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DEMOGRAPHIC DIVIDEND AND PROSPECTS FOR ECONOMIC DEVELOPMENT IN CHINA

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During the last 25 years, China has undergone demographic as well as economic changes of historic proportions. Demographically, China has transformed itself from a "demographic transitional" society, where reductions in mortality led to rapid population growth and subsequent reductions in fertility led to a slower population growth, to a "post-transitional" society, where life expectancy has reached new heights, fertility has declined to below-replacement level, and rapid population ageing is on the horizon. In the not-too-distant future—in a matter of a few decades—China's population will start to shrink, an unprecedented demographic turn in Chinese history in the absence of major wars, epidemics or famines. In this process, China will also lose its position as the most populous country in the world.

Economically, China has completed its transition from a socialist centrally planned economy to a market based economy. In moving from an economy under socialism that was closed to the outside world and plagued by low efficiency and stagnation, China has become, in the last two decades, one of the most dynamic and fastest-growing economies in the world. In less than twenty years' time, between 1982 and 2000, real GDP per capita for the Chinese population, adjusted for purchasing power parity (PPP), rose more than four-fold – a record unmatched elsewhere in the world.[1]

At the start of these historical transformations, China's leaders made raising the standard living of the Chinese population its new political mandate and the basis for political legitimacy. They accordingly formulated two basic national policies: developing the economy and controlling population growth. The Chinese Government announced its one-child-per-couple policy in 1980, an unprecedented act of governmental intervention in population. Such an extreme policy came about even though the fertility level in China had already more than halved during the previous decade, and was already at a level not much above the replacement level (Lee and Wang, 1999; Wang, 2005).

The rationale for China's one-child policy was a neo-Malthusian perspective on the relationship between population and development—a view largely dismissed by mainstream economists. The architects of China's population policy can point, however, to the post-reform economic record as evidence of the success of the policy. This assertion can be questioned on two grounds. The first is the extent to which the transition to low fertility was accelerated by the one-child policy (Wang, 2005). The second, considered in this paper, is the extent to which fertility decline, the slow-down in population growth, and changes in age structure contributed to China's economic success. In light of the recent and future changes in China's age structure, we also examine and speculate in this paper on the role of population age structure changes in affecting China's prospects for economic development in the coming decades of the twenty-first century.

This paper is organized as follows. In the first section below, we review briefly the recent and projected changes in China's population age structure. In the second and third sections, we evaluate the impact of changes in the age structure on China's economy, both in the past two decades and in the near future. We base our evaluations on calculations of two types of demographic dividends: a dividend associated with a relative increase in the population of labour force age due to fertility decline, and a dividend associated with population ageing (Mason and Lee, forthcoming; Wang and Mason, 2004).

A. China's Changing Population Age Structure

In some ways, changes in China's population age structure resemble those experienced elsewhere in the world, but in other ways China is different. Age structure change in China, as in other populations around the world, is driven by declining mortality and fertility. During the last half century, mortality decline in China has resulted in a near doubling of life expectancy, from 42 and 46 years for males and females, respectively, around 1950 to 71 and 75 years in the year 2000. Mortality decline was especially rapid during the two decades after the early 1950s, when life expectancy increased on average by more than one year annually (Banister and Preston, 1981). Fertility decline started as early as in the 1950s in parts of urban China. By the beginning of the 1970s, it had extended to the whole country (Lavely and Freedman, 1990; Wang, 2001). Assisted by a Government birth control program that called for later marriage, longer birth intervals, and fewer births, China's fertility level was more than halved within a decade, from a total fertility rate (TFR) of 5.8 children in 1970 to 2.3 in 1980. In the 1980s, despite the newly implemented one-child policy, the fertility level in China fluctuated around the replacement level of 2.1 (Feeney and others, 1989; Feeney and Wang, 1993). In the 1990s, however, China's fertility renewed its downward trajectory. By the end of the twentieth century, Chinese fertility was well below the replacement level, at around 1.6 children per woman (Retherford and others, 2005).

China's population age profile contains some unique characteristics, resulting from its history of social and demographic change. Two such special characteristics are of particular importance to changes in the population age structure. The first is the drastic fertility decline within a relatively short time period, rarely seen elsewhere in the world. The second is a sharp increase in mortality and a plunge in fertility caused by the Great Leap Forward famine of 1959-1961. The famine resulted in an estimated 30 million premature deaths and 33 million lost or postponed births (Ashton and others, 1984; Kane, 1988). It was also followed by a sharp rebound in the birth rate that lasted for several years in the 1960s.

China's population age structure reflects the effects of these underlying demographic forces. Figure I shows population age pyramids for China based on the 1982 and 2000 censuses and our projections for 2030. At the start of China's recent economic boom, 1982, China's population age structure was largely a bottom-heavy one, characteristic of a young and growing population. The population deficits due to the famine (those aged 20-24 in 1982) and the impact of fertility decline of the 1970s (affecting ages below 10 years) are clearly visible. In contrast, by 2000, China's population age structure was that of a mature population, where the largest shares are found in the working age populations. Projected only thirty years ahead, with assumptions of a moderate further improvement in life expectancy and continuation of the current fertility level, China's population age structure will be a very old one. Thus, within half of a century, China's age structure would have moved from one that is characteristic of a young and growing population to an old and declining one. What effect, if any, may these profound demographic changes as seen in these age structures have on China's economy? In the following sections of the paper, we attempt to answer this question.

