DEPARTMENT OF ECONOMICS

ISSN 1441-5429

DISCUSSION PAPER 16/06

POPULATION AGEING AND LABOUR SUPPLY PROSPECTS IN CHINA FROM 2005 TO 2050

Xiujian Peng and Dietrich Fausten*

ABSTRACT

Increasing life expectancy and rapid fertility decline in China since the 1970s have accelerated the rate of population ageing, fuelling the prospects of an ageing workforce and a significant slow-down in the growth of the working age population. The present paper examines the trend of labour supply in China over the next 45 years under alternative fertility scenarios by taking account of the demographic composition effect and potential trends of the age-and sex-specific labour force participation rates. The main finding is that the labour supply contraction will accelerate from 2020 onwards in response to population ageing and the probable attrition of the LFPR of the young population. Relaxing the current one-child policy may moderate the adverse labour market consequences by increasing the base of the working age population and decelerate the rate of population ageing.

JEL classification: J11; J14

Key words: population ageing, labour supply and China

* Xiujian Peng (corresponding author): Australian Institute for Social Research, the University of Adelaide. Email: xiujian.peng@adelaide.edu.au. Dietrich Fausten: Department of Economics, Monash University. Email: Dietrich.Fausten@BusEco.monash.edu.au. The authors wish to thank Xiaochun Qiao, Evi Nurvidya Arifin, the participants at the international conference on 'Population and Development in Asia: Critical Issues for a Sustainable Future' at Phuket, Thailand, 20-22 March 2006, and an anonymous referee for helpful comments and suggestions on earlier versions

POPULATION AGEING AND LABOUR SUPPLY PROSPECTS IN CHINA FROM 2005 TO 2050

1 INTRODUCTION

Increased life expectancy and rapid fertility decline since the 1970s have combined to create a very rapid rate of population ageing in China. These demographic developments are expected to result in an ageing workforce and a significant slow-down in the growth of the working age population. According to the UN medium variant of population projection, the size of the working age population will increase only slightly over the next 10 years and begin to shrink soon after 2020. Furthermore, since the participation rate of the elderly population is much lower than that of the prime-age labour force, ageing of the workforce will reduce the aggregate labour force participation rate (ALFPR). Stagnant growth of the working age population combined with the declining aggregate LFPR will put downward pressure on labour supply.

It is improbable that the demand for labour will fall to match prospective contractions of labour supply (McDonald and Kippen 2001). In fact, there are sound reasons for believing that labour demand will rise for years to come (Tsay 2003). Hence, the reduction of available labour has potentially important adverse implications for economic growth (Peng 2005). Government officials and scholars are, consequently, eager to identify suitable strategies to cope with the ageing problem. A common suggestion from scholars is that liberalization of the strict population control policy may help to decelerate the rate of population ageing, slow down the decrease in the labour force and mitigate the adverse prognoses for macroeconomic growth. However, any such liberalization will counteract the original object of China's family planning policy by increasing population growth. The potential conflict between achieving a desirable demographic structure and a desirable population size poses a dilemma for policy makers.

The present paper examines the future trend of labour supply in China over the period 2005 to 2050 under alternative fertility regimes. It investigates the impact of different age structures (demographic composition effects) on future labour supply and the implications of changes in the current level of the labour force participation rate.

Our analytical approach is similar to McDonald and Kippen (2001). However, unlike McDonald and Kippen, we do not consider international migration but we do include the impact on labour supply of changes in the age structure.

The paper is organized as follows: the next section places the present investigation in the context of the ageing – growth nexus by briefly summarising major findings about the adverse implications

of ageing for macroeconomic performance. Section three discusses the evolution of the working age population over the period 2005 to 2050 under alternative fertility scenarios. Section four explores the effects of population ageing on the labour force participation rate and, therefore, on labour supply. Possible changes in the age- and sex-specific labour force participation rates are investigated in section five, and the final section presents conclusions and policy implications.

2 AGEING AND ECONOMIC GROWTH IN CHINA – EVIDENCE FROM CGE MODELLING

The impact of population ageing on economic growth is a matter of deep concern to scholars and policymakers alike. A prominent link in the ageing – growth nexus is the behaviour of labour supply. This link was examined in an earlier study with the help of a computable general equilibrium model (PRCGEM) to simulate the macroeconomic consequences of population ageing in China during the 21st century (Peng 2005). The qualitative result of that investigation highlights the increasingly adverse growth consequences of a labour supply reduction regime.

More specifically, given the baseline scenario with constant fertility (at 1.62) and average labour force participation (at the 2000 level of 82.35 per cent) rates contraction of the labour supply reduces the growth rate of per capita real GDP by 2, 2.6 and 3.0 percentage points annually during the 2020s, 2030s and 2040s, respectively, compared with the growth rate of the first decade of the century. 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. Provided the rate of productivity improvement is maintained, this expansion would help mitigate the adverse effects of population ageing on macroeconomic growth.[1] If, on the other hand, the TFR continues to decline to very low levels (such as 1.35), then economic growth will fall even further. Initially, the reduction in the size of the total population serves to raise the growth of per capita real income slightly above the baseline scenario (during the first twenty years). However, from the 2030s onwards even per capita real income drops below the baseline level because the low TFR accelerates the rate of decrease of labour supply which, in turn, slows down the process of capital formation.

Constancy of the ALFPR (at the 2000 level of 82.35 per cent) during the simulation period is a very restrictive assumption. It is highly implausible that China's ALFPR will remain at such a high level throughout the 21st century. In the first instance, ageing of the workforce will cause the ALFPR to fall because the participation rate of the elderly population is much lower than that of the prime-age labour force. Secondly, expansion of educational opportunities will remove large, and possibly increasingly large, numbers of young people from the labour force and substantially reduce their labour force participation rate. Thirdly, the development of a pension system in China, especially in the rural areas, will weaken work incentives for the older age groups and, hence, may reduce the participation rate of the elderly population. Fourthly, as affluence increases private spending will be

devoted increasingly to luxury goods, including the consumption of leisure. The disposition to enjoy a more casual lifestyle invariably reduces the ALFPR by restricting the total number of hours available for work.[2]

The exceedingly likely reduction in the labour force participation rate, combined with negative growth of the working age population that is driven by low fertility, will put significant downward pressure on labour supply in China. Given the adverse implications for the macro economy of reductions in labour supply, it is important to understand the demographic forces that shape its temporal evolution. These involve prominently the LFPR and its interaction with the ageing profile of the population. This paper will focus on trend changes in China's labour supply over the period 2005 to 2050 under the assumption of alternative fertility regimes. We will explore the effects of demographic shifts on the ALFPR as well as on compositional changes of the labour force that are captured by the age-and sex-labour force participation rates.

3 ALTERNATIVE POPULATION SCENARIOS AND EVOLUTION OF WORKING AGE POPULATION

The rapid population ageing and potential labour supply contraction beyond 2020 are primarily the result of the dramatic decline in fertility rates during the 1970s and 80s and the low level of fertility in the 1990s. Family planning policy has played an important role in the rapid demographic shift (Hernandez, 1984; Kaufman, Zhang and Zhang, 1989, Wang, Keng and Smyth, 2002). [3] Since its introduction at the beginning of the 1970s there have been 300 million fewer births than would have occurred if the pre-existing birth rate had been maintained (Wu, 1997).

The significant success of the family planning policy in reducing population growth suggests that the institutional and cultural environment in China is conducive to the pursuit of active population policies. In particular, the Chinese government may be able to adjust the fertility rate by relaxing the current one-child per couple restriction. The main issue for scholars and policy makers are the question whether to adjust the current population policy, or how to adjust it.

3.1 The choice of population policy

So far there are mainly two views of the future direction of population policy in China:

Formatted: Bullets and Numbering

Negative population growth strategy.

It has been argued that the large size of China's population has hampered her economic growth and development (Zhai, 2000, 2001; Wu, et al. 2004 and Li, X. P. 2002). Therefore, controlling

population growth should remain the main objective of population policy. Secondly, the further increase in the population size that would result from easing the one-child policy will put additional pressure on the labour market and on the ecological environment, and restrain rapid economic growth. These considerations suggest that the fertility rate should be maintained below the replacement level in the long run. Government should implement a negative population growth strategy in the medium to long run.

