrate. Therefore, a higher labor supply for nonfarm activity must be accompanied by a higher wage level in the two sectors. Figure 5.1 illustrates the mechanism of rising wages with farmer out-migrations.

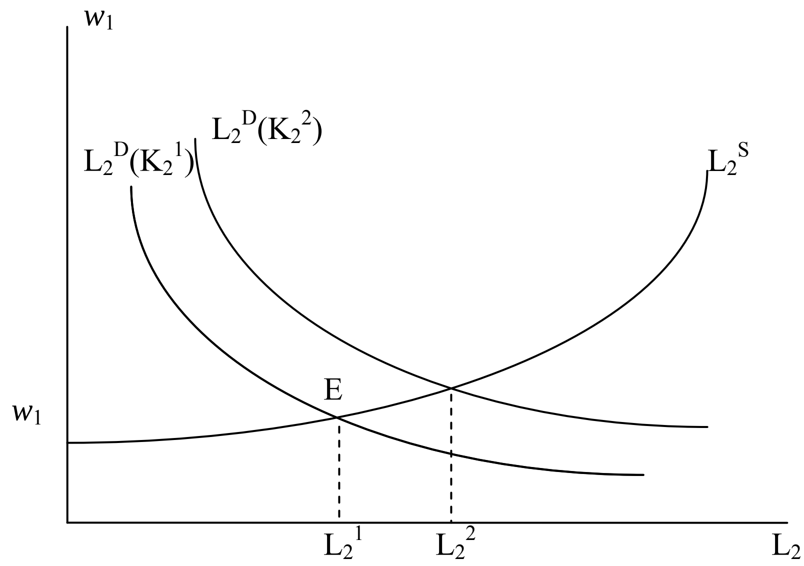

Figure 5.1 Increasing curve of labor supply

We introduce another figure to describe equilibrium on the intersectoral labor market. In Figure 5.2 below the horizontal axis represents total labor of the economy. It is allocated between the two sectors. Normalizing total labor as unity yields the familiar formula: $l_1 + l_2 = 1$. Because total labor is constant, Δl_1 or Δl_2 will function as h does. Vertical dash lines mark labor allocation at each point on the horizontal axis. Line AB, for example, marks a certain allocation of (l_1, l_2). Agricultural labor will be measured from the left-hand origin towards the right, and nonfarm labor from right to left. The production function for agriculture, Y_1, starts from the left-hand origin and rises rightwards. By contrast, the production function for the nonfarm sector, Y_2, begins from the right-hand origin and rises leftwards. Based on the assumption of higher labor productivity in the nonfarm than in the farm sector, the same quantity of labor will produce more in nonfarm activity than in agriculture, and the graph of the nonfarm production function curves up more steeply than does the farm production function in Figure 5. 2. The graph of the farm production function is weighted by p in order to make it comparable with the nonfarm production function. Therefore, both the left- and right-hand vertical axes measure the sectoral and aggregate product in term of nonfarm product and A, B on the allocation line AB are additive. The aggregate product, Y, is not illustrated in Figure 5.2, but it can be imagined as the sum of the values of farm and nonfarm product at a certain point on the horizontal axis. For example, Y is the sum of values of A and B on the vertical axis when total labor is allocated as (l_1, l_2) with the allocation line AB. The straight lines combining O_1 and points on pY_1 express the average value products of agricultural labor. Their angles with the horizontal axis, α_1, represent the average value product and

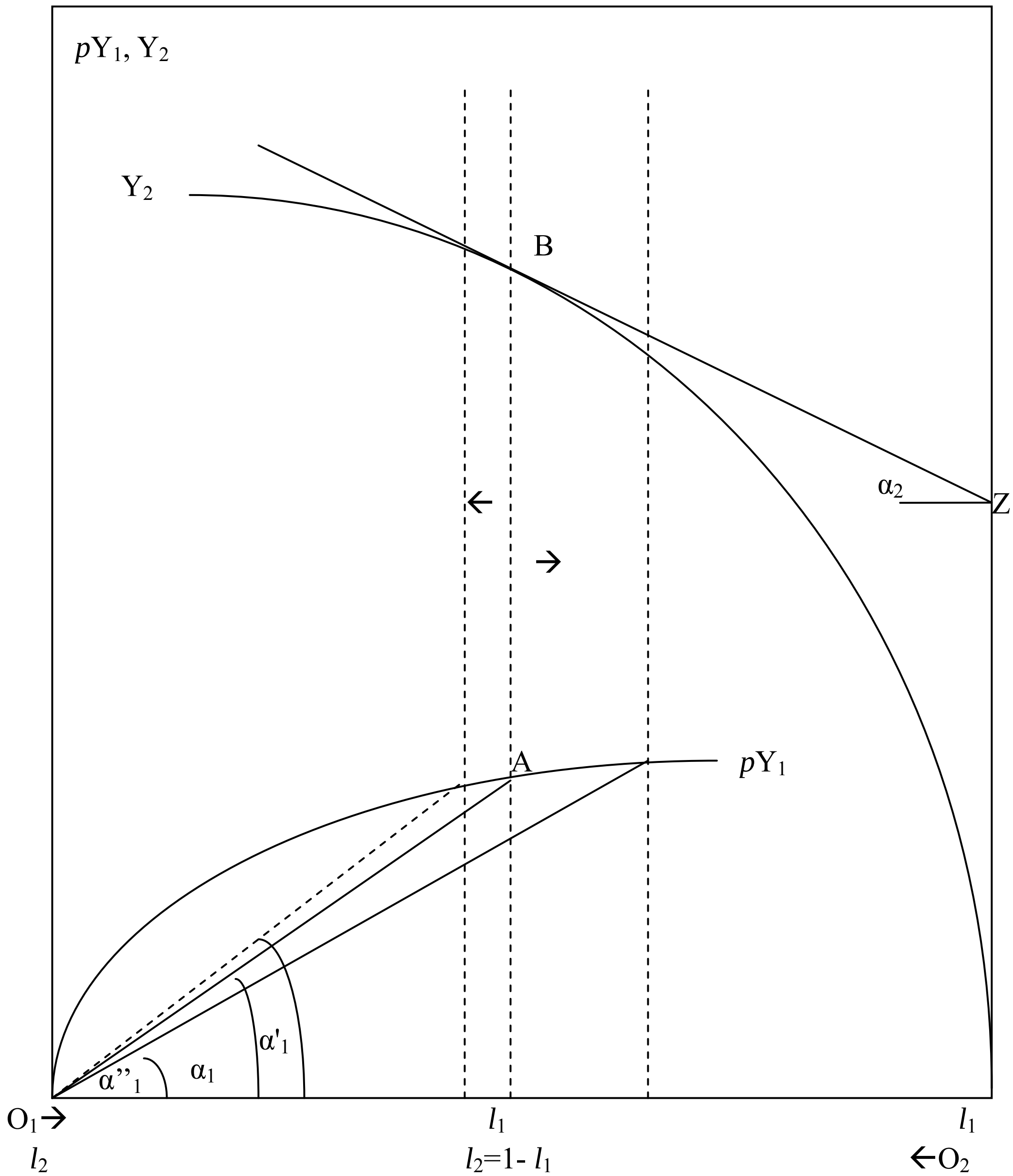

Figure 5.2 Equilibrium of the intersectoral labor market

$$\text{tg}\alpha_1 = p\frac{Y_1}{L_1} = pw_1$$

From point Z on the right-hand vertical axis above, a line ZB is drawn upwards and left to be tangent at B on the graph of Y_2. Its intersection with the horizontal at Z forms an angle α_2 and

$$\text{tg}\alpha_2 = \frac{df_2(L_2, K_2)}{dL_2} = w_2$$

Therefore, the equilibrium condition of (5.9) can be converted geometrically into

(5.19) $\alpha_1 = \alpha_2$

for Figure 5.2. The intersectoral labor market will equilibrate at the allocation line AB when the condition (5.19) is satisfied and l_1, l_2 ($=1-l_1$) are assigned to the farm and the nonfarm sectors, respectively. At this allocation, individuals have no incentive to migrate between the two sectors.

