Global Economics Paper No: 138

Will China Grow Old Before Getting Rich?

■ Looming demographic constraints raise concerns over China's future growth.

■ The rapid pace of aging is exacerbated by the unusually fast drop in the fertility rate resulting from the one-child policy.

■ We argue that two important factors will offset the slowdown in raw labor growth: 1) improvement in labor quality, and 2) the release of surplus labor from the agricultural sector.

■ After accounting for these two factors and if China were to ease the one-child policy from 2010, we estimate China's average real GDP growth over 2005-2050 at 5.3% per annum, 0.6 percentage point per year higher than the baseline scenario.

■ We are now more optimistic about the prospects for China's performance than we have been in our earlier BRICs reports.

■ Yes, China will become old. But by that time, we believe China will be much richer and will have reached developed-country status.

Important disclosures appear at the back of this document.

Helen (Hong) Qiao
February 14, 2006

Summary

- China's rapid economic growth over the past 27 years is unrivaled by any other country. However, some are doubtful this will continue. In particular, demographic constraints loom large. Over the next few decades, China will experience the fastest aging among the major developing economies.

- What makes China's population slowdown different from others is that China's one-child policy, implemented from 1979, exacerbated the drop in the fertility rate, and is now contributing to a sharp slowdown in the growth rate of the workforce.

- This demographic trajectory has made some observers pessimistic about China's long-term growth prospects. This pessimism ignores two important offsets: 1) improvement in labor quality and 2) the release of surplus labor from the agricultural sector. Also, the one-child policy could potentially be relaxed, which would also ease the constraint on the supply of labor.

- Labor quality is likely to continue to improve rapidly. In part, this just represents the process of economic development and China's commitment to expand educational opportunities. However, in China's case, labor quality is likely to get an additional boost. By making children scarcer and more valuable, the one-child policy has led parents to increase their per-child education and health care expenditures.

- The agricultural sector is also a source of additional labor. In particular, the Hukou (household registration) system, which has limited the ability of rural workers to move to the industrial sector, is in the process of being relaxed. The transfer of workers from the rural to urban sector would raise output because productivity levels in the urban sector are much higher.

- The growth outlook for China improves when we account for these labor-augmenting factors. Were China also to ease its one-child policy from 2010, we estimate average real GDP growth over 2005-2050 would reach 5.3% per annum, 0.6 percentage point per year higher than the baseline scenario, which assumes no policy response to address China's demographic constraint. We are now more optimistic about the prospects for China's performance than we have been in our earlier BRICs reports.

- Yes, China will become old. But by that time, we believe China will be much richer and will have reached developed-country status.

Introduction

China's unrivalled economic growth over the past quarter of a century has been recognized as an economic miracle of the 20th century. Its strong growth momentum has surpassed all records and created a new standard in the history of economic development. The progress is remarkable in both absolute and relative terms. The recent National Bureau of Statistics (NBS) nationwide census raised the average annual real GDP growth rate to 9.6% over the 1978 to 2004 period. This pace of growth is faster than that achieved by any East Asian economy during their fastest-growing periods.

Nonetheless, demographers have warned that rapid aging will limit China's future growth prospects and that the demographic tailwind will turn into a significant headwind. China has benefited from strong raw labor growth from the late 1970s till now, but the future demographic outlook suggests the growth of the labor force will slow down from now on, and ultimately decline after 2030[1].

Two forces drive these changes: 1) increased longevity, which is raising the number of those aged 65 and above, and 2) China's one-child policy, which has slowed the growth rate of young adults in the population. The implication on workforce growth is immediate and significant. When more workers reach retirement age and growth of the young adult population slows down, the dependent-per-worker ratio will increase and, China's "demographic bonus" will end.

Many observers are thus concerned that "China may get old before it gets rich[2]." Aging has been perceived as a problem for industrialized economies almost exclusively, following years of urbanization and industrialization[3]. Fewer people have associated aging with a developing country where labor is often ample and the cost of child raising inexpensive. China may be an exception. Still considered a developing country by many standards, China has the fastest aging trend among the 14 developing economies we surveyed in BRIC and N11[4].

Our analysis suggests that by the time China becomes an "aged society"[5] in 2027[6] it will probably be considered as a developed country, although not richer than the US or Japan on per-capita income basis. We believe the fast buildup of human capital and continued release of surplus labor from the agriculture sector will mitigate the negative influences on labor supply from aging.

Despite the slowdown in labor force growth, improved labor quality is likely to help sustain "quality-adjusted labor supply" growth. China's economic growth has coincided with a tremendous boost in human-capital accumulation. In addition to advances in education from improved living standards, China's one-child policy has led to increased human-capital investment on a per-child basis. As public and private education expenditure per person increased, the education attainment of China's labor force boomed. Smaller family sizes enabled China to achieve great success in promoting higher education and producing college graduates. This fast accumulation of human capital contributed 15% of China's overall growth between 1979 and 2004, while labor force growth only contributed 13%[7]. Further educational improvement should continue to support quality-adjusted labor growth in the future.

In addition, the release of rural laborers into the industrial and service sectors will also augment the available supply of labor. The ongoing gradual relaxation of the Household Registration (Hukou) System should facilitate this.

The balance of this paper is structured as follows: we first review the relationship between demographic changes and economic growth. We then discuss how the exceptionally fast accumulation of human capital and the further release of rural surplus laborers will help China remain on the fast-growth track. In the last section, we examine the policy and investment implications that stem from our results.

---

[1] The forecasted timing of the peak for total labor force is controversial. Some demographers suggest it may come as early as 2008. Our forecast is in line with the United Nations Population Division (UNPD) and Chinese official projections. For details, please see Appendix 1.

[2] For example, Jackson and Howe (2004).

[3] Lawson, S., R. Purushothaman, and D. Heacock: *60 Is the New 55: How the G6 Can Mitigate the Burden of Aging*, Global Economics Paper No 132, September 28, 2005.

[4] BRIC and N11 are acronyms of country groups from our preceding Goldman Sachs Economics Global Papers No: 99 & No: 134. BRICs refer to Brazil, Russia, India, and China. N11 includes Bangladesh, Egypt, Indonesia, Iran, Korea, Mexico, Nigeria, Pakistan, Philippines, Turkey and Vietnam. All but Korea are considered as developing economies.

[5] The United Nation defines an economy as an aged society once its population of people aged 65 and above as a percentage of total population reaches 14%.

[6] National Population and Family Planning Commission of China, Goldman Sachs Research estimates.

[7] Liang, Hong: *China's Ascent: Can the Middle Kingdom Meet Its Dreams?* Global Economics Paper No. 133, November 11, 2005.
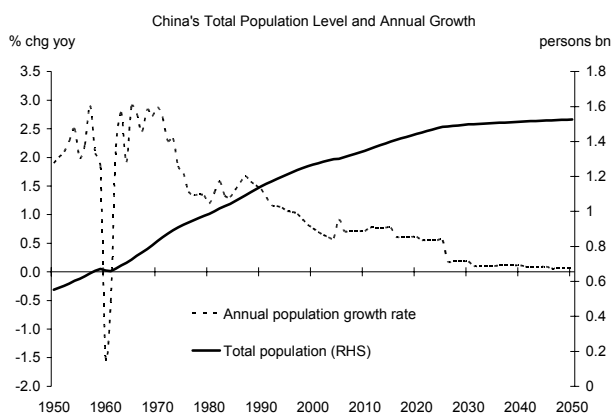
Assessing the population – slower population growth, aging and a rising dependency ratio

China is widely known to have the largest population in the world today. Average population growth over 1950 – 1978 was 2.01% per year [8] . Since then, China's population growth has slowed down substantially. From 1979 to 2004, growth averaged 1.16% per year. By 2005, the population growth rate had fallen to about 0.65%, which is half world average, and roughly 1/3 of where it was 50 years ago. We believe China's population growth will continue to slow[9] (see Exhibit 1). A decline in the absolute level of population will come later than the peaking of the work-age population, because lower fertility rates influence workforce growth faster than population growth due to lengthened life expectancy.

However, we believe the most significant change will be in the age distribution of the population rather than the population size. Among all the developing countries in BRICs and N11 that we have looked at, China will have the fastest pace in aging and the highest level of elderly ratio by 2050 (see Exhibit 2).

Aging has been lurking in China for some time. Since 1980, China's senior population has been growing faster than the average of the world and Asia (see Exhibit 3). Yet it was never considered a serious problem 20 years ago, because there was a large pool of young people of age 0–15, who rapidly replaced the elderly exiting the labor force. Unfortunately, when the reserve of youngsters is drained and the elderly surpasses the rest of the age groups in growth significantly, aging will soon become a credible threat to the sustainability of China's rapid economic growth (see Exhibit 4).

Exhibit 1: The sharp slowdown in China's population growth

China's Total Population Level and Annual Growth

Source: CEIC, Goldman Sachs Research estimates.

Exhibit 2: In 2005–2050, China will have the greatest change in elderly ratio and end up with the highest elderly ratio in 2050

The Elderly (65+) as a Percentage of the Total Population: 2005 - 2050

Source: UNPD, Goldman Sachs Research estimates.

Exhibit 3: China has continued to age faster than Asia and the world

Median age of China, Asia and the world

Year	China	Asia (including China)	World
1950	24	22	24
1980	22	21	23
2005	33	28	28
2015	37	31	30
2050	45	40	38

Source: UNPD, Goldman Sachs Research estimates.