Advocates of a negative population growth strategy debate how far fertility should be reduced. There are two main views:

- **Retention of the one-child policy.** The notable success in reducing the fertility rate has been accompanied by significant dispersion in fertility rates between rural and urban areas, and East and West China. This imbalance implies that any relaxation of the one-child policy will cause a new baby boom that is driven by the high fertility rates in many poor and backward areas.
- **Partial relaxation of the one-child policy.** The second view maintains that the total fertility rate should be stabilized in the long run at the average level of the late 1990s, around 1.8. In order to achieve this target, the government should partially adjust the restrictive one child policy regime at the beginning of the 21st century.

Formatted: Bullets and Numbering

Zero population growth strategy.

Other scholars are concerned about the consequences of low fertility and its potentially serious adverse effects on the economy. They vigorously advocate that China should maintain a stable population size in the long run. That is, policy should aim to raise the TFR to the replacement level of 2.1 or 2.0 and to maintain it there. This would require adopting a universal two child per couple policy at the beginning of the 21st century (Li, J.X. 2002)

3.2 Fertility scenarios and the proportion of the elderly population

Given the population policy choices that are under prominent discussion in China, we choose four fertility scenarios to capture roughly the major demographic effects of alternative population policy strategies - on the fertility rate, working age population and age structure. Our projection horizon extends to the middle of the 21st century.

- **Baseline scenario – constant fertility:** We choose the constant fertility variant prepared by the UN Population Division to be the baseline scenario. In this scenario, TFR remains at 1.7 until 2050.

- **Scenario 2 – low fertility variant**: In this scenario, TFR decreases from 1.7 (2000 to 2005) to 1.49 (2005 to 2010), 1.41 (2010 to 2015) and further to 1.35 (2015 to 2020) where it remains until 2050. This fertility scenario is approximately consistent with the one-child policy regime.
- **Scenario 3 – medium fertility variant**: In this scenario, TFR increases from 1.7 (2000 to 2005) to 1.74 (2005 to 2010), 1.81 (2010 to 2015), and further to 1.84 (2015 to 2020) where it remains until 2050. This scenario may capture the compromise solution of a partial adjustment to the current one-child policy mentioned above.
- **Scenario 4 – High fertility variant:** TFR in this scenario increases from 1.7 (2000-2005) to 1.9 (2005-2010), 1.95 (2010-2015), 2.0 (2015-2020), 2.05 (2020-2025), and further to 2.08 (2025 to 2030) where it remains until 2050. This high fertility scenario captures salient elements of the two-child policy option.

The population projections corresponding to the first three fertility scenarios were prepared by the UN Population Division in 2004. The last population projection is prepared by Qiao and Chen (2003). Tables 1, 2 and 3 report the profiles for the first half of the 21st century of total population sizes, proportions of the elderly population and working age population under the four fertility scenarios.

Formatted: Bullets and Numbering

Total population size

The total population size differs significantly between the four scenarios, especially from 2020 onward. Under constant fertility (TFR = 1.7), total population peaks at around 1,420 million in 2025, declining subsequently to reach 1,326 million in 2050. In the low fertility scenario where the TFR continues to decline to 1.35 after 2015, total population peaks earlier (in 2020) at around 1368 million and declines rapidly to 1,171 million in 2050. In contrast, in the high fertility variant (TFR increasing to 2.08), population reaches a peak of 1,502 million only in 2045. The total population falls to 1,498 million in 2050. The difference in population size between the low variant and high variant projections amounts to 327 million in the middle of the century. In scenario 3 (medium variant), population peaks at 1446 million in 2030. By 2050, the total population will be 1392 million. The gap of total population at the middle of this century between scenario 3 and scenario 2 is 221 million.

Table 1: China's population projection: total population size (million)

Year	Baseline (Constant fertility)	Scenario 2 (Low fertility)	Scenario 3 (Medium fertility)	Scenario 4 (High fertility)
2000	1,274	1,274	1,274	1,274
2010	1,353	1,342	1,355	1,358
2020	1,409	1,368	1,424	1,436
2025	1,420	1,364	1,441	1,467
2030	1,419	1,347	1,446	1,488
2040	1,389	1,278	1,432	1,501
2045	1,362	1,228	1,417	1,502
2050	1,326	1,171	1,392	1,498

Source: UN (2004) and Qiao and Chen (2003)

Formatted: Bullets and Numbering

The proportion of the elderly population and population ageing

The extent and speed of ageing depend *inter alia* on the fertility level (Table 2). None of the four population scenarios allows for changes in the absolute size of the elderly population. The reason is that the time horizon for our projections is limited to 50 years but the elderly population is defined as the group aged 65 and above. Hence, none of the alternative fertility assumptions can feed into the determination of the size of the elderly population within the time frame of our projections. From the perspective of economic growth, however, important considerations relate also to the proportionate size of the elderly population, not only to its absolute size.

Table 2: Trends of the proportion of elderly in China (per cent)

(Population aged 65 and over)

Year	Baseline (Constant fertility)	Scenario 2 (Low fertility)	Scenario 3 (Medium fertility)	Scenario 4 (High fertility)
2000	6.8	6.8	6.8	6.8
2010	8.3	8.4	8.3	8.2
2020	12.0	12.4	11.9	10.7
2030	16.6	17.5	16.3	14.1
2040	23.0	25.0	22.3	18.2
2050	24.8	28.1	23.6	18.4

Source: UN (2004) and Qiao and Chen (2003)

The proportion of the elderly in the total population increases most rapidly in the low fertility scenario (scenario 2). It reaches 12.4, 17.5 and 28.1 per cent, respectively, in years 2020, 2030 and 2050. In the baseline scenario (constant fertility) and in scenario 3 (medium variant), the proportions of the elderly rise to 24.8 and 23.6 per cent by 2050, while in the high fertility regime

the proportion of the elderly reaches only 18.4 per cent. By 2050 the difference between the low and high fertility scenarios (2 and 4) of the share of the elderly in the total population amounts to a remarkable 35 per cent. The differences in the proportion of the elderly population under the four fertility regimes illustrate the significant impact that fertility choice can exert on future population structure.

3.3 Working age population

The four scenarios show the same growth rate of the working age population during the first two decades because the change in the fertility level can affect the size of the working age population only after some 15 to 20 years (Table 3) and the working age population increases to reach a peak of 1,001 million around 2015. In the low fertility scenario, the working age population decreases at the fastest rate, falling to 720 million by 2050. Accordingly, continued decline in China's fertility rate to very low levels will lead to a rapidly shrinking labour force, reducing the working age population by some 17 percent over thirty years (2020-2050). However, if the Chinese government can manage to increase the TFR to the replacement level, for example by implementing a universal two-child policy (scenario 4), then the working population will declines slightly to 940 million in 2050. This represents a working age population that is 69 million larger than in 2000. It implies that by maintaining the replacement level fertility, China can prevent its working age population from declining during the first half of this century.

Table 3: Trends of working age population in China

(Population aged 15 to 64 in million)

Year	Baseline (Constant fertility)	Scenario two (Low fertility)	Scenario three (Medium fertility)	Scenario four (High fertility)
2000	871	871	871	871
2010	978	978	978	978
2015	1,001	1,001	1,001	1,001
2020	992	992	992	992
2030	959	934	966	987
2040	870	814	891	947
2050	810	720	845	940

Source: UN (2004) and Qiao and Chen (2003).

The difference in the total size of the working age population between the four fertility scenarios becomes significant by the middle of the century. For example, in scenario 2 it will be 23 percent less than in scenario 4 (high fertility), and 15 per cent less than in scenario 3 (medium fertility). The large differentials in the size of the working age population demonstrate the potentially substantial impact of population policy on China's future labour supply.

