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Population Ageing, Labour Market Reform
and Economic Growth in China -
A Dynamic General Equilibrium Analysis

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General Paper No. G-174 September 2008

ISSN 1 031 9034

ISBN 0 7326 1581 X

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Population Ageing, Labour Market Reform and Economic Growth in China

- A Dynamic General Equilibrium Analysis

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Abstract:

The dramatic fertility decline since the beginning of 1970s has decelerated the growth of China's working age population. From 2015, this growth will turn sharply negative, resulting declining labour force in China. This has caused concerns about the sustainability of China's economic growth. This paper sheds lights on the view that a more efficient allocation of labour between sectors is likely counter balance the negative effect of population ageing. Using a dynamic CGE model of China, we analyse the effects of removing labour market distortions that hinder the movement of labour from agricultural to manufacturing and services sectors over the period 2008 to 2020 in the context of declining growth of labour supply in China. Simulation results shows that removing the discriminations against rural workers in urban area will increase the labour shift from agricultural to non-agricultural sectors. The resulting increase in the movement of rural labour will mitigate the adverse effects of population ageing by raising not only the growth rate of total output but also household living standard. China can enjoy continued growth in its manufactured exports even with a slower growth in its labour force.

JEL classification: J21,J61,E17

Key words: population ageing, labour market reform, rural migration, CGE model, China

* The authors wish to thank Peter Dixon for his helpful comments and suggestions on this paper.

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1 Introduction

There has been increasing concern about the sustainability of China's economic growth in recent years, particularly in relation to the dramatic age structure change and population ageing.

Since the early 1970s, rapidly socioeconomic development and rigid family planning policy have caused a dramatic fertility decline, resulting in a rapid change to the age structure of China's population (Wang and Mason, 2004; Poston and Gu, 1987 and Coale, 1984).¹ China has completed its demographic transition (ie from a pattern of high fertility, low mortality and high population growth rate to a pattern of low fertility, low mortality and low population growth rate) within approximately 30 years, a very short transition period compared to most developed countries. The rapid fertility decline has brought China a substantial "demographic dividend".² This demographic dividend coincided with an economic boom that has persisted in China since 1978, further fuelling an already rapidly growing and dynamic economy. Scholars estimates that the demographic dividend accounts for one fourth of China's economic growth since 1978 (Cai, 2004 and Wang et al. 2004). However, that dividend is intrinsically transitory and will soon be exhausted because China's unusually rapid fertility declines means that its population will also face a more rapid and severe process of ageing (Wang and Mason, 2004).

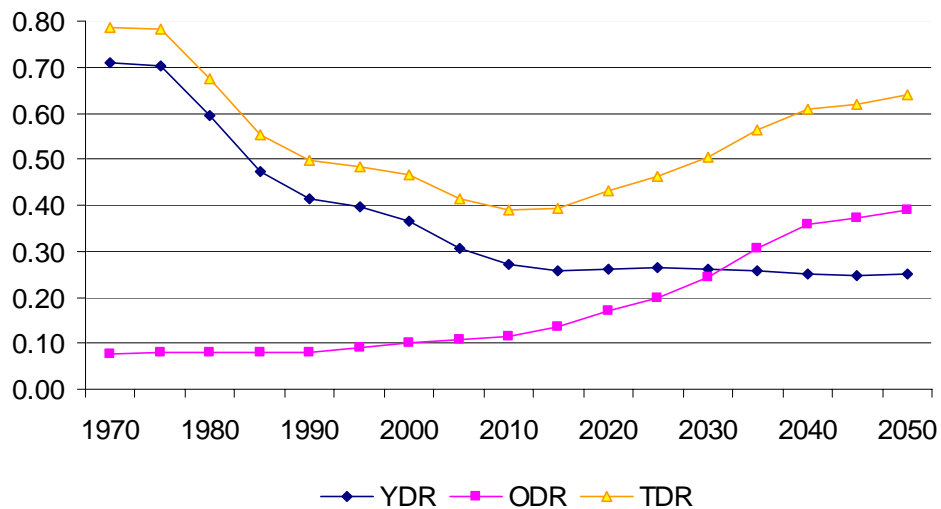
According to the United Nations medium variant population projection, the share of the population aged 65 and above will increase from 7.6 percent in 2005 to 11.9 percent in 2020, and further to 16.3 percent in 2030 (United Nations, 2004). Against the background of this rapid ageing process, the growth of the working age population has declined to about 1.5 percent per annum in the late 1990s after having peaked at twice that level (3 percent p.a.) in the late 1980s and early 1990s. It will continue to

¹ The proportion of the working age population aged 15 to 64 increased from 56 percent in 1970 to 70.6 percent in 2005, while over the same period, the proportion of the youth population aged 0-14 declined dramatically from 39.7 percent to 21.8 percent, and the proportion of elderly aged 65 and over increased from 4.3 percent to 7.5 percent (United Nations, 2004).

²The demographic dividend accrues to a population age structure characterized by a high proportion of working age population and low total dependency ratio. It opens up transitory opportunities for the country for an increased pace of economic growth (Bloom and Williamson, 1998). As the demographic transition proceeds, declining growth in the labour supply and rapid increase in the old dependency ratio will dissipate the demographic dividend and close the demographic window. In China the demographic window opened at around 1990 and will close at around 2020.

decline steadily until it ceases altogether by approximately 2015, then turn strongly negative (United Nations, 2004). The slight decline of the proportion of the young population aged 0-14, combined with the rapid increase of the elderly population and the sharp decline of the working age population will cause the total dependency ratio to rise dramatically after reaching its lowest point at around 2020. Figure 1 shows that China has reaped substantial benefits from its declining total dependency ratio, the so-called ‘demographic dividend’, since 1990. But this favourable age structure will gradually disappear when the total dependency ratio begins to rise to after 2020. The closing of ‘demographic window’ implies that the ‘demographic dividend’ will turn into a ‘demographic deficit’ with potential adverse economic consequences.