Obviously, labor market can not equilibrate if $\alpha_1 \neq \alpha_2$; more workers must transfer to the sector with the higher wage rate. Assuming $pw_1 < w_2$, that is, $\alpha_1 < \alpha_2$, part of the agricultural labor force will migrate into nonfarm activity; the line O_1A will rotate around O_1 leftwards leading to $\alpha'_1 > \alpha_1$. The marginal product of nonfarm labor will decrease with the influx of new workers, giving constant capital and technology in the nonfarm sector. That means line ZB will rotate downwards around Z and translate up at the same time, which will result in a smaller α_2. All these changes will be illustrated by the parallel translations of allocation line AB leftwards. Equilibrium will be restored at a point at which there is less labor in agriculture and correspondingly more labor in nonagriculture, allowing $\alpha_1 = \alpha_2$ to hold once again. One of the results from these changes is an increase in the equilibrium wage rate for the whole economy. By a similar argument, the two angles will move in the opposite directions if $\alpha_1 > \alpha_2$ and nonfarm workers would return to agriculture. The rightward translation of AB would bring the labor market to equilibrium with more labor in agriculture and a lower equilibrium wage in Figure 5.2.

Now we take a step further to look at the effects of fluctuations in relative prices on the labor market using Figure 5.3 below. Fluctuations in p will be expressed in corresponding ascending or descending movements of pY_1, the farm value production function, given Y_1 being unchanged. As pY_1 moves, the line O_1A and with it α_1 must change as well. The importance of price changes for labor market stability can be highlighted immediately by the equilibrium condition mentioned above: $\alpha_1 = \alpha_2$ or $pw_1 = w_2$. Even when wages in kind in both sectors remain unchanged, the original equilibrium changes with every movement in p. Suppose that p rises to p_1. That leads to an increase in pY_1 as Y_1 remains constant. The resulting p_1Y_1 will intersect with the allocation line AB at A', while O_1A rotates leftwards to O_1A' and α_1 extends to $\alpha'_1 > \alpha_2$. The resulting $pw_1 > w_2$ means that quantity of nonfarm product that can be purchased by the agricultural wage rate is more than by the nonfarm one. A part of the nonfarm labor force will transfer to farm work if p_1 does not return to p swiftly. As depicted in Figure 5.2, both a decrease in nonfarm labor and an increase in farm labor implies a rightward translation of the allocation line and a decline of agricultural labor productivity in kind, meaning p_1w_1 falls. At the same time, the marginal product of nonfarm labor and w_2 will rise as labor leaves the nonfarm sector. Therefore, the labor market will reach equilibrium again after AB moves to bring α_1 and α_2 to equality again. In the opposite direction, the similar mechanism will also restore equilibrium and let a reduction in *p* be absorbed by the leftward translation of AB. However, an increase or decrease in *p* and the resulting adjustments in labor market have different implications for the social welfare of various groups of people, and affect sectoral production and aggregate output differently as well.

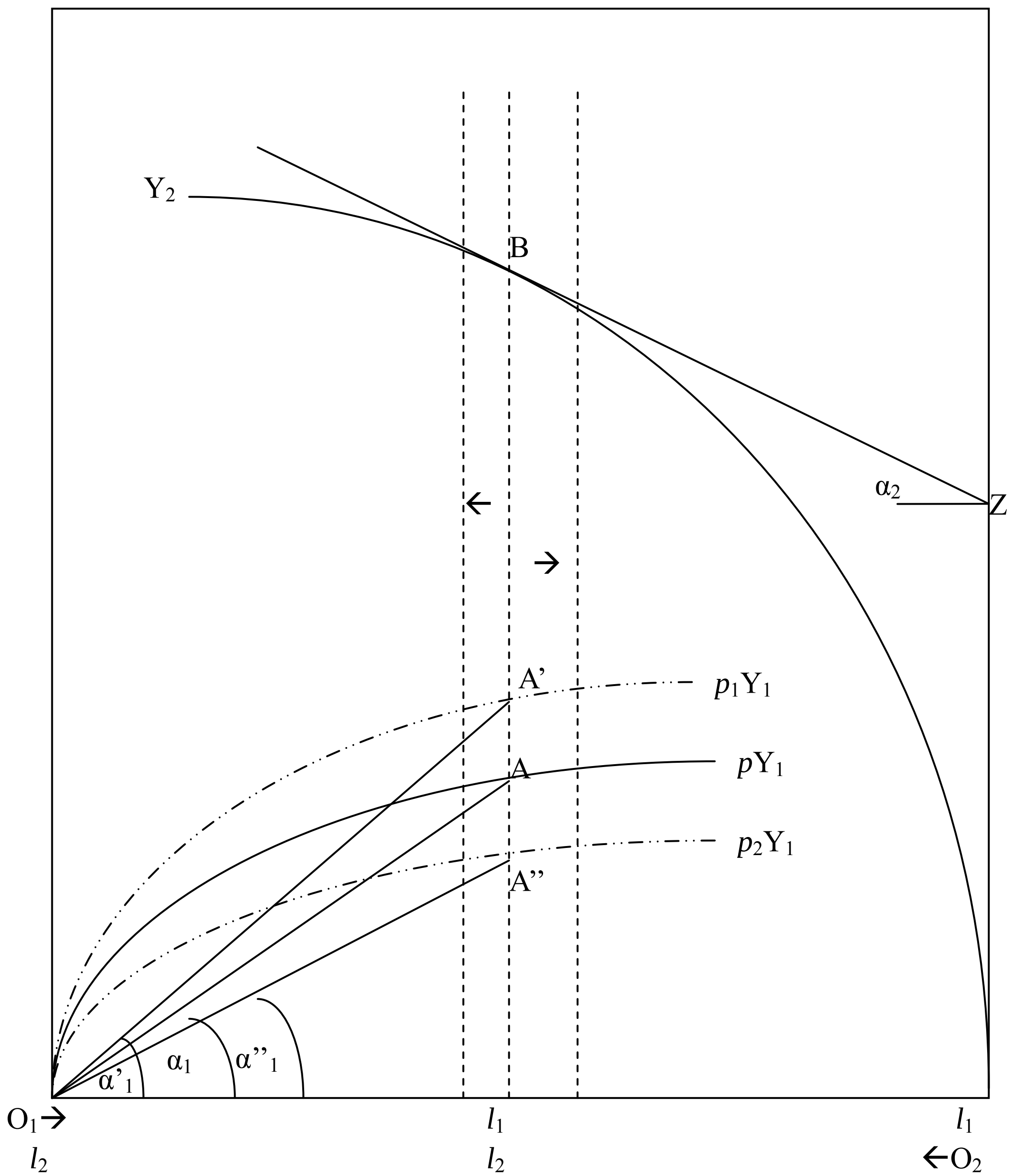

Figure 5.3 Changes in relative price and labor market fluctuations

5.2 Common equilibrium of labor and commodity markets

Changes in relative prices are discussed in many models with migration from agriculture, but are always treated as exogenous shocks, as presented in Figure 5.3. However, fluctuations in prices are integral phenomena in short-run macroeconomic cycles and so they should be considered and analyzed as endogenous to the model. We now will introduce relative price into the model of labor market set up above. To simplify the analysis, we are concerning only about changes in relative price caused by fluctuations in demand for and supply of agricultural product, for example food. Furthermore, we assume that the economy we study is so developed that it passed through the so called phase of subsistence. In our economy, agricultural product an individual consumes is clearly more than for biological needs for mere subsistence. Therefore, it is to assume that an individual's consumption of agricultural product would not fall down near to the subsistence level even when one has to reduce one's agricultural consumption because of decreases of one's income. A case of consumption of agricultural product to or below the subsistence level lies out of our research in this paper. Based on this assumption, how much an individual consumes agricultural product will depend on one's preference, income and agricultural prices. A farmer will consider, when he makes decisions to allocate his agricultural product into both self-consumption and market sale□selling prices of his products and his demands for nonfarm product for both consumption and investment for his agricultural production. Nonfarm firms try to market their products to farmers, while nonfarm households purchase agricultural product for daily consumption. We summarize all demands for agricultural product from farmers and nonfarm households together to get total demand on a united market of agricultural product and use pY^d_1 to represent it. In the short run, preference is supposed constant and a fixed part of one's income may be distributed for consumption of agricultural product if relative price does not change.[38] It is the individual's demand for agricultural product. The addition of all individual's demands will form the macroeconomic demand for it. Formally speaking, with the labor allocation of (l_1, l_2) and the corresponding aggregate product or total income of Y, total demand for agricultural product could be written as follows: [39]

[38] One can start from the familiar consumer's theory and assumes that, if all consumption goods are divided in both agricultural and nonagricultural product, marginal utility of the former decreases more speedily than that of the latter. In solving consumer's problem of max $U_i(Y^d_{1,i},Y^d_{2,i})$, where i stands for consumer, subject to $Y_i=Y^{\sim}_i$, $|d(dU_i/dY^d_{1,i})/dY^d_{1,i}| > |d(dU_i/dY^d_{2,i})/dY^d_{2,i}|$, one can get the relation of income constraint and consumption of agricultural product as $Y^d_{1,i}=f_i(Y_i)$ with $dY^d_{1,i}/dY_i > 0$, $d(dY^d_{1,i}/dY_i)/dY_i < 0$. It can be simplified as $Y^d_{1,i} = c_iY_i$ in a neighbor field of a certain $Y^d_{1,i}$. See e.g., Kongsamut, Rebelo and Xie (2001).

