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Demographic transition: implications for growth

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China will need to maintain an annual GDP growth rate of 7.2 per cent to meet official ambitions to raise the general prosperity of Chinese society, with GDP in 2020 predicted to be four times the level in 2000. Achievement of this goal would mean that China had sustained a high rate of annual economic growth for more than 40 years. This would not be unique. Economies in Asia, such as Korea, Malaysia, Singapore, Thailand and Hong Kong all sustained economic growth of more than 7 per cent per annum between 1960 and 2000 (Table 4.1). Growth patterns in the Japanese economy over the past 40 years, however, offer an alternative model. Between the early 1950s and mid 1970s, the Japanese economy grew quickly and overtook many industrial economies. High rates of economic growth in the 1980s were the product of an unsustainable 'bubble economy'; growth has stagnated since the bubble burst in the 1990s. The annual growth rate in Japan was 5.3 per cent between 1960 and 1990 but only 1.5 per cent during the 1990s.

What factors stimulate sustainable economic growth and what are the reasons for low growth rates? The literature is extensive. Growth economists consider a range of factors to explain economic growth, such as the domestic and international economic and political environment, improving education and public health standards, the implementation of family-planning and labour market policies, and policy support for greater international trade and savings (Barro 1997; Bloom et al. 2002). Demographic factors, especially the population and age structures, affect economic development. The reduction of high fertility rates creates opportunities for economic growth when accompanied by education, health and labour-market policies (Bloom et al. 2002). Sustained, rapid economic growth in East Asia demonstrates that

developing economies can move swiftly to bridge the income gap with industrial economies. Recent studies indicate these successes can be attributed to a considerable extent to the demographic transition that occurred in East Asian economies (Bloom and Williamson 1997; Williamson 1997).

Demographic transitions in East Asian economies began in the 1940s and 1950s. Prior to 1970, economic growth potential was limited, income per capita was low and accompanied by a high child-dependence ratio. The average per capita GDP growth rate was estimated at only two per cent. As a result of the demographic transition, the proportion of the working population to the total population increased, while the population dependence ratios declined (Table 4.1). These population trends favoured the labour supply and savings rate and provided an additional source of economic growth—the demographic dividend. According to Williamson (1997), between 1970 and 1995, East Asian economies grew at average annual rate of 6.1 per cent, 4.1 percentage points above the steady state growth rate. Demographic transition contributed 1.5 to 2.0 percentage points to the steady state growth rate, accounting for one-quarter to one-third of the actual growth rate and one-third to one-half of the steady state growth rate during the period.

As the demographic transition progresses, the aging of the population reduces the productiveness of the population and reduces the demographic dividend. Japan completed the demographic transition first in East Asia and now has the most rapidly aging population among developed economies. Some researchers (Hewitt 2003) attribute the sustained stagnation of the Japanese economy to its rapidly

Table 4.1 **Growth rates and dependence ratios in East Asia**

	China	Japan	Korea	Hong Kong	Singapore	Thailand	Malaysia
GDP growth Rate (per cent)							
1960–70	2.7	9.4	7.4	8.9	8.5	7.0	5.9
1970–80	6.3	4.5	7.5	9.4	8.9	6.9	7.9
1980–90	9.4	4.1	8.7	6.5	7.4	7.9	6.0
1990–2000	10.1	1.5	6.3	4.6	7.7	4.6	7.2
1960–2000	7.8	5.3	7.9	7.8	8.7	7.1	7.1
Average dependence ratios (per cent)							
1960–70	79.2	49.1	84.7	75.3	81.8	95.1	95.4
1970–80	75.3	47.1	71.2	57.0	59.0	89.1	84.1
1980–90	56.9	46.3	52.4	44.8	41.9	66.1	72.3
1990–2000	53.3	49.0	45.5	45.1	43.6	54.9	71.7
1960–2000	65.0	46.8	62.4	54.6	55.8	74.9	79.3

Source: The World Bank, 2003. *World Bank Online Database*. Available online at http://devdata.worldbank.org/dataonline/.

aging population and inadequate pension system. The dependence ratio in Japan declined much earlier than in other East Asian economies and then rose again, suggesting that, as the population aged, Japan lost an additional source of economic growth (Table 4.1).

With the implementation of family-planning programs, China has undergone demographic transition more rapidly than most industrial economies. Challenging questions currently face Chinese scholars and policymakers. First, will China become an aging society before it becomes wealthy (Jackson and Howe 2004)? Second, how can China sustain the demographic dividend through policy adjustments? Third, through what other sources can China generate a demographic dividend? This chapter attempts to answer these questions by identifying the turning point where the demographic dividend becomes the demographic debt, analysing the mechanisms by which the demographic transition affects economic growth, and estimating the contribution of the population factor to economic growth.

Demographic transition, demographic dividend and sources of growth

A variety of theoretical models is used to illustrate the relationship between population and economic growth. These models also indirectly influence the orientation of policymakers. Prolonged debates have not produced a consensus.Observation reveals a conflict between the facts and theoretical assertions (Hodgson 1988). Population should be acknowledged as a factor affecting the conditions of economic growth, but the nature of population's impact on economic growth is uncertain, although its influence is certainly not independent (Kelley 1988). One shortcoming in conventional economic theories of growth is that theories consider population change as a steady process—that is, they only focus on the magnitude and growth of population, while neglecting changes in the age structure during the demographic transition (Williamson 1997).