Exhibit 4: Youth population declines and the elderly increases in proportion of the total population

China's Youth, Work-Age and Elderly Population: 1950 - 2050

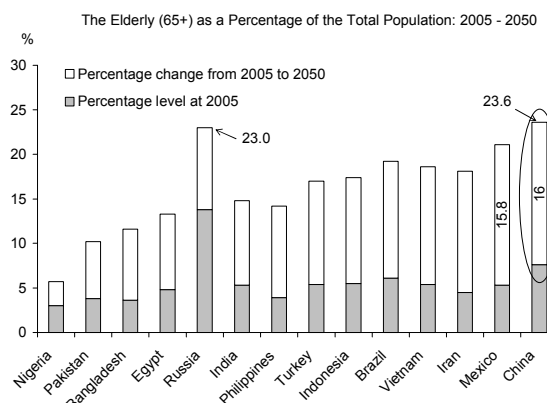Source: UNPD, Goldman Sachs Research estimates.

---

[8] There was a sharp drop in overall population growth during the great famine period of 1959–1961. The absolute level of population also declined over these years, which was mainly caused by a larger number of deaths and postponed pregnancies.

[9] See Appendix 1 for forecast details and a literature review on this subject.
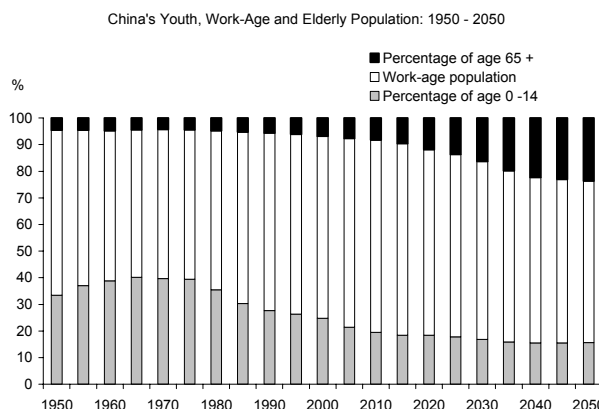
Exhibit 5: China's elderly population is larger in relative terms

The elderly population in China and India

	Absolute Size (Yr 2000 = 100)		As a Percentage of Total Population	
	China	India	China	India
2000	100	100	6.8	4.9
2030	271	269	16.3	9.3
2050	377	473	23.6	14.8

Source: UNPD, Goldman Sachs Research estimates.

The cause of China's aging problem lies mainly in the lack of young people, instead of the superabundance of the elderly. The reasoning is simple. Young cohorts tend to have a persistent impact on society because they are dependents today, workers tomorrow and the elderly afterwards, while the impact from the elderly is more transitory. For a concrete example, the absolute size of Chinese elderly of age 65+ is expected to virtually quadruple by 2050, while the same age group in India will grow by almost 5 times during the same period. Nonetheless, aging will not become a significant problem for India because it has a large young population, which when growing into adulthood, should more than offset the growth of the elderly population. In other words, it is really the shortage of youths that drives China's elderly ratio so much higher than India in the long run (see Exhibit 5).

China's shortfall in new births is partly due to the normal drop in fertility that accompanies economic development. Nonetheless the one-child policy introduced in 1978 has also played an important role (see Box 1).

The one-child policy has expedited China's aging process because it prevented millions of births [10] and caused population growth of children to decline sharply. The impact of this population control is unprecedented in human history, especially in a country known for its strong cultural preference for more offspring and the heavy reliance of its elderly on support from a large family. Despite such traditions, the Chinese government has managed to implement the Family Planning Policy consistently for the past 27 years. By limiting the total number of children each family has, it successfully cut down China's crude birth rate from 2.2‰ in 1980 to 1.4‰ per year in 2005, which is significantly lower than the current world average of 2.1‰ per annum (2.1 live births per 1000 people in a given year) [11].

Exhibit 6: The one-child policy weakens the youth base and the elderly population will increase in proportion to total population

Chinese Population Pyramid Charts of 1975, 2005, and 2050
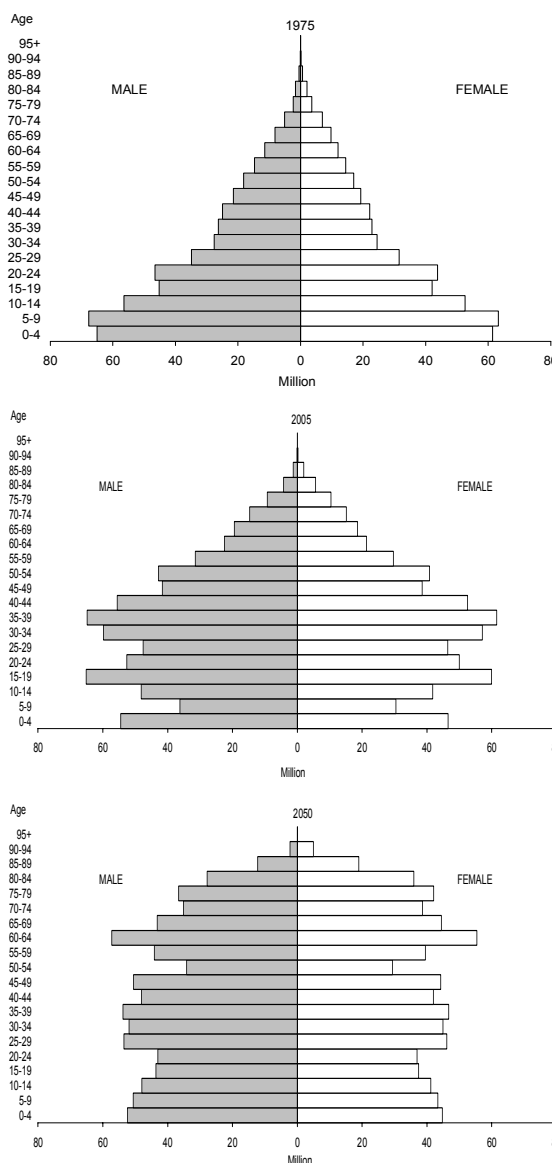
Source: UNPD (1975), CEIC, Goldman Sachs Research estimates.

The population pyramid charts above illustrate the demographic transition China is likely to experience from 1975 to 2050 if existing policies are left unchanged (see Exhibit 6). The total number of males and females of all age groups are placed on horizontal bars on the left and right respectively. The 1975 chart shows a strong base of young population under 15 before the initiation of the one-child policy in 1978. After 28 years of tight population control, China's demographic structure now looks more like a Christmas tree rather than the well-based pyramid of 30 years ago. The only-child generation born after 1978 occupies the entire lower portion of age

---

[10] The Chinese government has claimed that since the Family-Planning Policy was enacted, as many as 300 million new births have been prevented.

[11] Source: UNPD.

Box 1: A primer on China's one-child policy

Origins:
After the high infant mortality rate fell substantially in the 1950s, fear of exhausting food and other living resources among academics have increased. Demographer Ma Yinchu published his famous book *New Demography* in 1957 to echo this concern and proposed a variant of the Family Planning Policy.

However, the authorities (especially Mao) chose to subscribe to a Soviet view that high population would impact output growth favorably. This ushered a second baby boom in the late 1960s. In 1978, Deng Xiaoping embarked on economic reform, formally introducing the one-child policy.

The one-child policy was initiated in late 1978, and formalized in the Constitution in late 1982. Enforcement of this policy started for government and SOE employees as early as 1979 in urban areas. Later in the early 1980s, the "one-child-per-couple" rule was implemented and strictly enforced in both urban and rural areas.

A strict one-child rule?
Yes and no. The Family Planning Policy is commonly termed as the one-child policy, leading many to believe that the Chinese were not allowed to have more than one child per couple. However, this is not completely true.

First, the one-child-per-couple rule is strictly applied on urban residents, but not without exceptions. For example, families meeting one or more of the following conditions are allowed to have a second child: 1) permanent disability in the first born; 2) remarried families with only one child, and 3) pregnancy after long infertility but after adopting a child, etc. Second, rural couples, if first-borns are female, have been allowed to have a second child since the late 1980s. Third, couples of special groups (such as from minority groups or both from only-child families, or couples involving a foreign citizen) are subject to more relaxed rulings.

The carrot and stick enforcement
The effectiveness of this policy always makes people wonder how China did it. The carrot-and-stick approach China adopted was the key to effective control.

   Carrot:
   Families with only one child are rewarded by a monthly stipend albeit small in amount. All children born "within quota" (including the first and second child permitted) are issued a birth-approval certificate from the local government and a birth certificate from the hospital. These two permits allowed them to enter the household registration system (Hukou system) immediately after birth; this entitled them to social benefits such as free compulsory education and local preferential employment on reaching adulthood.

   Stick:
   Fines: Giving birth to children beyond the allowed limit would result in a "social fostering charge." This additional fee pays for the benefits and entitlements in the welfare system including free 9-year compulsory education. For a second child born without quota, this fee can range from 2 to 10 times of average annual dispensible income in urban/rural areas, or actual annual income, whichever is higher.

   Punishment: In addition to the pecuniary penalty, employers of those rule-breaking parents (especially those in the government or related organizations) may also take disciplinary actions against them, possibly affecting their career development. This measure used to work most effectively in urban areas because public-sector employees tend not to risk their jobs over a second child. There were also incidents where people were severely punished and harshly treated for pregnancy or births that are beyond assigned quota, especially during early years of implementation.