[39] In Cardoso (1981), $\delta\alpha Y$ is used to express the explicit demand function of agricultural product, where $1 > \delta, \alpha > 0$ and δ and α stand for ratio of food consumption to total consumption and propensity to consume, respectively. Her $\delta\alpha$ corresponds to c in (5.20) here.

$$(5.20)\quad pY^d_1 = cY, \qquad c > 0,$$

And

$$(5.21)\quad c = c(Y), \qquad \frac{dc}{dY} < 0,\ \frac{d^2c}{dY^2} > 0$$

(5.21) implies that pY^d_1 will increase as Y rises, but its share to Y, that is, $c = \frac{pY^d{}_1}{Y}$, will decline. The demand function for nonfarm product can be understood as difference of total income and demand for farm product: [40]

$$(5.22)\quad Y^d_2 = (1 - c)Y$$

Supply functions of farm and nonfarm product are their production functions, respectively:

$$pY^s_1 = pf_1(L_1, K_1)$$
$$Y^s_2 = f_2(L_2, K_2)$$

Therefore, the equilibrium conditions for both the markets can be formulated as

$$(5.23)\quad pf_1(L_1, K_1) = cY$$
$$(5.24)\quad f_2(L_2, K_2) = (1 - c)Y$$

Because of the equality between aggregate demand and supply for the whole economy with two commodity markets, Walras' law applies. Hence, we need to investigate equilibrium on only one of the two markets, namely the farm product market. Introducing (5.23) and $c = c^{\sim}$ $(1 > c > 0)$ into the labor market model built up above and taking away (5.14), that is, $p = p^{\sim}$, from it, we get a complete model of 13 equations with 13 variables (adding c to the groups of 12 variables of labor market) for both labor and commodity markets. Its equilibrium conditions are (5.9): $pw_1 = w_2$ and (5.23): $pY_1 = cY$. Mathematically, this model has the unique set of solutions for all variables (Hu, 2008a). We explain the solutions with Figure 5.4 below. Its difference to Figure 5. 3 lies only in that a demand curve for farm product, cY, is

[40] An important assumption should be made explicit here that individuals first decide how much their demand for farm product may be before to be concerning about their nonfarm product demands. In other words, demand for nonfarm product would be "surplus demand" of total income subtracted with demand for farm product. In the short-run analysis, the ideas of determination of consumption before that of savings were originated by Keynes (1936), while ideas of determination of farm product consumption before that of nonfarm product consumption are widely spread in the literature on economic development, e.g., Jorgenson (1961), Cardoso (1981), and Mutsuyama (1992). However, the assumption is too constrictive and should be given up in the further studies.

integrated into Figure 5.4. cY is dependent on Y, not on the labor measured on the horizontal axis. Considering the graph of Y. Because of $Y = pY_1 + Y_2$, we get

$$(5.25) \quad Y(l_1) = pY_1(l_1) + Y_2(1 - l_1)$$

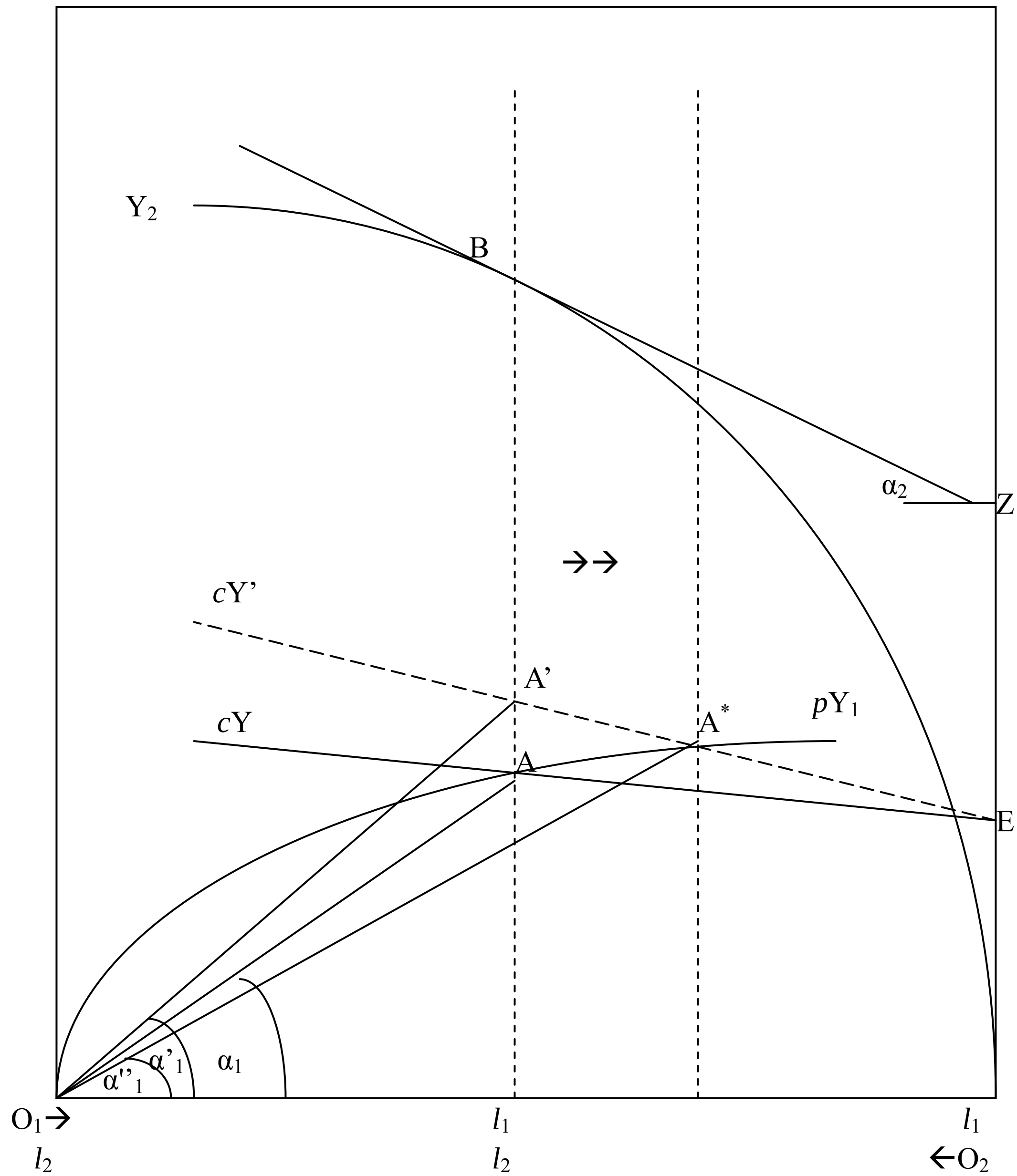

Figure 5.4 Common equilibrium on both labor and commodity markets

at each point on the horizontal axis or each line of labor allocations. With full employment and lower productivity in the farm sector, there exist the relations between Y and l_1 as follows:[41]

$$(5.26) \quad \min Y(l_1) = pY_1(l_1) + Y_2(1- l_1) \Leftrightarrow l_1 \rightarrow 1$$

and

$$(5.27) \quad \frac{dY(l_1)}{dl_1} < 0$$

It implies that Y would be minimal if all labor forces concentrate in farm production and l_1 is approaching to its maximum $l_1 = 1$. Y will keep in increasing along with continuous declines in l_1. Therefore, a graph of Y will start from a point E (> 0) on the right-hand vertical axis and run up leftwards with its values being fixed by adding $pY_1(l_1)$ and $Y_2(1- l_1)$ at each l_1 in the domain of $1 > l_1 > 0$. Corresponding to the graph of Y, we can draw a curve for $pY^d_1 = cY$. In the short-run, cY will, as same as Y, go from E up to the left-hand side monotonously. But cY rises much more slowly than Y because of $dc/dY < 0$. For the sake of convenience and no loss of generality, we draw a line for cY in Figure 5.4 (Hu, 2008a).