The process of demographic transition is characterised by a time differential, as the decline of the birth rate and mortality moves through three phases, from a high dependence ratio of children to a high proportion of working population and finally a high dependence ratio of the aged. Different age groups within the population have different consumption patterns, savings behaviour and labour participation, and therefore different age groups will have specific effects on economic growth. A high proportion of aged population and/or children increases the burden on society of dependents and reduces productive, therefore negatively affecting

economic growth. Similarly, when the working population is relatively larger, the population structure is more productive because the labour supply and savings rates are larger. The demographic dividend is created in these circumstances (Bloom et al. 2002). A developing economy or region with a productive population structure can take full advantage of the potential demographic dividend. The demographic dividend provides an additional source of economic growth. Changes in the population structure during the demographic transition have both a direct and indirect impact on economic growth.

The first impact is through the effects of labour supply on growth. The growth of the working population may not keep pace with the growth of the total population during the process of demographic transition. The demographic transition changes particular segments of the population as it passes through the three phases. While the working population grows more slowly relative to the total population, the population must assume a greater economic burden for dependents. In contrast, faster growth of the working population relative to the total population is accompanied by a declining economic burden on the population. Without economies of scale, the production process and factors of production could be substituted for one another and changes in the labour supply would have little effect on long-run growth. However, the division of labour creates economies of scale and a decreasing labour supply will weaken the effects of the division of labour and reduce total output and income per capita. Even assuming the unchanged productivity of labour, any reduction in the magnitude of labour supply will cause a proportional reduction in total output.

The second effect is the impact of changes in the population structure on the relative shares of consumption and savings in national income (Kelly 1973). Demographic transition is a prolonged process, encompassing the full lifespan of individuals or even several generations. Over an individual's lifespan, savings will increase upon entering the workforce and decrease in retirement. Thus, the national savings rate and overall national capital formation will rise as the working population increases. As the population ages, public investment expenditure increases with the provision of pensions and medical care. As the proportion of non-productive expenses in total income increases, the proportion of public investment in productive investment declines. Decline in the levels of private savings and public investment reduces the growth of total output and income per capita. Peterson (1999) summarises six negative effects of an aging population for society. Feldstein (1995) finds an increase in social security expenses crowds out 60 per cent of

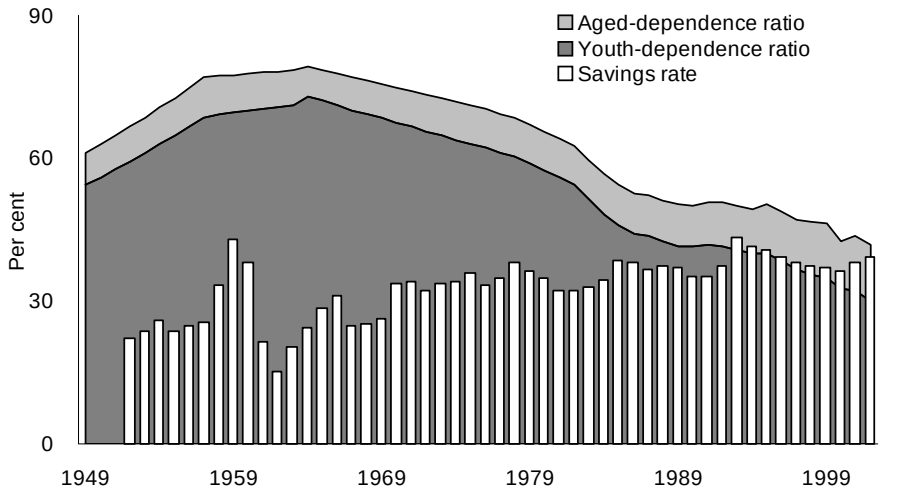
private savings. Another study (Pench 2000) demonstrates that shocks from the labour supply and public finances will negatively affect economic growth rates in the European Union and Japan by 0.5 percentage points and the United States by 0.25 percentage points.

In China, the demographic transition began to occur as early as the 1950s. Its first effect was a dramatic decline in the mortality rate. In 1950, the mortality rate in China was 19 per 1,000, whereas the birth rate was 37 per 1,000. The natural rate of population growth was a high 19 per thousand. In the following two decades, with the exception of 1960, the mortality rate continued to decline and was accompanied with a more slowly declining birth rate. As a result, the natural rate of population growth increased, a trend which continued until its peak in the 1960s. The introduction of family-planning programs and the effects of socioeconomic factors combined to alter population trends, and the birth rate began to decline gradually in the 1970s. Since the 1980s, the birth rate and natural growth rate of population have declined significantly as a result of economic and social reforms and the adoption of strict state family-planning policies in urban and rural areas.