B. Fertility Decline and the First Dividend

The demographic transition interacts with a fundamental feature of any economy—its lifecycle variation in consumption and production. Humans have an extended period of economic dependency at the beginning of their lives and, in modern industrial societies, at the end. During these ages of dependency or production-deficit ages, individuals consume, on average, more than they produce. During the prime working ages or surplus ages, individuals produce more than they

consume. Detailed information about the lifecycle of production and consumption in China is limited. However, the estimated production and consumption profiles for urban China in 2000 (figure II) are similar to those found in other countries.[2]

The divergence between production and consumption interacts with changes in population age structure to generate what is called a demographic dividend (Bloom and Williamson,1998; Mason, 2001; Bloom and others, 2002) which more recently has been described as two demographic dividends (Mason and Lee, forthcoming). The *first* dividend arises because the demographic transition induces changes in population age structure that increase the share of the population concentrated at the productive ages. The *second* dividend arises as individual behaviour and public policy respond to anticipated changes in population age structure, for example, increases in the need to provide for retirement, as discussed in more detail below. An important point that is emphasized below is that the demographic dividends are dependent on the policy environment in which population change is occurring, especially in China.

The first dividend refers to increases in the growth rate of income per capita that come about when the productive population grows at a faster rate than the total population. However, this period must eventually come to an end. As the demographic transition proceeds, growth in the working-age population will eventually become slower than that of the total population, as the proportion in the older ages rises. The effect will be to depress growth in per capita output and per capita consumption.

Analysis that emphasizes only the variation in productivity with age is incomplete. Consumption also varies with age. If age groups with low productivity and high consumption increase, the aggregate effects are magnified in comparison to growth in an age group with low productivity and low consumption. Thus, the analysis presented here uses the support ratio to quantify the first dividend (Mason and Lee, forthcoming). The support ratio is the ratio of the effective number of producers to the effective number of consumers. The effective number of workers is weighted by age-specific productivity weights while the effective number of consumers is weighted to allow for variation in consumption by age (Cutler and others,1990).[3] The first dividend is positive if the support ratio is increasing. Given constant age profiles of productivity and consumption, output per effective consumer increases at the same rate as the support ratio grows, which depends, in turn, entirely on changes in population age structure.

For China, the magnitude and sign of the first dividend vary substantially over three periods (figure III). From 1982 to 2000, the demographic situation was especially favourable as changes in the support ratio had a strong positive effect on output per worker. The support ratio increased by 28 per cent or at an average annual rate of 1.3 per cent. During the same period real GDP per capita (PPP adjusted) grew at an annual rate of 8.4 per cent per year (World Bank, 2004). Thus, the first demographic dividend accounted for 15 per cent of China's economic growth between 1982 and 2000.

For the most part the gains from the first demographic dividend have been reaped in China. Between 2000 and 2013 the support ratio is projected to continue to rise but at a much slower pace. For the entire period the first dividend yields an increase in output per capita of 4 per cent—an annual growth rate of 0.3 per cent. The support ratio is projected to reach a peak in 2013 and then begin a sustained, gradual decline. By 2050, the projected support ratio will be only 85 per cent of the level reached in 2013. Growth in output per capita will be reduced by 0.45 per cent per year between 2014 and 2050 as a result of changing age structure as the first demographic dividend passes.

Trends in the support ratio combine the changes in the effective labour force and the effective number of consumers that are of interest in their own right. These components are shown separately in figure IV. The growth rate in the effective labour force—producers—peaked in the late 1980s and early 1990s at 3 per cent per annum. Currently the rate of growth is about half that at 1.5 per cent per annum and is declining steadily. Labour-force growth will cease altogether by 2020 and turn strongly negative thereafter.

China's experience is similar to that of other East Asian economies (Mason and Lee, forthcoming). In order to compare China's demography with that of others, we have constructed the support ratio using the same productivity and consumption weights employed in the analysis for China, but demographic data for each of the economies shown in table 1. Taiwan Province's pattern is very similar to mainland China's although Taiwan's transition occurred somewhat earlier. Japan also experienced a dividend, but it came much sooner than in other East Asian countries. Throughout the 1982-2050 period, Japan's support ratio will be in decline—depressing growth in per capita output by 0.4 per cent per annum for the entire period. Many countries in the West also experienced rapid growth in their support ratios primarily because of the baby boom in the 1940s and 1950s, but many, as illustrated by the experience of France and the United States, are now in a period of decline (table 1).

In China—and elsewhere—the first dividend is a persistent but ultimately transitory phenomenon. In China, output per capita is projected to be higher by about 10 per cent in 2050 than in 1982 due to the first dividend. Were the projection extended further into the future the net effect would be smaller. The contribution to annual growth in output per worker during the roughly seven decades tracked is negligible. However, output per capita is substantially elevated over the demographic transition. This is an event of considerable economic significance to those alive during the era of the transition. Moreover, the first dividend can have long-lasting effects if the increased income is re-invested in the form of physical or human capital, and/or institutional development. This possibility is explored in more detail in the next section.

TABLE 1. AVERAGE ANNUAL RATE OF GROWTH IN THE SUPPORT RATIO (PERCENTAGE), 1982-2050, CHINA AND OTHER SELECTED SOCIETIES

	1982-2000	*2000-2013*	*2013-2050*	*1982-2050*
China	1.28	0.28	-0.45	0.15
Taiwan Province, China	1.07	0.01	-0.60	-0.04
Japan	-0.18	-0.24	-0.60	-0.42
United States of America	0.44	-0.46	-0.04	0.01
France	0.40	-0.41	-0.17	-0.06

NOTES: All values calculated using the income and consumption profiles for urban China in 2000 Single year of age data interpolated using Sprague multipliers.