4 THE DEMOGRAPHIC COMPOSITION EFFECT AND LABOUR SUPPLY

Labour supply is determined jointly by the size and the LFPR of the various age and sex categories of the working age population (McDonald and Kippen 2001). Since changing age structures affect the age-specific LFPRs, they change the aggregate LFPR (ALFPR) which is a weighted average of the component rates (Dugan and Robidoux, 1999).

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

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

where PR_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 working population cohort i in WP_t, the total working age population aged 15 to 64 in year t. We identify ten 5-year sex-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 - the demographic composition effect. Many social, economic and cultural factors influence the cohort participation rates. In this section we will ignore such changes, leaving the discussion to the next section, and only calculate the demographic composition effect.

Data from China's fifth population census in 2000 show that the ALFPR was 82.35 per cent. Detailed cohort and sex specific participation rates in 2000 are shown in Table 4. We estimate the trend of the ALFPR over the half century by assuming that the cohort participation rates remain at their 2000 levels ($PR_{i,00}$).

$$\overline{PR_t} = \sum_{i=1}^{j} s_{i.t} PR_{i,00} \quad (3)$$

where $\overline{PR_t}$ is the aggregate participation rate that would have been observed at time t if all cohort participation rates remained at their 2000 levels. Changes in $\overline{PR_t}$, therefore, reflect changes in the composition of the labour force. Table 4 presents estimates of ALFPR for the baseline scenario (constant fertility). The evolution of the demographic age structure reduces the ALFPR from 82.35 percent in 2000 to approximately 78.79 per cent in 2050 if the TFR remains at 1.7. The demographic composition effect is 3.6 percentage points. As a result, the labour force in the baseline scenario will contract to 638 million (Table 6. That represents an 11 percent decline from its level in 2000.

Table 4: Detailed demographic composition effect on Aggregate labour force participation rate in China from 2000 to 2050

Age group	2000			2010		2020	
	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**	**Source population weights** *(Per cent* **(4))**	**Contribution to aggregate participation rate** *(Per cent)* **(4)*(1)/100**
Men							
15-19	49.1	5.94	2.92	5.49	2.70	4.44	2.18
20-24	90.23	5.07	4.58	6.25	5.64	4.98	4.50
25-29	97.90	6.52	6.39	5.26	5.15	5.32	5.21
30-34	98.07	7.32	7.18	5.07	4.97	6.02	5.90
35-39	97.89	6.45	6.32	6.21	6.08	5.05	4.94
40-44	97.44	4.96	4.83	6.44	6.28	4.86	4.73
45-49	96.41	5.24	5.05	5.32	5.13	5.93	5.72
50-54	90.90	3.92	3.57	4.27	3.88	6.10	5.55
55-59	80.30	2.89	2.32	4.20	3.38	4.94	3.96
60-64	60.35	2.61	1.57	2.94	1.78	3.79	2.29
Men total	87.80	50.93	44.72	51.46	44.98	51.44	44.99
Women							
15-19	51.74	5.56	2.88	4.93	2.55	3.99	2.07
20-24	85.39	5.07	4.33	5.67	4.84	4.49	3.84
25-29	86.66	6.46	5.60	4.89	4.24	4.81	4.17
30-34	87.97	7.18	6.32	4.79	4.22	5.51	4.85
35-39	88.38	6.28	5.55	5.95	5.26	4.75	4.20
40-44	86.25	4.69	4.04	6.25	5.39	4.65	4.01
45-49	79.97	5.03	4.03	5.12	4.10	5.77	4.61
50-54	67.15	3.69	2.48	4.00	2.69	6.01	4.04
55-59	54.57	2.70	1.47	4.08	2.23	4.87	2.66
60-64	38.94	2.41	0.94	2.85	1.11	3.71	1.45
Women total	76.68	49.07	37.63	48.54	36.61	48.56	35.87
ALFPR**	**82.35**	**100**	**82.35**	**100**	**81.59**	**100**	**80.86**

*PR is participation rate.

** ALFPR is aggregate labour force participation rate

Table 4 (continued): Detailed demographic composition effect on aggregate labour force participation rate in China from 2000 to 2050

Age group	2030		2040		2050	
	Source population weights *(Per cent)* (5)	Contribution to aggregate participation rate *(Per cent)* (5)*(1)/100	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
Men						
15-19	4.59	2.25	4.47	2.20	4.26	2.09
20-24	4.49	4.05	4.83	4.36	4.41	3.98
25-29	4.53	4.43	4.99	4.88	4.74	4.64
30-34	5.04	4.95	4.86	4.77	5.11	5.01
35-39	5.36	5.24	4.88	4.78	5.27	5.16
40-44	6.04	5.89	5.42	5.28	5.12	4.99
45-49	5.05	4.87	5.74	5.54	5.13	4.94
50-54	4.83	4.39	6.44	5.85	5.66	5.15
55-59	5.79	4.65	5.30	4.25	5.91	4.74
60-64	5.75	3.47	4.89	2.95	6.43	3.88
Men total	51.47	44.20	51.82	44.86	52.04	44.58
Women						
15-19	4.14	2.14	4.05	2.09	3.86	2.00
20-24	4.05	3.46	4.37	3.73	4.00	3.41
25-29	4.09	3.54	4.52	3.92	4.31	3.73
30-34	4.58	4.03	4.41	3.88	4.64	4.09
35-39	4.89	4.32	4.44	3.92	4.80	4.24
40-44	5.60	4.83	4.97	4.29	4.67	4.03
45-49	4.82	3.85	5.30	4.24	4.70	3.76
50-54	4.70	3.16	6.05	4.06	5.24	3.52
55-59	5.76	3.15	5.15	2.81	5.54	3.02
60-64	5.89	2.29	4.93	1.92	6.22	2.42
Women total	48.53	34.78	48.18	34.86	47.96	34.21
ALFPR	**100**	**78.97**	**100**	**79.71**	**100**	**78.79**

Source: Data in column one is calculated from China's fifth population census in 2000 and data for the source population weights for different years is based on United Nations population projection (constant fertility variant) (2004).

Using the same methodology, we estimated the demographic composition effects under the other three fertility scenarios and calculated the corresponding ALFPR. The results are displayed in Table 5.

Table 5: Demographic composition effects *(percentage points)* and trends of aggregate labour force participation rates *(per cent)*

Year	Baseline (Constant fertility)		Scenario two (Low fertility)		Scenario three (Medium fertility)		Scenario four (High fertility)	
	Demographic composition effects	ALFPR	Demographic composition effects	ALFPR	Demographic composition effects	*ALFPR*	Demographic composition effects	ALFPR
2000	--	82.35	--	82.35	--	82.35	--	82.35
2010	-0.76	81.59	-0.76	81.59	-0.76	81.59	-0.76	81.59
2020	-1.49	80.86	-1.49	80.86	-1.49	80.86	-1.49	80.86
2030	-3.38	78.97	-3.03	79.32	-3.52	78.83	-3.15	79.20
2040	-2.64	79.71	-2.66	79.69	-2.63	79.72	-2.59	79.76
2050	-3.56	78.79	-4.19	78.16	-3.39	78.96	-3.16	79.19

Again, the alternative fertility scenarios cannot display any differences in the demographic composition effect during the initial 20 years. The differences that do emerge during the 2030s and 2040s are not significant in view of slight differences in the age structure. However, the difference becomes significant with the increasing divergence in the age structure. In 2050, the demographic composition effect is 1.03 percentage points larger in scenario two (low fertility) than in scenario four (high fertility). The most rapid population ageing in scenario two reduces the ALFPR to 78.16 per cent. As a result, the total labour force declines to 563 million, 21.5 per cent below its 2000 level (Table 6). However, in scenario four characterized by the high replacement fertility rate and relatively slower population ageing, the demographic composition effect is smaller (3.16 percentage points), generating a relatively higher ALFPR (79.19 per cent). As a result, the total size of the labour force will be 754 million in 2050, 5 per cent larger than in 2000.

