Estimating the Size of Rural Labour Surplus in China – A Dynamic General Equilibrium Analysis

by

YINHUA MAI

AND

XIUJIAN PENG
Centre of Policy Studies
Monash University

Estimating the size of rural labour surplus in China

- A dynamic general equilibrium analysis

Dr Yinhua MAI

and

Dr Xiujian Peng

Centre of Policy Studies

Monash University

June 2009

Abstract

China's dramatic economic growth during the past three decades is characterised by rapid industrialisation that was fuelled by a large pool of rural surplus labour in the agricultural sector. The large scale movement of labour from the agricultural to the industrial and services sectors witness in recent years raises pertinent questions about its sustainability: is there still a pool of surplus labourers in rural China? If there is, how large is that pool and how long can it last? These questions are hotly debated in China. The present study contributes to that discussion by providing a quantitative framework to estimate the size of the surplus labour under various scenarios. Applying a dynamic general equilibrium model of the Chinese economy, we present our estimates of the size of the rural labour surplus from 1997-2005 and forecast its size from 2006-2015. Two scenarios are presented in this paper, one is business-as-usual; the other with accelerated improvement of labour productivity in China's agricultural sector.

TABLE OF CONTENTS

1. Introduction

China's dramatic economic growth during the past three decades is characterised by rapid industrialisation that was fuelled by a large pool of rural surplus labour in the agricultural sector. According to the second Agricultural Census China had 130 million rural labour who worked for more than one month outside of their township of residence in 2006. The corresponding data is 74 million in 1997. The large-scale movement of labour from the agricultural to the industrial and services sectors witnessed in recent years raises pertinent questions about its sustainability: is there still a pool of surplus labour in rural China? If there is, how large is that pool and how long can it persist? These questions are currently hotly debated in China.

Many scholars insist that the large amount of surplus labour in rural areas continues to exist. The total amount is estimated between 150 to 200 million which is equivalent to approximately one third to one half of the total rural labour force. To shift this labour pool to non-agricultural sectors, especially to urban non-agricultural sectors, is a big challenge for the Chinese government, particularly in view of the large number of unemployed labourers in urban areas (China Daily, 2006). Conversely, some scholars argue that China's rural labour surplus is running out and that China will face serious labour shortages in the near future (Cai, 2007). Cai (2007) estimates that the rural labour surplus was less than 120 million in 2005, and that about 50 percent of this surplus pool are over 40 years old. This puts the current rural surplus labour at less than one fourth of China's total rural labour force. One prominent concern of this diagnosis is that the rapid increases in wage costs attributable to the persistent rural labour shortages in manufacturing sectors in east coastal areas could jeopardise China's competitive advantage in international markets and also reduce foreign direct investment in China (Wang, 2006).

Lack of robust knowledge of the evolution of the size of the rural labour surplus is a major limitation of the current research. Since the magnitude of that surplus varies with agricultural productivity, understanding of productivity developments is crucial for the estimation of the rural surplus labour. China's agricultural labour productivity has improved dramatically since 1978. However, this development has not been spread evenly across the agricultural sector. There are significant variations in the productivity growth rates of the various subsectors.

Detailed calculations of the subsectoral growth of agricultural productivity are very limited in China.

To fill this gap in empirical knowledge, this paper conducts historical estimations of the size of the rural labour surplus in China over the period 1997-2005. These estimates are based on the annual growth rates of agricultural output and labour productivity obtained from an intensive perusal of the relevant statistical literature. The paper will also generate forecasts of the size of rural labour surplus size over the period 2006-2015 under the assumption of continued growth of labour productivity and output in the agricultural sectors. In addition, hypothetical simulation exercise will be conducted to estimate the size of the rural labour surplus under the assumption that China's agricultural labour productivity catches up with productivity in developed countries.

The second part of the paper explains the modelling framework. The historical simulation covering the period 1997 to 2005 is explained in section three. Section four displays the forecast simulation results, and section five discusses the hypothetical simulation. Section six concludes the paper.

2. Modelling framework

The present paper uses a dynamic computable general equilibrium model – SICGE to estimate the size of the rural labour surplus. The SICGE (**S**tate-**I**nformation **C**entre **G**eneral **E**quilibrium) model is a dynamic Computable General Equilibrium (CGE) model of the Chinese economy. The core CGE part of the SICGE model is based on that of ORANI, a static CGE model of the Australian economy (see Dixon et al., 1982). The dynamic mechanism of SICGE is based on that of the MONASH model of the Australian economy developed at CoPS (see Dixon and Rimmer, 2002).

There are two versions of SICGE model: one based on 1997 input-output table and one based on 2002 input-output table of China. In this paper, the former was applied to conduct the historical estimation of the size of rural labour surplus for the period of 1997 to 2005. There

are 57 sectors and among which 14 are agricultural sectors.[1]

The SICGE model features a labour market module with categories of rural and urban employment. This section contains descriptions of labour categories and relevant data.

2.1 Categories of rural and urban employment

In the labour market module of SICGE, there are five categories of employment:

o **AGriculture** (**AG**): this category of employment includes those who hold rural residential status, live in rural area and engage in agricultural, forestry and fishing activities;

o **Rural Non-AGriculture** (**RNAG**): this category of employment includes those who hold rural residential status, live in rural area and engage in activities in the industrial and services sectors. People employed in township enterprises forms the bulk of this group;

o **Rural-Urban Employment** (**RUE**): this category of employment includes those who hold rural residential status, but work in industrial and services sectors in urban areas. This category represents the rural migrant workers;

o **Urban UnSkilled Employment** (**UUSE**): this category of employment includes those who hold urban residential status and work in unskilled occupations in urban sectors; and

o **Urban Skilled Employment** (**USE**)**:** this category of employment includes those who hold urban residential status and work in skilled occupations in urban sectors. The skilled labour is defined as employed persons with following educational attainment: College, University, and Graduate and Over (these are categories of educational attainment used in China Labour Statistical Yearbook).

There are also three types of unemployment and two types of new entrants to the labour markets:

o **Rural AGricultural Unemployment** (**RAGU**) or **rural surplus labour**: In the

---

[1] The fourteen agricultural sectors in the SICGE model are: paddy rice, wheat, cereal grains nec., vegetable, fruit and nuts, oil seeds, sugar cane and sugar beet, plant-based fibres, crops nec., cattle, sheep, goats and horses, animal products nec., raw milk, wool, silk-worm cocoons, forestry and fishing.

SICGE1 model with 1997 base year, this category contains rural redundant labour – those who hold rural residential status in 1997, live in rural area, in-name employed but is redundant in the production of agricultural, forestry and fishing products. SICGE with 1997 database is designed to address the question when rural redundancy will be exhausted. In this version of the model, two people employed half-day each is counted as one person-day of labour input in all the sectors including agriculture, forestry and fishing.

o **Rural-Urban Unemployment (RUU):** this category contains those who are temporarily out of job from the RUE category.

o **Urban Unemployment (UU):** this category contains those who are unemployed from the urban employment categories, UUSE and USE.

o **New entrants RURal (NRUR):** this category contains new entrants to labour market with rural residential status.

o **New entrants URBen (NURB):** this category contains new entrants to labour market with urban residential status.

The five employment, three unemployment and two new entrant categories form the categories of labour supply (Table 1). The five types of employment and the three types of unemployment form the types of activities (Table 2).