The structure of age within the population changes as the demographic transition moves through the three consecutive phases. The proportion of children in China's total population has declined and the proportion of working population increased, while the proportion of the aged population has not increased significantly. In the period between 1953, when first National Census was conducted, and 2000, when the fifth National Census was conducted, the proportion of children (0–14 years old) dropped from 36.3 per cent to 22.9 per cent, the proportion of working population (15–64 years old) increased from 59.3 per cent to 70.2 per cent, and the proportion of the aged population (65 years old and above) increased from 4.4 per cent to 7 per cent (National Bureau of Statistics 2001). Changes in the population structure have reduced population dependence, in terms of both child and overall dependence, and enhanced the productiveness of the population (Figure 4.1). The result has been strong labour supply and high savings rates, defined as the ratio of fixed asset value to total GDP, and potentially an additional source of economic growth—the so-called demographic dividend.

Given the potential economic advantages from the age structure of a population, high labour force participation and employment allow the productive use of human resources engendered by the population structure. In the period from 1978 to 2002, the size of the economically active population steadily increased and the labour force participation rate reached 70–86 per cent (Figure 4.2)—higher than

Figure 4.1 **Changes in the population dependence and savings rate**



Source: National Bureau of Statistics (NBS), various issues. *China Population Statistic Yearbook*, China Statistics Press, Beijing.

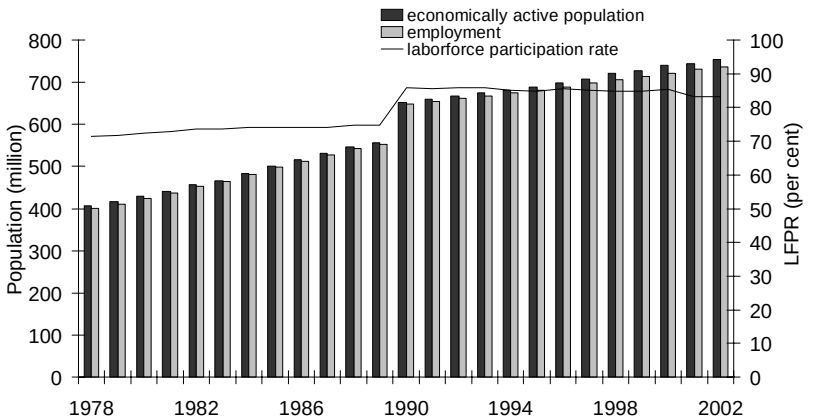
most economies around the world. Despite changes in sectors of the economy and ownership structures, economic growth has driven employment growth in urban and rural areas. With favourable labour endowments and increasing expanded opportunities for employment, economic growth in China has been supported by an ample supply of low-cost labour, enabling the transformation of an advantageous population structure into a comparative advantage in labour-intensive industries.

The growth of the economically active population and employment has produced an economic surplus and helped China establish a high savings rate. The savings has remained more than 30 per cent and peaked at 44 per cent in 1993 (Figure 4.1), primarily because of the decline in the total dependence ratio under the development of markets for production factors, which has lessened the social burdens of dependents and enhanced the productiveness of the population.

The demographic transition and savings rate

Although there is little evidence of an absolute positive correlation between the savings rate and income levels, a critical minimum savings rate is an important

Figure 4.2 **Economically active population, employment, and labour force participation**



Note: Labour force participation rate is the ratio of economically active population to working population; working population is calculated based on *China Population Statistic Yearbook*.
Source: National Bureau of Statistics (NBS), various issues. *China Population Statistic Yearbook*, China Statistics Press, Beijing.

factor for developing economies to take off and a sustained high level of savings is necessary for long-term growth. The general level of income per capita and growth rate are preconditions to obtain the minimum savings rate. Savings rates in high and middle-income countries are generally greater than those in low-income countries (Table 4.2) because households at subsistence level have little surplus income for savings. Savings rates tend to be higher when incomes are rising. During their economic take-off, East Asian economies such as Japan, South Korea, Thailand, Malaysia, Singapore and Hong Kong had high savings rates, which offer a good explanation for their economic performance. Savings rates in East Asian economies were significantly higher than both the world and developed economy averages (Table 4.2). For example, the savings rate in Japan was more than 35 per cent in the 1960s, while savings rates in Hong Kong, Korea, Thailand and Malaysia were 20 to 30 per cent in the 1970s and continued to increase during the subsequent two decades. As the Japanese economy and population matured, the savings rate dropped gradually during the 1980s and economic growth slowed in the 1990s.

Table 4.2 **Comparison of international savings rate** (per cent)