Sources: For China population data see text: For Taiwan Province population data ROC MOI (various years). For Japan, United States, and France, United Nations (2003).

C. POPULATION AGEING AND THE SECOND DIVIDEND

As shown above, China's rapid fertility decline in the 1970s has brought it a substantial demographic dividend. The arrival of the demographic dividend coincided with China's recent economic boom, thus further fuelling an already rapidly growing and dynamic economy. An

abundant labour supply, combined with relatively small shares of younger and older dependents, not only helped to make China become the world's factory at the turn of the twenty-first century, but also contributed to increasing output per capita and thus the standard of living. Such a dividend, as we discuss above, is transitory and will soon be exhausted. China's unusually rapid fertility decline means that it will also face undergo a more rapid and severe process of ageing. China's 2000 census revealed that the shares of the older population had risen to 10.5 and 7.1 per cent for those aged 60 and 65 above, respectively, from 7.6 and 4.9 per cent in 1982. China's rapid fertility reduction and its recent low fertility levels and improved life expectancy will accelerate China's ageing process in the near future.

Yet population ageing, given appropriate policy and institutional arrangements, may bring China a second demographic dividend. The first demographic dividend, discussed above, quantifies the effects of changes in the support ratio, holding output per worker constant. A second demographic dividend may arise because changes in age structure can influence the processes that lead to the creation of wealth. A possibility—one that has been realized in other East Asian economies—is that population ageing will lead to rapid accumulation of capital. When this occurs, the capital-intensity of the economy will raise labour productivity – output per worker. Traditionally, the effect of population on capital-deepening is considered in the standard neo-classical economic model that assumes that the saving rate is constant (Solow, 1956). The approach taken here, however, builds on elaborations of the neo-classical model that treat saving and wealth as endogenous (Tobin, 1967; Mason, 1987; Willis, 1988; Lee, 1994).

With increases in life expectancy, the expected duration of retirement rises. Individuals must accumulate additional wealth or face substantial reductions in standards of living during old age. The wealth can come in several forms, however. One possibility is the accumulation of additional capital. The other is the accumulation of transfer wealth—increases in the obligations of future generations to provide old age support either through public pension plans or as part of familial support systems. Either form of wealth can meet the retirement needs of a growing older population, but increases in capital influence the level of output and economic growth, while increases in transfer wealth do not (Lee, 1994). A third possibility is that neither transfer wealth nor capital is accumulated. In this case, favourable effects on productivity are not achieved and standards of living of the older persons deteriorate.

The analysis presented here relies on a highly stylized model of the economy (Mason 2005). Suppose that the cross-sectional age profiles of production and consumption—the shape but not the level—are held constant. The profile of production reflects persistent effects of experience and obsolescence. We abstract from changes in labour force behaviour, e.g., changes in retirement behaviour and changes in returns to experience related to increases in educational attainment or other forces. The profile of consumption reflects preferences about own consumption and preferences about the consumption of others reflecting altruism or political processes.

Under these conditions, changes in population age structure lead to a substantial decline in the resources that must be reallocated from working generations to children and a substantial increase in the resources that must be shifted from workers to the elderly. The shift is quite evident in figure V, which shows the distributions of aggregate consumption and labour income by age for 1982, 2000, and 2050 and the associated age reallocations. These charts are constructed using the profiles and population age distributions shown in figure I.[4]

Two inter-age flows, from workers to children and from workers to the elderly, are summarized by the arrows shown in figure V. The foot of the arrow in each of the panels in figure

V is located at the mean age of the outflow from workers and the head of the arrow is at the mean age of the inflow to recipients. For the 1982 panel, for example, the mean age of the outflow from workers to children is 37 years while the mean age of the inflow to children is 9 years. The width of the arrow is the per capita reallocation. Given the assumption of golden-rule, steady state growth, the area of each arrow is equal to aggregate lifecycle wealth that must be maintained to support each age reallocation (see Lee, 1994 and Lee, 2000 for an explanation). In the case of downward flows, that is, flows from older to younger age groups, the lifecycle wealth is negative. It is negative because those who are alive are obligated to make transfers to those who have not yet been born. The obligation is not a legal one. Rather it is a social obligation to provide support to the next generations of children. The actual level of that support is unknown, but under the simplified assumptions followed here children are supported at the same level relative to adults in the future as has been the practice in the past.

The effects of age structure on lifecycle wealth are quite pronounced (table 2). In 1982, transfers are strongly downward from workers to children and total life cycle wealth is more than nine times total labour income and negative. As population ageing proceeds, flows to children decline and are surpassed by flows to the elderly. By 2050, steady state lifecycle wealth will be 2.6 times labour income. Steady-state lifecycle wealth required to support consumption by the elderly will rise to 7.1 times labour income. The important implication of table 2 is that population ageing in China must lead to rapid growth in the capital stock, to an enormous expansion of public or familial-based transfer programs, or to a significant decline in living standards among the elderly.

TABLE 2. LIFECYCLE WEALTH IN CHINA, 1982, 2000, AND 2050

	1982	*2000*	*2050*
Mean age of consumption	28.0	32.5	44.4
Mean age of production	37.3	37.8	41.8
Ratio of lifecycle wealth to labour income			
Total	-9.2	-5.3	2.6
Support of child dependents	-11.2	-7.8	-4.5
Support of elderly dependents	2.0	2.5	7.1

NOTE: Calculations use age-profiles of household consumption and labour income estimated from the 2000 Urban Income and Expenditure Survey. Estimate of life cycle wealth for the support of child dependents is based on the mean age at childbearing in 2000 from the projections for China. Lifecycle wealth calculations assume golden rule, steady-state growth.

