Population Ageing, Retirement Age Extension and Economic Growth in China

--A Dynamic general equilibrium analysis

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Abstract

China is experiencing rapid population ageing with the proportion of the population aged 65 and above projected to increase almost threefold between 2010 and 2050. The growth of the working age population is expected to stop approximately in 2015 and to turn strongly negative. China's low retirement age compounds the ageing problem. One means to mitigate the negative effects of shrinking labour force on economic growth is to stimulate labour force participation among the current working age population. Raising the official retirement age is one strategy to encourage labour force participation. This paper first investigates the effects of population ageing on labour force participation rates and, thus, on labour supply over the period of 2010-2030. It then estimates the effects of retirement age extension schemes on the size of the labour force. Thirdly, applying dynamic computable general equilibrium (CGE) modelling, it examines the effects of retirement age extension schemes on China's economic growth. It finds that raising the retirement age increases effective labour input, real GDP, capital stock, household real consumption and exports. The main results are that retirement age extension is likely to boost China's economic growth and that the urban sectors will benefit more than the rural sectors.

1 Introduction

China has experienced remarkable economic growth in the past three decades. Her growing labour force has played an important role in this extraordinary growth phase (World Bank, 2012). However, the situation will change. The growth of the working age population will stop at around 2015 and turn strongly negative afterwards. Meanwhile, the proportion of the old population aged 65 and over will increase dramatically, from 8.2 per cent in 2010 to an estimated 25.6 per cent in 2050 (United Nations, 2010). As a result, the support ratio which is defined as the ratio of working age population to the elderly population will drop significantly from 8.8:1 in 2010 to 2.4:1 in 2050. This poses a significant threat to China's pension system and the sustainability of economic growth. Furthermore, China's low retirement age compounds the ageing problem. Currently the retirement age is 60 for male employees, 55 for female officials and 50 for female workers. Recognition of the current retirement ages would yield an even lower support ratio be. To mitigate the negative effects of the shrinking support ratio on economic growth, it is essential to secure an adequate labour force participation among the current working age population (World Bank, 2012). Increasing the official retirement age is one of the strategies to encourage labour force participation. Using the tools of dynamic CGE modelling, this paper will estimate the effect of retirement age extension on the supply of labour and, therefore, on China's economic growth over the period of 2010 to 2030.

This paper is organised as follows. The second section investigates the effect of population ageing on labour force participation rates and, therefore, on labour supply over the period 2010 to 2030. The third section estimates the effect of retirement age extension on the labour force. The modelling framework is discussed in section four. Section five discusses the effects of retirement age extension on China's economic growth, and the last section offers conclusion and policy implications.

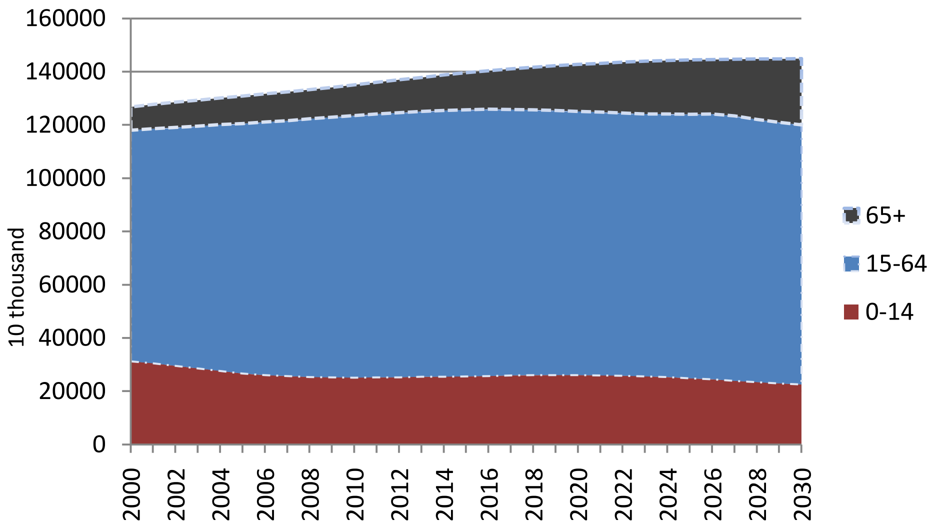
2. Population projection and China's labour supply

The rapid population ageing and potential labour supply contraction at around 2015 are primarily the result of the dramatic decline in fertility rates during the 1970s and 80s. The population evolution in the future will depend on changes in the fertility and mortality rates. In this paper we adopt Mai, Peng and Chen's population projection result with medium fertility rate and medium pace of mortality improvement assumptions (Medium-MP) (Mai, Peng and Chen, 2013) to explore the effects of population ageing on labour force participation rates and, therefore, on labour supply. The specific assumption about the fertility rate is that China's total fertility rate will increase linearly from 1.67 in 2005 to 1.8 in 2015 and then remain at that level till 2030. The reason for using these population projection results is that their fertility assumptions correspond more closely to China's future fertility targets. A TFR of 1.8 children per woman represents the government-targeted fertility level in the long run when the current fertility policy would be gradually changed to a two-child policy (The Project Group on National Population Development Strategies, 2007). In fact, China's central fertility policy has been increasingly localised and diversified at provincial and lower levels (Guo, Zhang, Gu, & Wang, 2003). Currently a two-child policy is applied to couples where both partners are the only child, and in rare cases, to couples where either partner is an only child. Birth spacing policies have also been relaxed or abolished in many provinces and restrictions on timing of marriage and births have largely been removed from existing policies. The medium fertility assumption is often considered to be the most likely future scenario (Mai, Peng and Chen, 2013). Future assumptions about changes in life expectancy at birth at Mai, Peng and Chen's population projection are made following the United Nations models (four different paces) for mortality improvement (United Nations, 2006). In this paper we adopt the scenario of medium pace of mortality improvement.

2.1 China's population from 2010 to 2030

Figure 1 displays the population projection for China over the period 2000 to 2030. Even though China's fertility rate is below replacement level, China's population will continue growing for many years because of population monument. The total population will increase from 1.27 billion in 2000 to 1.45 billion in 2030. The working age population aged 15 to 65 will reach its peak at 1.0 billion in 2016 and then begin to decline. There will be 974 million working age population in 2030. The older population aged 65+ will keep increasing. This age group numbered 87.1 billion at the beginning of the 21st century and will nearly triple to reach 249.7 million in 2030. Figure two shows that the proportion of the older population aged 65 and above will increase from less than 7 per cent in 2000 to more than 17 per cent in 2030. The rapid increase of this population cohort in, combination with the declining working age population will increase China's old dependency ratio[1] (ODR) dramatically. Figure 3 shows that ODR will increase rapidly from 0.1 in 2000 to 0.256 in 2030 and it will surpass the YDR in 2029. This means that from 2030 onwards support of the elderly population will become a major burden for the working age population. Though the declining YDR will slow the increase of TDR it cannot reverse its rising trend. TDR will reach 0.49 in 2030 which means that every two members of the working age population will support nearly one member of dependent population.

Figure 1: Evolution of China's population



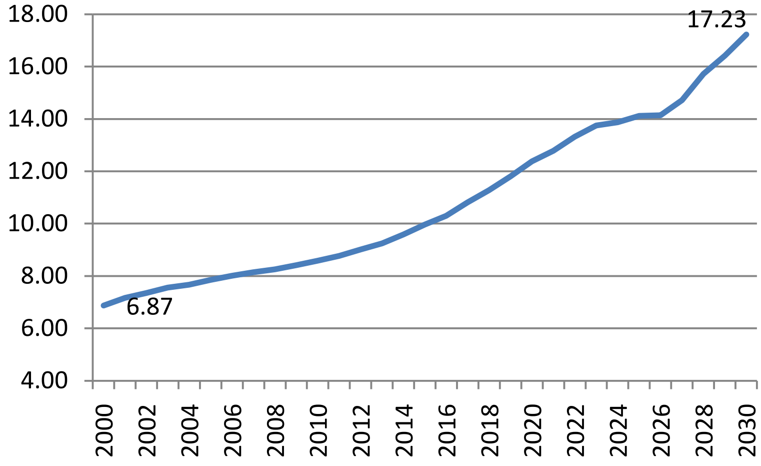
Source: Mai, Peng and Chen (2013)

2.2 Population ageing, labour force participation rate and labour supply

Since not every working age person is active in the labour market, the labour supply of a country is the product of the size of the working age population in each age and gender category and the age-and gender-specific labour force participation rates (McDonald and Kippen 2001). Since changing age structures such as population ageing affect the age-specific labour force participation rates, such events change the aggregate labour force participation rate (ALFPR) (Dugan and Robidoux, 1999) and therefore affect the total supply of labour. We use a simple accounting framework to calculate the trend of the ALFPR from 2010 to 2030 in China.

