China's Growth to 2030:

The Roles of Demographic Change and Investment Risk*

Rod Tyers and Jane Golley

College of Business and Economics
Australian National University

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Corresponding author:
Professor Rod Tyers
School of Economics
College of Business and Economics
Australian National University
Canberra, ACT 0200
rod.tyers@anu.edu.au

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Abstract:

China's economic growth has, hitherto, depended on its relative abundance of production labour and its increasingly secure investment environment. Within the next decade, however, China's labour force will begin to contract. This will set its economy apart from other developing Asian countries where relative labour abundance will increase, as will relative capital returns. Unless there is a substantial change in population policy, the retention of China's large share of global FDI will require further improvements in its investment environment. These linkages are explored using a new global demographic model that is integrated with an adaptation of the *GTAP-Dynamic* global economic model in which regional households are disaggregated by age and gender. Interest premia are integral with projections made using these models and in this paper their influence on China's economic growth performance is investigated under alternative assumptions about fertility decline and labour force growth. China's share of global investment is found to depend sensitively on both its labour force growth and its interest premium though the results suggest that a feasible continuation of financial reforms will be sufficient to compensate for a slowdown and decline in its labour force.

1. Introduction

In the last decade, the Chinese central government continued its drive away from state planning to a market-driven economy.[1] This shift towards the market is partly necessitated by increasing integration into the global economy, one measure of which is the level of official commitments to international arrangements such as the WTO, the satisfaction of which will entail significant short-term costs in a number of sectors, including financial services and state-owned enterprises (SOEs).[2] The Communist Party is aware that reform of the weak financial system is essential to achieving its growth projections. A measure of the need for this reform is the Chinese interest premium. Funds sourced locally attract an interest rate at least 40 per cent larger than that faced by investors in the US.[3] This is due in part to financial market incompleteness and segmentation, but also to higher risk due to factors that range from political stability to the efficacy of the legal system in combating fraud and protecting property rights.

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[1] The 11th Five-Year Program (2006-2010) was delivered by Premier Wen Jiabao in March 2006 at the 4th Session of the 10th National People's Congress. The switch to the word 'Program', after ten Five-Year 'Plans', is just one indication of the central government's strengthening commitment to shifting away from state planning and towards the market mechanism. For the first time, rather than setting mandatory objectives for key economic targets such as per capita GDP and GDP growth, the government has instead submitted 'projections'. China's GDP is projected to grow by 7.5% between 2005 and 2010, with per capita GDP increasing from 13,985 yuan to 19,270 yuan over the same period. These projections are in line with the central government's ambitions to raise the level of GDP in 2020 to four times the level in 2000, requiring an annual GDP growth rate of 7.2% (Cai and Wang, 2005).

[2] See Lardy (2002).

[3] The quotient of averages of daily 10 year bond yield quotations for China and the US over 2001-2005 is about 1.4.

Concurrent with the central government's relinquishing control over the economy, China's demography is becoming less and less state-planned. The demographic transition to slower population growth and the associated aging of China's population have been profoundly affected by the One Child Policy. Yet fertility rates would have declined anyway, affected as they have been in China's Asian neighbours by urbanisation, female education, increased labour force participation rates and the improved life-expectancy of new-born children. With a transition to a declining population in prospect, and with competing developing regions, such as South Asia, set to enjoy continued "demographic dividends", there is now extensive discussion of the encouragement of higher fertility by the state in the guise of "1.5 or two child" policies.[4]

Indeed, unless there is a substantial change in population policy, the retention of China's large share of global investment will require further improvements in its investment environment and hence it will depend on financial, legal and other institutional reforms. In this paper the linkages between demographic change and financial reform are explored using a new global demographic sub-model that is integrated with an adaptation of the *GTAP-Dynamic* global economic model in which regional households are disaggregated by age and gender. Interest premia are key parameters in projections made using this model. Their influence on China's economic growth performance is investigated under alternative assumptions about fertility decline and labour force growth.

The paper proceeds as follows. Section 2 discusses the theoretical and practical links between demographic change, the investment environment and economic growth in China. In Section 3 the demographic sub-model is detailed and a description is offered as to how it is integrated within *GTAP-Dynamic*. This yields a means to examine quantitatively the interactions between demographic change, investment premia and economic performance. Section 4 constructs a baseline scenario for the global economy through to 2030, while Sections 5 and 6 present the results for alternative assumptions about fertility rates and interest premia respectively. Conclusions are offered in Section 7.

2. Demographic Change and Economic Growth in China

A country's demographic change affects its economic performance via the levels and age-gender compositions of its population and the labour force. Changes in the size and composition of its population alter the scale and product composition of final demand and, more importantly, they affect households' division of their disposable incomes between consumption and saving.

[4] See Bloom and Williamson (1997) for a discussion of the demographic dividend across developing countries and Cai and Wang (2005) for a detailed examination of its implications for China.

On the supply side, variations in labour force participation rates and skill levels by age and gender affect the size and skill composition of the full time equivalent labour force. This, in turn, affects the marginal product of capital and hence the level of investment.