Figure 1: Demographic transition and ‘Demographic window’ in China



These profound demographic changes are causing increasing concern about the sustainability of China’s economic growth (Peng and Fausten, 2006; Cai and Wang, 2006 and Wang, 2006). Scholars and Chinese government officials worry that the looming demographic challenge may undermine China’s ability to grow rich before its population grows old (Jackson and Howe, 2004).

The negative effects of population ageing on economic growth are increasingly recognized (e.g., Peng, 2006 and Golley and Tyers, 2006). Peng’s simulation results show that if China maintains its current low fertility rate, the labour force decline caused by population ageing and low fertility rate will decelerate China’s economic growth rate by two percentage points annually during the 2020s and by three

percentage points annually during the 2040s (Peng 2006). In her investigation on China's population policy, Peng finds that if China's total fertility rate (TFR) were to increase to 1.8 or to the replacement level of 2.1 at the beginning of the century, then labour supply would expand. This expansion would help mitigate the adverse effects of population ageing on macroeconomic growth. However, per capita income may deteriorate because of the acceleration of the rate of growth of the total population induced by higher fertility regimes (Peng, 2005a). It seems that mitigating the negative effects of population ageing by raising fertility rate is not a good solution. This paper shed lights on the view that a more efficient allocation of labour between sectors is likely to be a better option than an increased fertility rate.

Since 1978, economic reform in China has allowed large amounts of rural labour to move to other more productive sectors such as construction, manufacturing and services. This large rural migration has proven to be a source of gain in allocative efficiency and labour productivity (Cai and Wang, 1999). Several studies have shown that the contribution to economic growth of inter-sectoral labour movements was 14 to 20 percent between 1978 and the mid 1990s (World Bank, 1997; Woo, 1998; Cai and Wang, 1999; Kuijs and Wang, 2005 and Dekle and Vandenbroucke, 2006).

But rural surplus labourers still exists in China. Estimates of the rural surplus labour vary considerably, but the number is in the hundreds of millions (China Xinhua News Agency, 2004). While underemployment or disguised unemployment remains widespread in rural areas, many industries in the economically advanced areas, especially in the eastern coastal areas have suffered serious rural labour shortages in recent years (China Daily, 2006 and Wang, 2006).³

This workforce imbalance is a direct result of the limited labour mobility in China (World Bank, 2005). Labour movement has been restricted by the household registration (*hukou*) system and associated regulations and policies. These institutional obstacles prevent the rural labour force from permanently migrating and

³China's comparative advantage lies in labour-intensive manufacturing. However, increasing wage costs in recent years as a result of rural labour shortages in manufacturing sectors in east coastal areas could jeopardise China's competitive advantage in the international market (Wang, 2006).

working in the cities. As a result, migration in China has taken place to a large extent only in the form of a “floating population” (Kuijs and Wang, 2005).

The paper will explore the economic impact of reducing labour market distortions against the backdrop of the population ageing and declining growth of labour supply over the period of 2008 to 2020 in China. By applying a dynamic general equilibrium analysis, the paper attempts to answer the question: whether accelerating transfer of employment from agricultural to non-agricultural sectors by reforming the *hukou* registration system and removing other institutional obstacles can mitigate the negative effect of population ageing on macroeconomic outcomes and enhance China’s ability to support its rapidly increasing elderly population in the future.

The paper will made a contribution to the literature by investigating the economic consequences of changes in the employment composition (eg rural labour reallocation) in the context of rapid demographic change and population ageing. Several studies have been conducted of the economic impact of population ageing in China. But all of these studies treat the labour force as a whole without paying attention to its employment composition (Cheng, 2003; Peng, 2005b, 2006 and Golley and Tyers, 2006).

The paper is organized as follows. After the introduction, the second section explains the model framework and discusses labour market distortions in China. The development of a baseline scenario and the simulation results are presented in section three. The impacts of labour market reform on economic growth are explored in the fourth section. The last section presents conclusions and policy implications.

2 Model framework and discussion of the labour market distortion

2.1 Model framework

The analytical framework applied in this study is a dynamic Computable General Equilibrium (CGE) model of the Chinese economy, the MC-HUGE model. This model was jointly developed by Hunan University and the Centre of Policy Studies

(Mai 2006 for the details of the MC-HUGE model). The model includes 57 sectors. Its base data reflects the 1997 input-output structure of the Chinese economy. The core CGE structure is based on ORANI, a static CGE model of the Australian economy (Dixon et al 1982). The dynamic mechanism of MC-HUGE is based on the MONASH model of the Australian economy developed by Dixon and Rimmer (2002). The MC-HUGE model captures three types of dynamic links: physical capital accumulation; financial asset/liability accumulation; and lagged adjustment processes in the labour market.

In MC-HUGE, production is modelled using nested constant elasticity of substitution (CES) and Leontief production functions which allow substitution between domestic and imported sources of produced inputs and between labour, capital and land. The production functions are subject to constant returns to scale. Household demand is modelled by the linear expenditure system (ELES). Trade is modelled using the Armington assumption for import demand and a constant elasticity of transformation (CET) for export supply. China is considered as a small open economy in import markets where foreign import prices are determined in world markets. Exports are demanded according to constant elasticity demand curves for most of commodities.

In the model, capital stock is accumulated through investment activities (net of depreciation). Investors respond to changes in expected rate of return. In this version of the model, we assume static expectations. Under static expectations, investors only take account of current rentals and asset prices when forming current expectations about rates of return.