Table 1: Categories of Labour Supply

Categories	Description
AG	Agriculture employment
RNAG	Rural non-agricultural employment
RUE	Rural-urban employment
UUSE	Urban unskilled employment
USE	Urban skilled employment
RAGU	Rural agricultural unemployment
RUU	Rural-urban unemployment
UU	Urban unemployment
NRUR	New entrants rural
NURB	New entrants urban

Activities are what people do during the year. Categories of labour supply at the beginning of the year are determined by what activities people engaged in last year. If someone was employed in activity AG last year, then at the beginning of this year the person is in the AG category of labour supply. If an urban person was unemployed (or in activity UU) last year, then, at the beginning of this year, the person is in the UU category of labour supply (Figure 1).

Table 2: Activities

Categories	Description
AG	Agriculture employment
RNAG	Rural non-agricultural employment
RUE	Rural-urban employment
UUSE	Urban unskilled employment
USE	Urban skilled employment
RAGU	Rural agricultural unemployment
RUU	Rural-urban unemployment
UU	Urban unemployment

Figure 1: Labour market dynamics
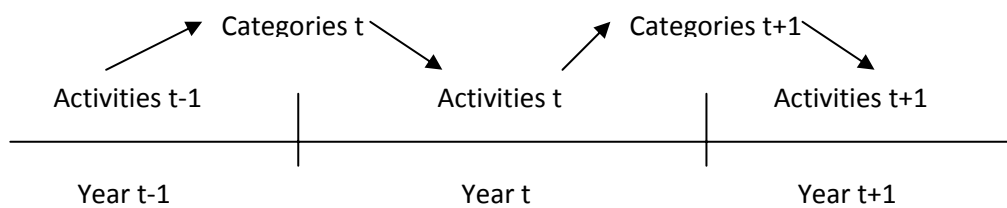
Different categories of labour supply are subject to different constraints to their offers to labour market (Table 3):

o the rural categories of labour supply (AG, RNAG, RUE, RAGU, RUU, and NRUR) can only make offers to rural categories of employment[2] (AG, RNAG, and RUE) with the

---

[2] A change in the residential status of rural migrant workers can be simulated as a policy change that shifts the workers exogenously from the RUE category to an urban employment category (for example, UUSE). However, when someone is in the RUE category, he or she cannot make labour market offers to urban categories of employment.

exception of rural new entrants;

o   the rural new entrant category (NRUR) can make offers to rural as well as urban categories of employment. This is based on the assumption that some urban enterprises may recruit new entrants from rural areas and grant them urban residential status. Rural new entrants with university degrees may acquire a job in a skilled occupation in city and obtain urban residential status;

o   the urban categories of labour supply (UUSE, USE, UU, and NURB) can only make offers to urban categories of employment (UUSE and USE).

o   in contrast to labour supply modules in our Australian and United-States models, we assume no categories of labour supply offers to be unemployed in China.

Table 3: Offers to labour market by categories of Labour Supply

	AG	RNAG	RUE	UUSE	USE	RAGU	RUU	UU
AG	*	*	*					
RNAG	*	*	*					
RUE	*	*	*					
UUSE				*	*			
USE				*	*			
RAGU	*	*	*					
RUU	*	*	*					
UU				*	*			
NRUR	*	*	*	*	*			
NURB				*	*			

Note: * indicates where offers to labour market are made. **indicates that most people prefer to offer to the category in which they were employed last year.

The number of person employed in a category of activity in the current year is determined by the demand for and supply to that category of activity (refer to Mai, et al., 2009 for details

about labour demand and supply equations). Those who made an offer to an employment activity but did not get a job will be forced into the relevant unemployed activity. They will make offer from the unemployed activity at the beginning of next year.

2.2 The modelling framework and data source

Figure 2 displays the closure used to estimate the rural labour surplus in China over the period 1998 to 2005. The rural labour surplus (RAGU) is the total number of rural employed persons that are not involved in agricultural employment (AG), rural non-agricultural employment (RNAG) and rural urban employment (RUE). Agricultural employment (AG) and rural labour surplus (RAGU) are treated as endogenous variables while rural employed person, rural non-agricultural employment (RNAG) and rural urban employment (RUE) are exogenous variables in the historical simulation.

China's Labour Statistical Yearbook provides the number of rural employed persons and the number of persons of RNAG. *China First Agricultural Census* and RCRE's (Research Centre of Rural Economy) *National Fixed-Cite Survey of Rural Households* provide the number of persons of RUE.

Agricultural employment in this study is defined as the effective labour input used to produce agricultural products in farming, animal husbandry, forestry and fishing sectors in person-years. It varies positively with output and negatively with labour productivity in these sectors. The rural labour surplus (RAGU) represents explicitly as unemployment in person years rather than underemployment.3 Annual agricultural output for all subsectors (there are 40 agricultural subsectors in this data source) is obtained from the China Rural Statistical

---

3 China does not have an index of rural unemployment. If a rural worker is not engaged in rural urban employment activity or in the rural non-agricultural activity, he/she is treated as an agricultural worker no matter to what extent his capacity is being used. That is why China has a large number of underemployed labourers in the agricultural sector. In China's Statistical Yearbook, the index of rural employed person includes rural underemployment labour. Our study determines the extent of agricultural underemployment explicitly by estimating the labour required to produce the agricultural output with given labour productivity. The total number of the labour required to produce the agricultural output with given labour productivity is defined as agricultural employment in our study. Agricultural underemployment or rural labour surplus in our study is then the residue of rural employed persons reported in China's Statistical Yearbook after subtracting the number of RNAG, RUE and the number of agricultural employment from our estimates.

Yearbook. The labour productivity can be calculated based on the data from the Cost and Revenue of Agricultural Products in China. After the effective labour input in the agricultural sector has been determined, the rural labour surplus can be solved as the residual of rural employed persons.