At a basic level, faster population growth should yield stronger GDP growth, but lower per capita income growth (assuming diminishing marginal productivity of labour and capital).[5] Fertility rates are key determinants of the rate of population growth and, in China, they have long been policy targets. Controlling for numerous other factors that affect population growth – including urbanisation, female education, increases in labour force participation and improved life expectancy – Sharping (2003) estimates that, in the absence of the state's birth control policies, China's population would have been 1.6 billion instead of the 1.27 billion reported at the end of the 20th century.

In the population projections by the United Nations (2005) it is noted, as elsewhere[6], that a key effect of low fertility has been the ageing of the population and labour force. Indeed, it is projected that China's population will age substantially over the next 25 years, with the percentage of over 60s predicted to more than double by 2030. Meanwhile, the percentage of the population of working age (15-59 years) is predicted to fall by more than a tenth during the same period. It is thereby suggested that, some time between 2015 and 2020, the growth of the working age population will become negative, which in turn suggests that GDP growth will suffer as a consequence.

Turning to the anticipated effects of demographic change on savings, the final phase of the demographic transition, during which fertility declines while death rates change slowly, is characterised by ageing and a high aged dependency ratio. Cai and Wang (2005) use a provincial panel dataset over the period 1980-2003, a period during which China's total dependence ratio dropped by a fifth, to claim that about one-quarter of per capita GDP growth could be attributed to the "demographic dividend" associated with low dependency ratios of the middle phase of the transition. They predict that this dividend will be exhausted in China by the year 2015, after which the aged dependency ratio will rise steadily, reaching 40 per cent by 2030. Since the dependent population is likely to live on accumulated wealth, it is expected that China's average saving rate will fall (Heller and Symansky, 1997).[7]

[5] This stems from the standard Solow-Swan model of growth. Faster-growing labour forces yield steady states with lower levels of capital per worker and hence lower per capita income.
[6] See also Peng (2005), Cai and Wang (2005) and Heller and Symansky (1997).
[7] The evidence that savings declines with age in the Chinese case is unclear, however, as the age-specific saving rates used in the model to be described in the next section attest.

Whether the saving rate falls substantially or not, the impact of ageing on economic growth is not clear cut. Higgins (1998) notes that the demographic 'centre of gravity' for investment demand occurs earlier in the age distribution than for savings supply, because the former is most closely related to the youth share in the population – via its connection to labour force growth – while the latter is most closely related to the share of mature adults – via their retirement needs. The divergence between these two centres of gravity means that the effect of the demographic transition on savings and investment depends on the country's openness to capital flows. In an open economy, ageing slows savings growth but the associated slowdown in its labour force also retards growth in its investment demand. If the slowdown in investment growth is either larger than, or precedes, that in saving, the consequence is a widening capital account deficit (current account surplus).[8]

While the link between demographic change, savings and the rate of economic growth appears fraught with ambiguity, the direct link between investment and economic growth is not: physical capital accumulation is a principal driving force behind economic growth and development. In a world with capital mobility, capital accumulation is financed by either domestic savings or foreign investment or both. The two key determinants of investment are the anticipated rate of return on installed capital, net of depreciation, on which investment volume depends positively, and the real cost of funds (the real borrowing rate), on which it depends negatively. Although these might be expected to converge on common values in a steady state, this is rare in practice. In developing countries, however, there are interest premia that drive both above the corresponding levels in the industrialised world. Indicative of this premium for the case of China is the spread between its domestic bond yields and those of US Treasury bonds. This is illustrated in Figure 1.

These "interest premia" have two components: a risk-free component, due to market segmentation, and a risk premium. The risk-free component depends on capital controls and other regulations that impair the free flow of financial capital across borders. De Jong and de Roon (2005) analyse the impact that decreasing segmentation has had on thirty emerging stock markets in the last two decades. They show that the average annual decrease in segmentation (measured by the percentage of assets not available for foreign investors) has reduced the cost of capital (measured by dividend yields) by about 11 basis points. Given that the Chinese stock market was the most highly segmented of all the economies in the sample (averaging 86%

[8] This is, indeed, the behaviour that emerges from our simulations, presented in Section 6. It contrasts with the work of Cheng (2003) who uses a numerical multi-period overlapping generations model for China through to 2030 and finds that there is no significant link between demography and per capita income growth (irrespective of financial capital mobility).

compared with 66% in South Korea, 18% in Malaysia and the lowest of 0.3% in Poland), these results suggest substantial potential gains from reforms that successfully erode the degree of segmentation.

The risk premium compensates investors for exchange rate risk, information asymmetries, and perceived risks of expropriation. Fernald and Rogers (1998) develop an asset-pricing model for China's segmented stock market in which uncertainty is implicitly incorporated as an equity risk premium in the required rate of return. They show that foreigners were paying only one quarter of the domestic price for shares on China's stock market in early 1998, and argue that this is accounted for by an increase in the return they required, which may be caused by either an increase in the risk-free real rate, an increase in the risk premium or both. Indeed at this time, increased volatility and uncertainty led to higher required risk premia across the Asian region (Fernald, Edison and Loungani, 1998).