Where does the government come in?
Local government provides contraceptive advice, medical consultations and "treatments" (abortions and sterilizations) free of charge. Local bureaucrats have strong monetary and career-driven incentives to limit the local birth rate below quotas assigned by the immediate upper-level government. Failing in one or more standards would result in "one vote negates all" in their evaluation, and may permanently taint their political future.

---

[1] Marked by the Report of Committee of Population and Family Planning under the State Council was released on October 26, 1978. It included detailed policies as the following, "Each couple is encouraged to have only one child, not exceeding the limit of two and with at least 3 years apart from each child."

0–30. By 2050, without changes to the one-child policy, China's population will be much less supported at the base by the youth, and overweighted at the top due to aging.

Having fewer babies was helpful for per capita income growth in the past 28 years, but will drag down labor force growth in the near future. From 1975 to 2010, having less young dependents reduced the burden on the workforce. Strong growth in raw labor largely reinforced China's manufacturing-based industrial success. However, once the shortage of youth translates into a slower growing work-age population in the near future, the dependency ratio will have to go back up:

Dependency Ratio = Population of (0-14) and (65+)/Population of (15-64)

Exhibit 7 shows that China's dependency ratio will begin to rise around 2010, turning the "demographic bonus" into a deficit. It will ultimately reach 70% in 2050, implying that every 10 work-age laborers will have to support up to 7 dependents (young and senior) in 2050 versus less than 4 today. The rise in the dependency ratio is due to arrive at a certain stage of economic development. It struck Japan in the 1990s but will not capture India until 2040 (see Exhibit 8).

What makes China's case unique is that the sharp rise in dependency ratio will arrive earlier in terms of per-capita income level relative to other countries. The dependency ratios in Japan and Korea are supposed to reach 50% in 2005 and 2026 respectively[12], when their GDP per capita are mostly likely to be well above USD30,000[13] (2005 price). In contrast, our BRICS series projected China's per capita GDP to be USD11,089 in 2030, when the dependency ratio approaches 50%. To what extent will China's early ageing affect China's future growth outlook? We try to find answers from existing economic literature on how ageing is supposed to affect growth (see Box 2).

Our literature review suggests a weak link between per-capita growth and raw labor growth. Exhibit 9 seems to support this argument. It shows that although Chinese raw labor growth slowed in the 1990s, economic growth remained robust. It is therefore likely that when aging becomes a more critical issue in the future, government policies and people's behaviors will change in response and those changes will help to sustain economic growth. In particular, we think favorable changes in two labor factors will boost future growth.

[12] According to forecast of UNPD (medium variant).

[13] We estimate Japan's per capita GDP to be USD35,773 in 2005 based on existing data, and Korea's to be USD51,923 in 2025 (2005 price) in our previous BRICs report. See O'Neill J., D. Wilson, R. Purushothaman and A. Stupnytska: *How Solid are the BRICs?* Global Economics Paper No 134, December 1, 2005.

Exhibit 7: Disappearance of demographic bonus–a rising dependency ratio
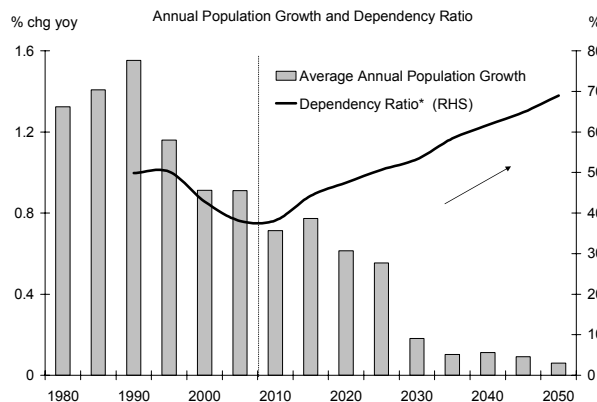
Source: World Bank, CEIC, Goldman Sachs Research estimates.

Exhibit 8: The rise in the dependency ratio due to arrive at a certain stage
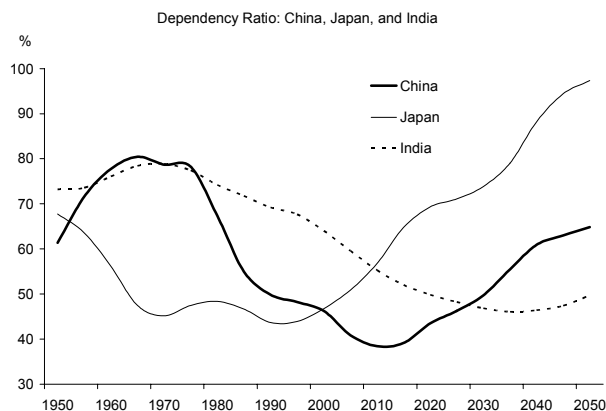
Source: UNPD, Goldman Sachs Research estimates.

Exhibit 9: Real output growth loosely correlated with the labor force growth

Source: CEIC, Goldman Sachs Research estimates.

Box 2: Academic literature is divided on the relationship between demographics and economic growth

Development economists are divided on how population and demographic changes have affected growth. The conventional wisdom is that fast population growth has a negative impact on per-capita growth, and development in most developing countries would benefit from a slower growing population[2].

On the other hand, aging probably also has negative implications on per-capita growth, because although total population growth slows, labor force growth usually slows even more. Studies on past growth experiences in East Asia showed economic growth was less rapid when growth of the work-age population slowed relative to total population[3].

Economists have diverse opinions on how aging **will** impact future growth due to different assumptions on how each production input will respond to aging. It seems obvious that if everything else were held constant, output growth will suffer if total labor supply growth slows down. Here assuming both that total labor supply will necessarily slow down, and that other production input factors (human capital, capital, Total Factor Productivity growth) will remain unchanged, is unrealistic. Economists therefore try to relax either or both of them in analyzing the growth impact of aging.

Those who allow all other production input to adjust are attempting measure the net impact of demographic transitions on growth. Batini, Callen and McKibbin (2006, IMF) claim aging in industrial countries will reduce aggregate growth over time. But there is also counter evidence from theoretical literature that aging increases the incentive to invest in human capital and save in physical capital, creating a favorable effect on productivity growth and the overall living standard[4].

Economists also suggest favorable policy changes will to a great extent help buffer the negative influence from ageing. These measures usually aim to raise the labor participation rate by encouraging more women and older workers to work and raising the propensity for youth to work-study[5]. In addition, theoretical literature[6] also pointed out that birth rates are negatively influenced by the growth rate of the social security system. It implies the pension regime can also become a policy lever to influence the future labor supply.

---

[1] Echrlich (1968).

[2] The National Research Council (of the US) (1987).

[3] Bloom and Williamson (1998).

[4] Scarth (2003).

[5] Burniaux, Duval and Jaumotte (2003) showed that such policies will help raise labor participation rates in OECD countries and sustain the labor growth from now to 2025. Similar suggestions on raising labor participation rate by maintaining the retiring labor force is made by Lawson, S., R. Purushothaman, and D. Heacock in 60 *Is the New 55: How the G6 Can Mitigate the Burden of Aging*, Global Economics Paper No. 132, September 28, 2005.

[6] Becker and Barro (1988).

We argue that after accounting for human capital improvement and a further release of surplus labor, China's quality-adjusted labor supply[14] growth may not slow much for several decades, and thus overall growth will hold up well.

Human capital accumulation

China has made remarkable progress in accumulating human capital as living standards improved since economic reform began in the late 1970s. Deng Xiaoping's policies revamped China's education development after years of repression during the Cultural Revolution. In addition, the one-child policy provided a huge impetus for education. Indirectly, population control makes children scarcer and more valuable to their parents, which encouraged parents to increase their educational investment on a per child basis within the family. Understandably, for each family with only one child, disposable income can be more generously allocated on that child than it would have been if there were several children. For the given government expenditure on education, each child also draws more benefits than if there were a larger cohort (see Exhibits 10 and 11).

Within a smaller family, parents are expected to raise their average expenditures on each child. Besides benevolent wishes, they do so in part because they want to hedge the risk of less future support from fewer children than desired, or as a result of peer pressure when they observe other parents stepping up their investments in their children.

The increased investment in human capital is not limited to monetary expenditure on formal education, books, health care and information-related products such as computers, newspapers and magazines. It also applies to

Exhibit 10: Real public education expenditure increased while young population growth slowed

Real Public Education Expenditure and Young Population Growth
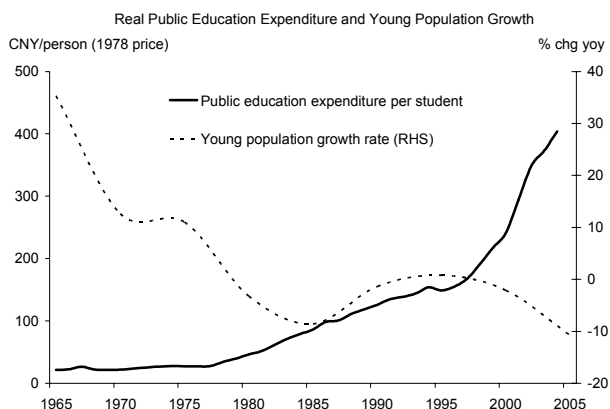
Source: UNPD, CEIC, Goldman Sachs Research estimates.