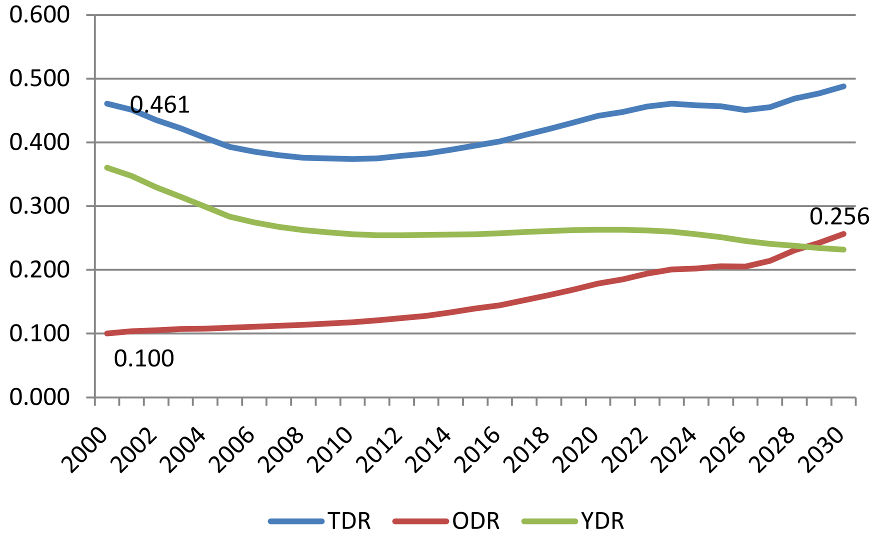
[1] Old dependency ratio (ODR) is defined as the ratio of the population aged 65 and above to the working age population aged 15 to 64. Youth dependency ratio (YDR) is defined as the ratio of the population aged 0 -14 to the working age population aged 15 to 64, and the total dependency ratio (TDR) is the sum of old dependency ratio and youth dependency ratio.

Figure 2: Proportion of population aged 65+



Source: Mai, Peng and Chen (2013)

Figure 3: Evolution of China's dependency ratio



Source: Mai, Peng and Chen (2013)

$$ALFPR_t = \sum_{i=1}^{j} s_{i.t} PR_{i,t} \qquad (1)$$

$$s_{i,t} = WP_{i,t} / WP_t \qquad (2)$$

where $ALFPR_t$ is the ALFPR in year t, $PR_{i,t}$ is the participation rate of cohort i in year t, and $s_{i.t}$ is the share of cohort i in the total working age population aged 15 to 64, WP_t, in year t.

We identify ten 5-year gender-specific cohorts (i=1, 2,…10) in the analysis. Equation (1) shows that changes in the ALFPR reflect either changes in cohort (age-specific) participation rates or changes in the composition of the working age population for given cohort participation rates - the demographic composition effect.

Many social, economic and cultural factors influence the cohort participation rates. In this section we will ignore such changes and only calculate the demographic composition effect.

The data from China's fifth population census in 2010 show that the ALFPR was 76.73 per cent. Detailed cohort and gender specific participation rates in 2010 are shown in Table 1 (second column). We estimate the trend of the ALFPR during 2010 to 2030 by assuming that the cohort participation rates remain at their 2010 level. It is convenient to define this effect with the following equation:

$$ALFPR_t = \sum_{i=1}^{j} s_{i.t} PR_{t,10} \qquad (3)$$

$ALFPR_t$ is the aggregate participation rate that would have been observed at time t if all cohort participation rates remained at their 2010 levels. Table 1 presents the estimates of aggregate labour force participation rates for the medium fertility scenario. The evolution of the demographic age structure reduces the ALFPR from 76.73 per cent in 2010 to approximately 74.39 per cent in 2030 if China's TFR remains at 1.8. The demographic composition effect from 2010 to 2030 is 2.15 percentage points. As a result, the total labour force will contract to 726.74 million (Table 2 and Figure 4) which is 14.4 per cent below its 2010 level.

Table 1: Detailed Demographic composition effect on labour force participation rate in China from 2010 to 2030 (selected years)

Age group	2010			2015	
	PR* *(Per cent)* (1)	Source population weights *(Per cent)* (2)	Contribution to aggregate participation rate *(Per cent)* (2)*(1)/100	Source population weights *(Per cent)* (3)	Contribution to aggregate participation rate *(Per cent)* (3)*(1)/100
Men 15-19	34.8	5.33	1.85	4.61	1.60
Women 15-19	32	4.79	1.53	4.09	1.31
Men 20-24	76.2	6.58	5.01	5.22	3.98
Women 20-24	69.3	6.03	4.18	4.69	3.25
Men 25-29	95.8	5.39	5.16	6.43	6.16
Women 25-29	82.1	5.03	4.13	5.90	4.85
Men 30-34	97	4.87	4.72	5.26	5.10
Women 30-34	83.2	4.67	3.88	4.92	4.09
Men 35-39	97	6.06	5.87	4.75	4.61
Women 35-39	84.4	5.73	4.84	4.57	3.85
Men 40-44	96.5	6.51	6.28	5.89	5.68
Women 40-44	84.8	6.17	5.24	5.60	4.75
Men 45-49	95.1	5.55	5.28	6.31	6.00
Women 45-49	80.1	5.26	4.21	6.02	4.82
Men 50-54	89.8	4.11	3.69	5.34	4.80
Women 50-54	62.4	3.83	2.39	5.10	3.18
Men 55-59	80.4	4.19	3.37	3.91	3.14
Women 55-59	53.8	4.02	2.16	3.68	1.98
Men 60-64	58.3	3.01	1.75	3.89	2.27
Women 60-64	40.6	2.88	1.17	3.81	1.55
Total	**76.73**	**100**	**76.73**	**100**	**76.98**

*PA is participation rate.

Table 1 (continued): Detailed Demographic composition effect on labour force participation rate in China from 2010 to 2050

Age group	2020		2025		2030	
	Source population weights *(Per cent)* **(6)**	**Contribution to aggregate participation rate** *(Per cent)* **(6)*(1)/100**	**Source population weights** *(Per cent)* **(7)**	**Contribution to aggregate participation rate** *(Per cent)* **(7)*(1)/100**	**Source population weights** *(Per cent)* **(8)**	**Contribution to aggregate participation rate** *(Per cent)* **(8)*(1)/100**
Men 15-19	4.19	1.46	4.46	1.55	4.87	1.69
Women 15-19	3.73	1.19	4.08	1.30	4.55	1.46
Men 20-24	4.64	3.54	4.18	3.18	4.52	3.45
Women 20-24	4.13	2.86	3.72	2.58	4.14	2.87
Men 25-29	5.24	5.02	4.62	4.42	4.23	4.05
Women 25-29	4.73	3.88	4.11	3.38	3.78	3.10
Men 30-34	6.46	6.27	5.22	5.06	4.68	4.54
Women 30-34	5.94	4.95	4.71	3.92	4.17	3.47
Men 35-39	5.28	5.12	6.42	6.23	5.28	5.12
Women 35-39	4.95	4.18	5.92	5.00	4.77	4.03
Men 40-44	4.75	4.59	5.23	5.05	6.48	6.25
Women 40-44	4.59	3.89	4.92	4.18	6.00	5.08
Men 45-49	5.87	5.58	4.70	4.47	5.27	5.01
Women 45-49	5.61	4.50	4.55	3.65	4.98	3.99
Men 50-54	6.25	5.61	5.76	5.18	4.70	4.22
Women 50-54	6.00	3.74	5.55	3.46	4.58	2.86
Men 55-59	5.23	4.21	6.07	4.88	5.71	4.59
Women 55-59	5.05	2.72	5.89	3.17	5.55	2.99
Men 60-64	3.74	2.18	4.99	2.91	5.92	3.45
Women 60-64	3.59	1.46	4.90	1.99	5.83	2.37
Total	**100**	**76.95**	**100**	**75.54**	**100**	**74.58**