Assessments of country risk – referring broadly to the likelihood that a sovereign state or borrower from a particular country may be unable and/or unwilling to fulfil their obligations towards one or more foreign lenders and/or investors – incorporate many economic, financial and political factors (Hoti and McAleer, 2004). The International Country Risk Guide (2005) offers a rating that comprises 22 variables in three categories – political, economic and financial – with the political risk comprising 12 components and the economic and financial risk each comprising five.[9] Four of the key political components for China are plotted in Figure 2, illustrating a volatile but generally upward trend in each, where higher scores equate to lower risk. While this trend does not exist for all political variables (for example, democratic accountability worsened throughout the 1990s), to the extent that lower risk ratings can be achieved we would expect this trend to reduce China's interest premium. Indeed, this is the conclusion from an analysis of asset prices by Zhang and Zhao (2004). They focus on the divergence in Chinese A-share and B-share prices over the period 1992-2000 and assess the determinants of stock price differentials. Their key conclusion is that political risk is a significant determinant of the valuation differential between Class A- and B-shares. Their findings also suggest that policy measures that reduce either the degree of political (or country) risk or market segmentation will reduce investors' required rates of return.

A complicating factor affecting China's interest premia is that policies have tended to bias the choice of the source of finance. Huang (2003) discusses how China's economic policies through to the turn of the 21st century were essentially biased in favour of foreign investment; the

[9] See these described at http://www.prsgroup.com/icrg/icrg.html.

establishment of special economic zones being the key example. With central and local governments providing such strong support and incentives for foreign investment, the perceived risks of investing in China were lowered. Given that ongoing reforms and WTO concessions should end this discrimination, it is quite possible that there will be an *increase* in the perceived risks of investing in China, at least for foreigners. Yet Huang argues that the discrimination has caused a "crowding out" of domestic by foreign direct investment, and that domestic investment will rise to the occasion once the playing field is levelled. Overall, the net effect of financial reforms on Chinese investment will depend upon their effects on incentives facing domestic savers and foreign investors.

The bias in favour of foreign investment is seen by Sicular (1998) as fostering private outflows of private financial capital. She attributes this to differences between residents' and non-residents' returns to and risks of investing in China and notes that the limited opportunities for locals to diversify their investment portfolios gives them the incentive to transfer savings offshore if they think they can get away with it. If further reforms improve internal opportunities, this could reduce the net outflows. On the other hand, the premature relaxation of capital controls could have the reverse impact.

Clearly, much depends on continued market-oriented reforms, particularly in the financial sector. Lardy (1998, 2003) argues that the reform of China's financial system is one of the most important decisions facing the Chinese leadership. Under the current system, declining government revenues relative to GDP have meant that the government continues to force SOEs to maintain excessive social obligations. In turn, state-owned banks have lent excessively to SOEs, supported by extremely high household savings rates. Without urgently needed reforms, the financial sector's liabilities to households, which vastly exceed their assets, has the potential to precipitate a financial crisis. This, more than anything, would lead to drastic increases in the risk premium for investors in China, whether domestic or foreign.

3. Modelling the Economic Implications of Demographic Change

The approach adopted follows Tyers (2005), in that it applies a complete demographic sub-model that is integrated within a dynamic numerical model of the global economy.[10] The economic model is a development of *GTAP-Dynamic*, the standard version of which has single

[10] See also Shi and Tyers (2004) and Tyers et al. (2005).

households in each region and therefore no demographic structure.[11] The version used has regional households with endogenous saving rates that are disaggregated by age group, gender and skill level.

3.1 Demography:

The demographic sub-model tracks populations in four age groups and two genders: a total of 8 population groups in each of 14 regions.[12] The four age groups are the dependent young, adults of fertile and working age, older working adults and the mostly-retired over 60s. The resulting age-gender structure is displayed in Figure 3. The population is further divided between households that provide production labour and those providing professional labour.[13] Each age-gender-skill group is a homogeneous sub-population with group-specific birth and death rates and rates of both immigration and emigration.[14] If the group spans T years, the survival rate to the next age group is the fraction $1/T$ of its population, after group-specific deaths have been removed and its population has been adjusted for net migration.

The final age group (60+) has duration equal to measured life expectancy at 60, which varies across genders and regions. The key demographic parameters, then, are birth rates, sex ratios at birth, age- and gender-specific death, immigration and emigration rates and life expectancies at 60.[15] A further key parameter is the rate at which each region's education and social development structure transforms production worker families into professional worker families. Each year a particular proportion of the population in each production worker age-gender group is transferred to professional status. These proportions depend on the regions' levels of development, the associated capacities of their education systems and the relative sizes of the production and professional labour groups.

In any year, for each age group, a, gender group g, skill group s, region of origin, r and region of destination, d, the volume of migration flow is:

---

[11] The *GTAP-Dynamic* model is a development of its comparative static progenitor, *GTAP* (Hertel et al. 1997). Its dynamics is described by Ianchovichina and McDougall (2000). Earlier applications of the standard model to the issues raised in this paper include those by Shi and Tyers (2004) and Duncan, Shi and Tyers (2005).