For the labour market, the wage rate is sticky in the short run and employment adjusts to clear the labour market. Over time, the wage rate adjusts to access supply/demand of labour so that employment returns to its long-run level. In the long run, employment is determined by demographic variables such as working age population and labour force participation rates.

2.2 Labour market distortion and wage differential

In China the *Hukou* registration system⁴ and other institutional factors have created barriers to mobility between sectors. Though the Chinese government has pursued labour market reforms since 1978, labour market segmentation continues to exist. The probability of a rural migrant securing urban employment in a given sector still depends on a set of institutional factors, including residence requirements and other constraints imposed by the state. Migrant work is typically limited to jobs that the urban population find too hard or demeaning. Meanwhile, rural migrants are often denied many of the basic social services enjoyed by permanent urban residents such as access to subsidized housing, medical care, and schooling for their children. This institutionalized and systematic discrimination is an important reason for the observed high rates of return migration from urban areas back to rural villages (Tuñón, 2006). Furthermore, rural land tenure arrangements continue to increase the cost of out-migration and dampen off-farm labour market participation.⁵ All these labour market distortions have increased the migration cost and slow down the pace of rural migration.

How can we model the effects of labour market reform on the labour transferring between agricultural⁶ and non-agricultural sectors and therefore on China's economic growth? Ample evidence of labour market segmentation by economic activity is presented by Knight et al. (1999) and Wang et al. (2000), Shi et al. (2002) and World Bank (2005) suggest a dual sector model with wage differentials in China. Existing empirical research indicates that the *Hukou* system plays a significant role in supporting wage differential between agricultural and non agricultural sectors and income inequality between rural and urban areas (Liu, 2005, Whalley and Zhang, 2007).

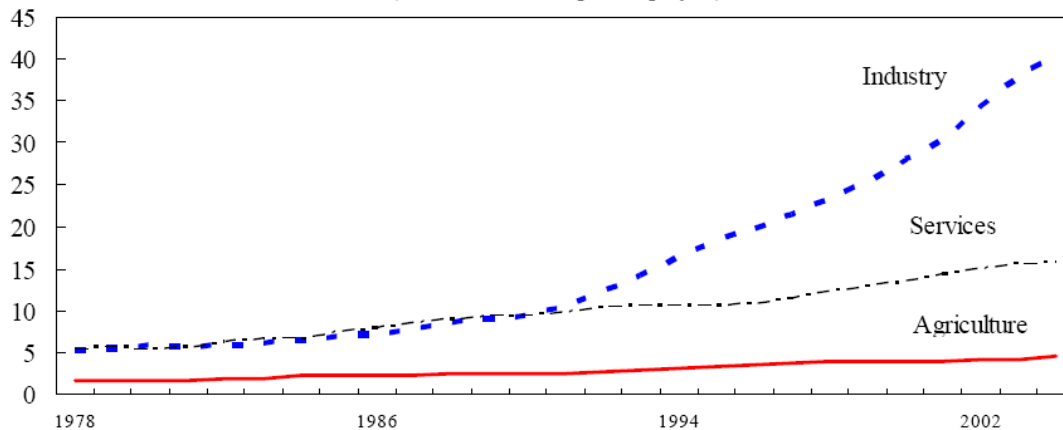
⁴ China has a strict household registration (*hukou*) system. Households must have an urban *hukou* in order to legally reside in an urban area. Without this registration, access to basic facilities and services including housing, education and social security are very limited and quite expensive.

⁵ Rural households that stop farming the land will lose the rights to it. This policy has increased the opportunity costs of leaving farming by creating a strong incentive to continue a low level of agricultural activity, even when profitability is quite low (Zhao, 1999).

⁶The agricultural sector in the present paper includes farming, forestry, animal husbandry and fishery. The rest of all sectors are defined as non-agricultural sector.

Figure 2: Labour productivities of three sectors in China

(1995 RMB, 000s per employee)



Source: Kujia and Wang (2005)

In the absence of barriers to the movement of labour between rural and urban areas, and between agricultural and urban non-agricultural sectors, real wages would be equalized for an individual worker with given characteristics (Hertel and Zhai, 2005). But in China, the wage rate in the agricultural sector has far below the wage rate in other sectors. The wage gap, which is defined as a ratio of the level of wage for agricultural and non- agricultural labour, was 3.79 in 1997 and it widened to 4.69 in 2005. The main reason for the low wage rate in the agricultural sector is its low labour productivity comparing with other sectors. In 2001, the labour productivity ratio of urban industry, urban services and rural-non-farm to agriculture in China is an astonishing 4-10 times larger than in other countries. More significantly, while the productivity ratios of other countries have generally been stable or falling, in China it has risen substantially over the last 25 years (Kuijs and Wang, 2005) (refer to Figure 2). These extremely high ratios as well as their rising trend are symptomatic of the major distortions in the labour markets, especially in its bias against the agricultural sector. The slow relocation of rural labour generated from the *hukou* system and related institutional barriers has hampered productivity growth in agriculture (Kuijs and Wang, 2005). But these same trends highlight the tremendous potential for efficiency gains and economic growth. They also support the scope for promoting sectoral and regional equality by reallocating labour resources between agriculture and other non-agricultural sectors (World Bank, 2005).

But how much is the wage differential between agricultural and non-agricultural sectors directly related to the *hukou* system and other institutional barriers? Shi (2002) explore wage differentials between rural and urban workers for nine different provinces using the China Health and Nutrition Survey (CHNS) data. After controlling for differences in personal characteristics, education, occupation and living costs he finds that approximately 28 per cent of the rural-urban wage difference can be explained directly by the coefficient on the *hukou* registration variable. Whalley and Zhang (2007) use a model with homogeneous labour in which wage inequality across rural and urban regions is supported solely by quantity based migration restrictions. They calibrate this model to base case data (the wage difference between rural and urban workers is 10581 Chinese Yuan in 2001) and when they remove migration restrictions wage difference disappears. Rural wage rate increases by 3208 Chinese Yuan, which represents 30 percent of wage difference in the base case data.