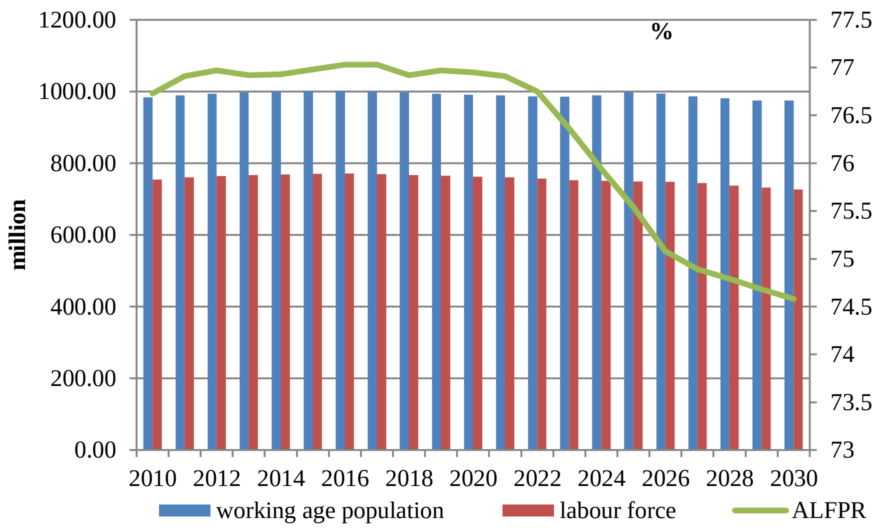
Source: Data in column one is calculated by the authors based on China's fifth population census in 2010 and data in columns two to eight is calculated by the authors based on Mai, Peng and Chen (2013) population projection (medium fertility and medium mortality improvement pace) (2013).

Table 2: Population aged 15 to 64, (selected years)

Year	Working age population (million)	Aggregate labour force participation rate (%)	Labour force (million)
2010	983.43	76.73	754.63
2015	1000.67	76.98	770.34
2020	990.66	76.95	762.32
2025	991.26	75.54	748.85
2030	974.39	74.58	726.74

Source: Mai, Peng and Chen (2013).

Figure 4: Evolution of China's labour force

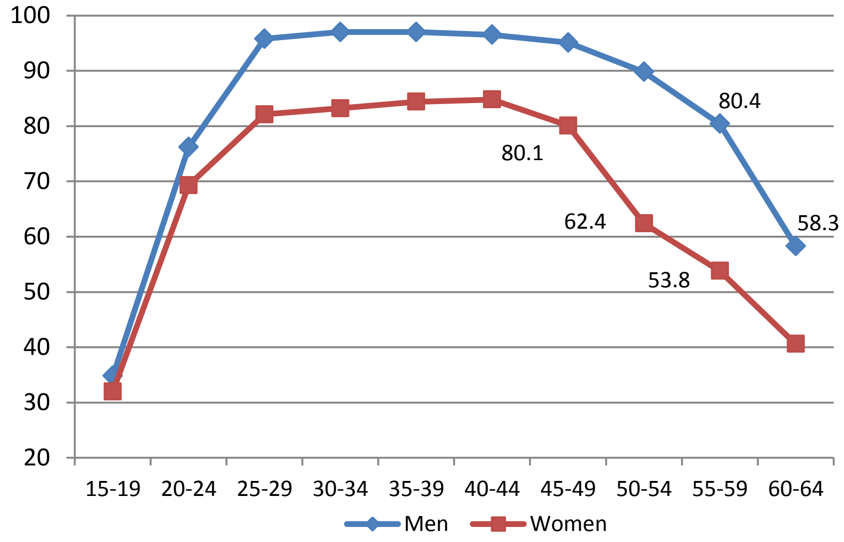


Source: data for working age population from Mai, Peng and Chen (2013). ALFPR and labour force are calculated by the authors based on China's fifth population census in 2010 and Mai, Peng and Chen (2013).

3. Retirement age and labour force participation rate

The labour force participation rate (LFPR) for the population aged 50 and over has a very close relationship with the official retirement age and pension policy. We notice that the LFPR for the female age group 45-49 is 80.1 per cent in 2010 (Figure 5). However it decreases sharply to 62.4 per cent for the female age group 50-54 (nearly 18 percentage points lower). It further declines to 53.8 per cent for the female group 55-59. One main reason is China's retirement policy. In China the retirement age for female workers is 50, for female officers 55 and 60 for male employees. For males, we notice that it decrease sharply for the age group 60-64 which is 58.3 per cent in 2010 while it is 80.4 per cent for the age group 55-59.

Figure 5: Labour force participation rate in 2010



Source: National Bureau of Statistics of China, 2012. *China 2010 National Population Census Tabulations.*

Compared with other countries China's retirement age is very low. For most of developed countries the retirement age is 65 for both men and women. With the expected decline of the working age population in China, an increase in the retirement age will be an effective way to increase the labour force participation rate. Furthermore, China's current retirement policy was introduced in the 1970s when the average life expectancy for both men and women was 65. But during the past 40 years, the life span of Chinese citizens has increased to 75 years (NBS, 2012). A gradual increase in the retirement age will not only help to slow down the reduction of the effective workforce but also lower the expected increase in labour costs. It will also help to reduce the pressure on the pension fund which has been reported in deficit in many provinces (CRIENGLISH, 2012).

In this paper we estimate the economic implications of retirement age extension in China. We assume that the Chinese government will gradually increase workers' retirement age from 2015 onwards. The retirement age for female workers will be gradually increased from the current 50 to 55, and for female officials from the current 55 to 60. For male employees it will be gradually increased to 65 from the current 60. The increase of retirement age will result in an increase in the LFPR. To our knowledge, there is no research on the extent to which a one year increase in the retirement age will increase the LFPR of the corresponding age group. Based on the corresponding age groups' LFPRs of Japan, Korea, G7 countries and OECD countries in 2011, we assume that the LFPR for the female group aged 50-54 will increase linearly from 62.4% in 2010 to 70% in 2019 which is the level of the OECD countries in 2011 (Table 3). The LFPR for the female group aged 55-59 will increase linearly from 53.8% in 2010 to 59.0 in 2019 which is slightly below the average level of the OECD countries in 2011. For the male group aged 60-64, the LFPR will increase linearly from 58.3% in 2010 to 70.0% in 2019 which is lower than Korea and Japan's level in 2011 and higher than both the G7 and the OECD countries' level in 2011. The main reason for the low LFPR in the G7 and the OECD countries for the male group 60-64 is their well-developed pension system. With the increase in the Age Pension age in the G7 countries in recent years and near future, we expect the LFPR for this age group in these countries will increase[2]. From 2020 to 2030, the LFPR for the female age groups 50-54 and 55-59 and male group 60-64 will keep their new levels at 2019.