[12] The demographic sub-model has been used in stand alone mode for the analysis of trends in dependency ratios. For a more complete documentation of the sub-model, see Chan and Tyers (2004).

[13] The subdivision between production and professional labour accords with the ILO's occupation-based classification and is consistent with the labour division adopted in the GTAP Database. See Liu et al. (1998).

[14] Mothers in families providing production labour are assumed to produce children that will grow up to also provide production labour, while the children of mothers in professional families are correspondingly assumed to become professional workers.

[15] Immigration and emigration are also age and gender specific. The model represents a full matrix of global migration flows for each age and gender group. Each of these flows is currently set at a constant proportion of the population of its destination group. See Tyers (2005) for further details.

(1) $M^{t}_{a,g,s,r,d} = \delta^{t}_{d} M^{R}_{a,g,s,r,d} N^{t}_{a,g,s,d}$, $\forall a,g,r,d$,

where δ^{t}_{d} is a destination-specific factor reflecting immigration policy in region *d*, M^{R}_{agsrd} is the migration rate between *r* and *d* expressed as a proportion of the group population in region *d*, N_{agsd} .

Given the migration matrix, M_{agsrd} , the population in each age, gender and skill group and region can be constructed. We begin with the population of males aged 0-14 from professional families in region *d* (*a=014, g=m, s=sk, r=d*).

$$
\begin{aligned}
N^{t}_{014,m,sk,d} &= N^{t-1}_{014,m,sk,d} + \frac{S^{t}_{d}}{1+S^{t}_{d}} B^{t}_{sk,d} N^{t-1}_{1539,f,sk,d} \\
&- D^{t}_{014,m,sk,d} N^{t-1}_{014,m,sk,d} + \sum\nolimits_{r} M^{t}_{014,m,sk,r,d} - \sum\nolimits_{r} M^{t}_{014,m,sk,d,r} \\
&+ \rho_{d} N^{t-1}_{014,m,unsk,d} - \frac{1}{15}\left[N^{t-1}_{014,m,sk,d} - D^{t}_{014,m,sk,d} N^{t-1}_{014,m,sk,d} \right], \quad \forall d
\end{aligned}
\tag{2}
$$

where S^{t}_{d} is the sex ratio at birth (the ratio of male to female births) in region *d*, B^{t}_{d} is the birth rate, $D^{t}_{014,m,d}$ the death rate and ρ_{d} is the rate at which region *d*'s educational institutions and general development transform production into professional worker families. The final term is survival to the corresponding 15-39 age group. In the corresponding equation for young males from production worker families the penultimate term is negative.

For females in professional families in this age group the corresponding equation is:

$$
\begin{aligned}
N^{t}_{014,f,sk,d} &= N^{t-1}_{014,f,sk,d} + \frac{1}{1+S_{d}^{\,t}} B^{t}_{sk,d} N^{t-1}_{1539,f,sk,d} \\
&- D^{t}_{014,f,sk,d} N^{t-1}_{014,f,sk,d} + \sum\nolimits_{r} M^{t}_{014,f,sk,r,d} - \sum\nolimits_{r} M^{t}_{014,f,sk,d,r} \\
&+ \rho_{d} N^{t-1}_{014,f,unsk,d} - \frac{1}{15}\left[N^{t-1}_{014,f,sk,d} - D^{t}_{014,f,sk,d} N^{t-1}_{014,f,sk,d} \right], \quad \forall d
\end{aligned}
\tag{3}
$$

For adults of gender *g* from professional families in the age group 15-39 the equation includes a survival term from the younger age group. It is:

$$
\begin{aligned}
N^{t}_{1539,g,sk,d} &= N^{t-1}_{1539,g,sk,d} + \frac{1}{15}\left[N^{t-1}_{014,g,sk,d} - D^{t}_{014,g,sk,d} N^{t-1}_{014,g,sk,d} \right] \\
&- D^{t}_{1539,g,sk,d} N^{t-1}_{1539,g,sk,d} + \sum\nolimits_{r} M^{t}_{1539,g,sk,r,d} - \sum\nolimits_{r} M^{t}_{1539,g,sk,d,r} \\
&+ \rho_{d} N^{t-1}_{1539,g,unsk,d} - \frac{1}{25}\left[N^{t-1}_{1539,g,sk,d} - D^{t}_{1539,g,sk,d} N^{t-1}_{1539,g,sk,d} \right], \quad \forall g,d
\end{aligned}
\tag{4}
$$

where the second term is the surviving inflow from the 0-14 age group and the final term is the surviving outflow to the 40-59 age group. Again, the skill transformation term is negative in the case of the corresponding equation for production worker families. The population of professional adults of gender *g*, in age group 40-59 follows as:

$$
\begin{aligned}
(5)\qquad N^{t}_{4059,g,sk,d} = {} & N^{t-1}_{4059,g,sk,d} + \frac{1}{25}\left[N^{t-1}_{1539,g,sk,d} - D^{t}_{1539,g,sk,d}N^{t-1}_{1539,g,sk,d}\right] \\
& - D^{t}_{4059,g,sk,d}N^{t-1}_{4059,g,sk,d} + \sum\nolimits_{r} M^{t}_{4059,g,sk,r,d} - \sum\nolimits_{r} M^{t}_{4059,g,sk,d,r} \\
& + \rho_{d} N^{t-1}_{4059,g,unsk,d} - \frac{1}{20}\left[N^{t-1}_{4059,g,sk,d} - D^{t}_{4059,g,sk,d}N^{t-1}_{4059,g,sk,d}\right], \quad \forall g,d
\end{aligned}
$$