Figure 2: Framework for the estimation of rural labour surplus
**(Historical simulation)**
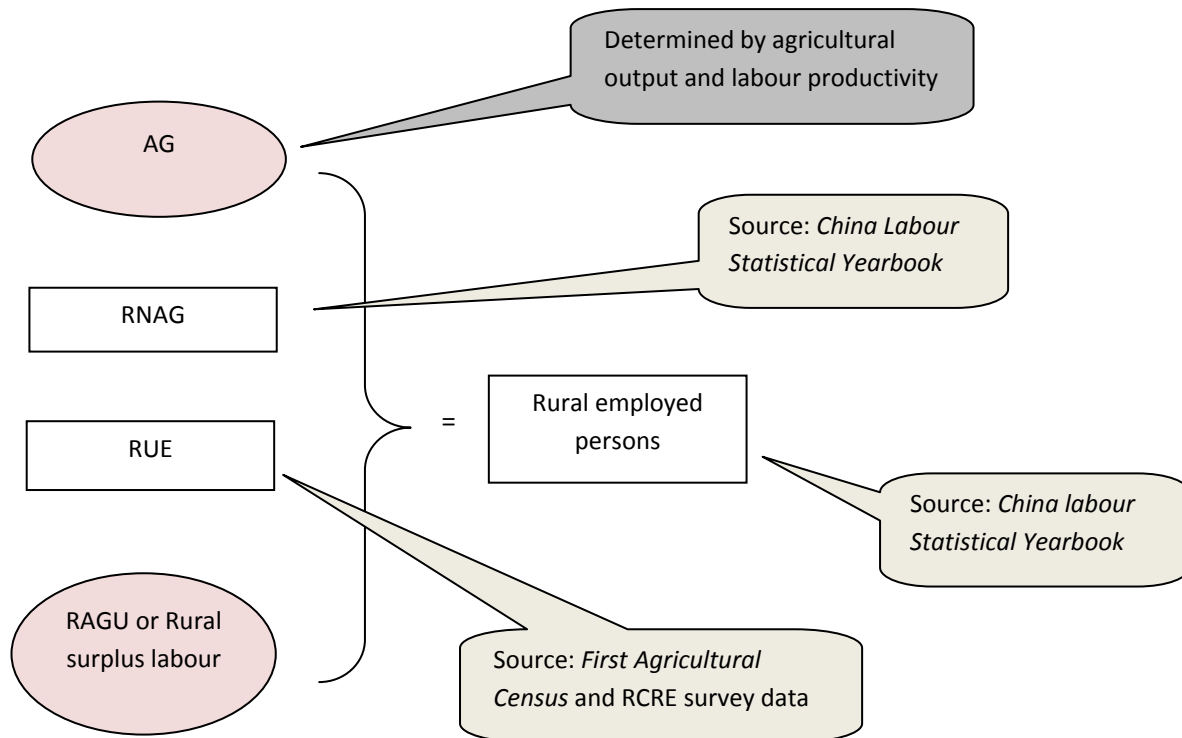
In the forecast simulation, rural employed persons are also treated as an exogenous variable. From the United Nations Population Projection (2008) we can get the growth rate of the working age population. We assume that the labour force participation rate maintains its historical level, so that the annual growth rate of the labour force is the same as the growth rate of the working age population. We also assume that China will continue its urbanization process and that the share of the rural labour force will keep declining while the share of the urban labour force will keep increasing.

The variables AG, RNAG and RUE are treated endogenously in the forecast simulation. Annual growth of RUE and RNAG is determined by the growth of the macro economy and the growth of the industry and services sectors. The annual growth rate of agricultural

employment depends on the growth rate of output and labour productivity in the agricultural sectors. We assume that the growth of output and labour productivity of the fourteen agricultural sectors will maintain their historical pattern but at a lower rate. The rural labour surplus can be estimated as the residual of rural employed persons (refer to Figure 3).

Figure 3: Framework for the estimation of rural labour surplus

(Forecast simulation)
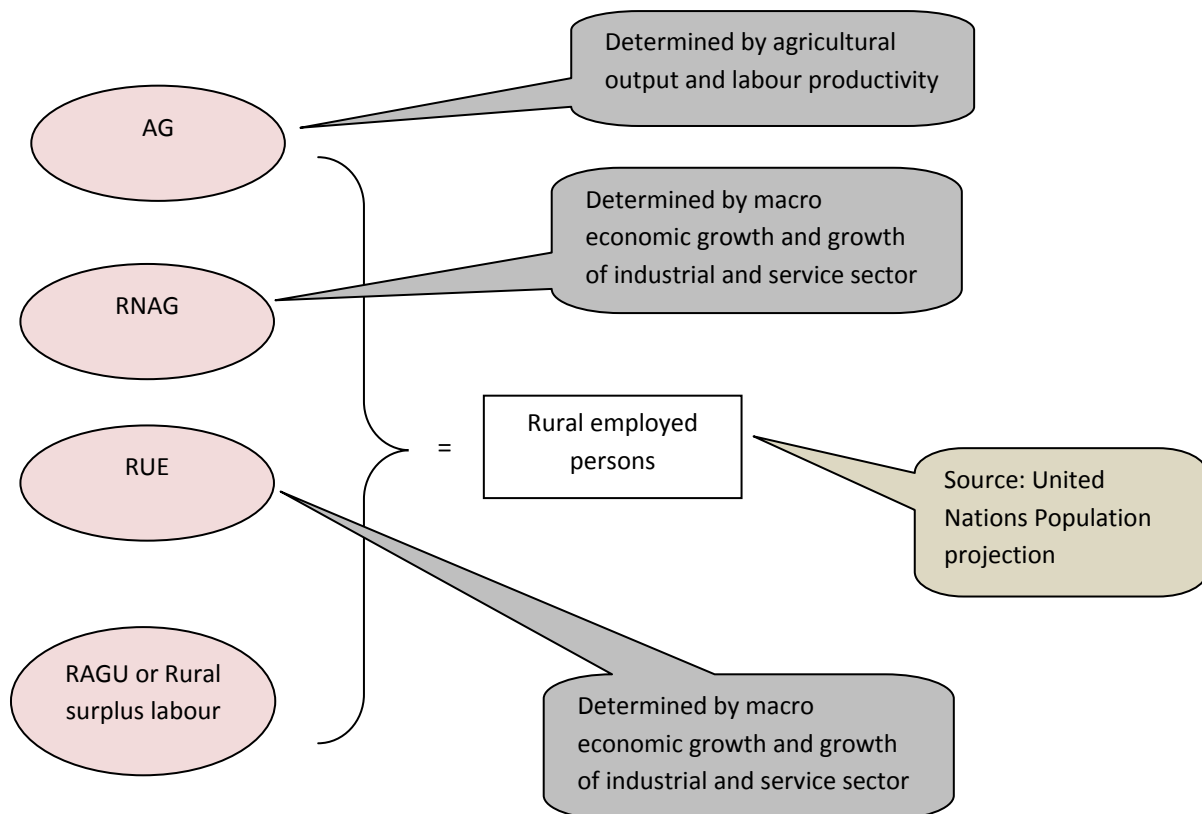
3. Historical estimation of rural labour surplus

As the basis for estimating the rural labour surplus we need to determine the effective labour input required to produce agricultural output (agricultural employment) in all subsectors. Sub-sectoral agricultural employment depends on output and productivity of that sector. Forty agricultural subsectors are reported in the *China Rural Statistical Yearbook* and the *Cost and Revenue of Agricultural Products* in China (Figure 4). We aggregate the output and labour productivity estimates for the 40 subsectors to match the 14 agricultural subsectors in our model.

Table 4 displays the average annual growth rates of output and labour productivity in 14 agricultural sub-sectors. The labour productivities in all fourteen agricultural sectors improve dramatically between 1997 and 2005 with the fastest improvement experienced in the wheat sector. However, output of wheat declined during this period. The output of paddy rice also declined while the output of the other twelve agricultural sub-sectors increased. The output of raw milk, animal products, cattle, sheep, goats and horses experienced fastest growth. This provides some indication of the change in the pattern of consumption as the economy expanded.