The increase of the LFPR of these age groups will increase ALFP and therefore the total size of the labour force. Figure 5 shows that ALFPR will increase to 77.18% in 2015 while the old ALFPR is 76.98%. In 2019, the new ALFPR will be 78.11% which is a 1.5% increase when compared with the old ALFPR (76.95%). The new ALFPR will be 75.91% while the old ALFPR is 74.58%. The increase in the ALFPR will result in an increase in the total labour force. Figure 5 shows that there will be 1.95 million more labour supply with the new ALFPR in 2015 when we compare the labour force with the old ALFPR. In 2030 labour supply will increase by 12.95 million with the new ALFPR compared to the old ALFPR. The increase in the ALFPR will delay the decline of the total size of labour force from 2016 to 2021 (Figure 6).

What are the economic implications of the increased labour force participation rates? We will use a dynamic general equilibrium model to simulate the effects.

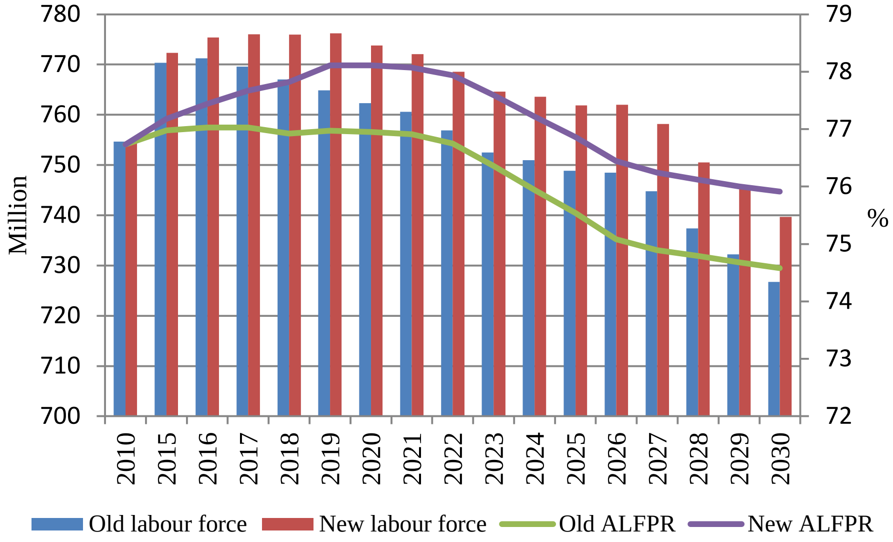
[2] For example, the Australian government announced in 2009 that the Age Pension age will increase from current 65 years to 65.5 years in 2017, and then in six month increments every two years, until it reaches the age of 67 in 2023 (SuperGuide, 2013). The United States, Iceland, Norway and Denmark currently have, or are moving towards, a retirement age of 67. The United Kingdom is increasing the Age Pension age to 68 (SuperGuide, 2013).

Table 3: LFPR, China and other OECD countries

Year	2010	2011	2015	2016	2017	2018	2019
50-54 women							
China	**62.4**		63.85	65.34	66.8	68.41	70.0
Japan		72.58					
Korea		62.03					
G7 countries		75.01					
OECD countries		**69.78**					
55-59 women							
China	**53.8**		54.8	55.82	56.86	57.92	59.0
Japan		63.82					
Korea		54.04					
G7 countries		65.68					
OECD countries		**59.61**					
60-64 men							
China	**58.3**		60.47	62.72	65.06	67.49	70.0
Japan		**75.61**					
Korea		**72.22**					
G7 countries		56.72					
OECD countries		55.32					

Source: data for Japan, Korea, G7 and OECD countries from OECD online database (2013). Data for China from National Bureau of Statistics of China, 2012. *China 2010 national population census tabulations*.

Figure 6: Total labour force and ALFPR with and without the increase in LFPR



4. Modelling framework and labour market module

4.1 CHINAGEM

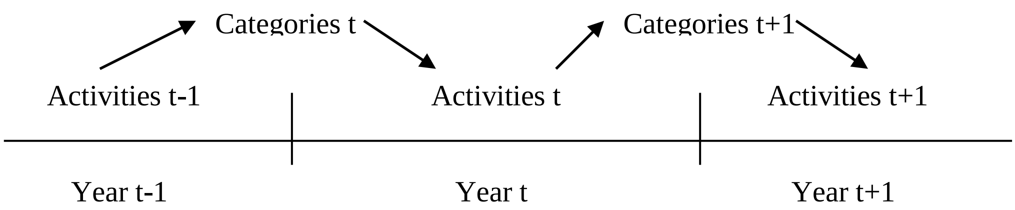
The model we use in this paper is CHINAGEM – a dynamic model of the Chinese economy. It includes 137 sectors and its base data reflect the 2002 input-output structure of the Chinese economy. The core CGE structure is based on ORANI, a static CGE model of the Australian economy (Dixon et al 1982). The dynamic mechanism of CHINAGEM is based on the MONASH model of the Australian economy (Dixon and Rimmer, 2002). The CHINAGEM model captures three types of dynamic links: physical capital accumulation; financial asset/liability accumulation; and lagged adjustment processes in the labour market.

In CHINAGEM, 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 with foreign import prices determined in world markets. Exports are demanded according to constant-elasticity demand curves for most commodities. In the model, capital stock is accumulated through investment activities (net of depreciation). Investors respond to changes in the expected rate of return.

4.2 Labour market module

Since the effects of a retirement age extension on urban labour markets may differ from those on rural labour markets, we introduce a labour market module into CHINAGEM which captures the specific features of China's labour market. Two crucial concepts in the CHINAGEM labour market module are categories and activities of labour supply. At the start of year t, the person-years of labour that will be available during the year are allocated to categories of labour supply. The categories are determined mainly on the basis of employment during the preceding year (t-1). Activities in year t are what people do in that year. The relationship between activities and categories is illustrated in Figure 7.

Figure 7: Labour market dynamics



The labour market module contains ten labour supply categories: five employment categories, three unemployment categories, and two new entrant categories (Table 4). The first eight of these categories are associated with corresponding activities. For example, the category AG for year t refers to the number of person-years of employment in rural agriculture in year t-1 that is still available for employment in year t. The activity AG for year t refers to the number of person-years actually absorbed in rural agricultural employment in year t. Most of the AG-category labour in year t is employed in activity AG in year t. However, some AG category labour may flow to other activities, and some labour from other categories may flow to the AG activity.

Different categories have different labour supply behaviour and there are different degrees of mobility between categories. We treat the entire rural labour force as unskilled workers and we assume that all rural employment and unemployment categories can only make offers to work in rural activities (AG, RNAG, and RUE) because of China's residential registration (hukou) system. But rural new entrants (NRUR) can make offers to rural as well as urban activities. This is based on the assumption that some urban enterprises 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 urban occupation and obtain urban residential status. For the urban labour force we disaggregate into two employment categories, urban skilled employment (USE) and urban unskilled employment (UUSE); one unemployment category (UU); and one new entrant category (NURB). We assume that urban categories make offers only to urban activities (UUSE and USE). We assume no voluntary unemployment in China. Consequently, no category makes offers to unemployment. We summarize the labour supply categories and activities in Table 4.

The number of persons employed in an activity in the current year is determined by the demand for and supply of that activity. Those who make an offer to an employment activity but do not get a job in that activity will be forced back to their previous employment activity or to the relevant unemployment activity.

The labour market module of the CHINAGEM model has the following equation blocks:

- demand for and employment of labour by activity;
- supply of labour by category;
- wage adjustment reflecting the gap between demand and supply;
- the determination of everyone’s activity in year t; and
- linking the number of people in activity o in year t to the number of people in category c in year t+1.

Please refer to the appendix for a formal presentation of the labour market module.