For adults in the 60+ age group, the corresponding relationship is:

$$
\begin{aligned}
(6)\qquad N^{t}_{60+,g,sk,d} = {} & N^{t-1}_{60+,g,sk,d} + \frac{1}{20}\left[N^{t-1}_{4059,g,sk,d} - D^{t}_{4059,g,sk,d}N^{t-1}_{4059,g,sk,d}\right] \\
& + \sum\nolimits_{r} M^{t}_{60+,g,sk,r,d} - \sum\nolimits_{r} M^{t}_{60+,g,sk,d,r} \\
& + \rho_{d} N^{t-1}_{60+,g,unsk,d} - \frac{1}{L^{t}_{60+,g,sk,d}} N^{t-1}_{60+,g,sk,d}, \quad \forall g,d
\end{aligned}
$$

where the final term indicates that deaths from this group each year depend on its life expectancy at 60, $L^{t}_{60+,g,sk,d}$. Again, the equation for aged production worker family members is the same except that the skill transformation term is negative.

Sources and structure:

Key parameters in the model are the migration rates, $M^{R}_{a,g,s,r,d}$, birth rates, $B^{t}_{s,r}$, sex ratios at birth, S^{t}_{r}, death rates, $D^{t}_{a,g,s,r}$, life expectancies at 60, $L^{t}_{60+,g,s,r}$ and the skill transformation rates ρ_{d}. The migration *rates* are based on recent migration records and are held constant through time.[16] The skill transformation rates are based on changes during the decade prior to the base year, 1997, in the composition of aggregate regional labour forces as between production and professional workers. These are also held constant through time.[17]

Asymptotic trends in other parameters:

The birth rates, life expectancy at 60 and the age specific mortality rates all trend through time asymptotically. For each age group, *a*, gender group, *g*, and region, *r*, a target rate is identified.[18] The parameters then approach these target rates with initial growth rates determined by historical observation. In year *t* the birth rate of region *r* is:

[16] The migration rates and the corresponding birth rates are listed in detail in Chan et al. (2005: Tables 2-5).
[17] Note that, as regions become more advanced and populations in the production worker families become comparatively small, the skill transformation rate has a diminishing effect on the professional population.
[18] In this discussion the skill index, s, is omitted because birth and death rates, and life expectancies at 60 do not vary by skill category in the version of the model used.

(8) $$B_r^t = B_r^0 + \left(B_{Tgt}^0 - B_r^0\right)\left(1 - e^{\beta t}\right) ,$$

where the rate of approach, β, is calibrated from the historical growth rate:

(9) $$\hat{B}_r^0 = \frac{B_r^1 - B_r^0}{B_r^0} = \frac{\left(B_{Tgt}^0 - B_r^0\right)\left(1 - e^{\beta}\right)}{B_r^0}$$, so that

(10) $$\beta = \ln\left[1 - \frac{B_r^0 \hat{B}_r^0}{B_{Tgt}^0 - B_r^0}\right] .$$

Labour force projections:

To evaluate the number of "full-time equivalent" workers we first construct labour force participation rates, $P_{a,g,r}$ by gender and age group for each region from ILO statistics on the "economically active population". We then investigate the proportion of workers that are part time and the hours they work relative to each regional standard for full time work. The result is the number of full time equivalents per worker, $F_{a,g,r}$. The labour force in region r is then:

(7) $$\overline{L}_r^t = \sum_{a=1539}^{60+} \sum_{g=m}^{f} \sum_{s=sk}^{unsk} L_{a,g,s,r}^t \quad \text{where } L_{a,g,s,r}^t = \mu_{a,r}^t P_{a,g,r}^t F_{a,g,r} N_{a,g,s,r}^t .$$

Here $\mu_{a,r}^t$ is a shift parameter reflecting the influence of policy on participation rates. The time superscript on $P_{a,g,r}^t$ refers to the extrapolation of observed trends in these parameters.[19]

Asymptotic trends in labour force participation:

For each age group, a, gender group, g, and region, r, a target country is identified whose participation rate is approached asymptotically. The rate of this approach is determined by the initial rate of change. Thus, the participation rate takes the form:

(8) $$P_{a,g,r}^t = P_{a,g,r}^0 + \left(P_{Tgt}^0 - P_{a,g,r}^0\right)\left(1 - e^{\beta t}\right) ,$$

where the rate of approach, β, is calibrated from the initial participation growth rate:

(9) $$\hat{P}_{a,g,r}^0 = \frac{P_{a,g,r}^1 - P_{a,g,r}^0}{P_{a,g,r}^0} = \frac{\left(P_{Tgt}^0 - P_{a,g,r}^0\right)\left(1 - e^{\beta}\right)}{P_{a,g,r}^0}$$, so that