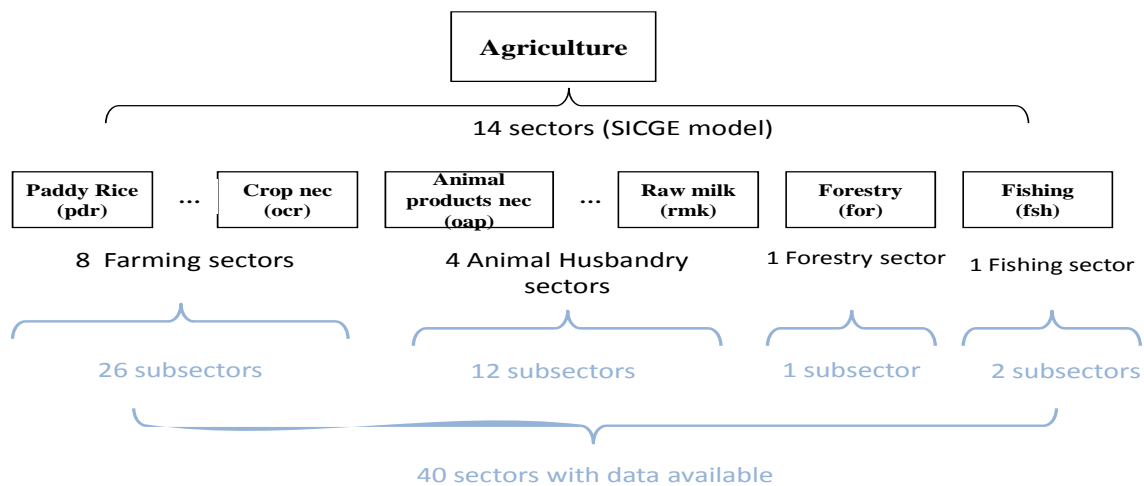## Figure 4: Composition of the agricultural sector

Table 5 and Figure 5 show the historical simulation results. Rural labour surplus declined sharply from 120 million in 1997 to 59.3 million in 2005. Although the fast growth of labour productivity has released nearly 20 million rural labours from the agricultural sectors (AG), the rapid growth in the demand for labour in the non-agricultural sectors (RNAG and RUE) has significantly reduced the pool of rural labour surplus. Employment in RNAG and RUE has grown between 1997 and 2005 at the rates of 4.79 percent and 6.70 percent, respectively (Table 5).

Table 4: Annual growth rates of output and labour productivity
(1997-2005)

| Sectors	Output	Labour productivity
Paddy rice	-1.16	-5.65
Wheat	-2.57	-7.09
Cereal grains nec	2.86	-9.30
Vegetables, fruit, nuts	3.51	-3.94
Oil seeds	3.03	-8.97
Sugar cane, sugar beet	1.25	-5.67
Plant-based fibers	2.90	-7.51
Crops nec	3.50	-3.26
Cattle, sheep, goats, horses	7.22	-6.13
Animal products nec	4.96	-4.37
Raw milk	7.98	-5.99
Wool, silk-worm cocoons	5.11	-5.93
Forestry	3.19	-5.12
Fishing	2.78	-5.83

Source: Authors' calculation based on the data from "*the Cost and Revenue of Agricultural Products in China*," various years and "*China Rural Statistical Yearbook,*" various years, China Statistical Press.

Table 5: Number of persons employed by categories of employment
(million persons)

|	1997	2002	2005	Annual growth rate (%, 97-05)
Rural employed persons	**490.39**	**487.91**	**484.76**	**-0.14**
AG	204.34	187.49	184.55	**-1.21**
RNAG	92.84	113.71	128.43	4.79
RUE	73.21	95.74	112.45	6.70
Rural labour surplus	**120**	**90.97**	**59.33**	**-6.32**

Source: simulation results

Figure 5: Number of persons employed by categories of employment

(10,000 persons)
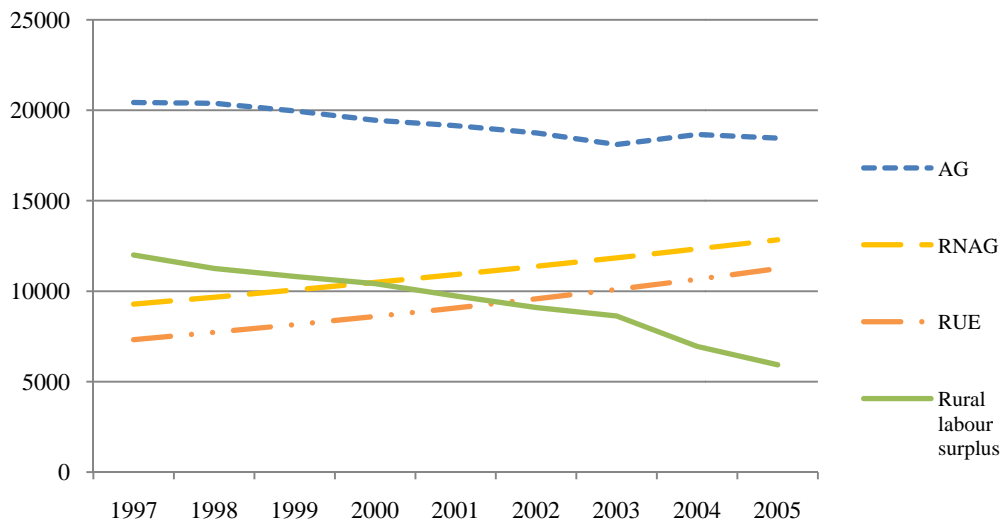
The employment structure of the rural labour force also changed (Figure 6). In 1997, 42 percent was engaged in agricultural activity and 34 percent in non-agricultural activities (19 percent in RNAG and 15 percent in RUE). 24 percent of the rural labour force was surplus. Non-agricultural employment had exceeded half the rural labour force in 2005, with 27 percent in RNAG and 23 percent in RUE, while the rural labour surplus had shrunk to 10 percent.

Figure 6: Employment structure of rural labour force in China
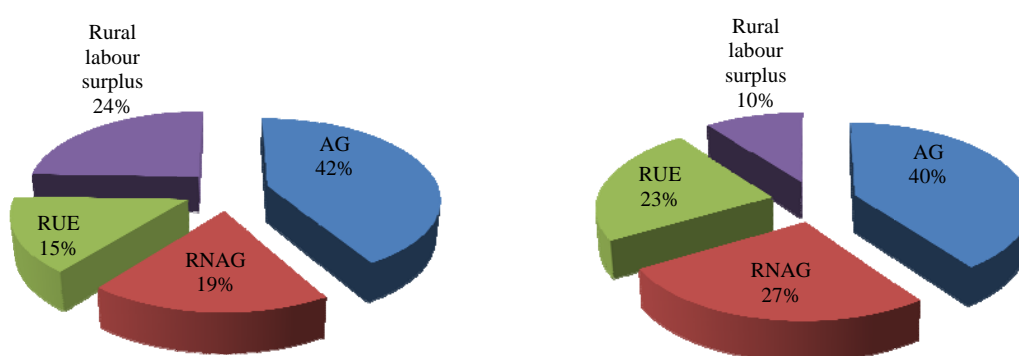
4. Forecast estimation of rural labour surplus in China

In the forecast simulation for rural labour surplus, 2006 to 2015, we assume that the Chinese economy grows slightly slower than historical trend (for example, the annual growth rate of GDP is 7.8 percent instead of 9 percent) but the pattern of growth is similar to the historical period. To illustrate, consumption grows slower and investment grows faster than GDP; export and import grow much faster than GDP; consumption of protein (meat, eggs, and dairy) grows faster than that of grain; consumption of services and consumer durables grow faster than that of food; the agricultural sector grows much slower than the industry and services sectors; low growth in output of oil and gas due to resource limits; and the share of the rural work force declines while the share of the urban work force increases reflecting the rapid urbanization in China. However, according to United Nations population projections, the growth rate of the working age population is much lower in the forecast than in the historical period. The annual growth rate of the labour force will be 0.74 percent in the forecast period compared to 1.36 percent in the historical period.