The magnitude of the second demographic dividend depends on the particular mechanisms used to reallocate resources. Economic reform adds complexity to the picture in China because the institutions and mechanisms used to achieve reallocations are a fundamental feature of reform. Resources can be reallocated from surplus ages to deficit ages in different forms and relying on different institutions (table 3). In China's post-reform economy three forms became available: capital, transfers, and credit. Capital can be accumulated at surplus ages; later, at deficit ages, it yields capital income and can be liquidated. An important point to note is that capital held by individuals can only be used to reallocate resources from younger to older ages. Secondly, those in deficit ages can rely on current transfers from those in surplus ages. Thirdly, individuals can rely on credit markets. Those at surplus ages can lend to children, relying on loan repayments later in life when they are at deficit ages. Credit markets play a small role in inter-age reallocation systems, however, because of constraints on indebtedness.[5]

TABLE 3. REALLOCATION SYSTEM

	Institution		
Form	*Family*	*Market*	*State*
Capital	Housing	Factories	Public infrastructure
	Consumer durables	Inventories	State owned enterprises
	Education	Farms	Funded pension plans
Transfers	Childrearing costs	Public debt	Public education
	Support of elderly		Public health care
	Bequests		Unfunded pension plans
Credit	Familial loans	Consumer credit	Student loans

NOTE: Adapted from Lee (1994).

In a market economy, three institutions are involved in reallocations. In many societies, the family is the principle institution responsible for reallocating resources across age groups, and in virtually all societies, families dominate reallocations to children. Two other institutions, the market and the state, vary in their importance depending on the economic system. In pre-reform China, market institutions played little or no role and the State played a dominant role. In post-reform China, the emergence of a market economy and the recognition of private property have expanded the mechanisms available for resource reallocations with important economic implications.

Suppose that the reallocation system for the elderly relied entirely on capital throughout the entire history under consideration. Prior to reform this would assume that the State was implicitly funding pensions by investing in State enterprise. After reform capital accumulation became a combined responsibility of the family, the market, and the State. A complete assessment of the economic implications of these changes would require a simulation model that could be used to track the complex dynamics involved. However, an indication of the importance of the demographic change can be assessed using a highly stylized model of the economy - steady-state, golden rule growth. Under these assumptions, the population is assumed to be in a stable equilibrium, i.e., no changes in age structure, the saving rate and the ratio of capital to total output is constant, all economic growth arises because of exogenous improvements in the productivity of workers, and the interest rate is equal to the rate of economic growth. Under these conditions, the path of consumption over time is at its maximum in the sense that consumption in no period can be increased without reducing consumption in some other period. Demographic conditions in 1982, under steady-state golden rule assumptions, would imply a capital-output ratio of 2.6. Demographic conditions in 2050, again under steady-state golden rule assumptions, imply a capital-output ratio of 7.1. Given simple assumptions, an increase in the capital-output ratio of this magnitude would lead to a doubling of output per worker.[6] The impact on the rate of growth of output per worker depends on the time frame over which the capital deepening occurs. Evenly spread over a century, output per worker would have to grow at 0.7 per cent per year. Spread over 50 years, output per worker would grow at 1.4 per cent per year as a result of capital deepening.[7] Such a dividend, if materialized, is by no means trivial. It is roughly the same magnitude as the first demographic dividend China reaped during 1982 to 2000, the fastest per capita income growth period in China's recorded history.

These calculations are suggestive and there are many complexities that are not addressed. One is that in pre-reform China a large portion of lifecycle wealth, perhaps all, was held as

transfer wealth rather than as capital. Lifecycle wealth represented the pension obligations or the implicit debt of future generations as embodied in the State and its organs, e.g., State owned enterprise. To an unknown extent economic reform destroyed that lifecycle wealth.

A continuing issue in China will be through what mechanisms and to what extent lifecycle wealth should be replenished. Transfer wealth will necessarily play a major role, because the greatest obligations are to those who are near or who have already reached retirement. For them, accumulating capital is not an option, only transfer wealth. The question then is the extent to which pension obligations are absorbed by the State (taxpayers), shifted to private firms including State-owned enterprises (SOEs) that are privatized, or shifted to families.

A second complication for China is separating the transitional issues associated with economic reform from the ongoing issues that arise with population ageing. Establishing a large-scale PAYGO pension system would most readily meet the short-term objective of fulfilling obligations to current pensioners. Such a strategy, however, could commit China to a path that foregoes the second demographic dividend.

Direct econometric support for the existence of a second demographic dividend comes in the form of studies of the effect of demographic factors on aggregate saving. Saving rates must rise above their equilibrium level to produce an increase in the capital-output ratio. There is no doubt in East Asia that aggregate saving rates are well above equilibrium, but there are many competing hypotheses about why saving rates are so high in East Asian economies. A number of studies have found evidence to support the view that saving rates have been influenced by changes in age structure (Mason,1987; Mason, 1988; Kelley and Schmidt, 1996; Higgins and Williamson, 1997; Deaton and Paxson, 2000) and life expectancy (Bloom and others, 2003; Kinugasa, 2004). The magnitudes of estimated effects are sensitive to the methods and data employed.