In the present paper, we will use the Shi's finding. We assign 28 per cent of the wage differential to the labour market distortion that has been directly attributed in Shi's econometric analysis to the *hukou* system and other institutional barriers in China's labour market. In the policy scenario, we will gradually remove this portion and simulate the economic impact of reforming the *hukou* system and related institutional arrangements.⁷

3 Simulations design and baseline results

Our analysis starts with historical simulations that update China's economic structure reflected in the model database to 2005. The historical simulations are followed by forecast simulations to 2020. Together, the historical and the forecast simulations provide us with a baseline scenario with which to compare the scenario when labour market distortion is removed. The baseline simulation from 2006 to 2015 follows Mai

⁷ We must mention that it is not very clear whether the wage differential related to the *hukou* system in the existing empirical research takes into account hidden income accruing to urban households such as housing, education, medical care, and other social benefits such as unemployment insurance, employment injury insurance, pension insurance and maternity leave. Since the majority of non-agricultural employment is urban located, excluding the social benefit that urban workers have will underestimate the wage differential related to the *hukou* system and labour market distortions.

(2006). For the purpose of this paper, we extend the baseline further to 2020. The macroeconomic variables in the baseline scenario are shown in Table 1.

The growth rate of total labour force is exogenous. It is determined by the growth rate of working age population and aggregate labour force participation rate. The growth rates of working age population from 2006 to 2020 are from United Nations medium variant population projection. The labour force participation rate of working age population is assumed to keep constant at 2000 level which is 82 percent.

In the baseline, the growth rate of real GDP is 7.9 per cent in 2008, and decreases gradually to 7.05 per cent in 2020. The growth rate of the capital stock is determined by the growth of investment and net depreciation of capital. The growth of total factor productivity represents the difference between the GDP growth and the growth rate supported by the accumulation of labour and capital. This ranges from 2.59 – 3.22 percent over the simulation period. With continued strong growth of exports China's terms of trade slightly deteriorates. Real wage rates, especially for non-agricultural sectors, show strong growth as a result of productivity improvement and declining growth of labour supply.

In the original model of MC-HUGE, total employment is disaggregated into 57 sectors. For the purpose of this paper, we categorize all the workers of 57 sectors into two groups: agricultural sector and non-agricultural sector.

The baseline scenario shows an increasing wage gap between the agricultural and non-agricultural sectors. This is consistent with China's historical experience from 1997 to 2005. The wage gap between the agricultural and non-agricultural sectors was 3.79 in 1997. It widened to 4.69 in 2005. In the forecast period the wage gap further increases to 5.29 in 2010 and to 5.77 in 2020. Even though rural households are deriving less income from the agricultural sector (the share of income from agriculture over the total income of rural household has decline from 61 percent in 1995 to 42 percent in 2006), the widening gap of the wage rate between the agricultural and non- agricultural sectors will still contribute to the growing income inequality between rural and urban residents.

Table 1: Summary of baseline calibration*

	2008	2010	2012	2015	2018	2020
<i>Exogenously specified variables</i>						
<i>Annual growth rate (%)</i>						
Consumption	6.03	6.03	6.02	6.00	5.29	5.26
Investment	9.93	9.90	9.80	9.79	8.74	8.68
Import	11.41	11.35	11.30	11.24	9.96	9.96
export	11.18	11.13	11.08	11.02	9.78	9.78
Labour force	0.90	0.90	0.52	0.50	-0.12	-0.12
<i>Calibrated results</i>						
<i>Annual growth rate (%)</i>						
GDP	7.87	7.89	7.87	7.90	7.07	7.05
Productivity improvement	2.59	2.75	3.07	3.20	3.05	3.22
Capital stock	10.46	10.14	9.86	9.47	9.00	8.66
Terms of trade	-0.18	-0.16	-0.09	-0.08	-0.57	-0.46
Real wage rate	6.72	6.70	6.71	6.72	8.47	7.88
<i>Level of</i>						
Wage gap between agriculture and other sectors	5.05	5.29	5.54	5.94	5.81	5.77
Share of agriculture employment in total labour force (%)	46.0	45.0	44.4	43.4	41.3	40.4

Source: Baseline simulation results.

* Only selected years results are displayed in this table.

The bottom row of Table 1 shows the evolution of the share of agricultural employment in the total labour force. Continuing its historical trend (1997-2005), the share of agricultural employment keeps declining throughout the simulation period. In 2020, its share will drop to 40.4 percent. The share of manufacture and services sectors will increase to 59.6 percent. The continued shift of labour from agricultural to non-agricultural sectors is the result of faster growth of non-agricultural sectors which create more employment opportunities and attract agricultural labour to move to these sectors.