Table 4: Categories and Activities

	Employment categories and activities
AG	**AG**riculture **-** Person-years of employment in rural agriculture sectors with rural residential status
RNAG	**R**ural **N**on-**AG**riculture – Person-years of employment of rural people in non-agriculture industries within their township of residence, such as in township and village enterprises and private enterprises in rural areas
RUE	**R**ural-**U**rban **E**mployment – Person-years of employment of rural people in non-agriculture industries outside of their township of residence
UUSE	**U**rban **U**n**S**killed **E**mployment – Person-years of employment of urban people in unskilled occupations
USE	**U**rban **S**killed **E**mployment – Person-years of employment of urban people in skilled occupations
	Unemployment categories and activities
RAGU	**R**ural **AG**ricultural **U**nemployment – Person-years spent by rural workers without a job in their township of residence
RUU	**R**ural-**U**rban **U**nemployment – Person-years spent by rural workers without a job outside their township of residence
UU	**U**rban **U**nemployment – Person-years of urban labour force that are not employed
	New entrants categories (no corresponding activities for these categories)
NRUR	**N**ew entrants **RUR**al – Person-years of new entrants into labour force with rural residential status
NURB	**N**ew entrants **URB**an – Person-years of new entrants into labour force with urban residential status

5. Baseline scenario

To analyse the economic effects of the retirement age extension, we first develop a baseline scenario - a business-as-usual scenario without the implementation of the policy change[3]. Then we conduct a policy simulation, an alternative forecast with the change in the retirement age. The effects of the policy change are measured by deviations of variables in the alternative forecast from their baseline levels.

Table 5: Summary of baseline calibration*

	2012	2015	2020	2025	2030
Exogenously specified variables					
Annual growth rate (%)					
Investment	10.08	10.45	9.47	8.05	6.71
Consumption	6.42	6.65	6.03	5.13	4.27
Labour force	0.35	0.21	-0.34	-0.28	-0.75
Output of					
Agricultural sectors	3.74	3.9	3.57	3.04	2.55
Industrial sectors	8.72	9.10	8.33	6.42	5.4
Service sectors	7.9	8.24	7.54	7.08	5.95
Calibrated results					
Annual growth rate (%)					
Real GDP	7.7	8.08	7.46	6.44	5.43
Capital stock	10.7	10.62	10.13	9.12	7.83
Real wage rate	10.42	10.20	9.29	7.77	6.93

Source: Baseline simulation results. ***** Only selected years results are displayed in this table.

To develop the baseline scenario, we first update the model's database to 2011. Then for the forecast period 2012 to 2030 we assume that the growth pattern of the Chinese economy will follow its historical trend but at progressively lower rates. For example, while the average annual growth rate of real GDP between 2002 and 2007 is 10.3 per cent we assume that the average growth rate of real GDP from 2012 to 2015 is 8 per cent, 7.5 per cent from 2016 to 2020, 6.5 per cent from 2021 to 2025 and 5.5 per cent from 2026 to 2030.We further assume that the service sector will increase faster than the industrial sector from 2021 and that imports will increase faster than exports from 2016 onwards. The growth rates of rural migrant workers and other labour categories in the baseline scenario are endogenized and determined by the exogenous macro variables such as investment, export and import, the growth rates of agricultural, industrial and service sectors, and the growth rate of total labour force

[3] For more detail about how the business-as-usual scenario is developed for the SICGE model, see Mai 2006.

(refer to Table 5 for the baseline results).

The growth rate of the exogenous variable, total labour force, is calculated based on the growth rate of working age population and the aggregate labour force participation rate (please refer to Table 2) we calculated in section 3 where we assume that the cohort labour force participation rates will remain at their 2010 levels until 2030.

6. The effects of retirement age extension

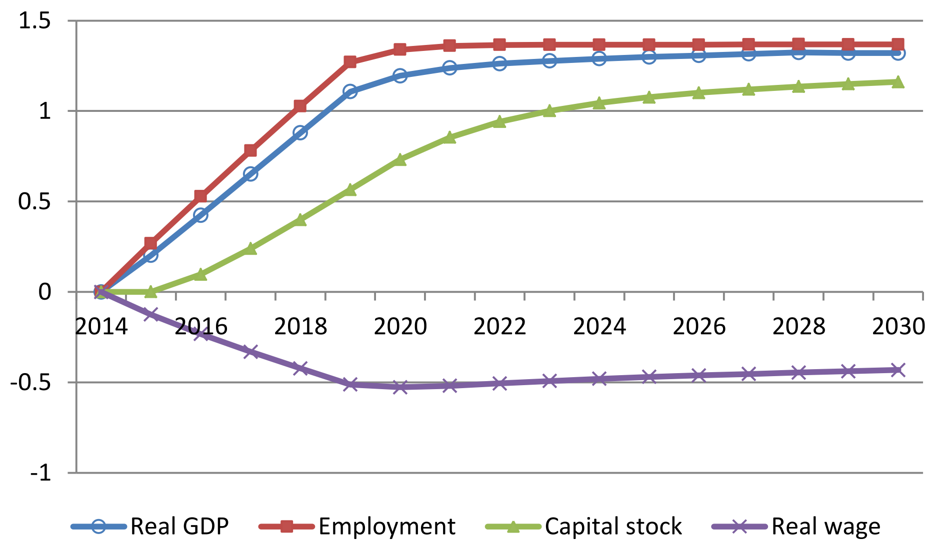
This section contains an analysis of the economic effects of raising the retirement age. In section 4 we assume that the Chinese government will gradually increase both male and female workers' retirement age from 2015 onwards. As a result, the labour force participation rates of the female age groups 50-54 and 55-59 will gradually increase from 62.4% in 2010 to 70% in 2019, and from 53.8% in 2010 to 59.0 in 2019, respectively. For the male group 60-64, their LFPR will increase gradually from 58.3% in 2010 to 70.0% in 2019. From 2020 to 2030, the LFPRs for these three age groups will keep the levels of 2019. The corresponding increase in the size of labour force from 2015 to 2030 has been calculated and displayed in Figure 5. In the policy simulation we assume that the retirement age extension policy is implemented in five years from 2015 to 2019 and we assume that this policy is only applicable to urban unskilled and urban skilled workers. The extension in the retirement age is simulated by increasing the labour supply of both urban unskilled employment (UUSE) and urban skilled employment (USE) categories from 2015 to 2019 with an average growth of 0.35% annually.

6.1 Real GDP and other macroeconomic indicators

The increase in the labour supply will boost China's economic growth. Figure 7 shows that in the long run real GDP will be 1.32 per cent higher than in the baseline scenario. There are two reasons for the higher real GDP. First, the increase in the labour supply as a result of the extension of the retirement age contributes to the growth of real GDP. The increase in the labour supply will exert downward pressure on the real wage of the economy. The declining growth rate of the real wage will stimulate employment. Figure 8 shows that by the end of 2030, the effective labour input will be 1.37 per cent higher than in the baseline scenario. Secondly, a growing capital stock contributes to higher GDP growth. In the long run the total capital stock will be 1.16 per cent higher than in the baseline scenario (Figure 8). The long-run increase in the capital stock relative to baseline is due to the increase in employment. We notice that the deviation of the capital stock from baseline scenario is lower than that of labour input. The reason is that the increase in labour supply will reduce the growth rate of real wages. By the end of the simulation period, the real wage will be 0.43 per cent lower than in the baseline scenario. The declining growth rate of real wages compared with the baseline scenario implies that labour is becoming cheaper and employers will have intention to substitute labour for capital, which will reduce the capital –labour ratio of the economy in the long run. The substitution between capital and labour will slow down the growth rate of the capital stock.