Table 6: Trends of labour force with demographic composition effects (million)

Year	Baseline (Constant)	Scenario two (Low variant)	Scenario three (Medium variant)	Scenario four (High variant)
2000	717	717	717	717
2005	763	763	763	763
2010	798	798	798	798
2020	803	803	803	803
2030	757	741	762	793
2040	693	648	710	765
2050	638	563	667	754

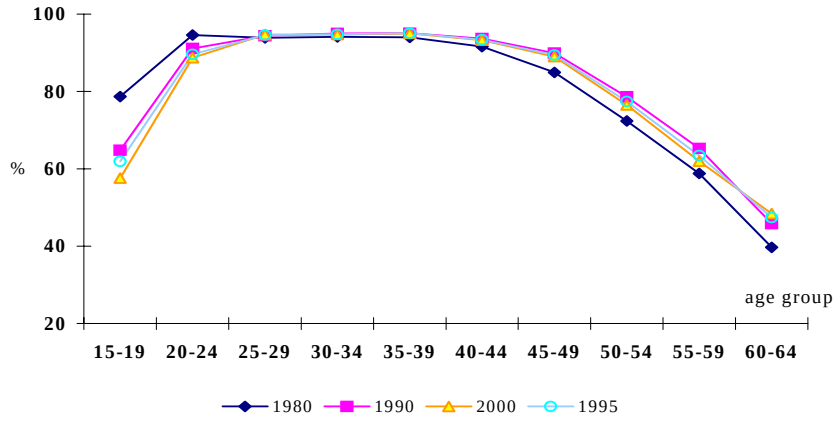
Changes in the demographic composition of the working population under alternative fertility scenarios feed into the total size of labour force. By 2050, the labour force will be 25 per cent lower in the low fertility scenario 2 than in scenario 4. Without the demographic composition effects, that difference would be 23 per cent.

5 AGE- AND SEX-SPECIFIC PARTICIPATION RATES AND LABOUR SUPPLY

Our investigation of the impact of the age structure on labour supply assumed that age and sex-specific participation rates remain at their 2000 levels. This section examines potential changes in the age- and sex-specific participation rates over that period.

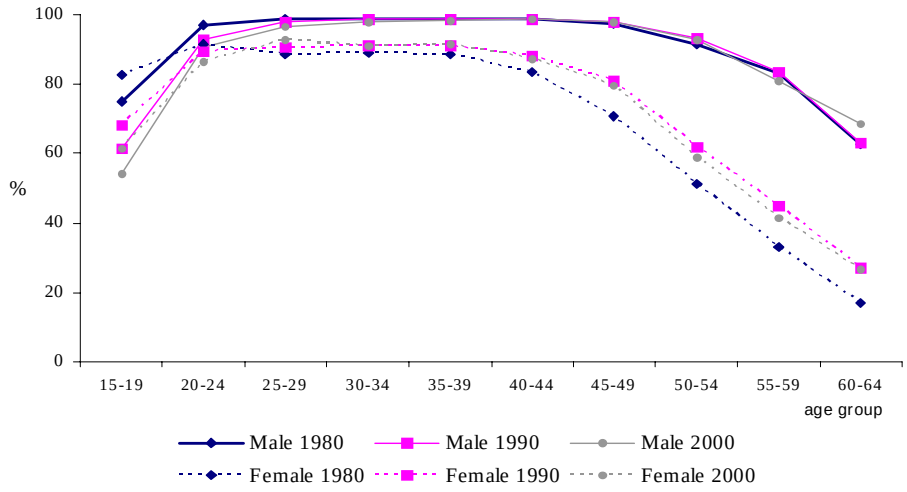
During the 1980s China experienced an increase in the ALFPR, from 82 per cent in 1982 to 85 per cent in 1990, that was spread across most working age groups. The only exceptions were the relatively young age groups 15 to 19 and 20 to 24, for whom participation rates dropped (Figure 1). Even though the ALFPR declined slightly during the 1990s, it remained at historically high levels. In 1995, it dropped slightly to 84.97 per cent, declining further to 82.35 per cent in 2000. All age groups contributed to this reduction in the ALFPR, but particularly the relatively young age groups whose participation rates displayed a sustained and fast drop.

Figure 1: Labour force participation rates in China from 1980-2000



Comparison of LFPRs by gender indicates that the evolution of the LFPR for women is the main driver for the changes in the ALFPR over the period 1980 to 2000 (Figure 2). The LFPR for males remains roughly stable (except for the young age group) while for females the LFPR increases in all age groups during the 1980s, except for the age groups 15-19 and 20-24, and then declines slightly during the 1990s.

Figure 2: Age-specific LFPR for males and females: China, 1980 - 2000



The historical evolution of age- and sex-specific LFPRs displayed in Figure 2 also shows that

- women's LFPR are lower than men's in all cohorts (except for cohort 15-19);
- the divergence increases significantly beyond age 45. Women's workforce participation declines substantially at age 45, while men maintain a high participation rate until they reach age 60. The difference in compulsory retirement age between men and women (55 and 50 years, respectively) is one reason;
- women enjoy lower education opportunities than men because the 15-19 cohort is the only age group for which women show a higher LFPR than men.

Many social, economic and cultural factors affect the age- and sex-specific participation rates. This section explores the nature of changes in those rates during the first half of this century in China.

5.1 Labour force participation of the young population

Table 7 compares the participation rates in 2000 of the age groups 15-19 and 20-24 in China with selected countries.

Table 7: Labour force participation rate at ages 15-19 and 20-24, by sex in 2000 (per cent)

Country and district	Ages 15-19		Ages 20-24	
	Males	Females	Males	Females
China	**54.1**	**61.4**	**90.7**	**86.6**
Thailand	38	30.9	77.2	66.4
Malaysia	32.3	22	85.4	61.5
Philippines	41.7	24.9	78.2	52
South Korea	11.5	12.4	52.4	60.9
Singapore	18	20.1	75.9	78.7
Taiwan*	20.4	18.5	64.8	61.6
Hong Kong	18.1	15.9	75.9	74.7
Japan	18	16	74	74
New Zealand	53.7	53.1	79.2	67.1
Australia	54.2	58.4	85	77.5
Canada	51.8	51.8	79.9	73.9
United States	50.2	51.2	81.6	73.1
Sweden	32	37.8	70	61.6
Germany	36	29	78	71
Italy	21.9	14.9	63.6	50.2
Greece	15.9	13.4	71	68.1

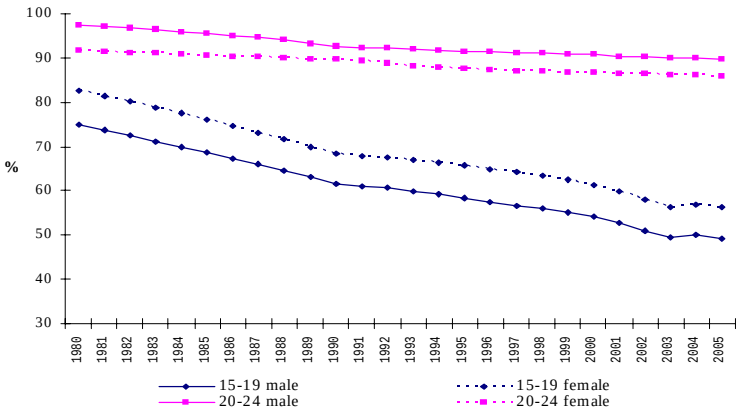
Source: For Taiwan, Tsay Ching-Lung (2003); for other countries, ILO (2006)

* 2001 data for Taiwan.

- **15-19 age group**

The LFPR for this age group (54.1 and 61.4 for males and females, respectively) is very high in China compared with other selected Asian and western countries and regions. For example, in South Korea the comparable rates were only 11.5 per cent and 12.4 per cent, respectively. The high participation rate in China reflects the very low rates of participation in education at these ages.[4] As educational opportunities expand, particularly for women, the LFPR of this group would be expected to decline. Indeed, historical data shows that the LFPR of this age group has already declined in China (Figure 3). In 2005, these figures were 49.3 and 56.4, respectively. Within 25 years, LFPR of this group has fallen by 34 per cent for males and by 32 per cent for females.