4 Policy simulations and results

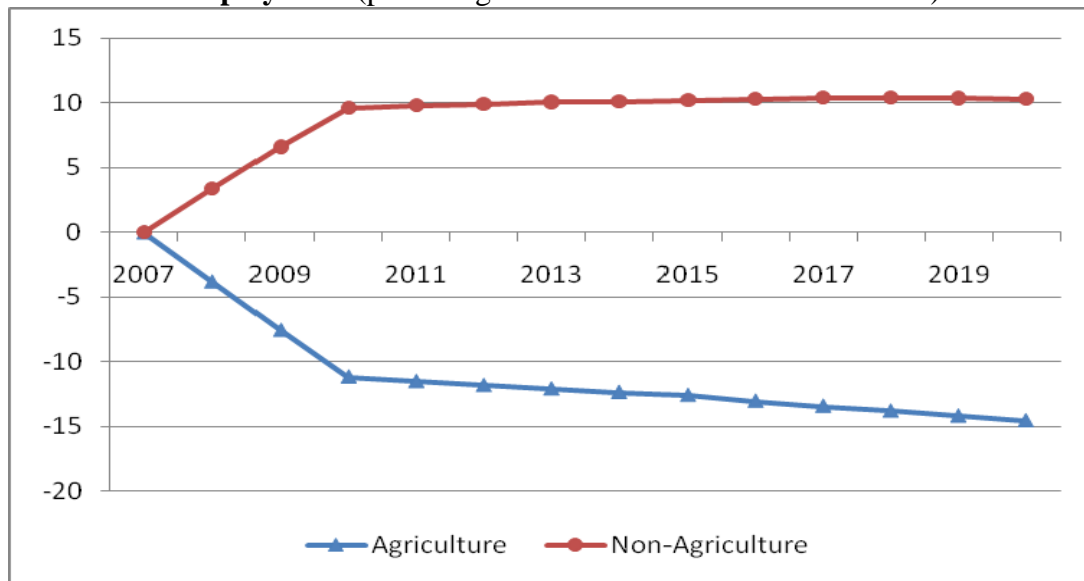
The paper conducted two policy simulations. The first simulation explores the effects of labour market reform on China's economic growth. The second simulation considers the consequences of productivity improvement in the agricultural sector.

4.1 Simulation one – effects of labour market reform

In the policy scenario, we assume that the Chinese government will continue its *hukou* system reform and the labour market distortions that hinder the movement of labour from agricultural to non-agricultural sectors will be removed between 2008 and 2020. We assume that the labour market distortions directly associated with the *hukou* system and other institutional obstacles is equivalent to 28 percent of the wage differentials between the agriculture and non-agricultural sectors. In simulation one, we shock the wage differentials to reduce by 11.4 percent annually from 2008 to 2010 (the total reduction of the wage difference in three years is 28%). The removal of the labour market distortion will drive more labour to shift from agricultural to non-agricultural sectors. This increased labour movement will slow down the growth of wage rate in the non-agricultural sector and increase the growth of the wage rate in the agricultural sector.

The simulation results are shown at Figures 2 to 5 and at column two of Table 2. The *hukou* system reform serves to increase labour shift from the relatively low productivity agricultural sector to the higher productivity non-agricultural sector. The total movement from agricultural to non-agricultural sectors is 50.14 million. As a result the share of agricultural employment is 14.55 percent lower and non-agricultural sectors is 10.28 percent higher than in the baseline scenario in the year 2020 (Figure 2). In other words, with the labour market reform the share of non-agricultural employment in 2020 will increase to 66.5 percent which is 6.88 percentage points higher than in the baseline scenario.

Figure 2: Policy simulation one: shares of agricultural and non-agricultural employment (percentage deviation from baseline scenario)



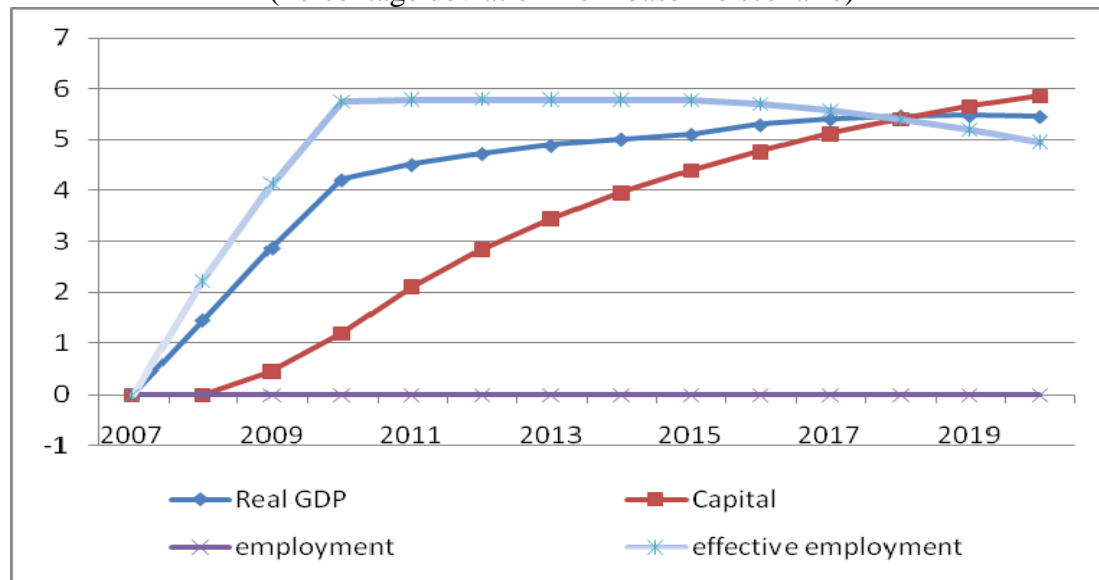
Source: policy simulation results

The increased migration of labour force is expected to boost all macroeconomic variables. For example, real GDP in 2020 will be 5.45 percent higher than in the baseline scenario. There are two reasons for the higher growth rate of GDP. First, the increased movement of labour from the relatively low productivity agricultural sector into higher productivity non-agricultural sector boosts economic growth directly. Even though the total labour supply is fixed at the level of the baseline scenario, the change in the employment composition of the labour force contributes to growth of GDP. The shift from low productivity agricultural sector into higher productivity non-agricultural sector increases the effective labour force. As a result, the total employment measured by wage bill weights increases. As Figure 2 shows by year 2020, employment measured in wage bill weights is 4.96 percent higher than in the baseline scenario. To illustrate, given the inter-sectoral wage difference of 34996 Chinese Yuan in 2020, the shift of 50.14 million workers into the non-agricultural sector will increase the total wage bill by 1754.7 billion Chinese Yuan, which accounts for 4.96 percent of total payment to labour).