Figure 8: Simulation results: real GDP, factor inputs and real wage

(Percentage deviation from baseline)



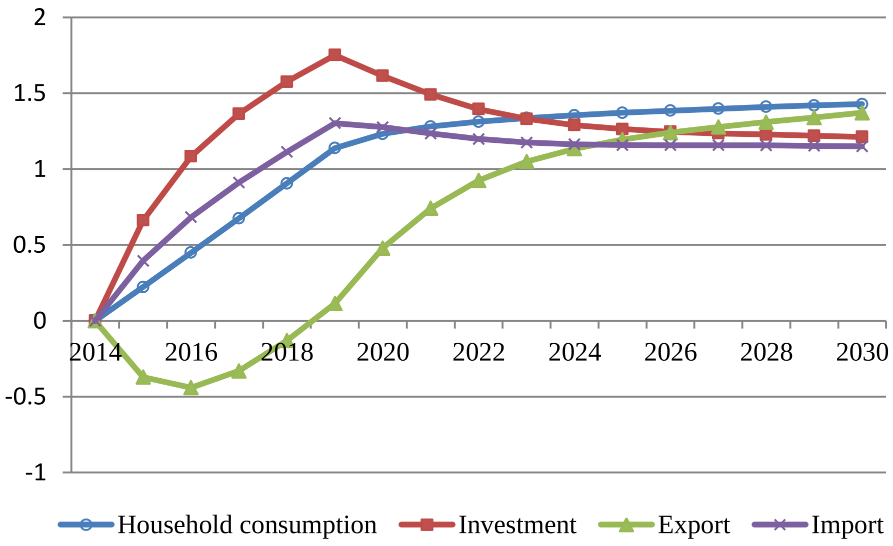
6.2 GDP Expenditures and household income

Due to the strong increase in the capital stock, aggregate investment increases strongly relative to its baseline path (Figure 9).

In the long run the increase in labour supply stimulates the growth of China’s exports. As Figure 8 shows, exports will be 1.37 per cent higher than in the baseline scenario. The reason is that with the slower growth of the wage rates of workers, labour cost in export sectors, especially in manufacturing, is reduced. This further increases the competitiveness of Chinese exports in the world market. As a result Chinese exports expand. The expansion of exports implies more employment opportunities which may further stimulate the development of export-oriented sectors in China. However, in the short- to medium-run when capital is being accumulated, export performance is damped by appreciation of the real exchange rate associated with an increased level of investment activity (Figure 10). In the long run, further expansion in exports will result in a real devaluation of RMB relative to the exchange rate path of the baseline scenario. Figure 10 shows that the value of RMB is 0.53 per cent lower than in the baseline case.

Figure 9: Simulation results: Expenditure-side of GDP

(Percentage deviation from baseline)



The increased labour supply also improves households' living standards measured by real consumption. As Figure 8 shows, real household consumption is 1.43 per cent higher than in the baseline scenario. We also notice that consumption increases more than real GDP. One reason is the decline of the price of consumer goods. Figure 10 shows that the consumer price index will be 0.24 per cent lower than in the baseline scenario. Why is the consumer price index lower in the policy scenario? The reason is that the increase in urban unskilled and skilled employment boosts the growth of outputs of not only industrial and services products but also the output of agricultural products. Figure 11 shows that agricultural production is 0.74 per cent higher than in the baseline scenario. The growth of agricultural output will reduce food prices and, therefore, the consumer price index in the policy scenario compared to the baseline scenario.

Figure 10: Simulation results: price indices, terms of trade and real devaluation

(Percentage deviation from baseline)

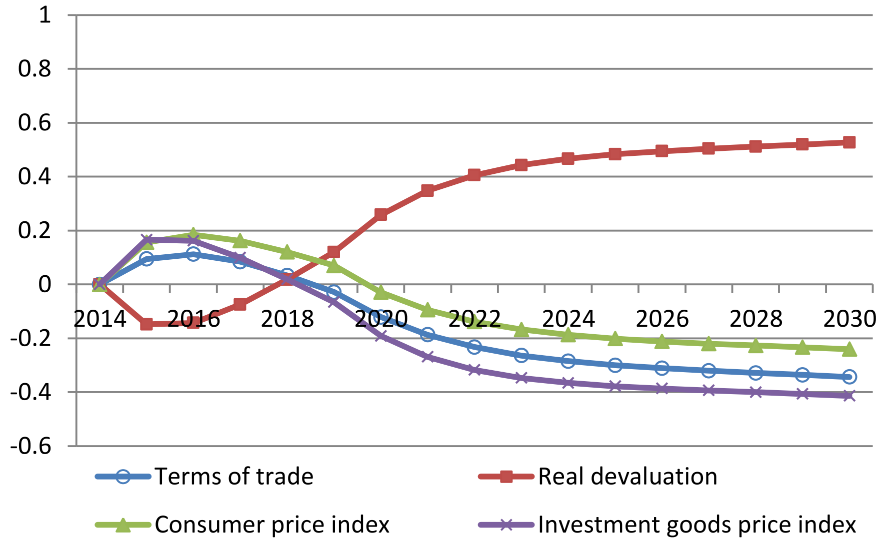
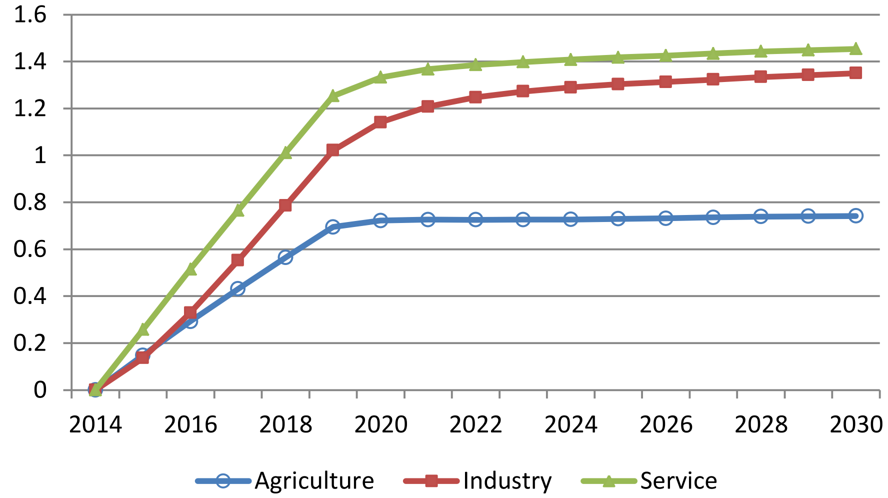


Figure 11: Simulation results: outputs of three aggregate sectors

(Percentage deviation from baseline)



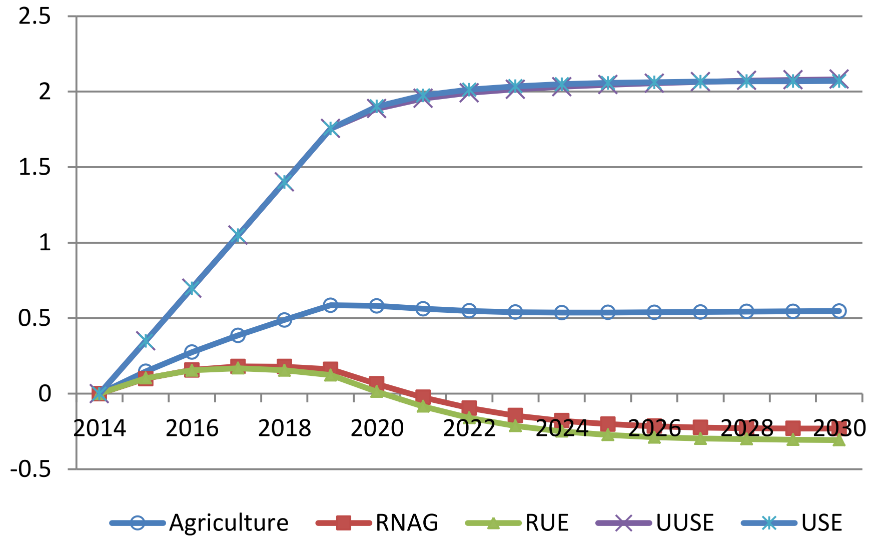
6.3 the effects on the labour market

With the extension of the retirement age, the labour supply of urban unskilled and urban skilled workers will increase. As a result, their real wage rates will decline (Figure 13). The real wage rates of urban unskilled and urban skilled labour will be 1.5% and 1.7% lower than in the baseline scenario, respectively, and employment of UUSE and USE will increase (Figure 12). The UUSE and USE will be 2.1 per cent higher than in the baseline scenario.

What are the effects of the increase in urban employment on the rural labour market? Figure 12 shows that employment of agricultural workers will also increase (AG) (by 0.5% in the policy scenario); while the employment of rural non-agricultural (RNAG) and rural-urban migrant (RUE) workers will increase in the short to medium run but decline in the long run.