(10) $$\beta = \ln\left[1 - \frac{P_{a,g,r}^0 \hat{P}_{a,g,r}^0}{P_{Tgt}^0 - P_{a,g,r}^0}\right] .$$

Target rates are chosen from countries considered "advanced" in terms of trends in participation rates. Where female participation rates are rising, therefore, Norway provides a commonly

[19] Although part time hours may well also be trending through time, we hold F constant in the current version of the model.

chosen target because its female labour force participation rates are higher than for other countries.[20]

Accounting for part time work:

For each age group, a, gender, g, and region, r, full-time equivalency depends on the fraction of participants working full time, $f_{a,g,r}$, and, for those working part time, the ratio of average part time hours to full time hours for that gender group and region, $r_{g,r}$. For each group, the ratio of full time equivalent workers to total labour force participants is then

$$(11) \qquad F_{a,g,r} = f_{a,g,r} + \left(1 - f_{a,g,r}\right) r_{g,r} \,.$$

Preliminary estimates of $f_{a,g,r}$ and $r_{g,r}$ are approximated from OECD (1999: Table 1.A.4) and OECD (2002: Statistical Annex, Table F).[21]

The aged dependency ratio:

We define and calculate four dependency ratios: 1) a youth dependency ratio is the number of children per full time equivalent worker, 2) an aged dependency ratio is the number of persons over 60 per full time equivalent worker, 3) a non-working aged dependency ratio is the number of non-working persons over 60 per full time equivalent worker, and 4) a more general dependency ratio is defined that takes as its numerator the total non-working population, including children.[22] That of interest here is the one of most widespread policy interest, the non-working aged dependency ratio:

$$(12) \qquad R_{r,t}^{ANW} = \frac{\sum_{g=m}^{f} \sum_{s=sk}^{unsk} \left(N_{60+,g,sk,r}^{t} - L_{60+,g,sk,r}^{t} \right)}{\overline{L}_{r}^{t}} \,.$$

The base line population projection for China:

The key parameters affecting China's projected population are listed in Tables 1-3, along with their assumed trends through 2030. In these tables, the parameters are contrasted with those for Japan, toward whose development path China might be expected to trend in the coming decades. Most notable is the declining trend in Chinese fertility, which extends the fall during the decade prior to the base year (1997) in an asymptotic approach toward the rates observed in

[20] The resulting participation rates are listed by Chan et al. (2005: Table 10).
[21] No data has yet been sought on part time work in non-OECD member countries. In these cases the diversity of OECD estimates is used to draw parallels between countries and regions and thus to make educated guesses. The results are listed by Chan et al. (2005: Tables 11 and 12).
[22] All these dependency ratios are defined in detail by Chan and Tyers (2004).

Japan. The level and age structure of the resulting base line population projection is then summarised in Table 4 and the corresponding labour force projection is summarised in Table 5. These projections are low compared with those by the State Council of China (2000) and Sharping (2003), yet those make no attempt to allow Chinese fertility to follow the declining trends observed in neighbouring countries.

To illustrate the striking slow-down in China's total population and labour force that is implied by the base line projection, both are contrasted with those of India in Figure 4. China's population is seen to begin declining during the next decade while its labour force declines earlier than that. Even though India is also ageing, its most populous age groups are very young and, as these groups age, they raise the labour force participation rate and the crude birth rate. Thus, in a period during which China's labour force shows little net growth, that of India rises by half. The same pattern is observed in other populous developing countries in South Asia and Africa. Compared with the rest of the developing world, then, the slow-down in China's population must be expected to constrain its labour supply and hence to retard its overall economic expansion. To assess this, we have embedded the demographic behaviour introduced above in a global economic model.

3.2 The Global Economic Model

GTAP-Dynamic is a multi-region, multi-product dynamic simulation model of the world economy. It is a microeconomic model, in that assets and money are not represented and prices are set relative to a global numeraire. In the version used, the world is subdivided into 14 regions, one of which is China. Industries are aggregated into just three sectors, food (including processed foods), industry (mining and manufacturing) and services. To reflect composition differences between regions, these products are differentiated by region of origin. This means that the "food" produced in one region is not the same as that produced in others. Consumers substitute imperfectly between foods and other products from different regions. A consequence of this is that, even without border distortions, the time paths of the prices of food in different regions can diverge, depending on regional differences in overall economic performance and the elasticity of substitution in consumption between the different regional foods.