[14] For details, see Box 3: Quality-adjusted labor and growth accounting.

parents' attention and advice. Abundant material and emotional resources are expected to promote cognitive capability as well as familiarity to new technology of the "only-child generation," contributing to improving labor quality.

Exhibit 11: Both public and private education expenditure increased on a per-student basis

China's Real Education Expenditure per Student
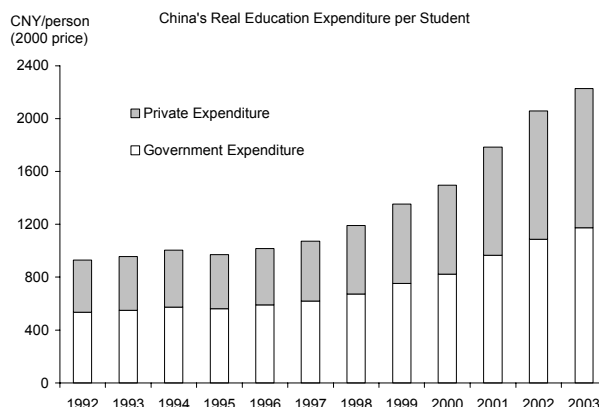
Source: China Statistical Yearbook (2005), Goldman Sachs Research estimates.

Exhibit 12: Promotion rate* and advancement rate** of higher-education institutions in China, Korea and Japan

	China	Korea (1)	Korea (2)	Japan
	Promotion Rate	Advancement Rate	Advancement Rate	Advancement Rate
	Senior Secondary School	General Senior Secondary School	All Senior Secondary School	All Senior Secondary School
1965	n.a.	43	38	25
1975	n.a.	42	40	34
1985	n.a.	54	42	31
1990	27	47	51	31
1995	50	73	69	38
1996	51	78	72	39
1997	49	81	73	41
1998	46	84	67	42
1999	64	85	65	44
2000	73	84	66	45
2001	79	85	66	45
2002	84	87	66	45
2003	83	90	66	45
2004	83	90	60	n.a.

* Promotion rate = all new entrants/senior high school graduates.

** Advancement rate = new entrants out of high school/senior high school graduates.

Source: National Bureau of Statistics of China, Ministry of Education & Human Resources Development of Korea, Korea National Statistical Office, Ministry of Education, Culture, Sports, Science and Technology of Japan, and Goldman Sachs Research estimates.

Compared to other countries at a similar stage of economic development, China's average labor quality has improved faster. It not only made huge progress in spreading 9-year compulsory education extensively in rural areas, but also has been successful in promoting more senior secondary school students into higher educational institutions (see Exhibit 12). From 1980–2004, China's gross enrollment rate of higher education jumped from 2% to 19%. Many more Chinese students have been offered the opportunity to go to universities or colleges. During the past 10 years, China has been producing college and university graduates at a significantly faster speed than Korea and Japan during their fastest growing periods (see Exhibit 13). Meanwhile, students' health conditions improved as well, as the result of a more balanced diet and higher priority placed on physical education.

This remarkable acceleration in human capital growth improves China's labor quality, and will become a buffer against the raw labor growth slowdown in the future (see Box 3). Looking forward, we expect this remarkable improvement in human capital to continue, amid more pressures from a competitive labor market.

Unleashing surplus labor

China's agricultural productivity has increased remarkably since the early 1980s, but its growth has lagged behind that of industrial productivity. Exhibit 14 shows that labor productivity in industrial sector has grown twice as fast as that in agriculture during 1979–2004 (see Exhibit 14).

The implied slower efficiency gain in the agricultural sector is partly due to less capital and poorer technology compared to other sectors, and partly due to the lower labor input hours per laborer in agriculture. We therefore expect when some laborers leave agriculture to work in the industrial or service sectors, the remaining laborers in agriculture may be able to increase their labor input in response (Sen 1966). In the end, real labor input in agriculture will not decline and total agricultural output growth will not be negatively affected (see Box 4).

The microeconomic picture is intuitive. When some family members leave agriculture to work at a part-time or full-time position in other sectors, other members of the family will likely step up their efforts to make up for his/her departure. After counting for the increased labor input, total output growth may be sustained. This seems to fit China's macro development path very well. Since 1978, a considerable amount of laborers migrated into cities and large areas were urbanized (see Exhibit 15). However, agricultural output growth remained robust despite the relocation of these laborers.

Exhibit 13: Annual average growth rate of graduates from higher education institutions: Chin, Korea and Japan

	China	Korea	Japan
1955-1965	n.a.	n.a.	5.9
1965-1975	n.a.	0.8	7.8
1975-1985	n.a.	n.a.	5.1
1985-1995	4.1	5.3	3.5
1990-2000	13.7	5.6	0.9

Source: National Bureau of Statistics of China, Ministry of Education & Human Resources Development of Korea, Korea National Statistical Office, Ministry of Education, Culture, Sports, Science and Technology of Japan, and Goldman Sachs Research estimates.

Exhibit 14: Productivity in the primary industry lagged significantly behind the secondary industry

Growth of Real GDP per Laborer of Primary and Secondary Industries
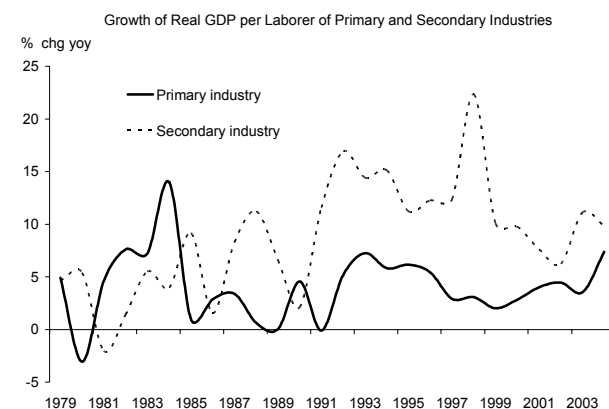
Note: Primary industry includes agriculture (crops and animal husbandry), forestry and fishing. Secondary industry refers to agricultural product processing, mining, manufacturing, and supply of electric power, gas, and construction.
Source: CEIC, Goldman Sachs Research estimates.

Exhibit 15: Fast urbanization since economic reforms

Urban and Rural Population as a Percentage of Total Population
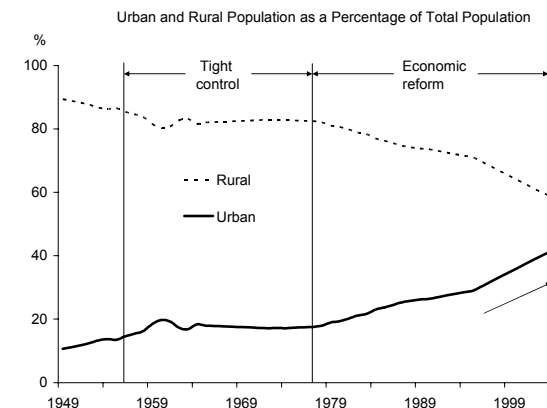
Source: CEIC, Goldman Sachs Research estimates.

Box 3: Quality-adjusted labor supply in production function

Economists tend to assume total labor supply consists of raw labor (L_{raw}) and human capital (*E*). What ultimately feeds into output growth is the quality-adjusted labor input ($L_{adjusted}$), together with capital input (*K*) and TFP (Total Factor Productivity) (*A*) in a production function, as follows:

$$Y = AK^{\alpha}L_{adjusted}^{(1-\alpha)} \text{, where } L_{adjusted} = E \cdot L_{raw}$$

To study the impact on output growth, we should inspect the growth outlook of quality-adjusted labor rather than that of raw labor alone.

In the context of this paper, we measure labor quality or human capital by average education attainment. We believe labor with a higher education attainment is capable of generating a higher value in all value-added activities, instead of a certain type of industry. We are inclined to think average years of education attainment is a more reliable and consistent indicator for China's human capital than the proxy variables usesd by other researchers (e.g., Young 2000). However, this is by no means to deny that other aspects of human capital, such as health conditions and training are also useful for productivity increase. Since education attainment should be positively correlated with these elements, they are reflected by our proxy indirectly.

Looking forward, we expect average education attainment to maintain its exceptional acceleration as the result of increased expenditure on education and training in China. Therefore, the growth of quality-adjusted labor should decline more slowly than that of raw labor. The likely scenario is illustrated below (see Exhibit B1).

Exhibit B1: Raw labor growth and quality-adjusted labor growth
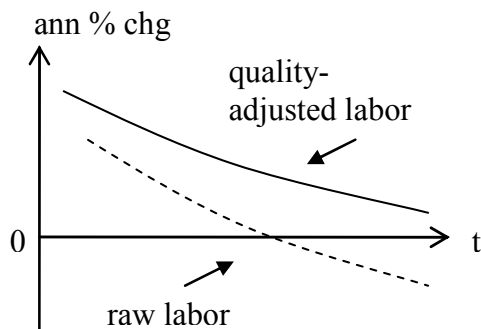
Box 4: China and the Lewis Model

The Chinese economy bears several characteristics that are similar to the dual-economy model Arthur W. Lewis developed in 1954. The Lewis model characterizes an economy where a traditional (agricultural) sector and a modern (industrial) sector co-exist. The traditional sector features unlimited labor supply but extremely low marginal product of labor [MPL] (close to zero). In the first phase of the model, laborers are constantly migrating from the traditional sector into the modern sector, but agricultural output does not fall appreciably. Unskilled labor moving into the industrial sector only lives on a minimum subsistence wage, which does not increase before the marginal product of labor in agriculture reaches the industrial-wage level.