Figure 12: Simulation results: employment of five labour categories

(Percentage deviation from baseline)



The reasons for the increase in agricultural employment are:

First, the employment increase in the urban sectors as a result of increased labour supply in the urban unskilled and skilled labour categories boosts economic growth which will result in an expansion of all the sectors including agricultural sector.

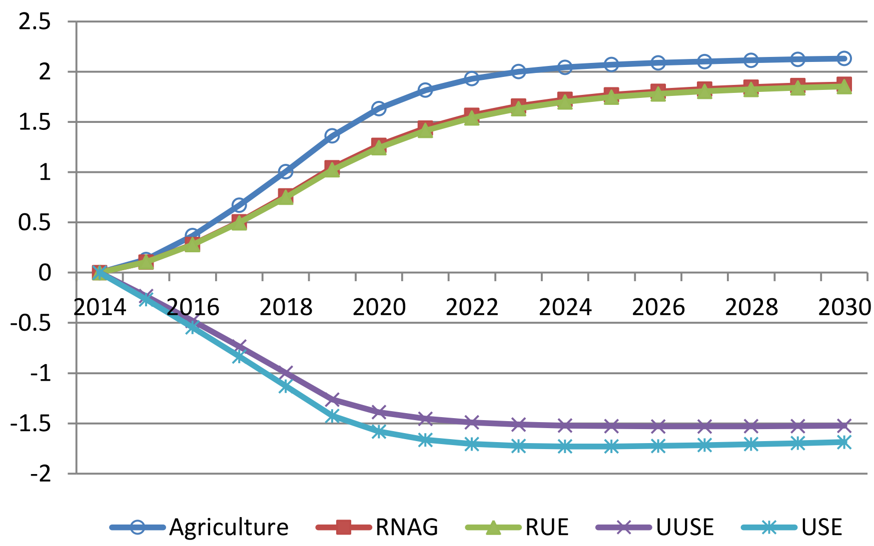
Secondly, labour becomes cheaper relative to capital because of the real wage decline caused by the increased labour supply in the urban market. As a result, all economic sectors have an intention to increase their labour demand. The whole economy will become more labour intensive in the long run compared with the baseline scenario.

As a result of the increased demand for agricultural employment, the real wage of agricultural workers increases. Figure 13 shows that by the end of 2030, real wages of agricultural workers will be 2.1 per cent higher than in the baseline scenario.

The reasons for the increases in demand for rural non-agricultural and rural-urban workers in the short to long run are the same as for agricultural labour. However, there is one additional factor. The RNAG and RUE workers are mainly working in the more labour intensive sectors, such as manufacturing and construction. The rapid increase in investment in the short to long run as a result of growth of employment and capital stock stimulates the growth of the construction, manufacturing and other investment–related sectors which will increase the labour demand in these sectors and push the real wage rates of RANG and RUE workers up. However, in the long run, the substitution between urban unskilled labour (declining wage rate) and RANG and RUE workers (increasing wage rate) will reduce the demand for the RANG and RUE workers and therefore stop the further increase of their real wage rates. Figure 12 shows that RNAG and RUE employment will be 0.23% and 0.31% lower than in the baseline scenario in 2030.

Figure 13: Simulation results: real wage rates of five labour categories

(Percentage deviation from baseline)



7. Conclusion and further study

China will expect a rapid population ageing in the next decade. The fast increase of the old population combined with an expected decline of the working age population is causing increasing concern about the sustainability of China's economic growth. The current low retirement age will further reduce the size of the labour force and put high pressure on the pension fund. Raising the official retirement age is one of the strategies to encourage labour force participation and increase labour supply. This paper estimates the effect of retirement age extension on the supply of labour and, therefore, on China's economic growth over the period of 2010 to 2030.

Using a dynamic CGE modelling approach, we found that by 2030, an extension of the retirement age will:

- Increase effective labour input by 1.37 per cent;
- increase China's real GDP by 1.32 per cent;
- increase households' real consumption by 1.43 per cent;
- increase China's capital stock by 1.16 per cent;
- increase China's export by 1.37 per cent; and
- decrease the real wage of the whole economy by 0.43 per cent.

The increase of the labour supply of urban skilled and unskilled workers resulting from the retirement age extension will decrease the real wage of urban workers. However, the expansion of the whole economy including agricultural, industrial and service sectors as a result of increased employment in the urban sectors will increase the demand for rural workers which will push their wages up. To summarize, the retirement age extension will boost the growth of China's economy with urban sectors benefiting more than the rural sectors.

The next step of the research will be calculating the effects of the retirement age extension on the pension fund. A pension module has been developed to calculate how much the contribution will be increased and how much the payment will be reduced after the retirement age .extension. Currently we are verifying the key data used in the module. A research report about the effects of retirement age extension on China's pension fund will be available soon.

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Appendix A: The equation system of the labour market module

A.1 Demand and employment of labour by employment activities

In the CHINAGEM model, to produce a certain level of output, a representative producer in an industry mixes intermediate inputs and a composite primary factor with Leontief technology. Once the level of the primary-factor composite is determined, the representative producer chooses the levels of capital, land and composite labour to minimise costs subject to a CES constraint.

The derived demand for composite labour in year t for each industry, $D_t^1(j)$, is a function[4] of: capital, $K_t(j)$; productivity (or technology), $A_t(j)$; and the real before-tax wage rate to the industry, $BTW_t^1(j)$:

$$D_t^1(j) = f_j^1\left(BTW_t^1(j);K_t(j);A_t(j)\right), \quad j = \text{industry} \quad . \qquad \text{(A1)}$$

The real before-tax wage rate to industry j in year t is a function of the real before-tax wage rates of labour by employment activities or equivalently occupations, $BTW_t(o)$:

$$BTW_t^1(j) = g_j^1\left(BTW_t(o), \forall \text{ employment activities o}\right), \quad j = \text{industry}. \qquad \text{(A2)}$$

The representative producer in industry j chooses labour in different occupations via a CES function given the required level of labour composite. The derived demand for labour by occupation and industry, $D_t(o,j)$, is represented by:

$$D_t(o,j) = D_t^1(j) * h_{o,j}\left(BTW_t(oo) \ \forall \text{ employment activities oo}\right),$$

$$\text{o = employment activity, j = industry} \qquad \text{(A3)}$$

where $BTW_t(o)$ is real before-tax wage rate of labour in employment activity o.

[4] For simplicity, we ignore land in this stylized representation of the labour module but not in our SICGE computations.

The total demand for labour in an employment activity o, $D_t(o)$, is the sum of demands over all industries:

$$D_t(o) = \sum_j D_t(o, j) \quad , \quad o = \text{employment activity} \quad . \tag{A4}$$

The employment of labour in an employment activity, $E_t(o)$, is determined by demand:

$$E_t(o) = D_t(o) \quad , \quad o = \text{employment activity}; \tag{A5}$$

A.2 Planned labour supply from categories to activities

The offer from each labour category c to each employment activity o, $L_t(c;o)$, is determined by an optimisation procedure where people in category c choose $L_t(c;o)$, for all activities o

$$\text{to maximise } U_c\left[ATW_t(o) * L_t(c;o) \ \ \forall \text{ activities o}\right]$$

$$\text{subject to } \sum_o L_t(c;o) = CAT_t(c),$$

where $CAT_t(c)$ is the number of people in category c; $ATW_t(o)$ is the real after-tax wage rate of labour in employment activity o; and U_c is a homothetic function with the usual properties of utility functions (positive first derivatives and quasi-concavity). In CHINAGEM, U_c has the CES form. Giving labour-supply functions of the form:

$$L_t(c\,;o) = CAT_t(c) * \left[\frac{\left(B_t(c;o) * ATW_t(o)\right)^{\eta}}{\sum_q \left(B_t(c;q) * ATW_t(q)\right)^{\eta}} \right],$$

$$c = \text{category}; \ o = \text{employment activity}; \tag{A6}$$

where

$B_t(c;o)$ is a variable reflecting the preference of people in category c for earning money in activity o in year t; and

$\eta>0$ is a parameter (discussed in the Appendix) reflecting the ease with which people feel that they can shift between activities.