Secondly, the relatively faster employment growth in the non-agricultural sector driven by the labour shift from the agricultural sector creates more demand for capital, which stimulates the growth of capital stock. By the end of 2020, the capital stock in

the policy scenario is 5.86 percent higher than base case. Relative faster growth of capital also contributes to the growth of GDP.

Figure 3: Policy simulation one: GDP, employment and capital
(Percentage deviation from baseline scenario)



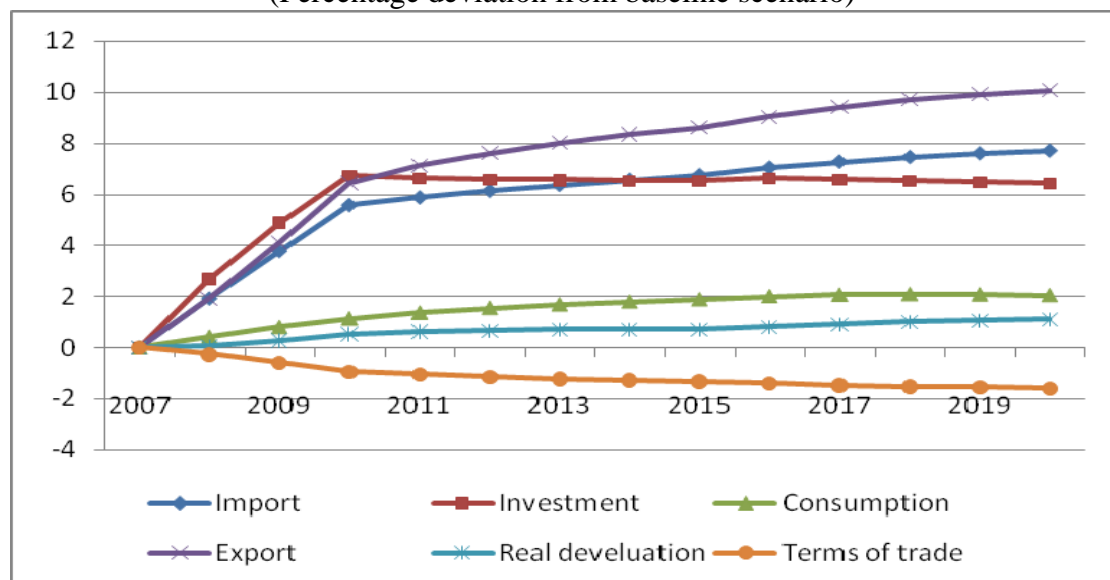
Source: policy simulation results

The movement of labour force from agricultural sector to non-agricultural sector lifts the growth of China's export dramatically. As Figure 4 shows export will be 10.07 percent higher than in the baseline scenario in 2020. The reason is that with the slower growth of the wage rates in non-agricultural sector (compared with the baseline scenario, the wage rate in non-agricultural sector is 11.85 percent lower in 2020), especially in manufacture sector, the labour cost in these sectors is reduced. This further increases the competitiveness of Chinese exports in the world market. As a result Chinese export expands. The expansion of export implies more employment opportunities which may further attract rural migrants.

The labour market reform also improves households' living standards measured by real consumption. As Figure 4 shows, the real consumption is approximately 2.05 percent higher than in the baseline scenario. We notice that the increase of consumption is lower than that of real GDP. One reason is the deterioration of China's terms of trade associated with the expansion of her exports. In 2020 the terms of trade are 1.60 percent lower than in the baseline scenario (Figure 4). The second reason is faster growth of the price of the agricultural products. The shift of labour from

agricultural to non-agricultural sectors causes the agricultural wage rate to increase, raising the price of agricultural products (as Figure 5 shows, the wage rate of agricultural workers is 59.66 percent higher in 2020 than in the baseline scenario). The contraction of agricultural output as a result of increased migration from agricultural to non-agricultural sectors also drives the food price to increase (agricultural output is 9.23 percent lower than in the baseline scenario in 2020 while non-agricultural output is 8.95 percent higher (Figure 5)). Since the food consumption represents nearly 40 percent of households' income, the higher price of agricultural products slows down the improvement of households' living standards.

Figure 4: Policy simulation one: Expenditure aggregates
(Percentage deviation from baseline scenario)



Source: policy simulation results

The removal of the labour market distortion drives more labour to shift from agricultural to non-agricultural sectors. This increased labour movement slows down the growth of the wage rate in the non-agricultural sector and accelerates the growth of the wage rate in the agricultural sector. As Figure 5 shows, the wage rate of agricultural workers is 59.66 percent higher in 2020 than in the baseline scenario, while the wage rate in the non-agricultural sector is 11.85 percent lower. The faster growth of the wage rate in the agricultural sector and relatively slower growth of the wage rate in the non-agricultural sector will narrow the income gap between rural and urban households and contribute to the decline of the rural-urban income inequality, assuming migrated rural labourers continue to send remittance home.