Table 6: Shocks of annual growth rates of output and labour productivity in the forecast simulation   (2006-2015)

Sectors	Output	Labour productivity
Paddy rice	-0.78	-5.25
Wheat	-1.49	-6.73
Cereal grains nec	1.92	-8.93
Vegetables, fruit, nuts	2.50	-3.52
Oil seeds	2.03	-8.28
Sugar cane, sugar beet	0.69	-5.34
Plant-based fibers	1.85	-7.31
Crops nec	2.58	-3.01
Cattle, sheep, goats, horses	4.83	-4.89
Animal products nec	3.56	-3.04
Raw milk	5.34	-3.72
Wool, silk-worm cocoons	3.42	-5.29
Forestry	1.49	-4.77
Fishing	2.14	-5.42

Table 6 displays the annual growth rates of output and labour productivity in the 14 agricultural sectors which we used for the forecast simulation. The growth pattern of output and labour productivity in these agricultural sectors is the same as in the historical period but growth rate is slightly lower.

Table 7: Number of persons employed by category of employment
(million persons)

|	1997	2005	2015
Rural employed persons	**490.39**	**484.76**	**475.15**
AG	204.34	184.55	171.17
RNAG	92.84	128.43	145.34
RUE	73.21	112.45	133.06
Rural labour surplus	**120**	**59.33**	**25.58**

Source: simulation results

Table 7 displays the forecast simulation results. If the Chinese economy continues to follow its historical evolution path the rural labour surplus will continue to shrink sharply. Its size will fall by more than half, from 59.3 million to 25.6 million. The growth of labour productivity will continue to release labour from the agricultural sectors (agricultural employment declines from 184.6 million to 171.2 million). The continued strong expansion of the non-agricultural sectors will keep driving more and more rural labour to engage in RNAG and RUE activities, drying up the pool of rural labour surplus. As a result, by 2015 nearly 60 percent of rural workers are engaged in non-agricultural activities while the rural labour surplus will have dropped to 5 percent (Figure 7).

The size of the rural labour surplus in the forecast simulation is influenced by the growth rates of output and labour productivity in the 14 agricultural sectors. It is also determined by the growth rates of the industry and services sectors which shift agricultural workers from agricultural to non-agricultural activities. According to the RCRE*'s Rural Labour Migration Report (2008),* nearly 50 percent of rural migrant workers are employed in the manufacturing and services sectors. The strong export demand for Chinese goods over the last 30 years is one of the mains reasons for the fast growth of the manufacturing sectors. By affecting the growth of the manufacturing sectors the change in export demand produces a strong effect on

the demand for rural workers. For instance, the sharp fall in export demand during the current world financial crisis has driven more than one million rural migrant workers back to their hometowns. In the present study we have ignored this effect and assumed a modest reduction in the growth of the industry and services sectors in consequence of the general slowdown in China's economic growth. We will explicitly simulate the effects of changes in export demand on the size of the rural labour surplus in a separate paper. The present paper concentrates instead on the effects of faster growth of labour productivity in the agricultural sectors.

Figure 7: Employment structure of rural labour force in China
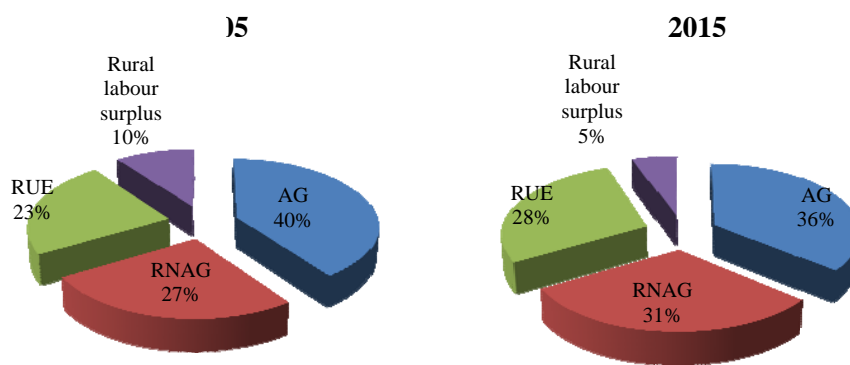
5. Hypothetical productivity scenario – faster labour productivity growth

5.1 Simulation design

Though China's agricultural sectors have experienced rapid productivity improvement since the 1980s, their labour productivity is still far below the levels in the developed countries. For instance in Japan, producing one kilogram of rice requires 0.0072 labour days, but in China the corresponding figure is 0.0264 (Table 8). Japan's labour productivity in agriculture is significantly higher than in China, for instance 3.7 times in the rice sector, 15.3 times in the wheat sector and 18.3 times in the hog sector. Even though China's growth rate of labour productivity has exceeded Japan's in recent years, it will take a very long time to catch up with Japan's labour productivity. Since labour productivity is one of the major determinants of the size of the rural labour surplus, in the present study we explore the effect of accelerated

growth of labour productivity. The simulation results of this hypothetical productivity scenario will be reported as deviations from the baseline case.

Table 8:   China and Japan: Labour productivity in agriculture sectors

Categories	China		Japan		Gap (Japan-China)
	2005 (level)	2000-2005 (%)	2005 (level)	2000-2005 (%)	
Rice (days per kg)	0.0264	5.8	0.0072	2.08	3.7
Wheat (days per kg)	0.0243	7.71	0.0016	3.07	15.3
Bean (days per kg)	0.0387	13.05	0.0082	n.a.	4.7
Sugar cane (days per kg)	0.0046	5.6	0.0018	n.a.	2.6
Sugar beet (days per kg)	0.0036	11.9	0.0003	n.a.	11.4
Hogs (days per head)	7.105	8.35	0.3875	n.a.	18.3

Sources: Authors' calculation based on data from C*ost and revenue of agricultural products in China,* various years, China Statistic Press. Japan Statistics Department, Minister's Secretariat, Ministry of Agriculture, Forestry and Fisheries, data based on Statistical Survey of Farm Management and Economy.
n.a.: not available.

In this hypothetical scenario we assume that the growth rate of labour productivity in agriculture will accelerate sufficiently to reduce the productivity gap between China and Japan by half in 2015. In order to achieve this goal, we impose an additional annual shock of the productivity growth rate in every agricultural sector for four years, from 2006 to 2009. These shocks are reported in table 9.

Table 10 illustrates how these additional shocks work with the example of the rice sector. In the baseline scenario, the productivity gap in the rice sector between China and Japan in 2005 is 3.69. The average annual growth rate of labour productivity in rice for China is assumed to be -5.26 percent, while the corresponding figure for Japan is -2 percent (the negative growth rate means the labour days required to produce one unit of the product is declining). The productivity gap will narrow to 2.63 in 2015 in the baseline scenario. In the hypothetical faster productivity growth scenario, we give additional annual shock of 16 percent from 2006 to 2009. This raises the annual growth rate of labour productivity to -11.64 percent, and reduces the productivity gap to 1.31 by 2015. This is approximately half the gap that prevails

in the baseline scenario (2.63).