Figure 3: Labour force participation rates of population aged 15 to 19 and 20 to 24: China, 1980-2005



Source: ILO (2006)

The experience of selected Asian countries and regions shown in Table 8 confirms our conjecture that labour force participation by this young age group has declined dramatically over the past 35 years throughout the Asian region. In Hong Kong it has declined by 68 per cent for males and by 74 per cent for females. Singapore has experienced a similarly dramatic decline. The fall is even more impressive in South Korea, amounting to 80 per cent for males and 74 per cent for females. In Thailand, the dramatic decline in LFPR occurred after 1990. Within 15 years (from 1990 to 2005), the LFPR for males fell by 51 per cent and by 71 per cent for females.

This historical evidence about the demographic composition of the labour force informs all the labour supply projections that were conducted for the present study. We assume that the LFPR of the 15-19 year age group follows its historical trend up to 2005 and declines thereafter at 1.6 per cent annually. This assumption generates LFPRs by 2050 of 23.9 and 29.1 per cent for males and females, respectively, for this age cohort (Table A1 provides detailed information). At that time China's assumed LFPRs are comparable to the levels that had been attained at the beginning of the 1990s in Hong Kong and Singapore, and in Japan already in the late 1970s. Given the very low participation rates observed for this age group in the East and South East Asian countries and regions (Table 8), this assumption may be an excessively optimistic conjecture.

Table 8: Labour force participation ate at ages 15-19 by sex (per cent)

Year	Hong Kong		Singapore		South Korea		Thailand		Japan	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1960	---	---	---	---	---	---	---	---	51.6	49.7
1970	---	---	55.7	43.0	45.9	40.3	77.4	77.2	36.6	35.9
1971	50.4	56.4	---	---	--	---	---	---	---	---
1975	---	---	--	--	46.0	47.5	---	---	---	---
1976	51.4	55.3	44.1	42.2	---	---	---	---	---	---
1980	41.8	40.7	45.8	48.1	27.3	34.4	70.9	71.0	20.3	18.8
1985	35.2	31.5	32.6	33.7	14.5	21.1	69.6	70.7	--	--
1990	29.6	25.8	26.9	28.3	10.8	18.7	67.7	69.4	19.9	17.4
1995	22.6	18.8	20.5	19.1	9.5	14.5	47.5	44.0	18.8	15.8
2000	18.1	15.9	18.0	20.1	11.5	12.4	38.0	30.9	17.4	15.4
2005	15.9	14.9	14.8	15.4	8.8	10.6	33.5	19.8	--	--

Source: Data for Japan is from National Institute of Population and Social Security Research, Japan (2006). All other data are from ILO (2006)

- **20-24 age group**

The LFPR for the group 20-24 has also declined in China, but the drop is much smaller than for the age group 15-19. Over the quarter century 1980 to 2005 the rate declined by 7.2 per cent for men and by 11 per cent for women (Figure 3). In 2005, the LFPR for men was 89.8 per cent and for women it was 85.9 per cent.

Table 9: Labour force participation rate at ages 20-24 by sex (per cent)

Year	**Hong Kong**		**Singapore**		**South Korea**		**Thailand**		**Japan**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
1980	89.8	80.2	92.5	79	76.5	53.5	87.8	80.3	74.7	71.1
1985	88.2	83.4	88.8	78.9	63.3	55.1	90.4	81.2	--	--
1990	85.8	83.2	84.0	80.9	60.2	64.6	91.6	81.7	75.4	75.5
1995	79.2	77.2	76.2	77.2	58.8	66.1	85.7	71.7	75.8	74.2
2000	75.9	74.7	75.9	78.7	52.4	60.9	77.2	66.4	70.2	70.5
2005	70.8	71.8	72.8	77.9	59.1	66.0	77.5	64.4	--	--

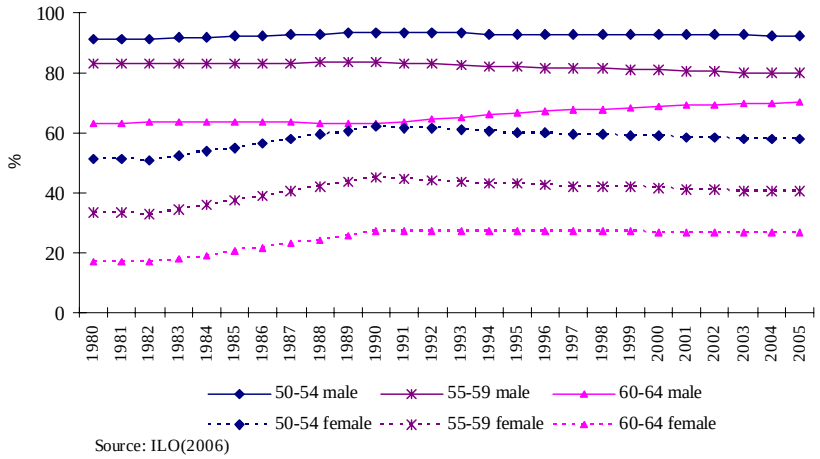
Source: Data for Japan is from National Institute of Population and Social Security Research, Japan (2006). All other data are from ILO (2006)

Compared with the countries shown in Table 7, the LFPR in 2000 of this age group is much higher in China than in the selected Asian and western countries and regions. The experience of the selected Asian countries and regions in Table 9 implies that with the continued economic development in China, the LFPR for this age group will also keep declining. Meanwhile, "as technology advances, and as those with high skills continue to receive high rewards from the labour market, it is likely that young adults will spend more time in acquiring higher levels of formal education" (McDonald and Kippen, page 7, 2001). In all the scenarios of the present paper we assume that the LFPR for this age group maintains its historical trend and continues to decline at 0.3 per cent annually for men and at 0.25 per cent for women until 2050 (changes in participation rates are reported in Table A1).

5.2 Labour force participation of the old population, 50 to 64 age group

The distinguishing feature of Figure 4 is that the female LFPR for each of the older age cohorts of the population is distinctly and persistently lower than for the corresponding males.

Figure 4: The LFPR for population aged 50-64 by sex in China 1980-2005 (per cent)



Source: ILO(2006)

- **Males' participation rates**

The changes in the participation rate for males aged 50-54 are positive but very modest, increasing from 91.5 in 1980 to 92.7 per cent in 2005. For the age group 55-59, the rate dropped slightly from 83.2 in 1980 to 80.9 per cent in 2005. However, the participation rate for males aged 60-64 has steadily increased from 62.9 in 1980 to 68.7 per cent in 2005 (Figure 4).

Compared with developed countries the Chinese rates are typically high, except for Japan (Table 10). But they are lower than in the selected Asian countries, which have similar or higher income levels.

Table 10: Labour force participation rate at ages 50-64, by sex in 2000 (per cent)

Country and district	Ages 50-54		Ages 55-59		Ages 60-64	
	Males	Females	Males	Females	Males	Females
China	**92.7**	**58.9**	**80.9**	**41.5**	**68.7**	**26.9**
Thailand	94.8	74.4	90.5	63.6	80.9	39.2
Malaysia	93.4	40.6	75.1	28.5	61.6	23.2
Philippines	95.6	68.0	89.3	55.7	79.1	50.3
South Korea	89.1	55.2	77.7	51.1	63.4	45.9
Singapore	91.3	46.7	74.4	29.6	49.6	15.3
Taiwan*	---	---	70.9	---	52.0	---
Japan	95.0	66.2	92.6	57.1	71.6	37.6
Australia	84.8	66.6	73	47.6	46.8	22.3
Canada	86.5	71.0	72.9	53.4	46.1	27.2
United States	86.8	74.1	77.1	61.4	55.0	40.2
Sweden	90.6	86.2	84.6	79.6	56.8	48.5
Germany	90.3	71.9	76.1	55.7	30.2	13.3
Italy	82.6	41.6	53.9	24.3	31.4	8.0
Greece	87.9	42.6	72.1	31.4	45.2	20.5

Source: ILO (2006) and Tsay Ching-Lung (2003) for the data of Taiwan.

* 2001 data for Taiwan.