Figure 5.4 shows the existence, uniqueness and stability of the solutions for our labor and commodity market model. Point A in Figure 5.4 where pY_1, cY and equilibrium allocation line AB intersect and both equilibrium conditions of $\alpha_1 = \alpha_2$ and $cY = pY_1$ exist represents an equilibrium state occurring on the both markets simultaneously. It means that the farm product the agricultural labor in quantity of l_1 will produce is just equal to, at a certain p, the total demand for the product which is induced from the aggregate income resulting from the labor allocation of (l_1, l_2) at which wage rates of the two sectors are just equal at this p. Because of demand meeting supply on the market for nonfarm product as well, all three markets for labor, farm and nonfarm product come to equilibrate at the same time.

In the meantime, there is only A on the line AB which can indicate the common equilibrium. Considering other points in Figure 5.4, e.g., A*. At A*, cY' intersects with pY_1 and commodity market is in equilibrium. But it cannot be stable because at A* with p, agricultural wage must be much lower than nonagricultural one and farmers will migrate out. As the resulting smaller l_1 leads to less Y_1, commodity market will go out of equilibrium and p must rise. If the economy still remains at A after cY shifts to cY' and maintains equilibrium on labor market, p must rise as well because the labor allocation marked by AB can not produce enough farm product to satisfy the demand resulting from the aggregate income brought about by the same labor allocation. But l_1 must increase to break labor market equilibrium as soon as p rises. Therefore, only equilibrium in one market is not stable. In fact, all points within the Figure 5.4 may be mapped to points on AB. A point on AB mapping A*

[41] Differentiating $Y(l_1)$ will give $dY(l_1)/dl_1 = p(dY_1/dl_1) + Y_1(dp/dl_1) + dY_2/dl_1$. Because of $dp/dl_1 < 0$, $dY_2/dl_1 < 0$ and $|dY_2/dl_1| > p(dY_1/dl_1)$, we get $dY(l_1)/dl_1 < 0$.

is A' which is clear unable to represent a common equilibrium on the two markets because of instability on labor market resulting from $\alpha_1 > \alpha_2$ at A'. However, the economy will come back to equilibrium at A, when cY is given, through fluctuations in p and w as well as labor mobility after the markets happen, with mapping when necessary, at another point than A on AB in Figure 5.4.

5.3 Comparative static equilibriums

From the long-run views, economic development starting from the point A where both labor and commodity markets equilibrate depends on investment and its allocations between the two sectors, if technical and institutional improvements are not taken into account and total labor force remains constant. K, K_1 and K_2 are supposed constant in the model presented above. But they must change as soon as our sight goes beyond the short-run. At labor allocation of (l_1, l_2), a part of both profits nonfarm firms get and wages farmers and nonfarm employed persons earned will be saved for investment, while a part of nonfarm product will be manufactured as investment goods to satisfy investment demands. Investment will enhance capacity. With increases in K_1 and K_2, the graphs of pY_1 and Y_2 will run steeper, meaning a certain labor force can produce more now. We add in Figure 5.4 bold curves to indicate the situation after one-time new investments and get Figure 5.5. Assuming the investments are allocated "adequately" between farm and nonfarm sector to ensure concerted growths of Y_1 and Y_2. Supply of farm product will always meet demand. p may keep stable. Therefore, the economy can develop between two time points with continuous income increases, capital enhancements and wage risings. During this course, the speed at which cY and Y_1 rise will be smaller than that for Y and much smaller than that for Y_2 because of $dc/dY<0$. Hence, production extension and investment growth will be implemented mainly in the nonfarm sector. Nonfarm investments raise marginal productivity of nonfarm labor and lead to $w_2 > pw_1$, attracting more migration of labor force out of farm sector, while investments in agriculture with resulting increases in labor productivity in kind make the out-migration of farmers possible. Thus, agricultural labor will transfer into nonfarm sector continuously in the process of economic development and the allocation line in Figure 5.5 will translate leftwards gradually. This development is illustrated by Figure 5.5 where A* represents the new equilibrium after a capital enhancement, or at the time point t* and A stands for that at t. (l^*_1, l^*_2) is the new labor allocation with $l^*_1 < l_1$, $l^*_2 > l_2$. Inevitably, there exists $w^* > w$ for the whole economy because of $\alpha^*_1 > \alpha_1$, implying the enlargement in social welfare for all from A to A*.

Based on the explanations of Figure 5.5, we define in the terms of comparative statics the equilibrium development and labor migration between the two sectors:

Economic development in comparative static equilibrium: Economic development between two neighboring time points of t and t* or two neighboring labor allocation lines of (l_1, l_2) and (l^*_1, l^*_2) is in comparative static equilibrium if both Y_1 and cY_1 move up between t and t* in such a way that $p^*=p$ illustrated in Figure 5.5. Economic development is in equilibrium if $p^1 = p^2 = \ldots\ldots = p$ among all time points or allocation lines in the course of economic development, where the superscripts stand for time points.