**Table 9: Shocks of growth rate of labour productivity
in the hypothetical productivity scenario**

Sectors	2006 -2009 (% p.a.)
Paddy rice	16
Wheat	20
Cereal grains nec	15
Vegetables, fruit, nuts	10
Oil seeds	13
Sugar cane, sugar beet	13
Plant-based fibers	10
Crops nec	10
Cattle, sheep, goats, horses	15
Animal products nec	15
Raw milk	10
Wool, silk-worm cocoons	10
Forestry	10
Fishing	10

Table 10: Simulation design: rice as an example

|	2005	2006	2007	2008	2009	2010	2015
Growth rate (base line) **-5.26** (% p.a.)							
Gap between Japan and China	3.69	3.57	3.45	3.34	3.23	3.12	2.63
Growth rate (faster productivity growth scenario) **-11.64** (% p.a.)							
Gap between Japan and China	3.69	3.00	2.44	1.98	1.61	1.55	1.31
Ashock	--	16%	16%	16%	16%	--	--

5.2 Simulation results

Figure 8 displays the results for the hypothetical productivity growth simulation. The accelerated productivity growth is associated with a significant drop in agricultural employment. By the end of 2015 an additional 36.38 million rural labourers will have been released from the agricultural sector. The pool of rural labour surplus will have expanded to contain 4.7 million more surplus labourers compared with the baseline scenario. But RNAG and RUE will have expanded as well. Approximately 16 million more rural workers will be engaged in the rural non-agricultural sectors, and approximately 15 million more rural labour will work in the urban areas as rural migrant workers.

**Figure 8: Accelerated agricultural productivity growth:
employment in rural categories**
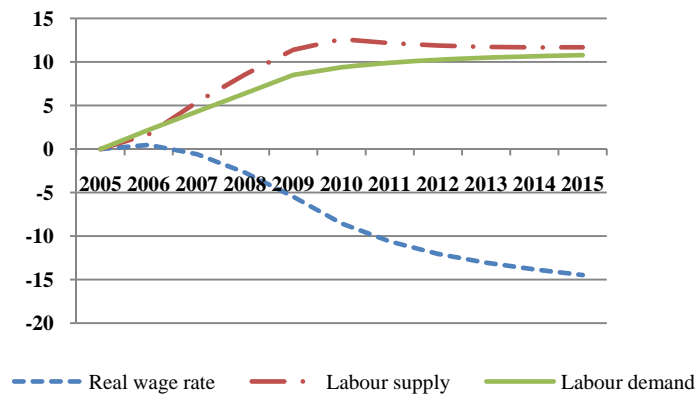(deviation from baseline, 10,000 persons)
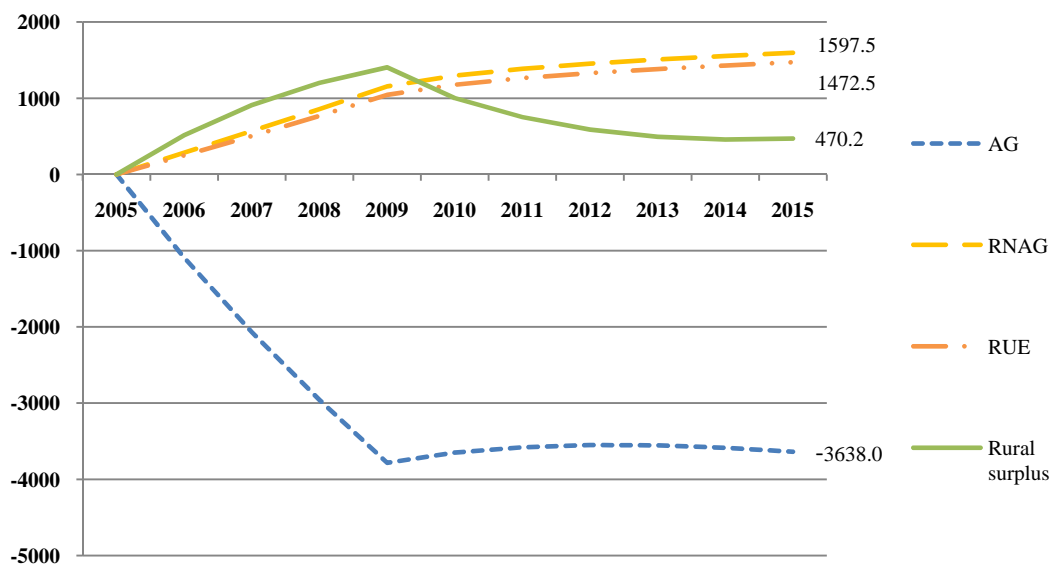
The accelerated productivity growth reduces the demand for agricultural workers dramatically, resulting in an excess labour supply in the agricultural sectors. As a result, growth of the real wage rate in the agricultural sector is slower than in the baseline scenario. As Figure 9 shows, by 2015 the real wage rate in the agricultural sector will be 19 percent lower than in the baseline scenario. The associated increase in the labour supply to the non-agricultural sectors puts downward pressure on the real wage in RNAG and RUE. The real wage rates in RNAG and RUE will be 14.5 percent and 14.6 percent lower than in the baseline scenario (Figures 10 and 11).
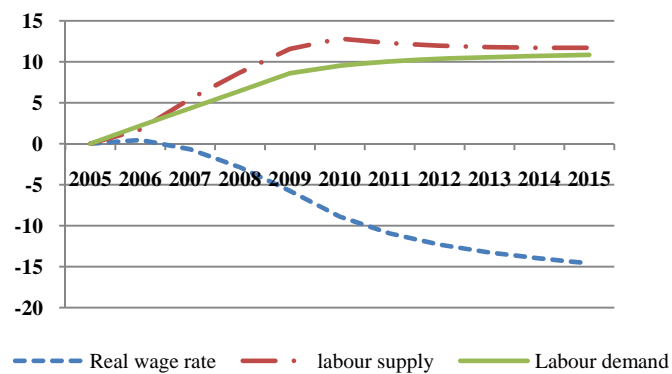
Figure 9: Accelerated agricultural productivity growth:
Agricultural employment
(deviation from baseline, %)

- - - real wage rate   —·—· Labour supply   —— Labour demand
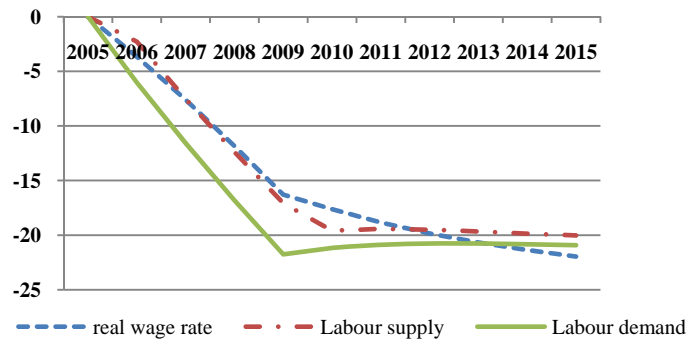
Figure 10: Accelerated agricultural productivity growth:
Rural non-agricultural employment
(deviation from baseline, %)

- - - Real wage rate   —·— Labour supply   —— Labour demand

Figure 11: Accelerated agricultural productivity growth:
Rural urban employment
(deviation from baseline, %)