- **Female's participation rate**

The participation rates of females aged 50-64 are much lower than those of males in China. In addition to the difference in retirement age for men and women the low education level of women in this age group constitutes another important reason for that disparity. The temporal evolution of the participations rates during the last 25 years of the three "old population" age groups shows the same tendencies: a slight increase during 1980s followed by modest declines during the 1990s (Figure 4).

The participation rates of females aged 50-59 are lower in China than in most of the countries and regions shown in Table 10. In Asia, only Singapore and Malaysia and in Western countries, only Italy and Greece have lower participation rates than China in 2000. For the age group 60-64, the participation rate shows a large divergence between the countries. The participation rate of women aged 60-64 is much lower in China than in Japan, South Korea, Thailand and Philippines.

Looking ahead, there is a great deal of uncertainty surrounding the evolution of the participation rate of these age groups for both males and females. This study assumes three hypothetical evolutionary trends over the next 45 years:

- **First, slight decline then stability:** Given the existing retirement ages, sustained economic growth, a rising living standard and gradual improvements of the pension system, the LFPR of the older population (50-59) is likely to decline slightly initially, and then to stabilize at that lower level. For the period 2005-2015, this study adopts the ILO projection. This is a conventional assumption and we define it, therefore, as the "conventional case" (CC).

- **Second, moderate increase:** The OECD (1998) suggests that, in an ageing society, attention should be focused on increasing the LFPR of men at older ages. This may be brought about by an increase in the retirement age. Furthermore, increasing educational engagement of women will stimulate their economic activities and labour force participation, especially after age 40. The expansion of educational opportunities is likely to affect all cohort participation rates albeit in different ways. Increasing school enrolments, especially at upper secondary and tertiary level, will reduce the participation rate, especially among the young (15-24) while increasing it later in life, especially after age 40. The evidence from Australia and Canada shows that there exists a positive relationship between education level and labour force participation rate, especially for women (Day and Dowrick, 2004; Dugan and Robidoux, 1999). Accordingly, for this scenario we assume that by 2050 the labour force participation rates for these three age groups will increase to the level of Japan in 2000. For men, the annual rates of increase will be 0.06, 0.3 and 0.04 per cent for age groups 50-54, 55-59 and 60-64, respectively. For women, the corresponding figures are 0.28, 0.76 and 0.52 per cent. We define this scenario as the "optimistic case" (OC).

- **Third, substantial increase**: Sweden has the highest female LFPR at ages 50 and above in the developed countries. We follow McDonald and Kippen (2001) to assume that in the next 45 years, female LFPR in China will increase to Sweden's 2000 level. Under this assumption, the annual growth rates of female LFPR for the age groups 50- 54, 55-59 and 60-64, will be 0.87, 1.5 and 1.3 per cent, respectively. We assume that the male labour force participation will be the same as in the optimistic case. We define this scenario as the "very optimistic case" (VOC).[5]

The LFPR for both sexes of the intermediate age groups, 25 to 49, are assumed to remain at their 2000 level.

5.3 Labour supply prospects over the period 2005 to 2050

Based on the assumed evolution of the age- and sex-specific LFPRs, the projected working age population and the demographic composition effects, we calculate the trends of the labour force for the period 2005-2050 for the three alternative scenarios. The results are shown in Tables 11 to 13.

In the conventional case (Table 11) the total size of the labour force declines in all alternative fertility scenarios after a slight increase during the first two decades. In the baseline case, the labour force declines to 582 million, which is equivalent to 76 percent of the 2005 labour force. In the low fertility scenario (TFR declining to 1.35), the total labour force drops to slightly over 500 million, implying that China would lose more than one quarter of her current labour force.

Table 11: Trends of labour force under conventional case (million)

Year	**Baseline** (Constant fertility)	**Scenario two** (Low fertility)	**Scenario three** (Medium fertility)	**Scenario four** (High fertility)
2005	763.2	763.2	763.2	763.2
2010	779.3	779.3	779.3	779.3
2020	766.7	766.7	766.7	766.7
2030	701.6	691.0	704.0	725.8
2040	642.2	602.6	656.0	693.3
2050	582.2	512.4	608.6	677.6

If we consider only the demographic composition effect, and if China maintains her age- and sex-specific participation rates at the 2000 level, then lifting the fertility rate to the replacement level (high fertility scenario) will help increase the labour supply over the next 45 years (Table 6). However, in the conventional case, with the assumed reduction in the LFPR of young people (aged 19 to 24) and slight change in the elderly population (aged 50 to 64), the total size of the labour force will fall after 2020 as in the baseline case and in scenarios two and three. By 2050, the labour force will be 11 per cent smaller than in 2005 in Scenario 4 (Table 11).

The evolutionary pattern of the labour force in the optimistic case is much closer to the conventional case (Table 12). The only difference is the slightly larger labour supply after 2020 as a result of the assumed increase in the LFPR for both males and females aged 50-64. For instance, in the low fertility scenario, by 2050 there will be 23.7 million more labourers in the

optimistic case compared to the conventional case. In the high fertility scenario, this figure is 24.4 million.

Table 12: Trends of labour force under optimistic case (million)

Year	**Baseline** (Constant fertility)	**Scenario two** (Low fertility)	**Scenario three** (Medium fertility)	**Scenario four** (High fertility)
2005	763.2	763.2	763.2	763.2
2010	781.7	781.7	781.7	781.7
2020	775.4	775.4	775.4	775.4
2030	716.5	706.0	718.9	740.0
2040	660.8	627.1	674.5	711.5
2050	606.0	536.1	632.5	702.0

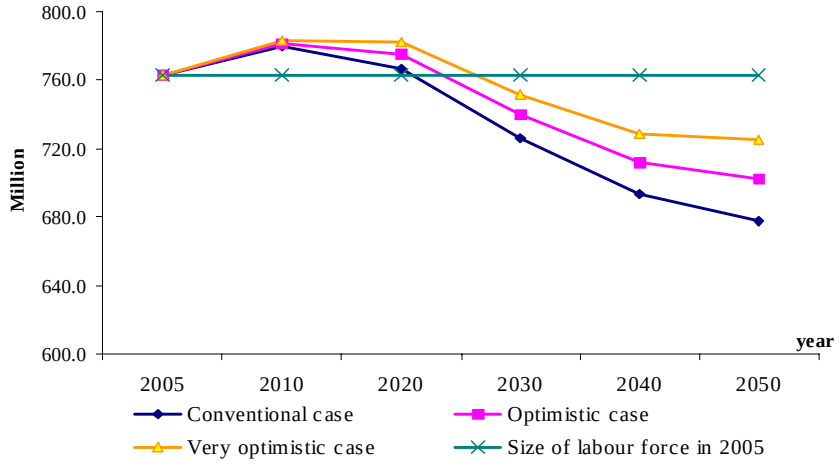
In the very optimistic case, the substantial increase in the participation rate of elderly females cannot completely offset the declining trend of labour supply in all fertility scenarios after 2020 (Table 13). But the extent of the fall has been considerably reduced. For instance, in the high fertility scenario, the total size of the labour force in 2050 will be only five percent smaller than in 2005.

Table 13: Trends of labour force under very optimistic case (million)

Year	**Baseline** (Constant fertility)	**Scenario two** (Low fertility)	**Scenario three** (Medium fertility)	**Scenario four** (High fertility)
2005	763.2	763.2	763.2	763.2
2010	783.3	783.3	783.3	783.3
2020	782.0	782.0	782.0	782.0
2030	728.5	718.1	730.8	751.5
2040	677.8	638.2	691.7	728.3
2050	628.6	558.6	655.1	725.5

Comparing these three evolutionary cases, by 2050 the labour supply will be 7 per cent larger in the very optimistic case than in the conventional case under high fertility scenario (Figure 5).

Figure 5: The comparison of trend projections of labour supply in three hypothetical cases (High fertility scenario)



This simulation exercise implies that even if China's TFR were to rise to near the replacement level, the total size of the labour supply will begin to contract after 2020 (Figure 5). This tends to reflect the decline in the LFPR of young people, irrespective of the behaviour of the LFPR of the elderly population. The dramatic drop in the participation rate of young people is the main driver of the labour supply contraction in the high fertility scenario. In contrast, the sharp decline of labour supply in the low, constant and medium fertility scenarios is mainly caused by the shrinking working age population which is, in turn, attributable to the low fertility.