D. Concluding Remarks

The available evidence supports the conclusion that the demographic transition has led to more rapid growth in output per capita in many East Asian countries where the demographic transition has been especially rapid. China has clearly enjoyed significant gains in output per effective consumer as a result of the first dividend. Whether or not China will enjoy a second dividend remains to be seen. Demographic change offers an opportunity for significantly more rapid economic growth, but only if the policy environment is supportive. It would be a serious error, however, to reach any welfare conclusions about demographic change, in general, and fertility decline, in particular. Two reasons for this seem to be particularly important to emphasize. The first is that capital deepening is achieved by foregone consumption. The resulting growth in output per worker is not a free lunch but comes at the expense of reduced material standards of living among those who are saving at such high levels. The second point is that rapid fertility decline in China may have involved an enormous sacrifice on the part of parents forced to have a single child. We do not know how many children would have been born in the absence of the one child policy. Nor do we know how to value the costs imposed by the loss of reproductive freedom.

In many ways, China has always been a demographic early achiever. Its mortality declined early and rapidly under a socialist planned economy and public health system. In this regard, China was much more successful than most other countries at similar income levels. China's fertility also declined much more rapidly and earlier in the development process than

elsewhere—due partly to a Government birth control program that finds no equal for the extent to which it intruded on the reproductive decisions of couples.

Such a compressed demographic transition positioned China to reap a relatively large demographic dividend at an opportune time. China's first demographic dividend, deriving from fertility decline, materialized at the same time that China underwent its most radical economic transitions and faced the strongest unemployment pressures. The demographic factor thus was a favourable factor in China's economic growth during the last quarter century.

Being an early achiever brings with it a cost. As consequences of such a forced demographic transition, China will soon enter a long period of decline in labour supply, and will face a rapid increase in the older population that cannot be reversed easily and quickly. Whereas this ageing process may bring with it a second demographic dividend, such an event depends heavily on the right institutional environment. State-enforced fertility decline has also resulted in deterioration in accuracy of the birth statistics collection system, has caused a sustained and sharp increase in the sex ratio at birth and in excess female mortality at young ages, and has forcefully altered the kinship structure for many Chinese families. These social costs are not only severe but also long lasting.

Moreover, the general assessments of the economic impact of changing demographics in China conceal important sub-national variation. China's economic growth in the last two and one half decades has been highly uneven geographically, with most of the growth concentrated in its cities and coastal areas. China's rapid ageing process will also take place unevenly across the country, due to the State's differential birth control policies in the past. Assuming current fertility and a moderate improvement in mortality, in twenty years China's urban population will be as old as that in Japan or Italy today, with one-fifth of the population aged 65 or over. China's rural population, in contrast, will not reach this level of ageing until the mid-twenty-first century. The extent to which the Chinese economy will be able to benefit from the capital accumulation associated with an ageing population depends not only on the institutional forms of resource allocation, but also the allocation and utilization of such sources among its citizens.