Since 1978, a large flow of rural labor in China was released from the agricultural sector into the industrial and service sectors in urban areas. This young and entrepreneurial workforce has largely satisfied China's demand for skilled and unskilled labor for industrial development. As substantial laborers moved out of farming, China's agricultural output growth remained firm as the result of improved resource allocation. Productivity in the agricultural sector increased rapidly but still lagged significantly behind the industrial sector, as described in the weaker form of the Lewis model.

Lewis predicts the second phase of the model should arrive when marginal productivity of labor rises above the prevailing industrial wages at the minimum subsistence level, which will force industrial wages to rise. Indeed, there are signs that wages for unskilled labor in China is beginning to rise rapidly. Will China lose the edge in low-cost labor in the near future?

In our view, if migration obstacles can be removed, wages may not have to rise significantly to attract more rural laborers. Existing institutions, such as the Hukou system and many non-Hukou barriers, create a prohibitive migration cost on top of the higher living expenses in the urban area. This migration cost reduces expected earnings for rural laborers migrating to the industrial sector and distorts the incentive mechanism of migration. In this case, although marginal productivity of labor in agriculture is still way below that in other sectors, rural laborers is slow to migrate out because

$$MPL_{agriculture} \geq Earnings_{expected} = Wage_{industrial} - Cost_{migration} .$$

A greater labor demand tends to bid up wages. But we argue that eliminating migration barriers will increase the labor supply without raising wages substantially. Current measures to relax the Hukou constraints and a potential reduction of other migration barriers will increase expected earnings and help postpone the arrival of the last phase of the dual-sector model.

Exhibit B2 illustrates this possibility. Suppose the economy is on the verge of the second phase. An increased labor demand will increase the equilibrium wage level above w. But if we lower the migration cost, it effectively increases labor supply at the same wage. This change induces the labor supply curve to shift outward so that the new equilibrium will be at S_2. At this new equilibrium point, a greater labor force ($L_2 > L_1$) will be hired at the same wage (w) as before. The first phase of the Lewis model is therefore extended by releasing agricultural surplus labor ($L_2 - L_1$).

Exhibit B2: Labor market with migration costs (phase 1 and 2 of the Lewis Model)
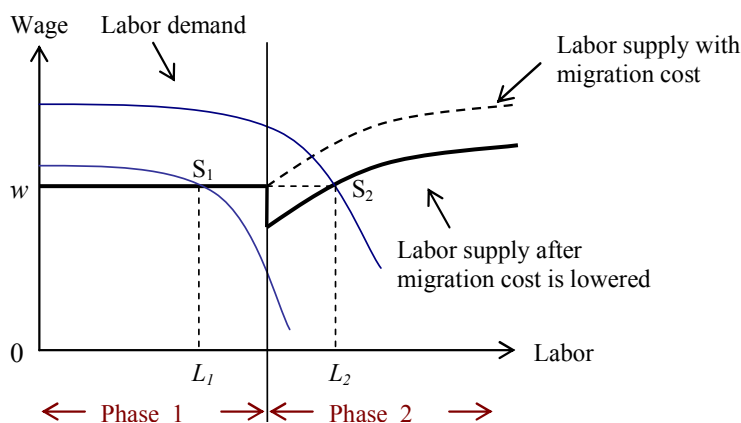
Past restrictions from the household registration system (or Hukou system) and various other barriers have largely prevented surplus laborers from migrating into cities to work for higher compensation (see Box 5). A person registered under a rural household used to be required to obtain multiple permits before and after he/she legally moved into urban areas and searched for a job. Such requirements are being phased out in various areas. Chinese authorities are also initiating Hukou reforms to eliminate rural-urban disparity. Several large cities have suspended the temporary residential permit requirement for migrants, and a few provinces are on the way to unify urban and rural household registration records so that residents will be free to move within the province.

Besides the constraints from the Hukou system, non-Hukou barriers also take up a formidable proportion of the migration cost. Before the migration decision is made, rural laborers have to worry about the potential forfeiture of their right of cultivation when they return in the future. They also have to keep in mind that they will have no access to high-paying urban jobs that are often reserved for urban residents in certain industries by the local government. Disappointment is easy to arise from job searching, the lack of unemployment insurance, and an unfavorable working and living environment in cities. These all add to the costs of migrating from their hometowns into the cities.

We view the ongoing Hukou reform and a potential reduction of the non-Hukou barriers as positive signals to reduce the distortion in resource allocation. There will likely be a windfall gain in relaxing the system and allowing workers to move more freely into the industrial sector.

The ongoing reform of state-owned enterprise (SOE), government and public service units will almost certainly free more redundant labor as the result of resource misallocation from earlier times. The total number of laborers that can be released from these sectors may not be significant when compared to that from the rural areas, but the potential social impact in urban areas can be challenging. We do not include this portion of labor in our scenario analysis mainly because it is difficult to estimate the number of eligible laborers with matched skills for openings.

A review on the world standard of agricultural population and output reveals that, as China progresses towards the standard of a developed economy, it will likely experience a further decline in both the proportion of work force and the value added in output in agriculture relative to the rest of the economy (see Exhibit 16).

We assume conservatively that roughly 20%–27% of the agricultural labor force (approximately 98–128 million) is

surplus[15]. Since those of age 15–29 are perhaps the most likely to migrate into cities[16], this implies that a gradual relaxation of the Hukou system and other migration barriers could potentially release 25–32 million young laborers into the industrial or service sectors potentially. In our growth projection below, we assume 27 million surplus laborers will exit the agriculture sector accumulatively in 2006–2050. The migration flow will presumably start with a one-million release in 2006, and adding 200,000 in the second year and gradually more in subsequent years. Since the remaining laborers in this sector will likely increase their labor input to compensate for those who have departed, it implies the economy will have a net gain of labor input worth of 27 million people in total.

A potential easing of the one-child policy

A change in the one-child policy would help sustain China's population growth in the long run and improve its demographic structure. In our view, a gradual and conditional easing of the one-child policy beginning in 2010 will significantly boost China's total population by 2050.

China's government is reported to be considering a gradual lifting of the one-child policy as early as 2010[17]. From past experience of one-child policy reforms, the authorities are likely to consider a variety of options proposed by demographic researchers. Among these proposals, we believe the plan documented in Sin (2005, World Bank) is more neutral in terms of timing and has a high likelihood of being adopted[18].

Exhibit 16: China's agricultural output and labor force in proportion to the entire economy is larger than other countries

Unit: % of Total	Value Added (2002)	Labor Force (2004)
World	4	43
Developed Countries	2	6
Industrialized countries	2	3
Transition Economies	7	14
Developing Countries	12	53
China	13	44

Source: Summary of World Food and Agricultural Statistics 2004, Food and Agriculture Organization of the UN, China data, CEIC and Goldman Sachs Research estimate.

---

[15] Our estimate is close to that in existing literature on this subject, which usually points to a range of 100 to 140 million surplus laborers in agriculture. For a detailed survey and estimation, see Cai et al 1996.

[16] Most surplus labor may have to migrate into cities given that the ability of township and village enterprises (TVEs) to absorb rural labor has decreased. Cai et al (1996).

[17] Sin (2005, World Bank).

[18] Academics such as Yi Zeng of CCER, Peking University, also advocated a similar approach to be enacted as early as 2006. Our estimate has a later initiation year and does not simulate a significant increase in women's average age to give births as suggested by Zeng. It is mainly because we believe when a larger percentage of women are allowed to have a second child, they are more likely to take their decisions rationally and avoid delivery at older ages.

Box 5: Deciphering the Hukou system

Hukou = household registration

Hukou (or Huji) is the common name for household registration in China. The origin of the Hukou system can be traced back to Shang Dynasty 3,500 years ago. Administration with legal enforcement was introduced into practice in Qin Dynasty in 220 B.C. The household registration system was in place to take count of residents and limit their mobility across regions and unify tax collection.

The new Hukou system under the communist regime was formally established in 1958, which strengthened the mobility constraint to prevent rural residents from moving into cities and urban residents migrating across cities.

Rationale behind the system

The household registration system ensured the extraction of agricultural surplus to facilitate the early episode of industrialization, as it was in the Soviet development model. Since the 1950s, China has placed unprecedented emphasis on developing heavy industries, supported by low living costs and a heavily-subsidized welfare system for urban workers. Academics believe the Hukou system helped the government separate urban-rural labor forces to ensure sufficient labor supply in agriculture (Cai, 2000).

A binding constraint on urbanization?

The Hukou system has become a binding constraint for most people to move. In a centrally-planned economy, the seamless integration of the Hukou system with other socialistic institutions helped keep people from moving.

For a long time, food quotas were allocated by Hukou record under the Unified Procurement and Unified Sales system of agricultural commodities. People were deterred from moving to other areas due to constraints on food allocation, employment and education. From 1958 to the early 1980s, any urban-rural migration was virtually forbidden except for official-planning purposes.