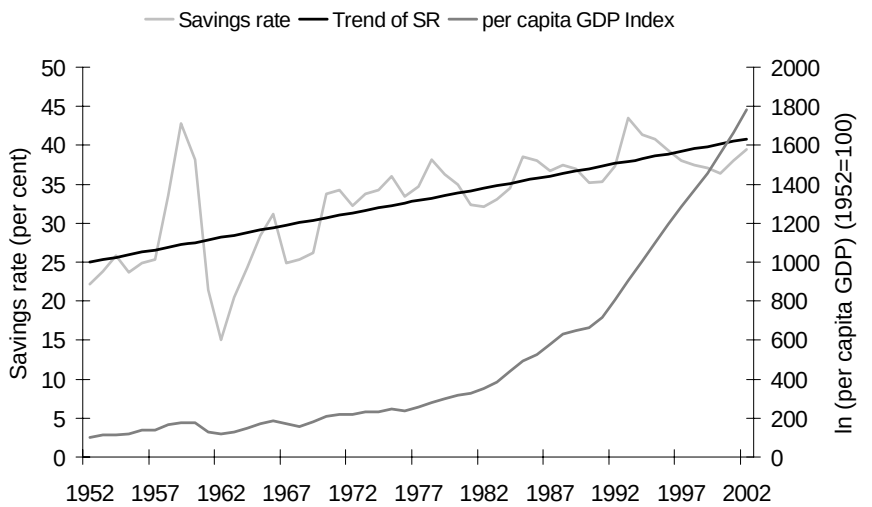
	1960–69	1970–79	1980–89	1990–99	2000–02
World average	24.5	25.3	23.4	23.1	21.6
High-income countries	25.6	25.5	23.1	22.8	20.6
Middle-income countries	-	25.3	25.7	25.3	26.1
Low-income countries	11.3	17.3	19.6	20.7	20.0
OECD countries	12.9	25.4	22.9	22.6	20.4
United States	19.9	19.6	17.8	17.0	15.4
Japan	35.3	35.6	31.8	30.7	26.9
European Union	-	24.8	21.4	22.6	22.4
East Asia region	-	27.8	31.6	36.4	35.8
China	-	30.5	34.7	40.9	41.1
Hong Kong	22.5	30.8	33.5	32.4	31.0
Korea	8.7	22.3	31.0	35.1	29.3
Thailand	18.7	22.3	26.5	35.3	31.1
Malaysia	21.9	27.1	30.2	40.7	43.8
Singapore	-4.0	28.6	41.7	48.2	45.6

Sources: World Bank, 2003. World Bank Online Database. Available online at http://devdata.worldbank.org/dataonline/.

The savings rate in China has continued to rise since the 1950s, with the largest fluctuation in the period between the Great Leap Forward and the Cultural Revolution. With the initiation of economic reforms in the late 1970s, income per capita has substantially increased and the savings rate has also steadily risen (Figure 4.3). The high savings rate has been viewed as a key factor contributing to rapid economic growth since the reforms. While most debates about the savings rate focus on government efforts to mobilise savings and capital market development, whether household savings and consumption behaviour has an impact on national savings and the extent of the impact has not been extensively discussed in the existing literature. As the Chinese economy continues to undertake market liberalisation and the structure of the population changes, the effects of the demographic transition on individual saving behaviour will have important implications for policymakers.

In addition to factors such as income level, the real interest rate, resident location in rural or urban areas, the mobility and maturity of the capital market and macroeconomic policies, demographic characteristics such as household size, household savings, consumption behaviour and population dependence have recently been included in models to explain the savings rate in the Chinese economy. Shi et al. (2002) constructed a model that explains the impact of the demographic

Figure 4.3 **Trends of savings rate and per capita GDP**



Source: National Bureau of Statistics (NBS), various issues. *China Population Statistic Yearbook*, China Statistics Press, Beijing.

transition on China's savings rate by employing variables such as the real interest rate, child-dependence ratio, aged-dependence ratio, and economic growth rate and time trends. Using a time-series dataset from 1958 to 1998, a cointegration regression was run, which showed that both the child and aged-dependence ratios were negatively correlated with the savings rate. However, the results are sensitive to the dataset. Leff (1969, 1971) ran a cross-section regression using data from 74 countries in 1964 and found variables such as per capita income, economic growth rate, child-dependence ratio, aged-dependence ratio and total dependence ratio have a significant effect on the national savings rate. Ram's (1982) further study used cross-section data of 128 countries in 1977 with similar findings.

Following Leff's (1969, 1971) model, this paper examines the impact of the Chinese demographic transition on the savings rate using a provincial panel data set. The data was collected in China's population censuses in 1982, 1990 and 2000, population sampling over 13 years (1987, 1989, 1991–99, 2001 and 2002), comprehensive statistical data and The Provincial Data in 50 years of People's Republic of China (1999) and *China Statistical Yearbooks* (2000–03) (all published by the National Bureau of Statistics). The variables are defined and generated as follows—the savings

rate is the share of gross capital formation in GDP; per capita income equates to per capita GDP at 1952 constant prices; the economic growth rate is a five-year arithmetic average to eliminate the influence of annual economic fluctuations; the child-dependence ratio is the percentage of population-aged 0–14 years to population aged 15–64 years; the aged-dependence ratio is the percentage of population aged 65 years and above to population aged 15–64 years; the total dependence ratio is the summation of child-dependence ratio and aged-dependence ratio.

The regression results of equations (1) and (2) in Table 4.3 are based on the Ordinary Least Square method (OLS). Except for the variable of per capita income, the coefficients for other variables including economic growth, the child-dependence ratio, the aged-dependence ratio and total dependence ratio, are all significant at the statistical level of 1 per cent or 5 per cent, and directions are consistent with theoretical expectation. Heteroscedastic tests of regression equations (1) and (2) show the values of χ^2 are 7.01 and 3.74 respectively; p-values for rejecting constant variances are 0.008 and 0.05 respectively, indicating the existence of heteroscasticity.