Figure I. Population Age Structure, China (Male, Female), 1982, 2000, 2030

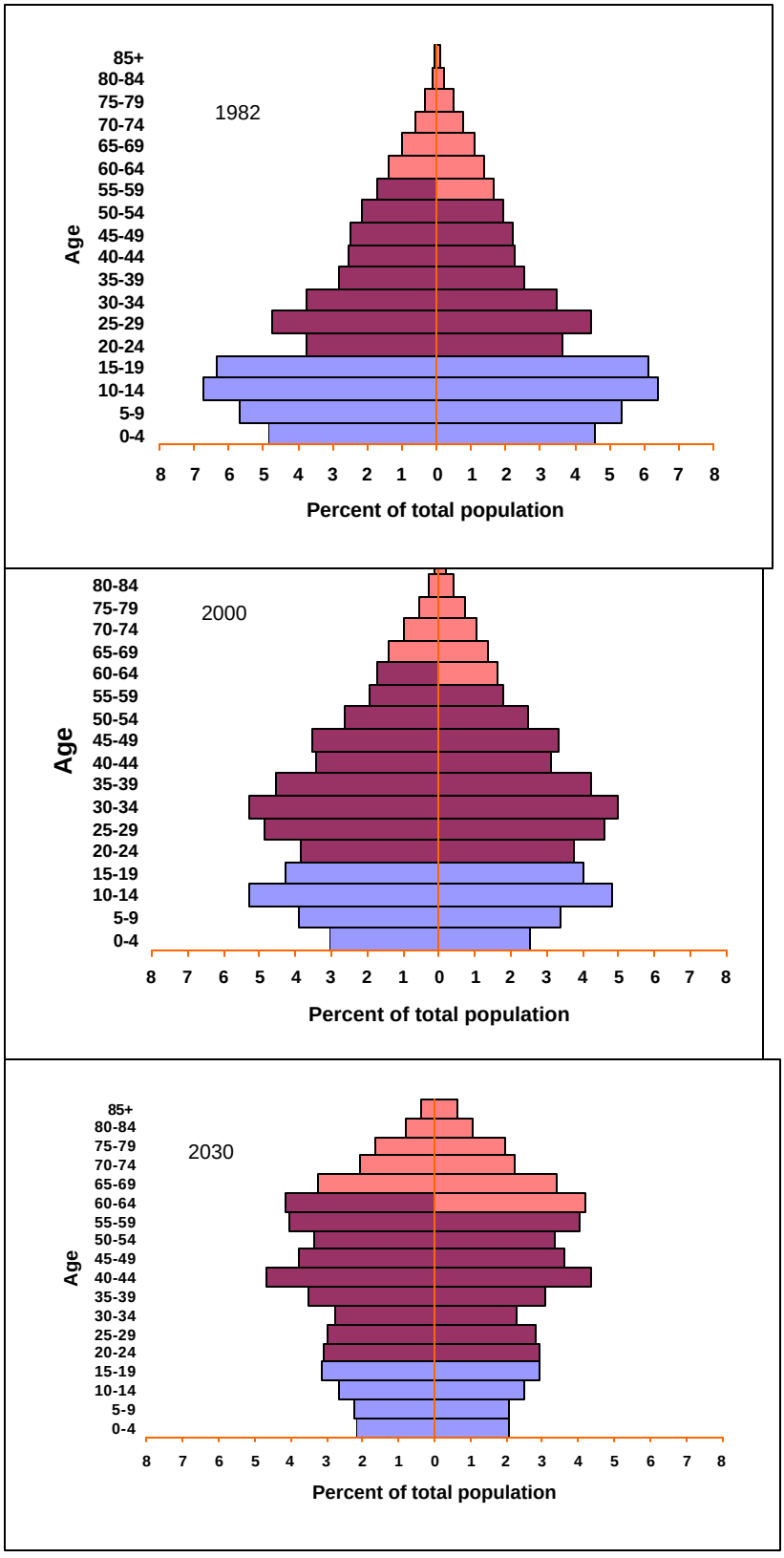
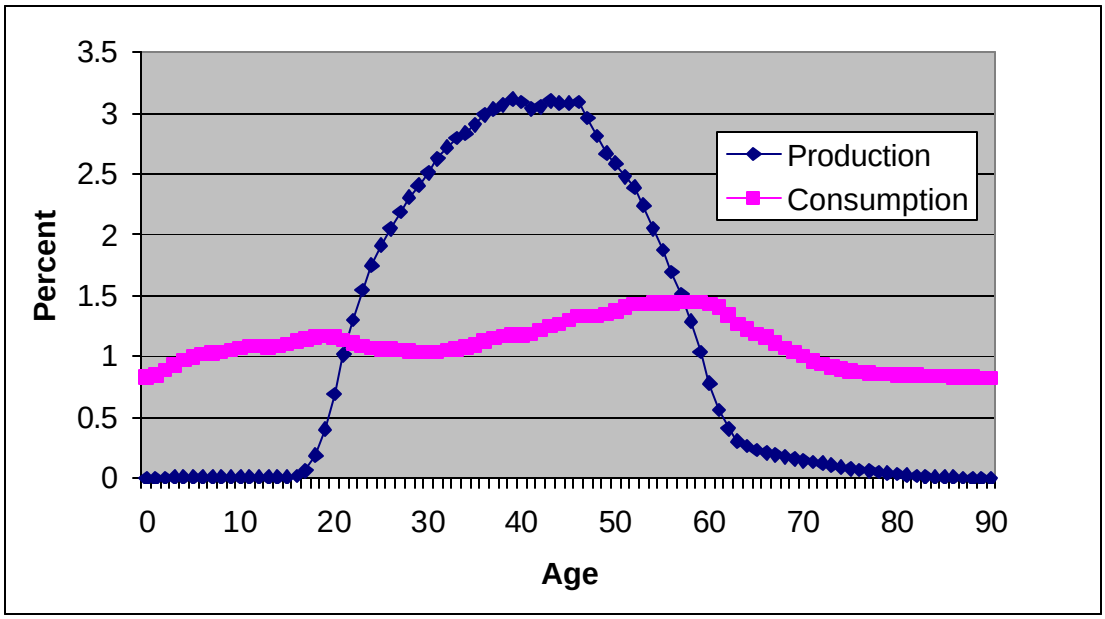


Figure II. Lifecycle Variation in Consumption and Production: Urban China, 2000



Note: Values normalized to total to 100 percent.