Figure 5: Policy simulation one: output and wage rate
(Percentage deviation from baseline scenario)



Source: policy simulation results

One notable feature of this simulation result is the sharp increase in agricultural wage rate and hence a large increase in the price of agricultural products and consumer price index. We think that we overestimated the impact of shifting rural labour to urban industries on the price of agricultural products. This is mainly due to the difficulty in estimating wage rates for the agricultural activities. We think that the level of implied wage for the agriculture sector in the model database⁸ is closer to the level of average product. The average product in agriculture is much higher than marginal product given widespread underemployment in the Chinese agriculture sector. This means that we overestimated the share of labour in the production costs of agriculture products. Our policy simulation result may therefore overestimate the increase in agricultural production costs in the presence of substantial labour movement into the urban sector. In our next round of simulations, we plan to modify our estimates of labour cost in agriculture.

In sum, the reform of the *hukou* system by removing the discriminations against rural agricultural workers will increase the pace of labour movement from agricultural to

⁸ The implied wage is calculated from total wage bill in the input-output table and number of persons employed in the China statistical yearbooks.

non-agricultural sectors. The resulting increase in the movement of rural labour will mitigate, to a certain extent, the adverse effects of population ageing by raising not only the growth rate of total output but also household living standard (real consumption). The induced expansion of China's economy provides a relatively solid foundation for supporting the rapidly increasing elderly population in the twenty-first century. Especially given the relatively faster ageing of rural population, the faster growth of agricultural wage rate will increase the rural labour's 'financial ability' to support the rapid growth of the rural elderly population.

4.2 Policy simulation two – effects of productivity improvement in the agricultural sector

We notice that when labour market reform increases the shift of labour from agricultural to non-agricultural sectors, agricultural output declines. One reason is that we did not consider the productivity improvement generated by the labour movement in the agricultural sector. In China land is very scarce. The per capita arable land is less than 0.1 hectares in 2005, which is very low comparing with the most of developing countries. Meanwhile there are about 2.5 agricultural labourers for every hectare of arable land (China Xinhua News Agency, 2004). The high density of agricultural labour has not only resulted in low labour productivity but also prevented the development of large-scale agricultural production. When more rural labourers move out of the agricultural sector, the possibility of developing large-scale modern agriculture arises. This implies large investment in the agricultural sector and fast technology progress. Meanwhile more rural surplus labourers moving out of agricultural sector will directly improve labour productivity. Thus ignoring the productivity improvement generated by increased labour movement from agricultural - to non-agricultural sectors implies the macroeconomic effects of removing labour market discrimination are underestimated. To illustrate this point, in policy simulation two, we assume that the 28 percent reduction in agricultural and non-agricultural wage gap leads to an increase in all-factor augmenting technical change in agricultural sector by 1.5 percent in 2012.⁹

⁹ China's agricultural sector has experienced fast productivity growth since the end of 1970s. Fan (1997) finds that the annual growth rate of total factor productivity in the agricultural sector was 5.1 percent from 1978 to 1984 and was 3.91 percent from 1985 to 1995 in China. The annual growth rate

The simulation results are shown in column three of Table 2. The productivity improvement in the agricultural sector will boost the growth of all macro variables. The macro economic performance will be further improved comparing with the results of simulation one (column two of Table 2): real GDP will be 5.87 percent higher than the baseline scenario. The reasons for the relatively faster growth of real GDP are:

- First, productivity improvement in the agricultural sector directly contributes to growth of real GDP.
- Secondly, productivity improvement in the agricultural sector reduces the demand for labour and releases more labour. This will further increase the labour shift from agricultural to non-agricultural sectors. Compared with the result in simulation one, there will be 1.58 million more worker moving out of the agricultural sector (in simulation one, there is 50.14 million labour shifting from agricultural to non-agricultural sectors. In simulation two, this figure is 51.72 million). As a result, the effective employment in the whole economy will increase further. The employment measured by wage bill weights is 5.12 percent higher than in the baseline scenario in 2020 (0.16 percentage points higher comparing with simulation one's result). The increased employment contributes to growth of GDP.
- Thirdly, given the rates of return on capital, the improvement of productivity and the increase of effective labour stimulate growth of capital stock. We notice in year 2020 the capital stock is 0.28 percentage points higher than in the simulation one and 6.14 percent higher than in the baseline scenario. The growth of real GDP is the result of growth of productivity, effective employment and capital stock.

The productivity improvement will also lift the households' living standards. As table 2 shows the real consumption is approximately 2.55 percent higher than in the baseline scenario.

from 1990 to 2000 is 1.95 percent based on Brümmer et al. (2006) and 1.97 percent based on Rao, et.al. (2004). In the present paper, our assumption of 1.5 percent increase in the agricultural productivity in 2012 generated by labour market reform is quite reasonable.

Table 2: Results of policy simulations – cumulative deviations from baseline scenario in 2020 (%)

	Simulation 1	Simulation 2*
Real GDP	5.45	5.87
Employment in number of persons	0.00	0.00
Employment by wage bill weights	4.96	5.12
Capital stock	5.86	6.14
Investment	6.44	6.74
Consumption	2.05	2.55
Export	10.07	10.29
Import	7.71	7.91
Real wage rate	-8.83	-8.32
Terms of trade	-1.60	-1.65
Real devaluation	1.11	1.30
Wage rate of agricultural sector	59.66	59.86
Wage rate of non-agricultural sector	-11.85	-11.74
Output of agricultural sector	-9.23	-8.26
Output of non-agricultural sector	8.95	9.24
Share of agricultural employment	-14.55	-15.07
Share of non-agricultural employment	10.28	10.61
Labour shift from agricultural to non-agricultural sectors (million persons)	50.14	51.72

Source: policy simulation results

* These simulation results show the combined effects of both shocks in the two policy simulations.

As a result of increased labour shift between sectors, the share of agricultural employment will further decline (15.07 percent lower than in the baseline scenario) and the share of non-agricultural employment will increase (10.61 percent higher than in the baseline scenario).