The variable $B_t(c;o)$ captures non-wage factors that might motivate people from category c to offer their labour to employment activity o. An example of such factors is a reduction in institutional barriers that might motivate people in rural categories to offer to urban employment activities. A 30% increase in $B_t(c;o)$ has the same effect on category c's labour supply as a 30% increase in the real after-tax wage rate $ATW_t(o)$.

$B_t(c;o)$ also allows the calibration of (A6) to reflect the properties of different labour supply category. For example, by setting $B_t(c;o)= 0$ for all categories c and for all unemployment activities o, we ensure that there are no offers to unemployment activities:

$$L_t(c\,;u) = 0; \text{ c= category; u = unemployment activity;} \qquad \text{(A7)}$$

The planned labour supply to each employment activity a, $L_t(a)$, is determined as the sum of offers to the activity by people from all categories:

$$L_t(a) = \sum_c L_t(c;a) \quad \text{a = employment activity.} \qquad \text{(A8)}$$

The real after-tax wage rate $ATW_t(o)$ for each employment activity o is linked to the real before-tax wage rate $BTW_t(o)$ via:

$$ATW_t(o) = BTW_t(o) * (1 - T_t), \text{ o = employment activity,} \qquad \text{(A9)}$$

where T_t is the payroll and income tax rate.

This equation can be thought of as determining the real before-tax wage rate $BTW_t(o)$. The real after-tax wage rate $ATW_t(o)$ is determined by wage adjustment equations to be discussed in the next subsection.

A.3 Wage Adjustment Equations Reflecting Demand and Supply

In policy simulations, we assume that wage rates adjust according to:

$$\frac{ATW_t(o)}{ATW_t^{base}(o)} - \frac{ATW_{t-1}(o)}{ATW_{t-1}^{base}(o)} = \alpha \left(\frac{D_t(o)}{D_t^{base}(o)} - \frac{L_t(o)}{L_t^{base}(o)} \right),$$

$$o = \text{employment activity}, \qquad \text{(A10)}$$

where the superscript "base" refers to values in the base case forecast and α is a positive parameter.

This equation implies that if a policy causes the market for employment in activity o in year t to be tighter than it was in the base case forecast (i.e., if the policy causes a larger percentage deviation in demand than supply), then there will be an increase between years t-1 and t in the deviation in activity o's real after-tax wage rate. In other words, in periods in which a policy has elevated demand relative to supply, real wages will grow relative to their base case values (for a more detailed discussion of the wage adjustment equation, see Dixon and Rimmer 2003).

A.4 The Determination of Everyone's Activity

The wage adjustment equations imply that gaps between supply and demand in employment activity o are allowed in the model. We therefore need to specify which offers to employment activity o are accepted and what activities are undertaken by those whose offers to employment activities are not accepted. For this purpose, we specify the flow from each category to each activity $H_t[c;a]$ in year t. Notice that $H_t[c;a]$ includes flows from all categories (employed, unemployed and new entrants) to all activities (employed and unemployed).

The starting point for determining $H_t[c;a]$ is the specification of vacancies, $V_t(o)$, in employment activity o:

$$V_t(o) = E_t(o) - H_t[o;o], \quad o = \text{employment activity}. \qquad \text{(A11)}$$

where vacancies equals employment less jobs filled by incumbents, $H_t[o\,;o]$.

Next, “off-diagonal” flows are determined according to:

$$H_t(c\,;o) = V_t(o) * \left[\frac{L_t(c;o)}{\sum\limits_{s \neq o} L_t(s;o)} \right],$$

c = category; o = employment activity; and c ≠ o. (A12)

Equation (A12) specifies that jobs in activity o given to non-incumbents are proportional to vacancies in o and to the share of category c in the supply of labour to activity o from people outside category o. Thus, if people in category c account for 10 per cent of the people outside category o who want jobs in employment activity o, then people in category c fill 10 per cent of the vacancies in o.

“Diagonal” flows are determined as a residual:

$$H_t(o;o) = CAT_t(o) - \sum_{a \neq o} H_t(o;a) \;,$$

o = employment category and activity. (A13)

Equation (A13) specifies that the number of incumbents, $H_t[o\,;o]$, who remain in employment-activity o equals the number of people in category o less the number who move out of activity o to other employment activities as well as to unemployment activities.

The flows from each employment category to each unemployment activity are determined by:

$$H_t(c;u) = DUMMY(c;u) * \mu(c) * CAT_t(c)\,,$$

c = employment category; u = unemployment activity. (A14)

where μ(c) is the fraction of category c people who become involuntarily unemployed. A dummy variable is included in (A14) to ensure that involuntarily unemployed people move to the relevant unemployment activity: rural agricultural and rural non-agricultural people to rural agricultural unemployment; rural-urban people to rural-urban unemployment; and urban people to urban unemployment.

Normally, $\mu(c)$ is exogenous. However, it is possible for (A14) in conjunction with (A12) to give values for $H_t(c;c)$ in (A13) that exceed $E_t(c)$. In this case, we see from (A11) that $V_t(c)$ would be negative. We avoid this situation by treating $\mu(c)$ as an endogenous variable. If $V_t(c)$ is greater than zero, then $\mu(c)$ equals an exogenously given minimum value determined by the rate at which individuals are dismissed because of their performance or other factors unrelated to overall demand for people in activity c. Alternatively, $\mu(c)$ moves sufficiently above its minimal value to ensure that $V_t(c)$ equals zero. When $\mu(c)$ is above its minimum value, then there are involuntary flows from employment category c to unemployment caused by overall shortage of jobs. In a fast growing economy such as China's, endogenous determination of $\mu(c)$ will rarely be required.

The flow from an unemployment or new-entrant category c to unemployment is given by the number of people in c less those who find a job:

$$H_t(c;u) = DUMMY1(c,u) * (CAT_t(c) - \sum_{a \in \text{employment activity}} H_t(c;a))$$

c = unemployment or new entrant category;

and u = unemployment activity. (A15)

The dummy coefficient in (A15) is used to ensure that: rural new entrants who don't get a job go to rural agricultural unemployment; urban new entrants who don't get a job go to urban unemployment; and people in unemployment category c who don't get a job stay in unemployment activity c;

The number of people in unemployment activities equal to the sum of the flow from all categories to unemployment activities:

$$E_t(a) = \sum_{c \in \text{categories}} H_t(c;a)), \quad a = \text{unemployment activity}; \qquad \text{(A16)}$$

A similar equation is not required for employment activities. Such an equation is implied by (A11) and (A12).

A.5 Linking the Previous-Year Activities to the Current-Year Categories

From (A1) to (A16), we can determine the number of people in each employment and unemployment activity in year t given the number of people in each category of labour supply at the beginning of the year and demands during the year. To complete the equation system, we need to determine the number of people in each category of labour supply at the beginning of year t. If t is the first year of a simulation, then we determine the number of people in categories mainly on the basis of data on activities for year t-1 (Appendix C). If it is a subsequent year then we determine the number of people in categories mainly on the basis of results for activities in year t-1.

For all except new entrant categories:

$$CAT_t\left(c\right) = ACT_{t-1}\left(c\right) * S(c), \text{ c = category; and } c \neq \text{ new entrant;} \qquad \text{(A17)}$$

where

$ACT_{t-1}\left(c\right)$ is the number of people in activity c in year t-1; and

$S(c)$ is the proportion of people in activity c in year t-1 who are allocated to category c at the start of year t.

In CHINAGEM, we assume $S(c) = 0.99$. This allows one per cent of people in every activity in year t-1 to drop out of the workforce at the beginning of year t either through retirement or death.

For new-entrant categories:

$$CAT_t(c) = \text{exogenous}, \quad \text{c = new entrant.} \qquad \text{(A18)}$$