Figure III. Estimated First Demographic Dividend, China, 1982-2050

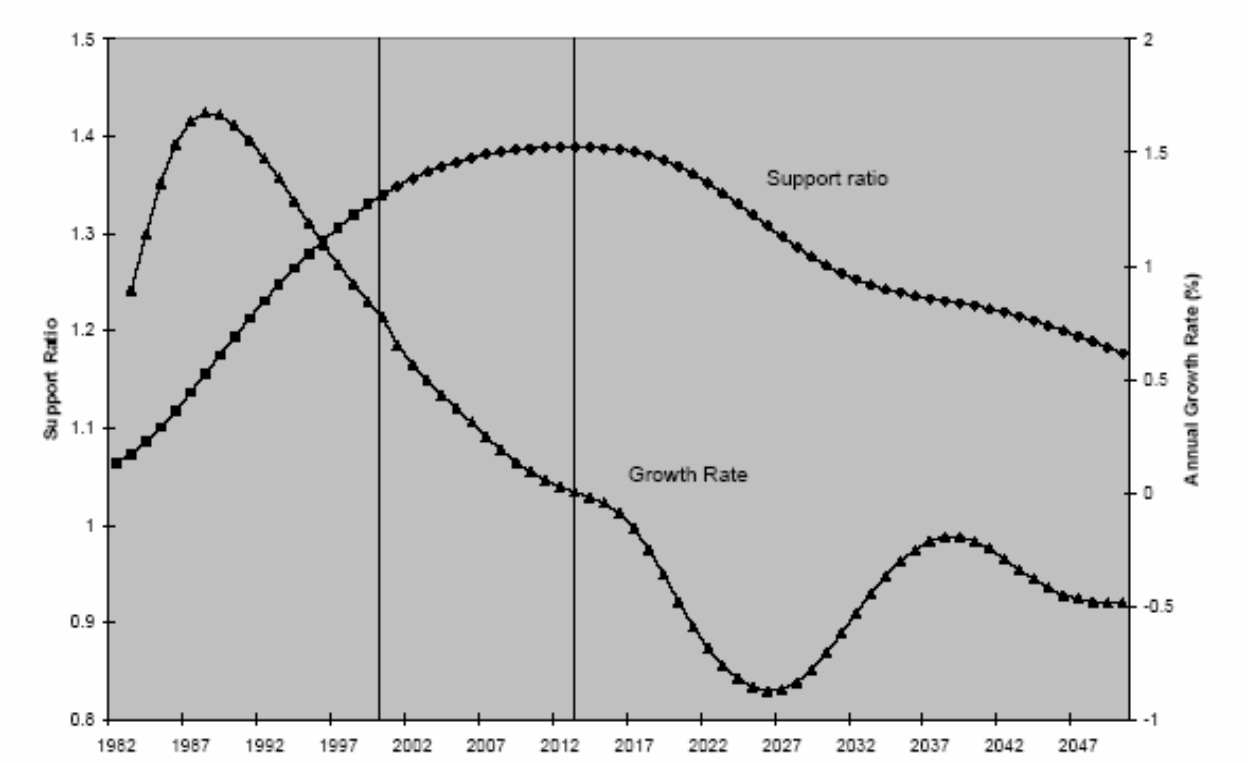


Figure IV. Effective Producers and Consumers, China, 1982-2050

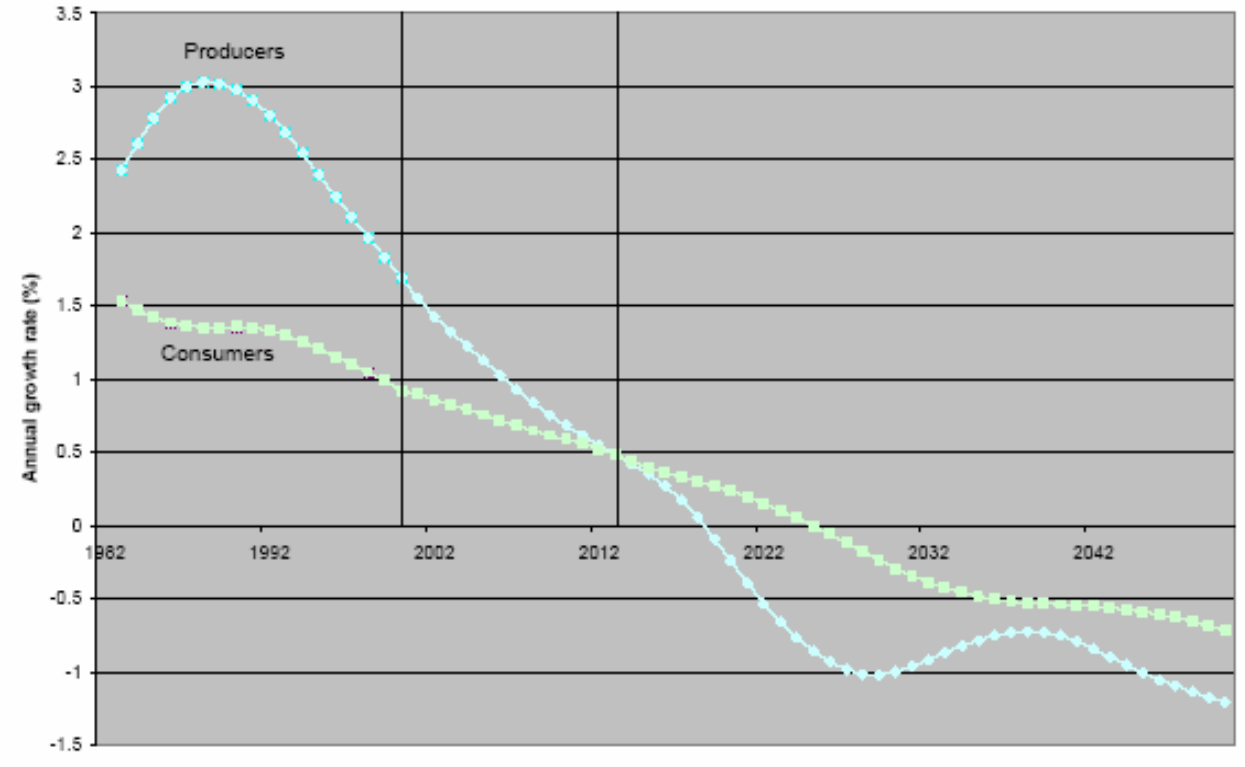
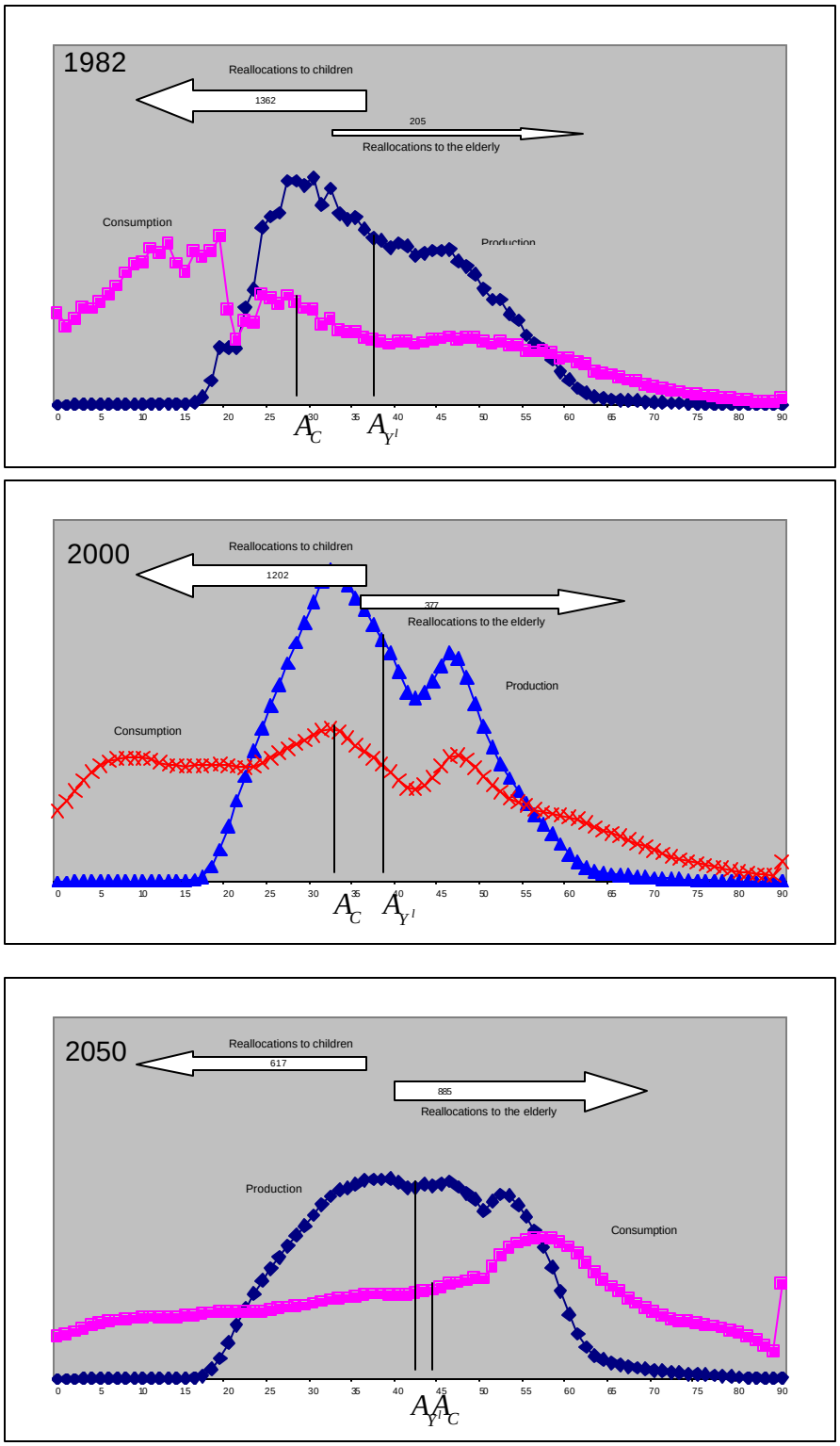