Migration of labor in comparative static equilibrium: Intersectoral migration of

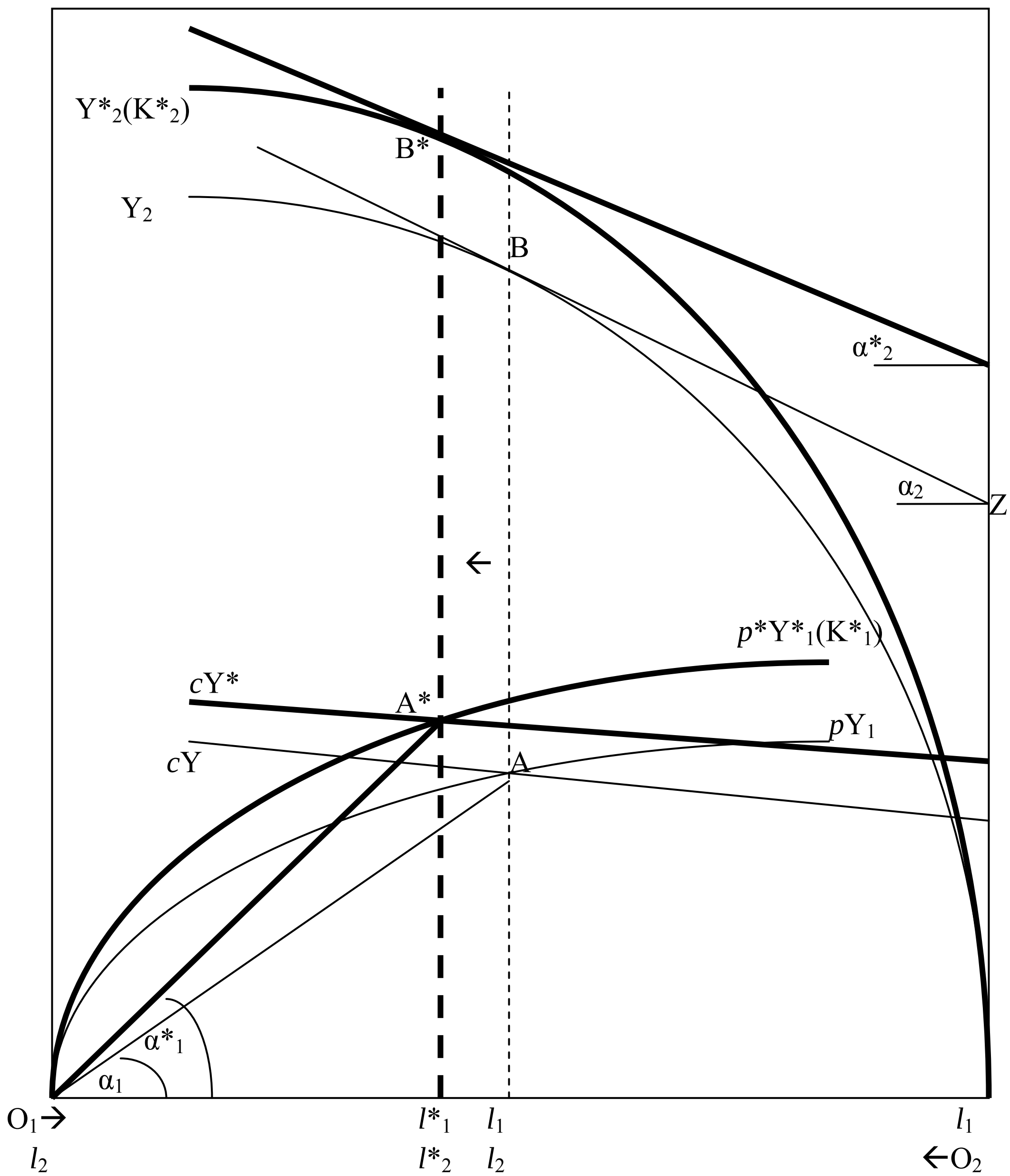

Figure 5.5 Development in comparative static equilibrium

labor force between two neighboring time points of t and t* or two neighboring labor allocation lines of (l_1, l_2) and (l^*_1, l^*_2), $|\Delta l_1|=|l^*_1-l_1|$, is in comparative static equilibrium if $|\Delta l_1|$ is just large so that there are $p^*w_1^* = w_2^*$ and $p^*=p$ at the new labor allocation (l^*_1, l^*_2), where $|\Delta l_1| = |l^*_1 - l_1|$ can be replaced with $|\Delta l_2| = |l^*_2 - l_2|$.

We look at Figure 5.5 with the economy growing from A to A*. The production functions in kind become known for the two sectors at two time points if changes in K_1 and K_2 between the time points are given. The economy moves from A to A* only when the quantity of labor forces migrating from farm to nonfarm activity reaches and just reaches the level of $-\Delta l_1 = l^*_1 - l_1$. If less farmers migrate out, the real migration $|-\Delta l_1^{\#}|$ is smaller than $|-\Delta l_1|$, the resulting labor allocation line will happen between AB and A*B*, meaning that the demand for farm product cannot absorb its supply. p^* will fall and the bold production function curve of $p^*Y_1^*$ must sink, which leads to the lower farm wage and $pw_1 < w_2$. Therefore, supply exceeds demand in commodity market as well as labor market. Both the markets plunge into instability and the economy cannot equilibrate. The adjustments should take place in the way that allocation line moves parallel to the left further because more farmers have incentives to transfer out to nonfarm sector. On the other hand, supply of farm product cannot meet demand if $|-\Delta l_1^{\#}| > |-\Delta l_1|$ happens and allocation line appears in the left of A*B*. Now p must rise, which pulls $p^*Y_1^*$ up and lets $pw_1 > w_2$ come forth. There is not supply enough in labor market as well. The economy is confronted with instability and has to witness return migration of agricultural labor force leaving nonfarm activity, implying allocation line will move right to A*B*. Therefore, there must be $|-\Delta l_1^{\#}| = |-\Delta l_1|$ to ensure, when new capital and its allocation are given, that the new labor allocation (l^*_1, l^*_2) can allow that farm product yielded by l^*_1 just satisfies quantitatively what all individuals in the economy are ready to purchase at $p^*= p$, while $p^* = p$ brings the average product of l^*_1 agricultural labor and the marginal product of l^*_2 nonfarm labor into equality. From here it is induced that $|-\Delta l_1|$ may be the equilibrium intersectoral migration of labor forces between two time points t and t*, the allocation (l_1, l_2) may be an equilibrium allocation corresponding to A and l_1 and l_2 are the equilibrium labor inputted in farm and nonfarm sector, respectively.[42]

[42] It is out of question that certain capital and its sectoral allocation are regarded as preconditions for the equilibriums defined here. In a two-sector economy, growth in capital will be influenced not only by aggregate income and the uniform rate of interest for the wholly economy, but also the relative price and wage dealt with in this paper. Theoretically speaking, we cannot know about “adequate” allocations of capital in the two sectors if we do not know about directions and magnitudes of changes in relative prices of commodities concerned, and we cannot know how to make the total savings invested, even when total savings could be fixed independent from sectoral variables. In fact, it is the changes in relative price that indicate intersectoral mobility of capital and allocation of investments. And the intersectoral mobility of labor and capital turn to be the forces that set up restraints for price changes. Taking capital as an endogenous variable into the model is beyond the scope of this paper.

5.4 Migrations and business cycles

What trigger the short-run fluctuations on labor and/or commodity market may be external shocks to the economy or internal disturbance which is accumulated within the economy. The fluctuations can extend to business cycles if they become large, strong and regular to be able to bring the economy to wave-shaped cycles. The first place in the economy which is attacked by an external shock, or in which the internal accumulated disturbances begin to get into play clearly, can be either of both demand or supply sides of the labor, farm product or nonfarm product markets. Figure 5.4 may be a powerful tool for analysis of such fluctuations and resulting adjustments. To substantiate the concrete economic meanings and derive implications for economic policy, short-run macroeconomic analysis often takes certain historical contexts as background for researches. We take into account the economic fluctuations in many developing countries since 2007 when the prices of agricultural product, especially grain, rose sharply to their historical height and inflation was announced to be the main threat to the macroeconomic stability and growth. The anti-inflationary policy was carried out in many countries until the middle of 2008 or even a little later. Then the main problem suddenly turned to be sharp fall in economic growth. Since then, the world economy as a whole and the most national economies got into a serious crisis. Not only the migration wave of agricultural labor to nonfarm sector since around the years of 2003 came to a halt, but many labor forces who had taken a job in nonfarm activity for a few years have to go back to their rural villages and do in agriculture again in countries as China. At the present day, the world economy is struggling to stabilize and get rid of the crisis.

We start from the sharp increase in prices of farm product in 2007 and assume a big external shock or a similarly strong, internally accumulated disturbance happens to the demand side of farm product market and namely raises demand suddenly. cY is pushed up to cY' in Figure 5.6.[43] At the labor allocation (l_1, l_2), cY' > pY_1 and cY' intersects with the allocation line AB at A'. It points out that demand for farm product is much higher than the supply at the price of p. One of the responses of markets is to increase in p. If the adjustments take place only on the commodity market, p will increase to p', pulling pY_1 up to $p'Y_1$ with unchanged farm production in kind. $p'Y_1$ is intersected with both cY' and AB together at A' now. Through the price adjustments, demand meets supply on commodity market again. It is expressed in Figure 5.6 that agricultural value production function forms a curve of O_1AA'A^ and kicks twice at A and A', representing a one-time push by rises of p to p'.

[43] In fact, China's Engle coefficient rose from 35.8% to 36.3% in urban areas and from 43.0% to 43.1% in rural ones from 2006 to 2007 (NBSC, 2008, Table 9-2).