6 CONCLUSION AND POLICY IMPLICATIONS

The present paper examines possible trends over the next 45 years of the labour supply in China. Alternative fertility scenarios have been constructed that take account of demographic composition effects and plausible changes in age-and sex-specific labour force participation. In order to focus on the role of demographic factors, the present analysis ignores international migration flows. The main findings are:

- First, given present levels of fertility the working age population in China will decline from 2020 onwards (constant fertility scenario-baseline case). If fertility declines to a very low level (low fertility scenario), then there will be a very sharp drop in the working age population. Conversely, increasing the current fertility level to 1.84 (medium variant) will increase the working age population only slightly without preventing the declining trend beyond 2020. In order to achieve sustainable growth of the working age population the fertility rate would need to increase to the replacement level. In that case, the working age population in 2050 will slightly exceed its 2000 level.

- Secondly, the upward shift of the age structure, i.e., population ageing, will put downward pressure on the labour supply in all fertility scenarios. This reflects the fact that population ageing reduces the aggregate labour force participation rate, even if the relevant cohort labour force participation rates remain at their 2000 levels. However, the demographic composition effect will be more severe in low fertility scenarios than with high fertility, enlarging the differences of labour supply in the alternative scenarios.
- Thirdly, the very likely reduction of the labour force participation rate of the young population (aged 15-24), especially of the very young aged 15-19, reduces the labour supply substantially from 2020 onwards in the low, constant and medium fertility scenarios. The higher fertility level in scenario four cannot completely offset the declining trend of the labour supply, irrespective of the LFPR behaviour of the elderly population.

China's economy has been and will continue to benefit from the "demographic window" [6] that will be opened during next 25 years by a low share of the total dependency ratio. However, when the demographic window closes around 2025, the demographic profile will be quite different. As population ageing becomes increasingly prominent, the annual supply of new labour will start to decline sharply in response to the low fertility of the 1990s. China will enter a long period of demographic crossover: a consistent reduction in the new labour supply coupled with a consistent rise of the elderly population (Wang 2005). The present investigation demonstrates that the demographic composition effects and the probable decline in the labour force participation rate of the young population will accelerate the declining trend of the labour supply and make the situation even worse. Furthermore, any feasible increase in the labour force participation rate of the old provides at best only a partial offset.

How can China sustain her economic growth in the light of these labour market developments? Without knowledge about potential changes in labour demand, it is difficult to determine whether a shrinking labour supply imposes a binding constraint on economic growth.

In the first instance, there is evidence that supports the importance of maintaining the size of the labour supply. Peng (2005) has demonstrated, for a constant fertility scenario (TFR= 1.62) during the first half of this century, that falling labour supply will reduce the growth rate of per capita real GDP.[7] The Productivity Commission in Australia found complementary evidence suggesting that the combination of falling labour supply and population ageing in Australia would halve the current economic growth rate, reducing it to nearly 1.25 per cent p.a., by the mid 2020s (Productivity Commission 2005). Similarly, Masson and Tryon (1990) from the IMF, Turner et al. (1998) at the OECD, and McMorrow and Roeger (1999) from the European Commission have completed major studies with large macroeconomic forecasting models. Their multicountry studies of industrial

nations project slowing growth after 2010 as a result of population ageing, and further deceleration of growth after 2025.

Secondly, there is no prior experience in an advanced country of falling labour supply over a long period of time. Advanced countries have typically experienced gradual to rapid increases in the labour supply during the last 30 years (McDonald and Kippen 2001). In the Asian "tiger" economies, such as Hong Kong, South Korea, Singapore and Thailand the labour force has more than doubled during the period 1970 to 1995. China's rapid economic growth during the last 25 years was accompanied by a 57 percent growth in the labour force.

Thirdly, it is improbable that the demand for labour will fall to match the reduction of labour supply. Even though increases in the price of labour could stimulate improvements to productivity, there is no suggestion that labour demand will fall overall to any significant extent. The counter argument is much more probable: rapid technological advance and the increasing availability of investment capital will stimulate the demand for people (McDonald and Kippen 2001, Judy and D'Amico 1997). Furthermore, population ageing will itself alter spending patterns and the required occupational structure of the labour force. Consumption demand will shift increasingly towards services and products that are consumed intensively by older members of the community. These outputs are typically labour intensive. It follows that the scope for technology to replace labour is limited (McDonald and Kippen 2001).

Fourthly, maintenance of a stable labour force is of crucial importance for China. International competition for skilled and even low-skilled workers will intensify during the coming decades with the progress of global population ageing and resulting labour shortages, particularly in developed countries. Significant amounts of capital will continue to flow from the advanced economies to the economies that have an abundant labour supply. China's comparative advantage lies in labour-intensive manufacturing. Contraction of labour supply places upward pressure on wages, progressively eroding China's low labour cost advantage in attracting capital. Since the ageing of China's population commenced at a relatively low per capita income level, the stance of policy needs to be growth-oriented. Maintaining an abundant labour supply to attract foreign capital will help to sustain economic growth and to accommodate the increasingly elderly population.

The importance of maintaining the labour supply for economic growth suggests prompt relaxation of the current one-child policy as a plausible and efficient policy option. A gradual increase in the fertility level would dampen the decline of the labour force by increasing the working age population and mitigating the adverse demographic composition effect on the LFPR. Though no policy change can prevent the occurrence of the demographic crossover, an early departure from

the one-child policy and a gradual increase in fertility could help to lighten the pressure of population ageing 20 to 30 years from now (Wang, 2005).

Expansion of educational opportunities will remove large numbers of young people from the labour force and sharply reduce their labour force participation rate. The output consequences of this effect may be compensated in due course by the improvement of productivity resulting from increases in the stock of human capital. However, in the short to medium term it will reduce the labour supply. Countervailing policy choices include increasing the obligatory retirement age and encouraging the elderly to remain in the labour force in order to raise the LFPR of the elderly. These strategies reflect the common policy approach in OECD countries. They constitute constructive policy options for China in ten to fifteen years when the supply of labour begins to decline.

REFERENCES

Bloom, E. D. and G. J. Williamson (1998), "Demographic Transition and Economic Miracles in Emerging Asia", *The World Bank Economic Review*, Vol.12 (3), pp.419-55.

Day, C. and S. Dowrick (2004), "Ageing Economics: Human Capital, Productivity and Fertility", *Agenda,* Vol.119 (1), pp.1-20.

Dugan, B. and Robidoux, B. (1999), "Demographic Shifts and Labour Force participation Rates in Canada", *Canadian Business Economics, Summer 1999,* pp.42-56.

Hernandez, D.J. (1984), *Success or Failure? Family Planning Programs in the Third World,* Westport, CT: Greenwood Press.

International Labour Organization (ILO) (2006), http://laborsta.ilo.org.

Judy R. and C. D'Amico (1997), *Workforce 2020: Work and Workers in the 21st Century*. Indianapolis, IN: Hudson Institute.

Kaufman, J., Zhang, Z. & Zhang, Y. (1989), "Family planning policy and practice in China, 1986-1988", *Population and Development Review,* 14(2), pp.245-86.

Li, J. X. (2002), "China's Population: 'Reduction of Population Size' should not to be the target", *Journal of Population Research*, No.6 (in Chinese).

Li, X. P. (2002), "The Necessity and Possibility of Further Reducing China's Fertility Rate", *Journal of Population Research*, No.4 (in Chinese).

Masson, P. R. and R. W. Tryon (1990), "Macroeconomic Effects of Projected Population Ageing in Industrial Countries," *IMF Staff Papers,* 37, pp.453-85.

McMorrow, K and W. Roeger (1999), *The Economic Consequences of an Ageing Population*, European Commission, Directorate-General for Economic and Financial Affairs (ECFIN), Luxembourg, Office for Official Publications of the European Communities.

McDonald, P and R. Kippen (2001), "Labour Supply Prospects in 16 Developed Countries, 2000-2050," *Population and Development Review,* 27(1): 1-32.