Total output of agricultural sector is still lower than in the baseline case. However, comparing with the results in simulation one, the performance of agricultural sector is improved.

In summary, the labour market reform combined with the productivity improvement in agricultural sector will accelerate the labour shift from agricultural sector to non-agricultural sector. The negative effect of declining agricultural employment on agricultural output will be mitigated by the productivity improvement. The gain generated from the labour re-allocation will further boost not only economic growth but also the households' living standard.

5 Conclusions and policy implications

The one-child population policy implemented since the late of 1970s in China has decelerated the growth of China's working age population since the 1990s. This growth is 0.9 in 2008 and it will decline to 0.5 in 2010 and from 2015, it will turn sharply negative, resulting declining labour force in China. What is the effect of the decline of the growth of working age population on China's economic growth? We conducted a counterfactual simulation by assuming that the growth rate of working age population will keep at its 2008 level throughout the simulation period (2008-2020) and all other exogenous variables are the same as the baseline scenario. We found that if the growth rate of working age population does not decline then the average annual growth rate of real GDP from 2008 to 2020 will be 7.87 percent (refer to Table A1). This implies that the declined growth rate of working age population as a result of sustained low fertility since the late of 1980s will reduce the average annual growth rate of real GDP by 0.31 percentage points from 2008 to 2020 (the annual growth rate of real GDP with the declining growth of labour supply is 7.56 percent). What is the suitable policy to mitigate this negative effect of declining growth of labour supply? This paper sheds lights on the view that a more efficient allocation of labour between sectors is likely to counter balance the negative effect of declining labour force. Using a dynamic CGE model of China, we analyse the effects of removing labour market distortions that hinder the movement of labour from agricultural to manufacturing and services sectors over the period 2008 to 2020 in the context of declining growth of labour supply in China.

The labour market distortion considered in this paper is the *hukou* system and other institutional barriers. These tight registration requirements and other institutional factors have supported the persistence of significant differences between agricultural

and non-agricultural wages. They also have contributed to the existence of more than 130 million temporary migrant workers. We model the impact of the reform of the *hukou* system by removing wage differential attributed to labour market distortions. This distortion is equivalent to 28 percent of wage difference between agricultural sector and non-agricultural sectors. Policy simulation shows that reducing the wage difference stimulates movement of labour from agricultural to non-agricultural sectors. The resulting increased inter-sectoral labour movement boosts the growth of total output and real consumption. The simulation shows that the average annual growth rate of real GDP from 2008 to 2020 is 8.01 percent (The annual growth rate of real GDP is 7.56 percent in the baseline scenario). This means that the labour market reform could mitigate the negative effect of declining labour supply by 0.45 percentage points annually. These simulation results are consistent with the empirical evidence and existing CGE analysis of the impact of factor market reforms: economic efficiency can be improved through institutional reform in factor markets aimed at improving rural-urban labour mobility (Hertel and Zhai, 2006).

The rapid population ageing and declining labour supply in the twenty first century presents a major challenge to China's policymakers. The expansion of China's economy resulting from the *hukou* system reform provides potential means to meet these challenges. The higher growth of the economy as a result of increased agricultural non-agricultural labour movement will mitigate the erosion of living standards of declining labour supply generated from low fertility and population ageing. Furthermore, increased rural migration helps China to reap the 'demographic dividend' by providing opportunities for rural labour to gain employment in the higher productivity sectors that are typically located in urban areas.

The basic policy message of the simulation exercise is that the Chinese government should undertake effective action to complete the reform of its *hukou* system and to remove other institutional barriers that restrict the flexibility of labour markets. The "demographic window" that will close in the 2010s has significant potential implications for economic growth (Cai, 2004 and Wang et al. 2004). However, a congenial policy environment is required to take full advantage of this demographic opportunity. Such an environment should be designed to improve the integration of rural and urban labour markets. Integration of the national labour market will reduce

the systematic gap between rural and urban labour market outcomes. It will help rural migrants to enjoy employment opportunities, wage payments, public services and social security protection that are increasingly comparable to those experienced by urban residents.

Some limitations of the present investigation must be noted. First, as explained in section 4.1 we suspect the impact of inter-sectoral labour movement on the price of agricultural products is overestimated due to the high agricultural wage rate in the database. Since the agricultural wage rate is a very important variable for our study, in future investigation we attempt to modify the estimation of the labour cost in agriculture. Secondly, our paper did not consider the endogenous productivity improvement by the expansion of the export derived by labour shift between sectors. As China expands its exports to the world markets, Chinese firm will import more capital- and technology- intensive goods as both investment and intermediate inputs from industrial countries. These goods are usually embodied with advanced technology from abroad, thus stimulating productivity growth (Zhai and Wang, 2002). Furthermore the relatively lower cost of labour will attract more foreign direct investment and further improve China's productivity and boost economic growth. However, these endogenous productivity improvements that might be generated from removing the labour market distortion are not considered in the current simulation. In this case, the increase in real GDP due to removing labour market distortion is underestimated in this study. Thirdly, we use the 28 percent of wage differential between agricultural and non-agricultural sectors to represent the labour market distortions. This value is obtained from the existing empirical research. In the future more effort will be put into the calculation of the wage differential between agricultural and non-agricultural sectors which directly derived from the labour market distortion.

Table A1: Counterfactual simulation results

(Assumption of constant growth rate of working age population from 2008 to 2020)

	Annual average growth rate (%)	Average annual deviation from baseline (percentage point)
Real GDP	7.87	0.31
Employment in number of persons	1.28	0.40
Capital stock	9.71	0.13
Investment	9.68	0.27
Consumption	6.04	0.31
Export	10.85	0.24
Import	11.02	0.23

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