Since China began its transformation into a market economy and especially after the 1990s, rural-urban migration has become more feasible for those who completed their education and would like to search for jobs in informal sectors. It particularly catered to the young rural population, who first ventured into construction, manufacturing and service afterwards in urban areas.

Looking forward, a greater proportion of the population may urbanize either by migrating to, or choosing to stay longer in cities. Alternatively, even if people stay home, their hometowns could be urbanized soon. To facilitate urbanization, the current Hukou reform is certainly laudable, but more has to be done. Reducing other migration costs and improving living conditions for migrant workers will be essential to keep them in cities.

Exhibit 17: If the one-child policy were lifted, China will have a higher population growth

Population in Baseline Scenario and After the One-Child-Policy Lift

Source: CEIC, Goldman Sachs Research estimates.

Exhibit 18: ... and a more balanced demographic structure

2050 (The One Child Policy Lifted)
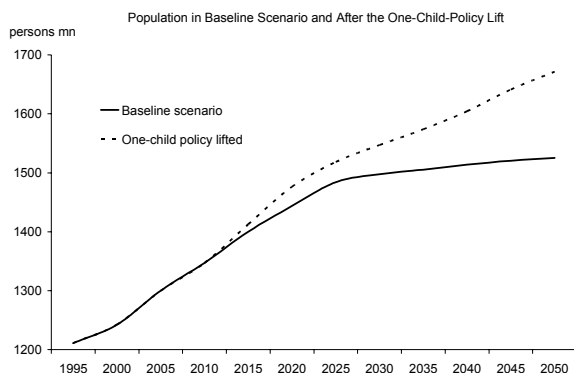
Source: CEIC, Goldman Sachs Research estimates.

It allows women aged 35 and over to have up to two children (regardless of gender) per woman beginning in 2010, followed by a lowering of the 35-year age limit by one year every year.

As a result of such assumptions, initial shocks from released birth quotas may cause an upsurge in fertility rates in the early years following the policy change. Ultimately, birth rates are likely to stabilize around a level above developed country standard but below that of developing countries. As it is shown above, the potential lifting of the one-child policy boosts the prospects for population growth for China (see Exhibit 17), and potentially secures a significantly larger young population at the base of the demographic structure for the future (see Exhibit 18).

Output growth forecast

We believe economic growth will be affected by the combination of forces including the demographic transition, fast improving human capital, and the further release of surplus labor from the agriculture sector. We show in the following analysis that output growth will hold up well after accounting for the last two factors, as well as a potential easing of the one-child policy.

We project real GDP growth in three scenarios (see Exhibit 19):

- Scenario 1 is the baseline case and does not account for any human capital acceleration or further reduction of rural-labor migration barriers. It implicitly assumes China will undergo a modest accumulation of human capital, and has no change in the urbanization or one-child policy.

- In Scenario 2, we take into account the fast acceleration of education attainment going forward, and allow rural surplus laborers to migrate more freely starting 2006. The potential policy environment needed for the second scenario seems to be shaping up well.

- Scenario 3 takes into account labor quality improvement and surplus labor release, and assumes a phase-out of the one-child policy beginning in 2010, with details consistent with the proposal discussed in the previous section. As we mentioned above, the extensive review on the one-child policy implies increasing optimism for the conditional easing of the one-child policy. Hence, we are inclined to think among the three scenarios, Scenario 3 is the most likely to take place.

Exhibit 19: Assumptions of different scenarios

	Scenario 1 (Baseline)	Scenario 2 (+)	Scenario 3 (++)
One-child policy	No change	No change	Lift in 2010
Human capital	Status quo	Fast improvement	Fast improvement
Hukou system	Status quo	Relaxed	Relaxed

Source: CEIC, Goldman Sachs Research estimates.

Our growth estimates (see Exhibits 20 and 21) show that the labor quality improvement and a further release of rural labor force will indeed buttress China's future growth. The baseline estimate in Scenario 1 is similar to our earlier BRIC projections. Scenario 2 and 3 take into account labor improvement and released labor, suggesting an even more bullish growth prospect than Scenario 1, or the BRICS estimates we made previously.

In particular, the forecast for Scenario 3 demonstrates that the easing of the one-child policy will likely further accelerate total GDP growth by 12 basis points and have a limited negative impact on per-capita GDP income. It is because a greater proportion of the added population will be in urban areas and thus enjoying better education opportunities. Improvement in average labor quality will ultimately outweigh the burden from the increasing dependent population, and help sustain overall growth especially towards 2050.

Together these results suggest, by the time China gets old, it should be fairly developed judged by many criteria, but perhaps still not richer than the US or Japan in terms of per-capita income.

Richness is usually defined in relative terms, while economic development is both an absolute and relative concept. More than often, an economy will be considered a developed economy upon its accession into the OECD[19], the so-called "rich man's club." Korea was admitted in 1997 with a GNP per capita at USD9,460 in 2001 terms. Some economists therefore take USD10,000 as a benchmark of the development stage and consider those who surpass this level to be a developed economy. In fact, this standard turns out to be less arbitrary than it appears, and seldom gives a wrong call. Economies above this line are fairly developed, and are often consistent in sectoral composition of output, urbanization, life expectancy, national wealth, capital stock per labor hour, education and service-sector development, etc.

For China, this day may not be too far away. Our analysis shows that by the time China becomes an aged society in 2027, its per-capita GDP should have surpassed USD10,000 (2005 terms) in all scenarios – the benchmark for developed economy with a reasonable level of industrialization. However, even by the year of 2030, the most optimistic scenario suggests that China's per capita GDP could reach USD21,626 (2005 price), but stay well below BRICs estimates of per capita GDP of the US (USD61,336), Japan (USD60,177) and Germany (USD51,176) of that year [20].

---

[19] With notably exception of Mexico, admitted into OECD in 1994 with per-capita GDP of less than USD5,000 (1995 price).

[20] Estimates of US, Japan and Germany per capita GDP from O'Neill, J., D. Wilson, R. Purushothaman and A. Stupnytska: *How Solid are the BRICs*. Global Economics Paper No: 134, December 1, 2005.

Exhibit 20: Projected real GDP growth: 2005–2050 annual average

Unit: % ppts	Scenario 1	Scenario 2	Scenario 3
Total GDP	4.69	5.17	5.29
GDP growth per capita	4.32	4.80	4.71

Source: Goldman Sachs Research estimates.

Exhibit 21: Projected China's real GDP growth

avg % chg yoy	BRIC	Scenario 1	Scenario 2	Scenario 3
2005 – 2010	7.6	7.5	8.9	8.9
2011 – 2015	6.0	6.0	7.0	6.9
2016 – 2020	5.0	5.7	6.5	6.3
2021 – 2025	4.5	5.1	5.3	5.4
2026 – 2030	4.0	4.5	4.9	5.1
2031 – 2035	3.8	3.8	4.0	4.3
2036 – 2040	3.8	3.6	3.9	3.9
2041 – 2045	3.4	3.1	3.2	3.5
2046 – 2050	2.8	2.9	3.0	3.5

Source: Goldman Sachs Research estimates.

In summary, our study on China's future labor supply has the following implications:

1. In the medium term, "demographic deficits" will likely be counterbalanced by an unusually fast accumulation of human capital and a further release of rural surplus laborers.

2. In the longer run, China's growth will likely hold up well as the dragon ages. By the time it gets old, China will be considered a developed economy although probably not richer than the most developed countries.

3. Our BRIC projection of China's real GDP growth may still have some upside, if China adopts a favorable policy mix to address the labor issues. A potential easing of the one-child policy after 2010 will help boost China's long-term growth especially towards 2050.

Policies to watch

In our view, China is taking the necessary steps in education and labor market to ease the demographic constraints, which means that Scenario 2 and 3 are more than likely to take place than Scenario 1. Potential policy changes in these areas are important levers China can and should push to counter the negative influence from demographic changes. In this sense, we believe demographics are not going to determine China's destiny to the extent as most people have thought.

Making education affordable and flexible

China will most likely become more committed to educational improvement during the 11th Five-year Plan. There is potential room for expansion of China's public expenditure on education, which as a percentage of GDP appears low relative to others (see Exhibit 22)[21]. A strong commitment to improve on this level would help build a more evenly distributed network to provide high-quality compulsory education, especially if the youth base were augmented by a relaxation of the one-child policy.

Premier Wen's recent commitment to completely free compulsory education will certainly provide an extra boost. Since the one-child policy allows rural households to have more children than urban families, the future Chinese population will tilt towards rural areas in weight. It will become even more important to address the regional disparity and income inequality problem. The government will help increase the average labor quality if it reduces financial burdens to continued education in rural areas and make sure rural students are not left behind. Only if youngsters from the countryside receive better education opportunities and skill sets for work, will they be able to migrate into cities to take more permanent positions in high valued-added industries.

In addition to increased input, making the education system more flexible in structure and content will enable China to further improve labor quality. If the government allows private schools to provide quality service in vocational schools, continued studies and various trainings, it will supplement the formal public education system with a back-up arrangement for early drop-outs. Such measures will ultimately benefit the continuous accumulation of human capital in the long run. In addition, the government's permission on more flexibility on the content of school education will help students adjust towards the market demand for labor.

China has an additional advantage over others because its overseas Diaspora society[22] offers a reservoir of highly skilled labor. Once they decide to come back, China's labor supply will be largely enriched at the top end. How China performs in the near future and how friendly its policies of attracting these people back will largely determine how many of them will indeed return one day.