When a regression equation has a heteroscedastic issue, the estimated coefficients are unbiased and consistent, but the statistical values of the regression equation, like the t-value and F-value, are inefficient. To overcome the problem, the Feasible Generalised Least Square method (FGLS) was run to generate equations (3) and (4). The significant difference between the results from the two methods is that the coefficients for variables of per capita income in the new equations reached the one per cent significance level, and the direction is consistent with theoretical expectations. The coefficients for variables of economic growth and dependence ratio are also significant, but the absolute values are less than equations (1) and (2).

The eastern region of China was chosen as a reference group. In all regression equations, coefficients for the central region dummy variable reached the one per cent significance level, but coefficients for the western region dummy variable were insignificant. Earlier economic reforms and liberalisation in the eastern region attracted a greater inflow of foreign capital and investment, which quickened economic growth there relative to other regions. Financial transfers from the central government contributed to savings and investment in the western region, but the absence of preferential policies has led to a low savings rate in the central region when other variables are held constant.

Apart from the regional dummy variables, the coefficient for other variables in Table 4.3 is values for the elasticity of savings rate. Absolute values for the elasticity of the child-dependence ratio, aged-dependence ratio and total dependence ratio are greater than for per capita income and economic growth, indicating the demographic age structure has an important effect on the savings rate.

Table 4.3 **Regression results of the demographic transition on savings rate**

Variables	OLS Method		FGLS Method	
	(1)	(2)	(3)	(4)
ln(per capita GDP)	0.013	0.015	0.044	0.040
	(0.89)	(1.05)	(3.44)**	(3.52)**
ln(average growth rate of GDP in the previous five years)	0.127	0.092	0.058	0.054
	(3.03)**	(2.23)*	(2.41)*	(2.53)*
ln(child-dependence ratio)	–0.186		–0.109	
	(3.25)**		(2.48)*	
ln(aged-dependence ratio)	–0.216		–0.113	
	(3.74)**		(2.59)**	
ln(total dependence ratio)		–0.225		–0.154
		(2.99)**		(2.97)**
Central region dummy	–0.216	–0.186	–0.178	–0.159
	(7.25)**	(6.64)**	(9.90)**	(10.73)**
Western region dummy	–0.035	0.009	–0.037	–0.006
	(1.02)	(0.28)	(1.50)	(0.33)
Intercept	4.622	4.377	3.749	3.734
	(15.21)**	(13.24)**	(16.57)**	(15.70)**
R^2	0.38	0.36		
Observations	426	426	426	426

Note: (1) Variables of year dummy are deleted for simplicity; (2) Absolute values of t-statistics in parentheses in equations (1) and (2); Absolute values of z-statistics in parentheses in equations (3) and (4); * significant at 5 per cent level; ** significant at 1 per cent level.
Source: Authors' calculations.

These results support Leff's (1969) findings. Although the coefficients for all variables are significant and the directions consistent with theoretical expectations, the absolute values for coefficients differ in magnitude with Leff's results. Based on cross-country data, Leff (1969) reported the values of the elasticity of savings rate of per capita income, economic growth rates, child-dependence ratio, aged-dependence ratio and total dependence ratio were 0.160, 0.025, –1.352, –0.399, and –1.489 respectively. The absolute values of coefficients for China are less than Leff's results. The greater variability in the cross-country dataset is the main reason for the difference between the magnitudes of the coefficients in Leff's results and this study. However, the provincial dataset used in this study has an advantage in that it effectively eliminates the unobserved effects of policies and institutions. These possible effects cannot be eliminated from a cross-country dataset. Another possible reason for the difference is the introduction of a year dummy variable into regression equations to control for temporary shocks on the

savings rate. The coefficients of year dummy are significant with a range from 0.13 to 0.39, which may absorb some effects of other variables.

Based on the values of elasticity in equation (3), the average contribution of explanatory variables to the savings rate was calculated. The contribution of per capita income is 17 per cent. Of that, economic growth rates comprise 0.3 per cent, the child-dependence ratio 4.9 per cent, the aged-dependence ratio –5.1 per cent and total dependence ratio 5.1 per cent. There is a mutually opposing trend between the child-dependence ratio and aged-dependence ratio; the effects of each ratio counteract the other.

In assuming the child-dependence ratio and aged-dependence ratio affect the savings rate in the same way, equation (4) defines the relationships appropriately for further discussion. The contribution of total dependence ratio to savings rate was calculated as approximately 5.0 per cent. Dividing the contribution of the total dependence ratio into two components—namely, the contribution of child-dependence ratio and aged-dependence ratio—allows the relative changes to be examined. From 1982 to 2002, the total dependence ratio dropped by 33.3 per cent, of which –17.2 percentage points can be attributed to the decrease of child-dependence ratio and 017.2 percentage points to the increase of aged-dependence ratio. Therefore, the contribution of the child-dependence ratio to the savings rate is 6.0 per cent and the contribution of the aged-dependence ratio to the savings rate is –0.9 per cent.

From the discussion of the results summarised in Table 4.3, we can draw some conclusions. First, per capita income and economic growth rates are two important determinants of the savings rate. Second, the demographic transition has a significant impact on the savings rate. The decrease of child-dependence ratio reflects the reduction of both the economic burden on the working-age population and consumption expenditures for the national income, contributing to an increase in the savings rate. However, this effect is offset by the increase in the aged-dependence ratio as the population ages. Finally, dummy variables denoting regional policies and institutions have a significant role in explaining the savings rate.