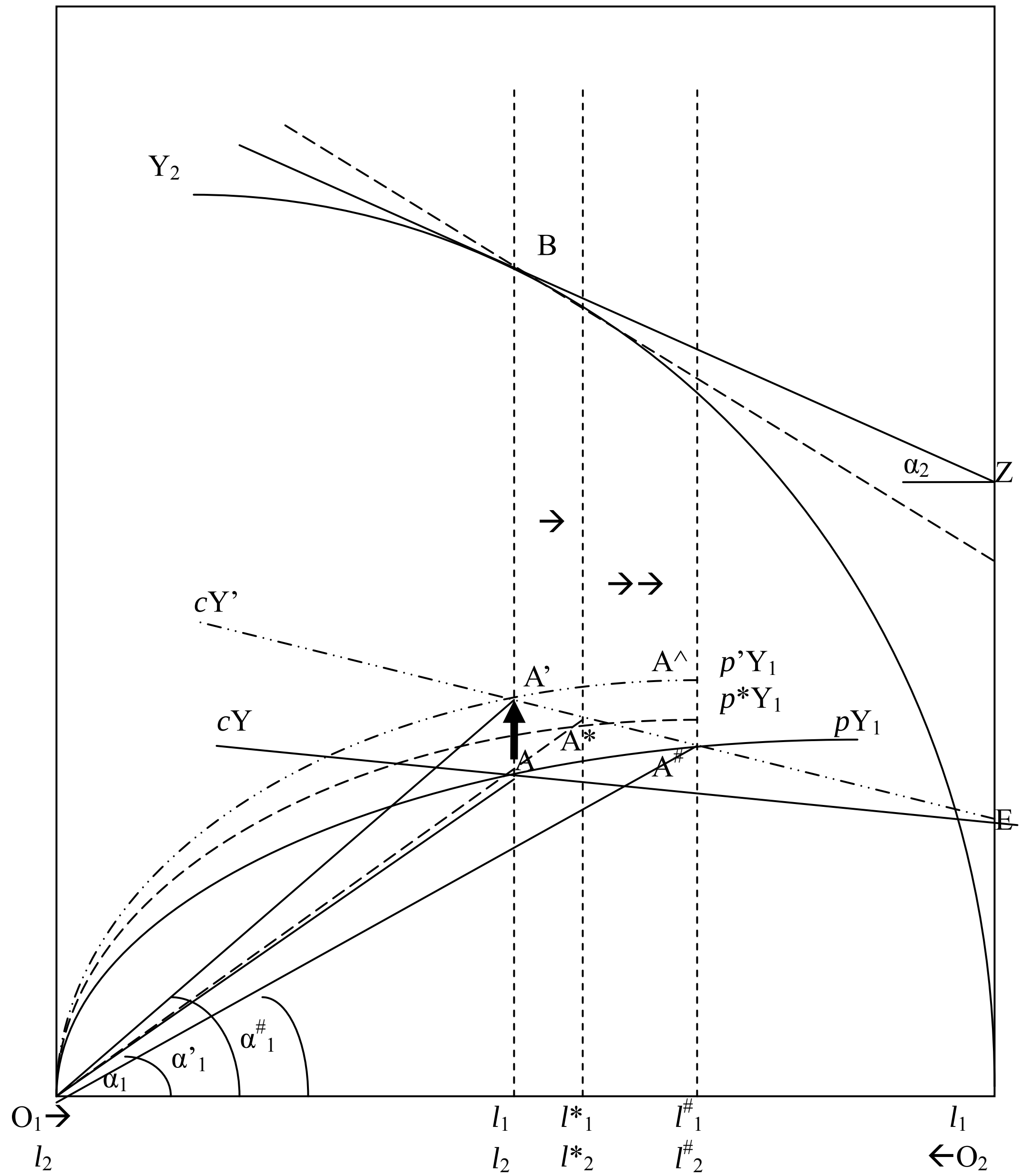

Figure 5.6 Increases in demand for farm product and price adjustments

However, the equality between of demand and supply on the commodity market at A' is not stable because of $\alpha'_1 > \alpha_1 = \alpha_2$ following the leftward movements of O_1A to O_1A'. At A', $p'w_1 > w_2$ and the equilibrium on labor market also breaks. A part of nonfarm labor force will transfer to farm sector with higher earnings. If it is realized, Y_1 will rise, which can bring commodity market out of equilibrium again. *p* must change further in the response to increases in supply. But changes in *p* have effects on wage comparisons between the two sectors at the same time and labor market gets in fluctuations again.

In face of the demand shocks or disturbance, the adjustments could take place wholly in labor market as well. As depicted also in Figure 5.6, many of nonfarm labor forces migrate back into agriculture and labor allocation line translates right to ($l^{\#}_1$, $l^{\#}_2$), causing the decline in Y_2 and Y while enhancing farm production, as p remains untouched. As demand for farm product falls along with declines in Y, it may meet supply and commodity market comes to equilibrium at $A^{\#}$ on the allocation line ($l^{\#}_1$, $l^{\#}_2$). But $A^{\#}$ is not a stable equilibrium point either because $\alpha^{\#}_1 < \alpha_1 = \alpha_2$, that is, $pw^{\#}_1 < w_2$. Labor forces have strong incentives to leave agriculture and nonfarm firms have strong incentives to hire more labor forces out of agriculture. But as soon as farm labor becomes less than $l^{\#}_1$, the commodity market will go out of equilibrium again.[44]

The interactions of commodity and labor market make clear that no single market or variable can absorb the external shock or accumulated disturbance alone. Any shocks or disturbances which first destroy equilibrium on a market must be transmitted to another market through changes in relative price and wage rates. In an economy with flexible price, wage rates and labor forces, a one-time shock suddenly raising demand for farm product will launch adjustments in the commodity and labor simultaneously: Increases in p will bring about higher pw_1, which leads labor force to move from nonfarm to farm sector. After l_1 rises, Y_1 will increase and induce p to turn to fall. At the same time, w_2 will go up to reach the risen pw_1 as l_2 decreases. Through a series of these adjustments, the economy may come to equilibrium at A* and realize that demand meets supply on both the markets again. The new equilibrium price, p^*, seems probable to be higher, which can be seen as a footprint of an external shock or an internal accumulated disturbance in the past. As to other macroeconomic variables, $p^*w^*_1$, w^*_2, Y^*_1 and l^*_1 will surpass the last equilibrium level, while Y^*_2, l^*_2 and profits that nonfarm firms earn may fall below the last level. Y*, the aggregate product or the national income, computed in terms of nonfarm product, will exceed the earlier equilibrium level, but merely due to the increases in p. According to Equation (5.27), however, the deflated or real Y* must decrease in the course of absorption of the shocks through market adjustments, because, as the result of the adjustments, more labor is inputted in lower productive farm sector and less in the higher productive one. On the whole, the economy experiences an inflation wave and a downturn, with an inevitable phenomenon of return migration of agricultural labor forces.

In regard to income distribution, more national incomes will be transferred to wage earners in both the sectors at A* than at A. We look at profits of nonfarm firms and share of profits to national income. Let Π stand for profits and define Π as follows

$$(5.28) \quad \Pi = Y_2 - w_2L_2 = f_2(L_2, K_2) - w_2L_2$$

We differentiate (5.28) in respect to p and get

[44] It may describe exactly what happened in China before 50 years. The totalitarian government held food prices stable while forcing the population to leave for rural areas as it realized the famine was in place.

$$(5.29)\quad \frac{d\Pi}{dp} = \frac{df_2}{dL_2}\frac{dL_2}{dp} - \frac{dw_2}{dp}L_2 - \frac{dL_2}{dp}w_2$$

$$= \left(\frac{df_2}{dL_2} - w_2\right)\frac{dL_2}{dp} - \frac{dw_2}{dp}L_2$$

$$= -\frac{dw_2}{dp}L_2 < 0$$

Remembering that K_2 is a constant. Equation (5.29) < 0 because $\frac{dw_2}{dp} > 0$ and $(\frac{df_2}{dL_2}$ - $w_2)$ = 0 as nonfarm firms insist on the marginal principle for wage determination. Here it is assumed that changes in w_2 respond to that in *p* completely. The loss in profits caused by the increases in *p* is the amount by which the increase in w_2, called forth also by the increases in *p*, multiplied by number of nonfarm labor force. But the presupposition of complete responses of w_2 is not realistic in many cases because firms will try, in face to falling profits, to suppress the responses of w_2 to increases in *p*. Nevertheless, profits still fall even if w_2 does not respond any more, as shown by (5.30)

$$(5.30)\quad \frac{d\Pi}{dp} = \frac{df_2}{dL_2}\frac{dL_2}{dp} - \frac{dw_2}{dp}L_2 - \frac{dL_2}{dp}w_2$$

$$= \left(\frac{df_2}{dL_2} - w_2\right)\frac{dL_2}{dp} < 0$$

For (5.30), we suppose that $\frac{dw_2}{dp}$ =0, meaning w_2 remains unchanged no matter how *p* changes. There must exist $\frac{df_2}{dL_2} - w_2 > 0$ because $\frac{df_2}{dL_2}$ will rise as L_2 declines and w_2 remains unchanged. With $\frac{dL_2}{dp} < 0$, we have (5.30)<0. The mechanism of the fall in Π is that a rise in *p* will result in less L_2 and then contraction of nonfarm production. When w_2 rises in response to a unit increase in *p* partly, the amount of profit loss will lie between $|-\frac{dw_2}{dp}L_2|$ and

$|(\frac{df_2}{dL_2} - w_2)\frac{dL_2}{dp}|$. In any cases, profits must fall if p rises.