- - - Real wage rate   —·— labour supply   —— Labour demand
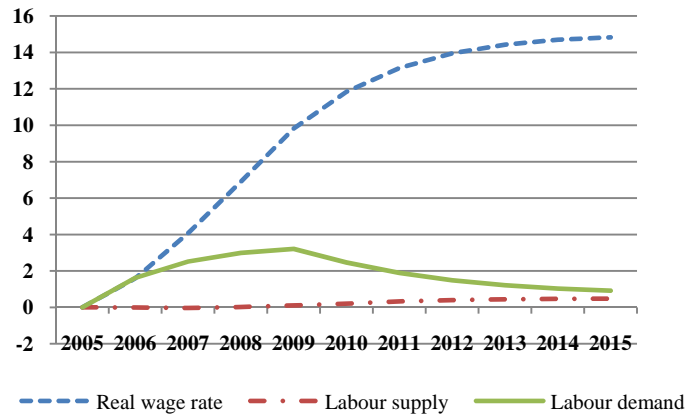
Figure 12: Accelerated agricultural productivity growth: employment in urban categories
(deviation from baseline, 10,000 persons)
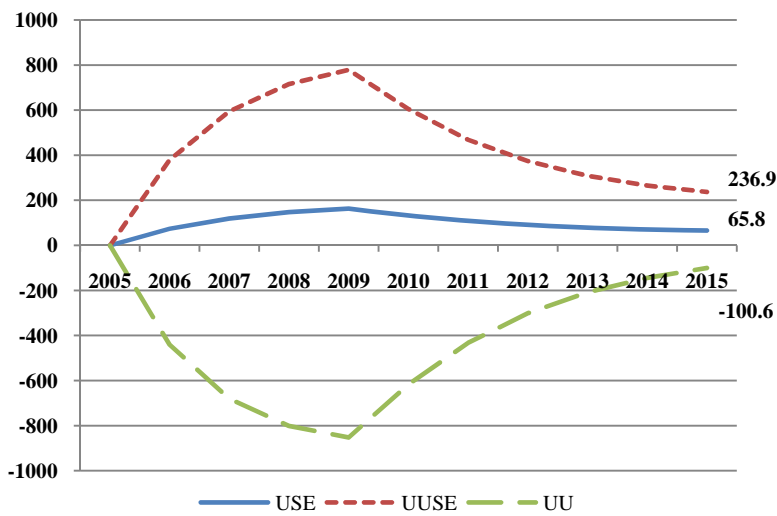
We notice that the accelerated agricultural productivity growth also boosts the growth of urban employment. The migration of rural surplus labour increases the demand for "urban products" as well as the demand for skilled urban labour for the management activities in those urban sectors that are intensive in rural labour such as manufacturing and services sectors. Figure 12 shows that by the end of 2015 an additional 2.37 million urban unskilled workers and 0.67 million urban skilled workers will be employed. As a result, urban unemployment will fall by one million. The increased demand for urban skilled and unskilled workers drives their real wage rates up. The real wage rates for urban unskilled and skilled workers will be 14.8 percent and 14.6 percent higher than in the baseline scenario, respectively (Figures 13 and 14).

**Figure 13: Accelerated agricultural productivity growth:
Urban unskilled employment**
(deviation from baseline, %)

- - - - Real wage rate   — · — Labour supply   ——— Labour demand

**Figure 14: Accelerated agricultural productivity growth:
Urban skilled employment**
(deviation from baseline, %)

- - - - Real wage rate   — · — Labour supply   ——— Labour demand
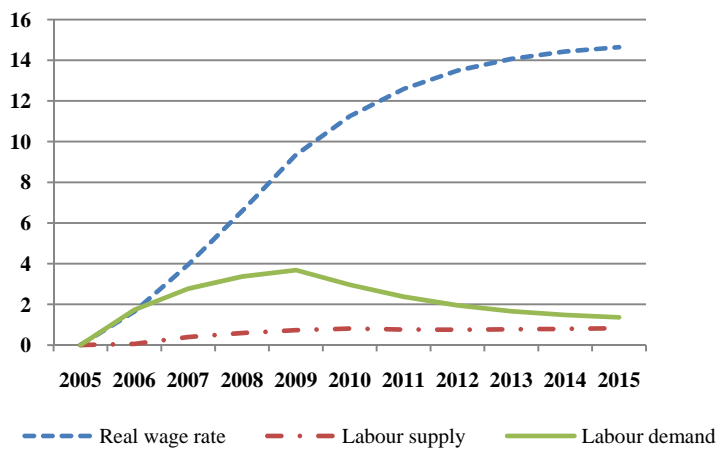
The faster growth of labour productivity in the agricultural sector also boosts the growth of the whole economy. By the end of 2015 real GDP will be 5.1 percent higher than in the base case scenario (Figure 15) .There are several reasons for the faster growth of real GDP.

- First, the faster growth of agricultural labour productivity directly increases the average productivity growth of the economy. The economic wide productivity will be 2.2 percent higher than in the baseline scenario.

- Secondly, the economy benefits from efficiency gains in the deployment of labour. Even though total employment in persons in the whole economy declines, the

employment measured by the wage bill weights increases. Since the share of agricultural employment in the whole economy is very high in China (26 percent in 2005), the sharp decrease in agricultural employment represents a 0.35 percent reduction in total employment in persons for the whole economy in 2015 (Figure 15). As more rural workers shift from the lower productivity agricultural sector to the higher productivity non-agricultural sectors, the employment measured in the wage bill weights increases by 1.6 percent. The increased employment contributes to the growth of real GDP.

- Thirdly, the increase in employment (wage bill weights) and productivity growth stimulate the growth of the capital stock. The capital stock will be 4.4 percent higher than the baseline scenario.

Figure 15: Accelerated agricultural productivity growth: macroeconomic indicators

(deviation from baseline, %)
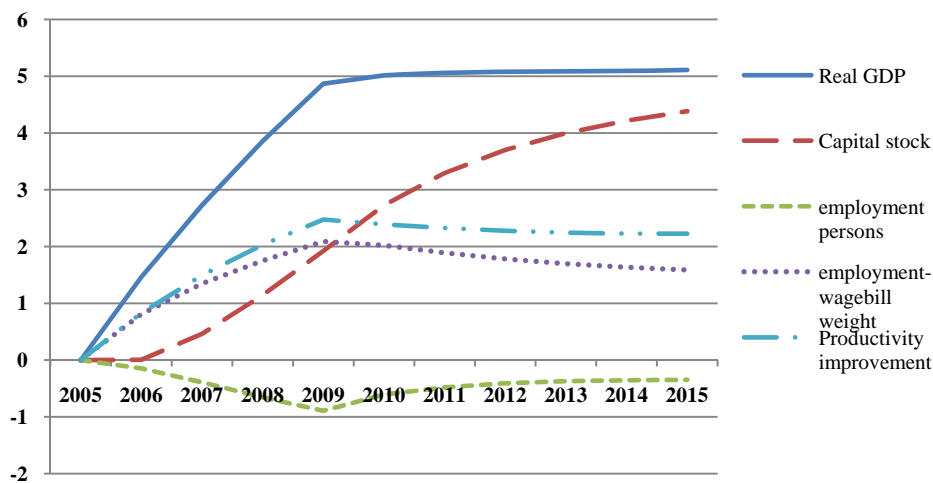
Households will also benefit from the faster growth of agricultural labour productivity insofar as the prices of agricultural products decline. Since the share of food consumption in household's budget is still very high in China, lower food prices cause the CPI to decline and real consumption to increase. This effect is reinforced by the economy wide increase in real wages. Real consumption will be 5 percent higher and real wage will be 3.1 percent higher than in the baseline case in 2015 (Figure 16).