As in other dynamic models of the global economy, in *GTAP-Dynamic* the endogenous component of simulated economic growth is due to physical capital accumulation. Technical change is introduced in the form of exogenous trends. A consequence of this is that it exhibits the property of dynamic models of the Solow-Swan type, namely that an increase in the growth rate of the population raises the growth rate of real GDP but reduces the level of real per capita income. Driving this behaviour are recursive multi-regional dynamics. Unlike the McKibbin models[23] it incorporates no forward-looking agents. Instead, investors have adaptive expectations about the real net rates of return on installed capital in each region. These drive the distribution of investment across regions. In each, the level of investment is determined by a comparison of net rates of return with borrowing rates yielded by a global trust to which each region's saving contributes. Given that labour abundance is a key determinant of the marginal product of physical capital, we introduce region-specific interest premia to prevent the unrealistic allocation of investment to the most populous regions (discussed below).[24]

To capture the full effects of demographic change, including those of ageing, the standard model has been modified to include multiple age, gender and skill groups in line with the structure of the demographic sub-model. In the adapted model, these 16 groups differ in their consumption preferences, saving rates and their labour supply behaviour. Unlike the standard *GTAP* models, in which regional incomes are split between private consumption, government consumption and total saving via an upper level Cobb-Douglas utility function that implies fixed regional saving rates, this adaptation first divides regional incomes between government consumption and total private disposable income. The implicit assumption is that governments balance their budgets while private groups save or borrow.

Private disposable income is then split between the eight age-gender groups in a manner informed by empirical studies of age and gender specific consumption behaviour. For each age-gender group we then use a Keynesian consumption equation to split disposable income between saving and consumption expenditure. Group private saving rates then become endogenous, depending on real disposable income and the real interest rate, thereby relaxing the fixed average saving rate assumption in the standard model. Once group consumption expenditures are known, the standard *GTAP* CDE[25] consumption preferences are applied to each, with preference parameters varying to reflect age-gender differences in tastes. Finally, consumption volumes are totalled across groups to obtain final demand for each product and consumption expenditures are

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[23] See, for example, Bryant and McKibbin (2001).

[24] A second distinguishing characteristic of *GTAP-Dynamic* is that the base period equilibrium is not usually a steady state and there are no restrictions on the steady states ultimately reached following shocks. All regional households consume within their budget constraints, and hence all inter-regional payments always balance. Yet, should a region's savings fall relative to its investment the gap between them is financed by foreign savings and this can cause secular trends in current account balances. A final distinction is that the process of physical capital accumulation is region-wide and not sector-specific. This requires the assumption that physical capital is perfectly mobile between industries in the very short run. Most global dynamic models make this assumption. An exception at the regional level is Australia's MONASH model (Dixon and Rimmer 2002). This model has very substantial sectoral detail and physical capital accumulation is sector-specific. As yet, this behaviour has not been given global scope.

[25] This refers to the "constant difference of elasticities of substitution" demand system. See Hertel et al. (1997) and, in particular, Huff et al. (1977).

subtracted from group disposable incomes to obtain group saving levels, which are then totalled across groups to obtain regional saving.

In splitting regional disposable income between the eight age-gender groups, the approach is to draw from empirical studies of the distribution of disposable income between age-gender groups for "typical" advanced and developing countries.[26] Individuals in each age-gender group then split their disposable incomes between consumption and saving. For this a reduced form approach is taken to the intertemporal optimisation problem faced by each. It employs an exponential consumption equation that links group real per capita consumption expenditure to real per capita disposable income and the real interest rate. This equation is calibrated for each group and region based on a set of initial (1997) age-specific saving rates from per capita disposable income.[27] The initial saving rates by age group are listed in Table 6. Importantly, these show transitions to negative saving with retirement in the older industrial regions. This is what gives rise the declines in average saving rates as populations age. The empirical studies on age-specific saving behaviour are less clear, however, when it comes to developing regions. In the case of China, only modest declines in saving rates are recorded when people retire.[28] If these rates represent Chinese behaviour accurately, they imply that ageing in China can be expected to have less impact on the average Chinese saving rate than it does in the older industrial economies.

4. Constructing the Base Line Scenario

The base line scenario represents a "best judgement" projection of the global economy through 2030. Although policy analysis can be sensitive to the content of this scenario, the focus of this paper is on the extent of departures from it that would be caused by alternative trends in

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[26] The analytics of income splitting are described in detail by Tyers et al. (2005).

[27] The age-specific initial saving rates are recalibrated for consistency with the overall private saving rate in each region indicated in the *GTAP* database. A substantial empirical literature examines rates of saving from disposable income by age and gender group. Most of it is cross-sectional. The intertemporal and panel studies that are available cover relatively short periods of time. These studies imply elasticities of per capita consumption expenditure to disposable income less than unity and therefore very high marginal saving rates. Consequently, as per capita income grows through time, the average saving rates of age-gender groups tend to grow. This change is a departure from the underlying intertemporal optimisation by households and age-gender groups. The solution adopted here is to construct new elasticities that are consistent with the following hypothetical scenario: 1. North American per capita disposable income grows at 3%/yr for 100 years, 2. Growth in all other regions is sufficient to attain North America's per capita disposable income levels within the century, 3. When the other regions catch up, all regions attain identical group-specific saving rates, and 4. The income, consumption and saving transitions are smooth and exponential. For further details, see Tyers et al. (2005).

[28] New research by Kinugasa and Mason (2005) and Feng and Mason (2005) offers useful results on the relationship between age and saving in China. The complication is that a comparatively large proportion of consumption spending by the Chinese elderly is probably financed from the income of younger family members. We have attempted to take this into account in selecting the age-gender income weights and initial saving rates for China.