Facilitating migration

In addition to the current reform of the Hukou system, reducing non-Hukou barriers to migration will be important policies to watch. The rural economy has to be restructured away from small household leaseholds of uncertain tenure to larger commercial farms with more

Exhibit 22: China's government expenditure on education lags behind other countries

Public Expenditure on Education as a Percentage of GDP: 1999/2000
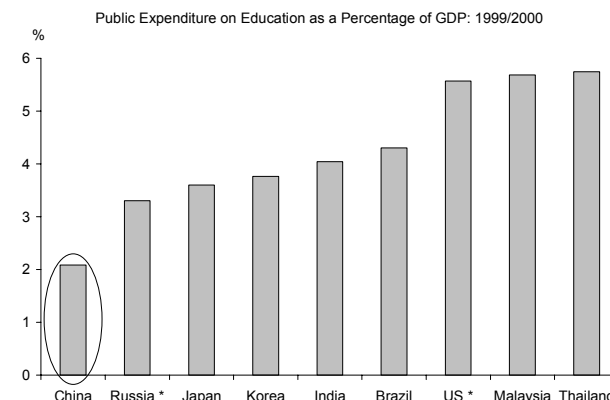
*The US and Russian data are not available for 1999/2000, and thus are substituted by the average of 1998/1999 and 2000/2001.
Source: UNESCO, Goldman Sachs Research estimates.

secure property rights. Otherwise, migration is likely to stall.

Changing the one-child policy

We believe the one-child policy is highly likely to be eased. Our estimates have shown that such a lifting, even just conditionally and gradually, will not hurt China's per capita growth. Instead, relaxing this policy would boost further growth by supplying more laborers while higher income will enable them to be educated to a higher standard. It is also wise to reduce the large enforcement cost while improving China's international image.

Deepening rather than expanding the pension reform

The direction of the pension reform may also influence the future labor supply. China is probably better off by avoiding the mistakes of over-expansion that has occurred in many OECD countries. The current scope of the pension reform offers sufficient support for a limited number of retirees [23] without building up huge government debts for future generations or discouraging child-raising [24]. For farmers and the self-employed, private savings still would be considered the most effective support. To encourage private accounts to be fully funded, and sustain private savings, China will have to liberalize and put in order its capital markets before investors can pour money in without worrying about losing long-term support.

---

[23] Scholars have suggested OECD economies should increase the required retirement age to lift labor participation rate. It would likely be less effective for China at least in the near term, because current requirements (retirement age at 60 for men and 55 for women at managerial positions and 50 otherwise) are far from being binding anyway. However, notably, the practice of retaining some skilled employees approaching retirement age is becoming less uncommon. We deem it beneficial to expand such practice to battle against ageing in the mid-to-long run.

[24] The World Bank has warned China against expanding pension coverage too rapidly and advised it to place priority on funding the pension system as it is. (Sin, 2005)

---

[21] For public education expenditure as a percentage of total government expenditure, the contrast between China and other countries is smaller.

[22] It may also include people from Hong Kong, Macau and Taiwan and their Diaspora societies overseas, who wish to work in mainland China.

Implications of an aging but fast-growing China:

- **China is graying but its economy should continue to grow fast** with the help of a better-educated labor force and fast urbanization. The early arrival of aging relative to industrialization will allow China to reap the gain from human capital development and intensive urbanization, which helps buffer the slowing labor growth in the future.

- **The strong economic outlook for China will provide renewed opportunities for its Asian neighbors**, **as well as** compensate for the relative slowdown of **the G-7 economies**. It implies that policy agendas in industrial economies should be oriented toward helping them benefit from China's rise, rather than preventing them from achieving such gains by cutting ties with China.

- For China, **the demographic transition will likely become a positive catalyst for financial markets**, as a larger percentage of savers come into their highest earning periods (see Exhibit 23). Financial asset prices may rise during the early stages of aging. But when a large number of pensioners start to switch into less-risky assets, stock prices will likely decline[25].

- In our view, **investment growth will remain solid** for two reasons: first, the rural-urban migration requires more capital deepening to equip laborers coming into the industrial and service sectors. Second, even in the distant future when laborers are in short supply, investment has to increase to replace labor with capital. But ultimately, at a certain point of industrialization, investment may slowly decline as a percentage of GDP when headline growth relatively slows.

- **Future growth also ensures the market potential for commodities as well as multinationals producing consumer goods in China for the local market**. Commodity prices will benefit as China industrializes and transforms into a developed economy.

- **Aging will result in some winning sectors** such as insurance, pharmaceuticals, biotech and health foods. We also foresee rising opportunities for the financial-services industry to offer a larger variety of products as they cater for the needs to accumulate and preserve wealth. New industries such as nursing homes and new property opportunities such as vacation homes are likely to gain as well.

- **Consumption patterns will not only shift because of aging, but more importantly, due to behavioral changes induced by added human capital and rapid urbanization.** Chinese consumers will become more sophisticated and their spending habits will evolve to look more like consumers in developed countries. This may translate into positive catalysts for the traveling, entertainment, media, fashion, luxury goods, consumer appliances sectors as well as property in the medium term as these people gain more purchasing power. Rural migrants moving into an urban environment are likely to pick up urban consumption patterns, albeit with a time lag and with less preference for durability and quality.

Exhibit 23: More savers come into being implying a financial market boom after 2015?
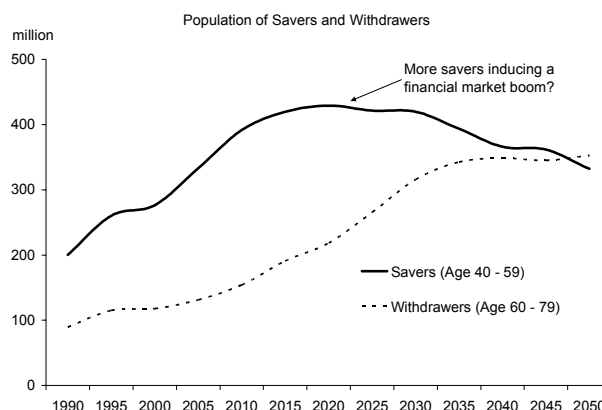
Source: CEIC, Goldman Sachs Research estimates.

---

[25] The World Economic Outlook (September 2004, IMF).

Appendices: Technical Notes

Appendix 1: Population forecast methodology and assumptions

For our population forecast of 2005–2050, we divided the entire population into 5-year cohorts for each gender to create 40 age groups in total. Information on age structure and gender composition was extracted from the 2000 data published by the National Bureau of Statistics (NBS). We then projected this data onto year 2005 and onwards using age-specific fertility and mortality assumptions obtained from the World Bank Population Unit.

The World Bank assumptions are sufficient to allow us to analyze implications of population policy changes in great detail. It is the only database from which we have received such detailed information on cohort-based fertility rates. Such assumptions are essential for our study on the impact of an age-specific lift of the one-child policy by 2010.

As a result, our population projection differs from but remains consistent with those of other databases. Our result is mostly comparable with Sin (2005, World Bank), which applies the same assumption set for projection on the basis of the 1999 data from the NBS. Our estimate has limited difference quantitatively from other forecasts such as those of the US Census Bureau[26], and bears more resemblance to the official forecast from the National Population and Family Planning Commission of China. Comparing with the UNPD database, our projection lies between their medium-variant and high-variant fertility rate forecasts.

We are aware that some researchers tend to disagree on the arrival time and level of the population peak[27]. Zhang Ji of the Chinese Academy of Social Science recently argued that the population peak will arrive much earlier than the consensus period and at a much lower level. Clint Laurent of Asian Demographics Ltd was quoted to claim that Chinese new-birth numbers have been over-estimated by millions, and thus the aging problem is more pressing than suggested by the official records[28].

We are inclined to think the official statistics on population growth have both upside and downside risks, and the true number may not lie far from what is reported officially. On one hand, the government may over-report the fertility rate to prevent criticism of the one-child policy. On the other hand, "above-quota" births in the

rural area largely escaped the Hukou system and population census, and thus may not be fully reflected in the statistics.

In contrast, our projection is based on detailed assumptions from the World Bank Population Unit, and slightly adjusted towards the UNPD medium-variant standard. Hence it takes into consideration the general context of developing countries while accounting for consequences brought by the one-child policy.

Our projection methodology is as follows. We used the World Bank assumption on the age-specific mortality rate to calculate the probability for each cohort to survive to the next time period. At the beginning of each period, we assume there are new births from survived women in the last period, calculated by age-specific fertility rates. Due to the well-known problem of gender bias in new births in China, the World Bank Population Unit also assumed a sex ratio at birth that is close to what is found in the 2000 population census. Hence, the population of each new period is calculated as the following: add the population of the last period, new births, and deduct total deaths and net emigrants:

$$P_t = P_{t-1} + (number\ of\ births) - (number\ of\ deaths) + (number\ of\ immigrants) - (number\ of\ emigrants)$$

Our baseline-scenario population forecast is shown in Exhibit A1. The upside potential from a lifting of the one-child policy in 2010 is placed in Exhibit A2, which was applied in the Scenario 3 of our growth projection.