In the similar manner, the share of profits to the national income will also decline as soon as p rises, even when w_2 does not increase enough to maintain its real purchase power. This can be proved from the following definition equation:

$$(5.31) \qquad \frac{\Pi}{Y} = \frac{Y_2 - w_2 L_2}{pY_1 + Y_2}$$

Differentiating with respect to p, we get [45]

$$(5.32) \qquad \frac{d\frac{\Pi}{Y}}{dp} = -\frac{\frac{Y_1}{L_1}L_2}{pY_1 + Y_2} - \frac{Y_1(Y_2 - w_2 L_2)}{(pY_1 + Y_2)^2} < 0$$

Because $Y_2 > w_2 L_2$ and all other terms in denominators and numerators are positive, there must be $\frac{d\frac{\Pi}{Y}}{dp} < 0$ with or without effects of changes in p on w_2. The economic meanings of (5.32) can be explained as follows. After increase in p, a certain quantity of farm product can be changed with more nonfarm product. Since Y is computed in terms of nonfarm product, Y will increase as p rises. If farm and nonfarm production remains at the earlier level, agricultural share in Y, $\frac{pY_1}{Y}$, must move up. But all farm products are distributed to farmers as their wages. Therefore, the augmentation in Y, although only due to price increase, will come to wage earners fully and $\frac{\Pi}{Y}$ must decrease even when Π does not reduce. In the meantime, in the adjustment process analyzed above, nonfarm production has to shrink as less labor forces are employed there, $\frac{\Pi}{Y}$ should decrease more clearly.

[45] It can also be proved by $\frac{d\frac{\Pi}{Y}}{dp} = \frac{d\Pi/dp}{dY/dp} < 0$ because, as seen already above, $\frac{d\Pi}{dp} < 0$ and $\frac{dY}{dp} > 0$.

5.5 Explaining the on-going economic crisis

The last subsection pointed out how an external shock or internally accumulated disturbance, which first happens to the demand for the farm product, can lead to inflationary instability and then an economic downturn with return migration of agricultural workers. It showed further that flexible wage rates and prices with a mobile labor force can adjust the economy to a new, stable equilibrium, although real national income ("Y"), profits (Π) and the profit share in the national income (Π/Y) must fall for the absorption of the shock or disturbance.

But there are many frictional forces in the economy that may hinder market adjustments or swift adjustments. Sometimes, these forces even extend and strengthen the first shocks or disturbances and lead the economy further from the downturn into a deeper crisis. It was, in many aspects, just what many developing countries have been experiencing since 2007 when the above described increases in demand for farm product occurred. This subsection tries to investigate with the tools we have made in this paper why the crisis can be possible.

We go back to the scene that p rises suddenly. Farm product market becomes tense, supply is short of demand. To enhance farm production, more labor force in agriculture is needed. Some labor force should transfer back from nonfarm activity to agriculture. At least no additional farmers should go out for nonfarm work. The relatively increased agricultural income can help to attract farmers to remain and even emigrated farmers to go back, although income gaps between the two sectors still exist. However, many factors hindering farmers to return have stronger effects and should be mentioned here.

The first factor may be "production to order" by a large number of nonfarm firms. It is a usual business practice that firms produce for orders they accepted from other businesses. It is necessary and rational because of both time intervals the production of the ordered goods must take and certainty firms in manufacture and wholesale in supply and demand sides need for their business planning. Many nonfarm firms of the developing countries produce for orders even from overseas. During the period from acceptance of orders to shipping the deliveries firms are unable to adjust production, often unable to renegotiate on the selling prices listed in the orders as well. If the firms are not capable to change capital inputted and improve techniques, they even cannot adjust labor forces they employ. After p rises suddenly, pw_1 goes up. Firms have to raise w_2 to maintain their employment, which necessarily leads to fall in profits if the firms cannot enhance labor productivity through adjusting their capital inputs and techniques as well as raising selling prices of their deliveries or cannot do these quickly. From macroeconomic points of view, that labor demand from nonfarm sector is difficult to respond to increase in p implies the adjustments to the demand shock may be made only on commodity market. Therefore, the extent to which p rises will be much bigger than that if labor market adjusts simultaneously. With bigger increases in p, w_2 must go up more for employees to maintain the purchase power of their wage in term of farm product and for employers to prevent labor forces from leaving for agriculture. The clear rises in p, pw_1 and w_2 are translated to overheating in both markets: supply of agricultural product is short of demand on the one hand, supply of labor forces is short of demand on the other. More labor is demanded in agriculture to produce more farm products and in nonfarm sector to reduce or ease the pressure of rises in w_2. But there are not redundant labor forces to be employed either in agriculture or in nonfarm firms. A Lewisian economy or a developing country usually characteristic of massive labor forces saved in agriculture suddenly finds itself being in a dilemma of labor shortage. It seems unavoidable that some firms are forced to reduce production because of unexpected high labor costs. The production reduction by these firms must have effects predicted by the domino theory. Many firms have to follow and some even go bankrupt. A turn comes more suddenly than the shock begins. At one blow, labor cannot find demands any more. Wage rates cannot go up any more. Prices begin to fall. Migrated agricultural labor forces have to go back to their original villages. A slowdown or a downturn of economic activity which occurs to absorb the rise in p caused by a shock will turn to be a serious and desperate crisis. .

One of the other factors which contribute to the crisis could be the belief that there would be in agriculture a big reservoir of man power which could be utilized for economic growth without any macroeconomic costs or any clearly increasing costs for nonfarm firms as well as for agriculture.[46] Not many economists are conscious, partly because of deficiency in statistics on intersectoral migrations in the developing countries, to the massive migration of agricultural labor force in the last decade which may change the pattern of "surplus" labor supply fundamentally in many of these countries. A shortage of unskilled labor is wholly unimagined for nonfarm firms and policymakers in these countries. All their production plans and investment programs are based on low and constant wage rates for labor out of agriculture. After p starts to go up, therefore, the natural responses of firms are not to prepare for wage increases and eventual slowdowns of their extension of production, but to continue their extension courses, with helps of the loose monetary policy, with rises of prices of their nonfarm product. However, the rises in price of nonfarm product cannot compete with that of farm product and, later when general level prices climbs clearly, will be fought against by the central bank. As firms turn their courses finally, the crisis is ready to come.

The other factor which is worthy to mention here should be the "only-growth" policy by governments in many developing countries. These governments find the solutions for economic problems of their countries only in growth and fail to acknowledge that growth slowdowns are sometimes necessary for adjustments to external shocks and internal disturbances. Because economic growth is driven mainly by nonfarm production, the governments promote investments particularly in this sector, encourage farmers to migrate out, and suppress p to a low level in domestic markets for farm products. With the globalization of international financial markets and transfer of manufacturing industries from the developed countries to the developing ones, many developing countries are freed from constraints of savings for investments for the first time in their history of modern economic growth. They will fully utilize their "surplus" labor forces out of agriculture to impel growth.

[46] To my presentation of these explanations in Beijing in June, 2009, some economists even insist that marginal product of agricultural labor in China were still zero.

Therefore, as p began to rise in 2007, the governments of the developing countries did not realize that the supply of labor, particularly the unskilled labor, would be short of demand at the present wage level. They continued to stimulate investments in nonfarm sectors and did such investments by themselves as well with the hope to use cheap migrated agricultural labor forces further. However, governments could do nothing but saw the downturn come as the overheating was transmitted from commodity markets to labor markets. The on-going economic crisis came unexpectedly, as unexpectedly when several millions or ten-millions farmers found their access to nonfarm activity in many developing countries in a few years in the new century.[47]

[47] Naturally, the analytical tools used in this paper can help to explain the enormous waves of out-migration of agricultural labor in many developing countries in the recent years. It could respond to an external shock that raises foreign demand for nonfarm product. For example, foreign investments could have made the Y_2 graph steeper while that of Y_1 remained unchanged, so that w_2 greatly exceeded pw_1. With the liberation of the domestic economic order, agricultural workers transferred to nonfarm activity in greater volume than previously experienced.