Effects of demographic transition on growth

The steady-state growth of income per labour is theoretically determined by a series of variables that includes physical and human capital, technological advances, natural resources endowment, policies and institutions. This is illustrated as $y^* = X\beta$ .Where y^* is the steady-state growth of income per unit of labour; X is a vector representing the initial conditional and structural variables, and β represents the marginal effects of the variables. In this standardised conditional convergence model, the factor of demographic transition is often

excluded. However, if the variable of demographic transition is incorporated into the above steady-state growth equation, the following mathematical equation reveals that the demographic structure variable does have an impact on economic growth.

$$\tilde{y} = \frac{Y}{N} = \frac{Y}{L} * \frac{L}{N} = y\frac{L}{N} = y\frac{1}{(L + L * D)/L} = y\frac{1}{1 + D}$$

Where Y is Gross Domestic Product (GDP), L is the number of labour force, N is the number of total population, D is the total dependence ratio, y is GDP per labour using the number of labour force as denominator and $\tilde{y}$ is per capita GDP. Applying logarithm manipulation to both sides of the formula, the growth rate of per capita GDP equals the growth rate of GDP per labour minus the logarithmic value of total dependence plus one, expressed as

The formula introduces the variable of demographic transition, demonstrating that the increase (decrease) of total dependence ratio has a negative (positive) impact on the growth of per capita income. The conditional convergence theory asserts that the growth of per capita GDP is a function of initial conditional variables and economic, policy and institutional structural variables. The demographic structure should be included as one of the structural variables determining long-run growth of per capita income. The regression equation can be expressed as

$$g_{\tilde{y}} = \beta_0 + \beta_1 \ln GDP78 + \beta_2 \ln Life82 + \beta_3 Invest + \beta_4 Open + \beta_5 Gov + \beta_6 D + e$$

where *GDP78* represents the initial per capita GDP, *Life82* represents the initial life expectancy, *Invest* represents the investment rate, *Open* represents the share of trade in GDP, *Gov* represents the share of government consumption in GDP, *D* represents the total dependence ratio, β_i represents parameters and *e* is the error term.

According to these theoretical assumptions, β_2, β_3, β_4 are positive, while β_1, β_5, β_6 are negative. After controlling for structural variables, the growth of per capita GDP is negatively correlated with the initial level of per capita GDP, which implies that it is possible for low-income regions to catch up with more advanced regions. Life expectancy is a proxy for the human capital stock variable. A longer life expectancy equates with a high stock of human capital, and is expected to have a positive

effect on economic growth.[1] Investment is the sole means to increase physical capital stock. A higher investment rate can induce more rapid economic growth. Trade has been viewed as an important engine of economic growth. The share of trade in GDP was selected as an indicator of economic openness that indicates the level of regional market development and integration into the international market. Government intervention is generally assumed to have a negative impact on long-run economic growth. The share of government consumption in GDP is used as a proxy variable for government intervention. The total dependence ratio represents changes in the demographic structure, which can affect economic growth through the labour supply, savings rate and technological advances. These are negatively correlated with economic growth.

The dataset is from the same source used in in the previous section. Assuming that the long-run economic growth rate is the same as the steady-state economic growth rate is the most common method used. The effects of initial conditional variables and structural variables (Barro 1997, Bloom and Williamson 1997, Demerger et al 2002) on the long-run economic growth rate are examined. Given data availability, two periods of time were selected—1982 to 1990 and 1990 to 2000 for the regressions. There were two considerations; first, three population censuses conducted in 1982, 1990 and 2000 can provide the necessary detailed information about total population and age structure at a provincial level, and, second, the two periods of time have a close interval, 8 years and 10 years. Pooled data on a provincial level from the two time periods can substantially increase the sample observations and thus improve the efficiency and precision of regression estimation.

Dependent and explanatory variables are defined as follows. Per capita GDP growth rates are the provincial arithmetic average in each period of time. Initial per capita GDP is the logarithmic value of provincial per capita GDP in 1978. Investment, share of government consumption and openness ratios are also the provincial average values in each time period. The total dependence ratios are the average of provincial ratios in the same period of time. Because of the unavailability of data for Tibet, Hainan, Chongqing and Ningxia before 1990, there are 27 sample observations in the period between 1982 and 1990, while there are 28 in the period between 1990 and 2000.

Equations (1) and (2) are derived from regressions from the data from each period, while equations (3) and (4) are from regressions from the pooled data (Table 4.4). Equations (3) and (4) are more significant. In equation (4), equation (3) was expanded by introducing a time period dummy variable, but the coefficient was insignificant. Therefore the results from equation (3) are used for further analysis. The good fit (R^2) of the equation (3) indicates the regression equation can explain about 57 per

cent of the variation in the economic growth rate. The coefficients for variables of the initial per capita GDP, investment ratio, openness, and total dependence ratio are all significant at the 5 per cent or 1 per cent levels. The coefficient for the variable of life expectancy is close to the 10 per cent significant level, but the share of government consumption is insignificant. The coefficients for all variables have the expected signs.