Exhibit A1: Chinese population 2005–2050

Million persons	Male	Female	Total	Total Growth (ann % Chg)
2005	672	629	1300	0.91
2010	697	651	1347	0.71
2015	724	676	1400	0.77
2020	747	697	1444	0.61
2025	768	717	1484	0.55
2030	774	724	1498	0.18
2035	777	728	1505	0.10
2040	781	732	1514	0.11
2045	785	736	1521	0.09
2050	788	737	1525	0.06

Source: Goldman Sachs Research estimates.

Exhibit A2: Chinese population with the one-child policy relaxed in 2010

Million persons	Male	Female	Total	Total Growth (ann % Chg)
2005	672	628	1300	0.91
2010	696	651	1347	0.71
2015	730	683	1413	0.96
2020	762	715	1476	0.89
2025	781	737	1518	0.56
2030	794	753	1547	0.38
2035	804	769	1574	0.34
2040	817	787	1604	0.39
2045	833	808	1641	0.45
2050	846	826	1671	0.37

Source: CEIC, Goldman Sachs Research estimates.

---

[26] The US Census Bureau forecast is based on data from national statistics office, UN agencies and their own estimates, and close in result with that of the UNPD.

[27] Such disagreement comes from different assumptions on fertility rates, which may indicate different speeds of aging. If the actual fertility rates turned out to be substantially below the official records, as suggested by Zhang Ji and Clint Laurent, our estimate on the timing and impact of ageing would have to be adjusted, although not yielding results that are qualitatively different.

[28] The Economist, February 24, 2005.

Appendix 2: Growth model assumptions

We base our growth accounting on a Cobb-Douglas-form production function in a partial-equilibrium framework. Since the long-run growth path is determined by supply-side factors, our supply-driven results should not be qualitatively different from that of a general-equilibrium model. The study focuses on the response in labor supply and its impact on long-term growth, supported by reasonable assumptions on TFP growth, capital depreciation and formation. Our assumptions are mostly based on our findings in the preceding work[29] on China's TFP estimation and remain in line with the BRICs reports.

- We assume the production technology keeps an unvarying form with constant income share of capital assumed of 0.4. It ensures that 1) production remains to be constant-return-to-scale, and 2) any further economic growth is technology-neutral.

- Assumptions on the initial stock and depreciation rate of capital are all made on the basis of our TFP estimation aforementioned. We assumed the capital depreciation rate to be 0.042, identical with that in the TFP paper.

- Given the high TFP growth China demonstrated in the past 26 years, we allow China's TFP growth to remain high and only gradually converging to the US long-term TFP growth rate of 1.3% towards 2050 (BRICs).

- Raw labor growth comes from our forecast on the work-age population and a constant unemployment rate. Scenario 2 assumes a gradual release of laborers starting 2006, beginning with 1 million migrants coming into cities in 2006, while adding 200,000 in the second year and gradually more in subsequent years. Altogether we assume conservatively a total of 27 million laborers of age 15–29 will be released by 2050. Scenario 3 assumes a gradual release of the one-child policy starting 2010, with detailed measures and the population projection described in the population outlook section.

- Human capital accumulation is assumed to sustain robust growth, with a higher literacy rate, a more extensively executed compulsory-education program coming in the next 5 years and a higher promotion rate from junior secondary school to secondary high school after 2010. By the year 2050, China's average education years will be 12.4 years, comparable to industrialized-country levels today.

---

[29] Liang, Hong: *China's Ascent: Can the Middle Kingdom Meet Its Dreams?* Global Economics Paper No. 133, November 11, 2005.

Reference:

Baumgartner J., S. Kaniovski, T. Url, H. Hofer and U. Schul. (2004). *A Long-run Macroeconomic Model of the Austrian Economy: Model Documentation and Simulations*

Batini N., T. Callen, and W. McKibbin, *The Global Impact of Demographic Change*, IMF working paper

Becker, *G. Definition of Human Capital from the Concise Encyclopedia of Economics*, the Library of Economics and Liberty

Becker G. and R. Barro (1988). *A Reformulation of the Economic Theory of Fertility*, Quarterly Journal of Economics

Bloom D. E. and J. G. Williamson (1998). *Demographic Transitions and Economic Miracles in Emerging Asia*, The World Bank Economic Review, Vol. 12, No. 3: 419 – 55

Burniaux, J., R. Duval and F. Jaumotte (2003). *Coping with Ageing*, OECD Economic Department Working Paper No. 371

Cai, Fang. (2000). *The Invisible Hand and Visible Feet: Internal Migration in China*, Working Paper Series No. 5, December, Chinese Academy of Social Science

Cai, Fang, C.A. Carter and F. Zhong (1996). *China's Ongoing Agricultural Reform*, The 1990 Institute

Cai, Fang, Zhengming Wang and Meiyan Wang. (2001). Chinese Population and Family Planning Policies: Enforcement and Consequences, Working Paper, CASS

The Economist. (2005). *China's Golden Oldies*, February 24th, and *It's the people, stupid*, March 3rd

Ehrlich, P.R. (1968). *The Population Bomb*, Ballentine, New York

International Monetary Fund. (2004). *World Economic Outlook*, September (Washington)

Jackson, R. and N. Howe. (2004). *The Graying of the Middle Kingdom: The Demographics and Economics of Retirement Policy in China*. Center for Strategic and International Studies.

Jiang, Lihua (2002). *A Historical Perspective of China's Huji System*. Northwest Demographics, volume 1.

Liang, Hong (2005). *China's Ascent: Can the Middle Kingdom Meet Its Dreams*. Goldman Sachs Global Economics Paper No. 133

Martins, J. O, F. Gonand, P. Antolin, C. de la Maisonneuve, and K.Y. Yoo. (2005). *The Impact of Ageing on Demand, Factor Markets and Growth*, Economics Working Papers No. 420, OECD

National Research Council. (1986). *Population Growth and Economic Development: Policy Questions*, National Academy Press, Washington, D.C.

O'Neill, J., D. Wilson, R. Purushothaman and A. Stupnytska. (2005) *How Solid are the BRICs*, Goldman Sachs Global Economic Paper No: 134

Scarth, W. (2003) *Population Ageing, Productivity, and Growth in Living Standards*, GSEP Research Report No. 380.

Sen, A.K. (1966) *Peasants and Dualism With or Without Surplus Labor*, Journal of Political Economy 74, 425 – 450

Sin, Y. (2005) *China Pension Liabilities and Reform Options for Old Age Insurance*, the World Bank working paper series.

Wilson, D. and R. Purushothaman. (2003) *Dreaming with BRICs: The Path to 2050*, Goldman Sachs Global Economic Paper No: 99

Xia, Long. (2004). *A Study on the Implementation of the Rural Family Planning Policy*

Young, A. (2000). *Gold into Base Metals: Productivity Growth in the People's Republic of China during the Reform Period*, NBER working paper #7856

Yoshikawa, H. (2000) *Technical progress and the growth of the Japanese economy - past and future*, Oxford Review of Economic Policy, 16: 34-45; doi:10.1093/oxrep/16.2.34

Zeng, Yi (2005) *The necessity and feasibility of implementing a gradual two-child late-birth policy*, CCER, Peking University, No.C2005010

Recent Global Economic Papers

Paper No.	Title	Date	Author
137	Housing Holds the Key to Fed Policy	3-Feb-2006	Jan Hatzius
136	Dark Matter or Cold Fusion?	16-Jan-2006	Willem Buiter, Advisor
135	German Manufacturing will Survive EU Enlargement	9-Dec-2005	Dirk Schumacher
134	How Solid are the BRICs?	1-Dec-2005	Jim O'Neill Dominic Wilson Roopa Purushothaman Anna Stupnytska
133	China's Ascent: Can the Middle Kingdom Meet Its Dreams?	11-Nov-2005	Hong Liang Eva Yi
132	60 Is the New 55: How the G6 Can Mitigate the Burden of Aging	28-Sep-2005	Sandra Lawson Roopa Purushothaman David Heacock
131	Is Foreign Direct Investment an Engine for Economic Growth?	16-Sep-2005	Binit Patel Monica Fuentes Anna Stupnytska
130	What Italy Needs to Do	14-Sep-2005	Kevin Daly Ines Calado Lopes
129	China and Asia's Future Monetary System	12-Sep-2005	Jim O'Neill
128	The Impact of Pension Reform on the Capital Markets	8-Sep-2005	Dambisa F. Moyo
127	The "ABC" of Asia's FX Regime Shift	1-Sep-2005	Sun-Bae Kim Tetsufumi Yamakawa
126	Europe: Challenged by Globalisation	13-Jul-2005	Erik F. Nielsen Nicolas Sobczak
125	Inflation Targeting—The Case for More?	15-Jun-2005	Jim O'Neill
124	Merging GSDEER and GSDEEMER: A Global Approach to Equilibrium Exchange Rate Modelling	16-Apr-2005	Jim O'Neill Alberto Ades Hina Choksy Jens J. Nordvig Thomas Stolper
123	Africa's Long Road Ahead: Laying Down the Potential	14-Mar-2005	Carlos Teixeira Roopa Purushothaman Mike Buchanan
122	Germany Profits From Restructuring	24-Feb-2005	Dirk Schumacher
121	The Lisbon Strategy and the Future of European Growth	21-Jan-2005	Kevin Daly
120	Thoughts on Social Security Reform	18-Jan-2005	William Dudley Edward McKelvey Jan Hatzius
119	Can the G7 Afford the BRICs Dreams to Come True?	30-Nov-2004	Jim O'Neill