Appendix

Table A1 Labor force and intersectoral migration of agricultural labor force in China 1952-2007

Year	L	L_1	*n*	l_1	Δl_1	$\mathcal{H}$	H	*h*
	m	m	%	%	%	m	m	%
1952	207.29	173.17		83.54				
1953	213.64	177.47	3.06	83.07	-0.47	1.00	-4.30	-2.01
1954	218.32	181.51	2.19	83.14	0.07	-0.15	-4.04	-1.85
1955	223.28	185.92	2.27	83.27	0.13	-0.29	-4.41	-1.98
1956	230.18	185.44	3.09	80.56	-2.70	6.23	0.48	0.21
1957	237.71	193.09	3.27	81.23	0.67	-1.58	-7.65	-3.22
1958	266.00	154.90	11.90	58.23	-23.00	61.17	38.19	14.36
1959	261.73	162.71	-1.61	62.17	3.93	-10.30	-7.81	-2.98
1960	258.80	170.16	-1.12	65.75	3.58	-9.27	-7.45	-2.88
1961	255.90	197.47	-1.12	77.17	11.42	-29.22	-27.31	-10.67
1962	259.10	212.76	1.25	82.12	4.95	-12.82	-15.29	-5.90
1963	266.40	219.66	2.82	82.45	0.34	-0.91	-6.90	-2.59
1964	277.36	228.01	4.11	82.21	-0.25	0.69	-8.35	-3.01
1965	286.70	233.96	3.37	81.60	-0.60	1.73	-5.95	-2.08
1966	298.05	242.97	3.96	81.52	-0.08	0.25	-9.01	-3.02
1967	308.14	251.65	3.39	81.67	0.15	-0.45	-8.68	-2.82
1968	319.15	260.63	3.57	81.66	0.00	0.01	-8.98	-2.81
1969	332.25	271.17	4.10	81.62	-0.05	0.16	-10.54	-3.17
1970	344.32	278.11	3.63	80.77	-0.85	2.91	-6.94	-2.02
1971	356.20	283.97	3.45	79.72	-1.05	3.74	-5.86	-1.65
1972	358.54	282.83	0.66	78.88	-0.84	3.01	1.14	0.32
1973	366.52	288.57	2.23	78.73	-0.15	0.55	-5.74	-1.57
1974	373.69	292.18	1.96	78.19	-0.54	2.04	-3.61	-0.97
1975	381.68	294.56	2.14	77.17	-1.01	3.87	-2.38	-0.62
1976	388.34	294.43	1.74	75.82	-1.36	5.27	0.13	0.03
1977	393.77	293.40	1.40	74.51	-1.31	5.15	1.03	0.26
1978	406.82	283.18	3.31	69.61	-4.90	19.94	10.22	2.51
1979	415.92	286.34	2.24	68.85	-0.76	3.17	-3.16	-0.76
1980	429.03	291.22	3.15	67.88	-0.97	4.14	-4.88	-1.14
1981	441.65	297.77	2.94	67.42	-0.46	2.02	-6.55	-1.48
1982	456.74	308.59	3.42	67.56	0.14	-0.64	-10.82	-2.37

Year	L	L_1	n	l_1	Δl_1	$\mathcal{H}$	H	h
	m	m	%	%	%	m	m	%
1983	467.07	311.51	2.26	66.69	-0.87	4.06	-2.92	-0.63
1984	484.33	308.68	3.69	63.73	-2.96	14.34	2.83	0.58
1985	501.12	311.30	3.47	62.12	-1.61	8.08	-2.62	-0.52
1986	515.46	312.54	2.86	60.63	-1.49	7.67	-1.24	-0.24
1987	530.60	316.63	2.94	59.67	-0.96	5.08	-4.09	-0.77
1988	546.30	322.49	2.96	59.03	-0.64	3.51	-5.86	-1.07
1989	557.07	332.25	1.97	59.64	0.61	-3.40	-9.76	-1.75
1990	651.32	389.14	16.92	59.75	0.10	-0.68	-56.89	-8.73
1991	658.43	390.98	1.09	59.38	-0.37	2.41	-1.84	-0.28
1992	665.16	386.99	1.02	58.18	-1.20	7.98	3.99	0.60
1993	672.28	376.80	1.07	56.05	-2.13	14.33	10.19	1.52
1994	679.31	366.28	1.05	53.92	-2.13	14.46	10.52	1.55
1995	685.85	355.30	0.96	51.80	-2.11	14.50	10.98	1.60
1996	695.03	348.20	1.34	50.10	-1.71	11.86	7.10	1.02
1997	703.97	348.40	1.29	49.49	-0.61	4.28	-0.20	-0.03
1998	712.08	351.77	1.15	49.40	-0.09	0.64	-3.37	-0.47
1999	719.69	357.68	1.07	49.70	0.30	-2.15	-5.91	-0.82
2000	726.80	360.43	0.99	49.59	-0.11	0.78	-2.75	-0.38
2001	737.06	365.13	1.41	49.54	-0.05	0.39	-4.70	-0.64
2002	745.10	368.70	1.09	49.48	-0.06	0.41	-3.57	-0.48
2003	752.32	365.46	0.97	48.58	-0.91	6.81	3.24	0.43
2004	760.27	352.69	1.06	46.39	-2.19	16.63	12.77	1.68
2005	766.64	339.70	0.84	44.31	-2.08	15.95	12.99	1.69
2006	772.47	325.61	0.76	42.15	-2.16	16.67	14.09	1.82
2007	777.30	314.44	0.63	40.45	-1.70	13.21	11.17	1.44

Note: m means million. L: total labor force, L_1: agricultural labor force, n: growth rate of L, $l_1=L_1/L$, $\Delta l_1=\Delta l_{1,t}-\Delta l_{1,t-1}$, $\mathcal{H}=-\Delta l_1 L$, $H=-(L_{1,t}-L_{1,t-1})$, $h=H/L$.

Sources: Data of L and L_1 from 1952 to 1977: NBSC, 2005, Table 4; from 1978 to 2007: NBSC, 2008, Table 4-3. Data of L and L_1 from 1990 to 2000 were adjusted by NBSC with results from the 5th census in 1990. Computations of n, l_1, Δl_1, $\mathcal{H}$, H and h were done by author.

Table A2 Farmer migration and Unemployment in China, 1978-2007

Year	ℋ	H	U	ΔU	|ℋ|-|ΔU|	|H|-|ΔU|	|ΔU|/|ℋ|	|ΔU|/|H|
	m	m	m	m	m	m	%	%
1978	19.94	10.22	5.30					
1979	3.17	-3.16	5.68	0.38	2.79	2.78	11.98	12.03
1980	4.14	-4.88	5.42	-0.26	3.88	4.62	6.27	5.33
1981	2.02	-6.55	4.40	-1.02	1.00	5.53	50.59	15.57
1982	-0.64	-10.82	3.79	-0.6	0.04	10.22	93.78	5.55
1983	4.06	-2.92	2.71	-1.08	2.98	1.84	26.61	36.99
1984	14.34	2.83	2.36	-0.36	13.98	2.47	2.51	12.72
1985	8.08	-2.62	2.39	0.03	8.05	2.59	0.37	1.15
1986	7.67	-1.24	2.64	0.26	7.41	0.98	3.39	20.97
1987	5.08	-4.09	2.77	0.12	4.96	3.97	2.36	2.93
1988	3.51	-5.86	2.96	0.2	3.31	5.66	5.69	3.41
1989	-3.40	-9.76	3.78	0.82	2.58	8.94	24.09	8.40
1990	-0.68	-56.89	3.83	0.05	0.63	56.84	7.41	0.09
1991	2.41	-1.84	3.52	-0.31	2.10	1.53	12.87	16.85
1992	7.98	3.99	3.64	0.12	7.86	3.87	1.50	3.01
1993	14.33	10.19	4.20	0.56	13.77	9.63	3.91	5.50
1994	14.46	10.52	4.76	0.56	13.90	9.96	3.87	5.32
1995	14.50	10.98	5.20	0.43	14.07	10.55	2.97	3.92
1996	11.86	7.10	5.53	0.33	11.53	6.77	2.78	4.65
1997	4.28	-0.20	5.77	0.24	4.04	-0.04	5.61	120.00
1998	0.64	-3.37	5.71	-0.06	0.58	3.31	9.31	1.78
1999	-2.15	-5.91	5.75	0.04	2.11	5.87	1.86	0.68
2000	0.78	-2.75	5.95	0.2	0.58	2.55	25.52	7.27
2001	0.39	-4.70	6.81	0.86	-0.47	3.84	221.61	18.30
2002	0.41	-3.57	7.70	0.89	-0.48	2.68	215.54	24.93
2003	6.81	3.24	8.00	0.3	6.51	2.94	4.40	9.26
2004	16.63	12.77	8.27	0.27	16.36	12.50	1.62	2.11
2005	15.95	12.99	8.39	0.12	15.83	12.87	0.75	0.92
2006	16.67	14.09	8.47	0.08	16.59	14.01	0.48	0.57
2007	13.21	11.17	8.30	-0.17	13.04	11.00	1.29	1.52

Source: Data of migration: see Table A1. Data of U from 1978-2003: NBSC, 2005, Table 4; from 2004-2007: NBSC, 2008, Table 4-1, 4-3. Computations of ΔU and the last 4 columns were done by author.

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