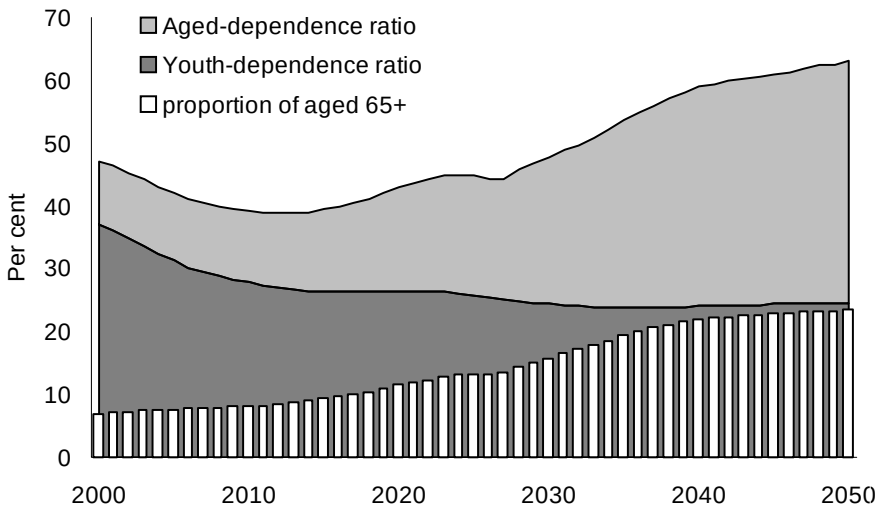
This study also focuses on the impact of the demographic transition on economic growth. In equation (3), the marginal effect of total dependence ratio is –0.115, implying an increase in the total dependence ratio of 1 percentage point will cause a decrease in economic growth of 0.115 percentage points. From 1982 to 2000, China's total dependence ratio dropped by 20.1 percentage points, contributing the equivalent of 2.3 percentage points to the growth rate. The average growth rate during the same period was 8.6 per cent. That is, about one-quarter of the growth rate in per capita GDP can be attributed to the decline in the total dependence ratio during the period.

Table 4.4 **Regression results of economic growth versus demographic transition (OLS)**

	1982–90	1990–2000	1982–2000	1982–2000
ln (per capita GDP in 1978)	–3.239	–2.933	–3.234	–2.801
	(3.53)**	(3.20)**	(5.64)**	(4.09)**
ln(Life expectancy in 1982)	–7.01	25.87	10.783	13.004
	(0.84)	(3.25)**	(1.84)	(2.11)*
Investment ratio	0.065	0.086	0.077	0.079
	(1.62)	(2.38)*	(2.63)*	(2.71)**
Share of government consumption	0.059	–0.272	–0.067	–0.114
	(0.55)	(2.15)*	(0.85)	(1.29)
Openness	0.088	0.021	0.039	0.033
	(3.29)**	(1.89)	(4.03)**	(3.12)**
Total dependence rate	–0.158	–0.031	–0.115	–0.072
	(2.25)*	(0.41)	(2.87)**	(1.33)
Time period dummy				0.745
				(1.15)
Intercept	61.629	–80.654	–14.126	–28.075
	(1.55)	(2.22)*	(0.54)	(0.98)
R^2	0.48	0.69	0.57	0.58
Observations	27	28	55	55

Note: Absolute values of t statistics are in parentheses; * represents significance at 5 per cent; ** represents significance at 1 per cent.
Source: Authors' calculations.

Figure 4.4 **Predicted child-dependence ratio, aged population-dependence ratio and rate of population ageing**



Source: Authors' own calculations, as based on data provided by China Center for Population and Development Studies.

Conclusion and policy implications

China has had the potential to take advantage of the demographic dividend since the mid 1960s, but reforms were necessary to take advantage of the potential sources of economic growth. Since the reforms, the decline of the total dependence rate has contributed 5 per cent to the increase in the savings rate and one-quarter of GDP growth. However, the increase in the working population will slow by about 2015, and the size of the aging population will increase (Figure 4.4). Recent predictions suggest the total dependence rate in China will further decline from 42.6 per cent in 2000 to 39.4 per cent in 2015, and the 3.2 percentage point drop in total dependence rate will add 0.4 percentage points to annual GDP growth. The demographic dividend will have contributed one-third of the annual economic growth rate before the turning point is reached in 2015, when the demographic dividend becomes a demographic debt. Most industrial countries have benefited from the demographic dividend, but this extra source of growth eventually ceases as the demographic transition is completed.

Fulling using the economic potential of its advantageous population structure will not only sustain economic growth, but also enable China to prepare for a rapidly aging population. The next 10 years are a critical period for China, to simultaneously reap the demographic dividend and promote alternative sources of economic growth. China has undertaken a demographic transition quickly—experience with unprecedented fast growth suggests the pace and direction of the demographic transition can be guided by appropriate government policies. The adjustment of population policies is needed to prevent the Chinese population from aging too rapidly. Industrial economy experience suggests the use of a favourable population structure as an extra source of growth can be replaced by other factors, such as fuller employment, improved education and health levels and more efficient institutional environments for economic activities.