Figure V. Consumption and Income Profiles, China, 1982, 2000, 2050



NOTES

[1] China's best record prior to the current growth period was between 1952 and 1972, when its economy grew by 64 per cent per decade, a record far below the recent one. Comparable fast-growing periods in other countries are: Germany during 1880 and 1914, with a 33 per cent per decade; Japan between 1874 and 1929, with 43 per cent per decade; and the Soviet Union between 1928 and 1958, 54 per cent per decade (Meisner 1999, 417- 418).

[2] The production and consumption values in figure II are estimated from the 2000 Urban Family Income and Expenditure Survey for China. Both profiles are normalized to aggregate to 100. Production is an estimate of the economic value of labor based on reported earnings and self-employment income. Consumption is based on detailed information on family expenditure on food, clothing, housing, entertainment, recreation, transportation and communication, etc. Housing consumption includes the imputed value of owner-occupied housing. The methods employed are comparable to those used in Mason (2005) and described in more detail in Lee and Mason (2005).

[3] The effective number of producers is measured using the age-profile of productivity shown in figure II to weight the population. The effective number of consumers uses the age-profile of consumers. Rural profiles are not available although we hope to explore this more in the future.

[4] For a detailed discussion of the theoretical underpinnings of intergenerational transfers see Lee (1994).

[5]Credit could, in theory, play an important role if children financed their own consumption by borrowing from adults with a lifecycle surplus. The debt would be repaid when children reached lifecycle surplus ages and their creditors reached lifecycle deficit ages. When children's consumption is financed through transfers from parents and, to a lesser extent, the state, there is little demand for credit for lifecycle purposes.

[6] Given a Cobb-Douglas production function, the relationship between output per worker and the capital-output ratio is:

$$\frac{Y}{L} = \left(\frac{K}{Y}\right)^{\frac{b}{1-b}}$$

Given an elasticity of output with respect to capital (b) of 0.35, a widely used estimate, a rise in the capital-output ratio from 2.0 to 7.1 would produce essentially a doubling of output per worker.

[7]See Lee, Mason, and Miller (2003) for a dynamic simulation analysis of Taiwan Province of China. The simulated transition from a low to a high capital-intensive economy required closer to fifty than to 100 years.

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