Figure 16: Accelerated agricultural productivity growth:
real consumption

(deviation from baseline, %)
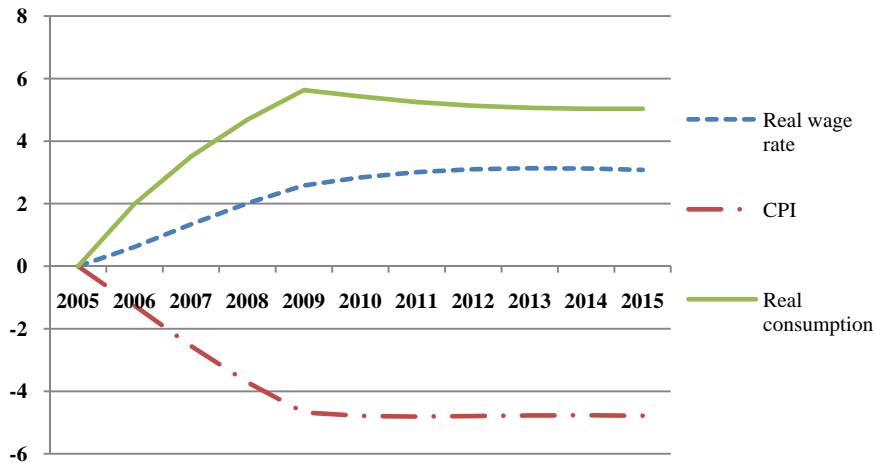
To summarize, the accelerated increase in agricultural labour productivity releases a large number of rural workers from the agricultural sector. This creates an excess rural labour supply in the agricultural and non-agricultural sectors and reduces rural labour costs, compared to the baseline scenario. Rural non-agricultural and rural urban employment will expand. The expansion of rural labour intensive sectors stimulates the demand for urban skilled and unskilled workers, increasing both their employment and real wage rates. The labour shift from the relatively low productivity agricultural sector to the relatively high productivity non-agricultural sector contributes to the growth of the economy. The pool of rural labour surplus will expand and continue to provide cheaper labour for the manufacturing and services sectors. The reduced labour cost improves China's competitiveness in the world market, increasing exports and attracting foreign direct investment.

A major limitation of the hypothetical productivity scenario is that we treat the productivity acceleration as a "manna from heaven". How can China accelerate her agricultural labour productivity growth? Increasing rural investment is one possible avenue. To illustrate, Japan's capital stock in the agricultural sectors is much higher than China's. The number of combines per million hectare arable land in Japan is 91 times larger than in China. The number of tractors per million hectare arable land is nearly five times larger than in China

(Table 11). Furthermore, Japan also uses various kinds of small agricultural machinery that is totally absent from China's agriculture. This implies that a substantial increase in agricultural investment may provide a significant boost to the growth of labour productivity. This raises the related questions of who will finance that investment, and what will be its cost. These issues are ignored in the present simulation and will be explored in future research.

Table 11: China and Japan: Agricultural machinery, 2005

	China	Japan
Land, million ha	156.33	4.09
Number of households (10 thousand)	25,222.6	284.8
Combines	410520	972168
tractors	15667915	1910724
Combines per million ha	2626	237694
Tractors per million ha	100223	467170
Number of households per million ha	161	70

Sources: China Rural Statistical Yearbook, 2006. Japan Statistics Department, Minister's Secretariat, Ministry of Agriculture, Forestry and Fisheries, data based on Statistical Survey of Farm Management and Economy.
n.a. not available.

6. Conclusions and limitations of the study

Applying a dynamic general equilibrium model of the Chinese economy, the paper estimates the size of the rural labour surplus from 1997-2005 and forecasts its size from 2006-2015. The historical simulation shows that the size of the rural labour surplus has declined sharply during the period 1997 to 2005. Even though the rapid agricultural productivity improvement has been releasing labour from the agricultural activities, the strong demand for rural labour in rural non-agricultural activities such as village and township enterprises and in the urban sectors has kept drying the pool of labour surplus. If the growth patterns of agricultural output and labour productivity continue, and if China's macroeconomic growth maintains its historical trend, then the rural labour surplus will shrink significantly, leaving only 25.6 million rural surplus labours by the end of 2015.

Since the 1980s China has experienced rapid improvement in agricultural labour productivity. However, its labour productivity is still very low compared with developed countries. We investigate the effects of an acceleration of agricultural labour productivity growth in a hypothetical productivity scenario. We find that a large amount of labour will be released from the agricultural sector and the pool of rural surplus labour will expand. Meanwhile, more rural labour will shift to rural non-agricultural and urban sectors which will boost the growth of economy. The expansion of the non-agricultural sector stimulates the growth of urban skilled and unskilled employment and reduces urban unemployment. By reducing food prices the accelerated improvement of agricultural labour productivity puts downward pressure on the consumer price index and stimulates household real consumption.

There are several data issues that we will deal with in future research.

- First, the size of the rural labour surplus (120 million) in the initial year 1997 in our data base was obtained from a literature survey. Our more recent calculations, based on the output and productivity in all 40 agricultural subsectors, suggests that this figure should be significantly higher than 120 million (Peng and Mai, 2010). We will use our own estimates in subsequent studies.

- Secondly, the data for rural migrant workers (the RUE category) at base year has been obtained from *China's First Agricultural Census* which reports only persons, not person-years (how many days the rural worker actually worked in the urban sectors). The definition of a rural migrant worker is a rural worker who worked for more than one month outside their township of residence in 1997. The number of RUE will be smaller if it is based on person-years. This means that our current data overestimate the actual size of the stock of rural migrant workers. The data needs to be translated into employed person-years as effective labour input in the industrial and services sectors. RCRE's *National Fixed-Cite Survey of Rural Households* provides both the number of persons and the number of working days of rural migrant workers by industry for the period 2003-2007. From this information we can extrapolate the corresponding figures for the period 1997-2002. These refinements enable us to calculate the effective person-years of RUE category in total employed rural persons.

- The data on output and productivity growth rate for the forestry sector is not available. In our paper we assume that these growth rates equal the average growth rates of output and labour productivity in the other 13 agricultural sectors.

References:

Cai, F (2007), "The Myth of Surplus Labour Force in Rural China," *China Population Science*, Vol.2, 2007.

China Daily (2006), "Rural Labour Shortage Beginning to be Felt," *China Daily*, 29 May 2006, chinadaily.com.cn.

Dixon, P. B., Parmenter, B. R., Sutton, J., Vincent, D. P. (1982), *ORANI: A Multisectoral Model of the Australian Economy*, North-Holland, Amsterdam.

Dixon, P.B. and Rimmer, M.T. (2002), *Dynamic General Equilibrium Modelling for Forecasting and Policy: a Practical Guide and Documentation of MONASH*, North-Holland Publishing Company, Amsterdam.

Mai, Y., Peng, X. J., Dixon, P. B., Rimmer, M. T. (2009), "The Effects of Facilitating the Flow of Rural Labour to Urban Employment in China," CoPS working paper No.G-188, Melbourne, Australia.

Peng, X. J. and Y. Mai (2010), "Estimating China's Rural Surplus Labour," CoPS working paper, Melbourne, Australia.

RCRE (2008), *China Rural labour migration report – based on the data of 2003 -2007,* Ministry of Agriculture, Beijing, China

United Nations Population Division (2008), *World Population Prospects: The 2008 Revision,* New York.

Wang, D. W. (2006), "Changes in the Relationship between Labour Supply and Labour Demand and China's Economic Growth in the Low-fertility Era," Working paper No.55, Institute of Population and Labour Economics, CASS, Beijing, China.