Models of long-term economic growth assume the work-age population will remain fully employed and unemployment is only a phenomenon of the short-term business cycle. That is, stable labour force participation rates and full employment of the work-age population are assumed for regression analysis. If unemployment becomes a long-term problem for a high proportion of the economically active population, the total dependence rate will not reflect the actual population burden and the contribution of the potential demographic dividend will be less than the regression results would indicate. Since the late 1990s, radical reform of state-owned enterprises has caused massive unemployment and a fall in labour force participation in China. Increasingly, levels of employment and the economically active population have lagged behind increases in the size of the working population. Therefore a demographic dividend still exists. While economic growth is a precondition for full employment, maximum employment *per se* is a source of economic growth. The more effectively labour resources are utilised, the longer the demographic dividend is maintained and the advantageous development conditions, from low labour costs and high savings rates, can be maintained. These conditions will require further reforms in a variety of areas, including the elimination of institutional barriers that deter labour mobility and the market-based determination of wages.

While the greatest advantage of the demographic dividend in China has been the size of the labour force, this advantage will soon be lost. The accumulation of human capital through increasing returns has been fuelled by the enormous size of the labour force until now. The Chinese government faces two contemporary challenges. First, the reallocation of public investment in education is critical for improving education levels throughout the country. Second, it must promote the development of a more efficient labour market that encourages individuals and

families to accumulate human capital through investment in education because returns to human capital can only be generated in the labour market.

The population structure will continue to age on average in the coming decades. China will need to establish a sustainable pension system and make some critical policy adjustments to safeguard society in this process. First, the transition from the pay-as-you-go system to a fully funded pension system must be immediately implemented. This transition will require setting up individual accounts for workers who entered the labour market after 1997, the year in which pension system reform began. Second, the government needs to undertake a variety of policy adjustments and public education programs to make society better informed and prepared for an aging population. Third, improving labour market efficiency is a critical condition for transformation of the pension system. Creating more work opportunities in the labour market and raising the retirement age will reduce the dependence of older people on social pensions by prolonging the number of years in the workforce. Including rural-to-urban migrant workers in the pension system will also enhance the total premium and financially support the transformation of the pension system.

Note

[1] The number of years of schooling was included in the regression, but the coefficient was insignificant.

References

Barro, R.J., 1997. *Determinants of Economic Growth*: *a cross-country empirical study*, MIT Press, Cambridge.

Bloom, D.E. and Williamson, J.G., 1997. *Demographic transitions and economic miracles in emerging Asia*, NBER Working Paper No.6268, National Bureau Economic Research, Massachusetts.

——, Canning, D. and Sevilla, J., 2002. *The Demographic Dividend: a new perspective on the economic consequences of population change*, RAND, California..

Demurger, S., Sachs, J.D., Woo, W.T., Bao, S., Chang, G. and Mellinger, A., 2002. 'Geography, economic policy and regional development in China', *Asian Economic Papers*, 1(1):146–97.

Feldstein, M., 1995. *Social security and saving: new time series evidence*, Working Paper No. 5054, National Bureau of Economic Research, Massachusetts.

Hewitt, P.S., 2003. *The gray roots of Japan's crisis*, Asia Program Special Report, No.107, Woodrow Wilson International Center for Scholars, Washington, DC.

Hodgson, D., 1988. 'Orthodoxy and revisionism in American demography', *Population and Development Review*, 14(4):541–69.

Jackson, R. and Howe, N., 2004. *The Graying of the Middle Kingdom: the demographics and economics of retired policy in China*, Center for Strategic and International Studies, Washington DC.

Kelly, A.C., 1973. 'Population growth, the dependence rate, and the pace of economic development', *Population Studies*, 27(3):405–14.

Leff, N. H., 1969. 'Dependence rates and savings rate', *American Economic Review*, 59(5):886–96.

——,1971. 'Dependence rates and savings rate: reply', *American Economic Review*, 61(3):476–80.

——, 1984. 'Dependence rates and savings rate: another look', *American Economic Review*, 74(1):231–33.

National Bureau of Statistics (NBS), 1999. *The Provincial Data in 50 Years of People's Republic of China*, China Statistic Publishing House, Beijing.

——, 2001. *Tabulation on the National Census in 2000*, China Statistic Publishing House, Beijing.

——, (various years). *China Population Statistical Yearbook*, China Statistic Publishing House, Beijing.

Pench, L., 2000. Ageing and economic growth in Europe, Paper presented at The Graying of the Industrial World: a policy conference on global ageing, Washington, DC, 25–26 January.

Peterson, P.G., 1999. *Gray Dawn: how the coming age wave will transfer America and the world*, Random House, New York.

Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2002. *World Population Prospects: the 2002 Revision and world urbanisation prospects—The 2001 Revision*, United Nations Secretariat, New York.

Ram, R., 1982. 'Dependence rates and aggregate savings: a new international cross-section study', *American Economic Review*, 72(3):537–44.

Shi, Y., Reza, S. and Zhu, L., 2002. The impact of changes in China's population-age structure on its national saving behavior: an empirical analysis, Department of Economics, National University of Singapore, Singapore (unpublished).

Williamson, J., 1997. *Growth, distribution and demography: some lessons from history*, NBER Working Paper No. 6244, National Bureau of Economic Research, Massachusetts.

World Bank, 2003, *World Bank Online Database*. World Bank, Washington, DC. Available online at http://devdata.worldbank.org/dataonline/.

Yang, Z., 1996. *Historical Population Data in China*, Reform Publishing House, Beijing.