National Institute of Population and Social Security Research, Japan (2006), http://www.ipss.go.jp/index-e.html.

Peng, X. J. (2005), "Population Ageing, economic Growth and Population Policy options in China – A computable General Equilibrium Analysis", *PhD Dissertation, Monash University.*

Productivity Commission (2005), "Economic Implications of an Ageing Australia", *Research Report of Productivity Commission in Australia.*

Qiao, X. and Chen, W. (2003), “Forecast of the Population Development Trend in China”, Research Report of Institute of Population Research, Renmin University of China.

Tsay, Ching-lung (2003), “Below-replacement fertility and prospects for labour force growth in Taiwan,” *Journal of Population Research*, Vol.20 (1): 67-87.

Turner, D., C. Giornio, A. D. Serres, A. Vourc’h, and P. Richardson (1998), “The Macroeconomic Implications of Ageing in a Global Context”, *Economics Department Working Paper,* No.193, OECD.

United Nations (2004), World Population Prospects: The 2004 Revision.

Wang, F. (2005), “Can China Afford to Continue its One-Child Policy?” Asia Pacific Issues, No.77, East-West Centre.

Wang, J., L. Keng and R. Smyth (2002), “China's population policy and design alternatives: using the market to regulate China's population growth”, *Asian Profile*, Vol.30 (5), 379-91.

Wang, J. Y, Y. Y. He, Z. C. Wang and C. R. Duan (2004), “An Assessment of Total Fertility Rate of the Provinces of China in 2000”, *Journal of Population Research,* No.2, pp.10-19 (in Chinese).

Wu, C. P. (1997), *General Report of China’s Changing Population and Its Development* (in Chinese), Beijing, Higher Education Press.

Wu, C. P., L. Wang and Z. F. Miao (2004), “Process, Prospects and Countermeasures of Population Ageing with Chinese Characteristics”, *Journal of Population Research*, No.1, pp.8-16 (in Chinese).

Zhai, Z. W. (2000), “Stabilizing the low fertility rate: Concept, Theory and Strategy” (in Chinese), *Journal of Population Research*, No. 3.

— (2001), “Analysis on the Dilemma between Population Size and Age Structure in China”, *Journal of Population Research*, No.3 (in Chinese).

APPENDIX:

Table A1: The possible evolution of the LFPR at ages 15-24 from 2005 to 2050 by sex (per cent)

Year	Aged 15-19		Aged 20-24	
	Males	Females	Males	Females
2005	49.3	56.4	89.8	85.9
2010	45.5	52.4	88.4	84.8
2015	42.0	48.7	87.1	83.8
2020	38.7	45.2	85.8	82.7
2025	35.7	42.0	84.5	81.7
2030	33.0	39.0	83.2	80.7
2035	30.4	36.3	82.0	79.7
2040	28.1	33.7	80.7	78.7
2045	25.9	31.3	79.5	77.7
2050	23.9	29.1	78.3	76.7

Table A2: The possible evolution of the LFPR at ages 50-64 from 2005 to 2050 by sex (per cent) – conventional case

Year	Aged 50-54		Aged 55-59		Aged 60-64	
	Males	Females	Males	Females	Males	Females
2005	92.5	57.8	79.8	40.3	70.2	26.8
2010	92.2	57.4	79.3	39.7	70.8	26.7
2015	92.0	57.3	79.0	39.5	71.0	26.7
2020	92.0	57.3	79.0	39.4	71.0	26.7
2025	92.0	57.3	79.0	39.4	71.0	26.7
2030	92.0	57.3	79.0	39.4	71.0	26.7
2035	92.0	57.3	79.0	39.4	71.0	26.7
2040	92.0	57.3	79.0	39.4	71.0	26.7
2045	92.0	57.3	79.0	39.4	71.0	26.7
2050	92.0	57.3	79.0	39.4	71.0	26.7

Table A3: The possible evolution of the LFPR at ages 50-64 from 2005 to 2050 by sex (per cent) – optimistic case

Year	Aged 50-54		Aged 55-59		Aged 60-64	
	Males	Females	Males	Females	Males	Females
2005	92.5	57.8	79.8	40.3	70.2	26.8
2010	92.8	58.6	81.1	41.8	70.4	27.8
2015	93.0	59.5	82.4	43.5	70.5	28.8
2020	93.3	60.4	83.8	45.1	70.7	29.9
2025	93.6	61.2	85.1	46.9	70.8	31.1
2030	93.9	62.1	86.5	48.7	71.0	32.2
2035	94.1	63.0	87.9	50.5	71.1	33.4
2040	94.4	63.9	89.4	52.5	71.3	34.7
2045	94.7	64.9	90.8	54.5	71.4	36.0
2050	94.9	65.8	92.3	56.6	71.6	37.3

Table A4: The possible evolution of the LFPR at ages 50-64 from 2005 to 2050 by sex (per cent) – Very optimistic case

Year	Aged 50-54		Aged 55-59		Aged 60-64	
	Males	Females	Males	Females	Males	Females
2005	92.5	57.8	79.8	40.3	70.2	26.8
2010	92.8	60.4	81.1	43.4	70.4	28.6
2015	93.0	63.0	82.4	46.7	70.5	30.5
2020	93.3	65.8	83.8	50.3	70.7	32.5
2025	93.6	68.8	85.1	54.2	70.8	34.7
2030	93.9	71.8	86.5	58.3	71.0	37.0
2035	94.1	75.0	87.9	62.8	71.1	39.5
2040	94.4	78.3	89.4	67.6	71.3	42.1
2045	94.7	81.8	90.8	72.8	71.4	44.9
2050	94.9	85.5	92.3	78.4	71.6	47.9

NOTES

[1] It should be noted that an increase in economic growth may indeed be associated with a deterioration of per capita income because of the acceleration of the rate of growth of the total population induced by higher fertility regimes.

[2] The hours worked per worker in the manufacturing sector have declined by almost ten per cent over seven years, from 181.7 hours per month in 1991 to 162.9 in 1998 (ILO 2006).

[3] The past thirty years have witnessed significant achievements in this area. China has achieved noticeable reductions in the birth rate, death rate and natural growth rate within a comparatively short period of time (Wang, Keng and Smyth, 2002). The crude birth rate of about 14.5 per thousand and population growth rate of 7.3 per thousand in 2000 are both less than half the comparable figures in the 1970s. The total fertility rate has dropped sharply from 4.01 in 1970 to 1.92 in 1990 and further to 1.8 in 2000, close to the average level of developed countries.

[4] The relatively high LFPR at the age group 15–19 in some developed countries, such as New Zealand, Australia, Canada and United States reflects a combination of formal education with part-time work. (McDonald and Kippen 2001).

[5] Documentation of the hypothesized changes in the participation rates for the alternative scenarios are provided in Tables A2, A3 and A4 in the Appendix.

[6] The dramatic fertility rate decline that started in the early 1970s has created rapid change in the population age structure in China. The child dependency ratio (the ratio of the population aged 0-14 to the working age population 15-64) fell from 0.7 in 1975, to 0.4 in 1995 and will continue to decline to 0.26 in 2025 (medium variant population projection from UN, 2004). The old dependency ratio (ratio of elderly population to the working age population) has been rising gradually from 0.08 in 1970 to 0.09 in 1995. From 2010 onwards, its rate of increase will accelerate to reach 0.20 in 2025, and almost 0.4 in 2050. The interplay between these two trends – the decline in child dependency ratio leading the increase in the old dependency ratio by about one generation - has reduced the total dependency ratio below 0.5. This “golden age structure” characterized by a total dependency ratio less than 0.5 will last approximately 30 years (from 1995 to around 2025). That period is often referred to as the “demographic window” or “demographic bonus” or “demographic dividend” because it provides the potential for an increased pace of economic growth. At the later stage of the “golden age structure”, the stagnant growth in the labour supply and rapid increase in the old dependency ratio will dissipate the demographic dividend and close the demographic window.

[7] The projected reduction in GDP growth is two percentage points annually during the 2020s, and three percentage points p.a. during the 2040s.