Chinese fertility on the one hand and investment risk on the other. Nonetheless, it is instructive to describe the base line for two reasons. First, all scenarios examined have in common a set of assumptions about future trends in productivity and, second, some exposition of the base line makes the construction of departures from it clearer.

Exogenous factor productivity growth

Exogenous sources of growth enter the model as factor productivity growth shocks, applied separately for each of the model's five factors of production (land, physical capital, natural resources, production labour and professional labour). Simulated growth rates are very sensitive to productivity growth rates since, the larger these are for a particular region the larger is that region's marginal product of capital. The region therefore enjoys higher levels of investment and hence a double boost to its per capita real income growth rate. The importance of productivity notwithstanding, the empirical literature is inconsistent as to whether productivity growth has been faster in agriculture or in manufacturing and whether the gains in any sector have enhanced all primary factors or merely production labour. The factor productivity growth rates assumed in all scenarios are drawn from a new survey of the relevant literature (Tyers et al. 2005), the values for China are detailed in Table 7. Agricultural productivity grows more rapidly than that in the other sectors in China, along with Australia, Indonesia, Other East Asia, India and Other South Asia. This is due to continued increases in labour productivity in agriculture and the associated shedding of labour to the other sectors. In the other industrialised regions, the process of labour relocation has slowed down and labour productivity growth is slower in agriculture. In the other developing regions, the relocation of workers from agriculture has tended not to be so rapid.

Interest premia

Aside from exogenous productivity growth, a key aspect of the base line projection is the allocation of investment across regions. The standard *GTAP-Dynamic* model takes no explicit account of investment risk and so tends to allocate investment to regions that have high marginal products of physical capital. These tend to be labour-abundant developing countries whose labour forces are still expanding rapidly. It finds them particularly attractive prospects for this reason, yet we know that risk and market segmentation considerations limit the flow of foreign investment at present and that these are likely to remain important in the future. To account for this we have constructed a "pre-base line" simulation in which we maintain the relative growth rates of investment across regions. In this simulation, global investment rises and falls but its allocation between regions is thus controlled. To do this the interest premium variable (*GTAP Dynamic* variable *SDRORT*) is made endogenous. This creates wedges between the international and regional interest rates. They show high interest premia for the populous developing regions of Indonesia, India, South America and Sub-Saharan Africa. Premia tend to fall over time in other regions, where labour forces are falling or growing more slowly. Most spectacular is a secular fall in the Chinese premium. This is because the pre-base simulation maintains investment growth in China despite the eventual decline in its labour force. This simulation is therefore overly optimistic with respect to China and so we reject the declining premium in constructing the final base line scenario. The time paths of all interest premia are set as exogenous with China's held constant through time. Regional investment is freed up in all regions. The endogeneity of investment is an element of the model's closure that is maintained in all subsequent simulations.

The base line projection

Overall base line economic performance is suggested by Table 8, which details the average GDP and real per capita income growth performance of each region from 1997 to 2030. In part because of its comparatively young population and hence its continuing rapid labour force growth, India attracts substantial new investment and is projected to take over from China as the world's most rapidly expanding region. Rapid population growth detracts from India's real per capita income performance, however. By this criterion, China is the strongest performing region through the three decades. Indonesia and "other East Asia" are also strong performers, while the older industrial economies continue to grow more slowly. The African regions enjoy good GDP growth performance but their high population growth rates limit their performance in per capita terms.

5. Alternative Demographic Scenarios for China

Following Sharping (2003) and the State Council of China (2000), two higher-fertility scenarios are constructed. These differ only in their fertility rates. Death rates and migration behaviour are assumed to remain as in the base line projection. The first higher-fertility scenario offers a comparatively stable Chinese birth rate, with the fertility rate trending from 1.90 to 1.80 over the three decades to 2030. It is similar to the State Council "one child policy", and to Sharping's "tight rule, fraud as usual" scenario. The second trends toward two children per couple throughout China, with a fertility rate of 2.3 achieved by 2030. It is similar to the State

Council's "two child policy" and to Sharping's "delayed two child policy …". The implications for China's total population under these scenarios are indicated in Table 9.

The correspondence between these simulations and State Council projections is close. A transition to a two-child policy would raise the 2030 population by 11 per cent relative to the stable fertility case. Our low-fertility base line, on the other hand, achieves a 2030 population seven per cent below the stable fertility case. These implications are displayed graphically in Figure 5. Critically, the associated labour force changes are smaller in magnitude and transitions occur earlier than those in the populations. The Chinese population ages in all three scenarios, but more slowly the higher the fertility rate. This can be seen from the non-working-aged dependency ratio in Figure 6. It rises substantially by 2030 in all three cases. After 2015, however, there are discernable differences, with the two-child policy yielding a 2030 ratio that is lower by four percentage points than the low-fertility base line.

Economic Implications:

The three main avenues through which higher fertility affects economic performance are via the labour force, which it expands, the savings share of income, which tends to rise with the share of the population of working age, and the product composition of consumption, which more strongly reflects the preferences of the young when population growth accelerates. The comparisons made by Tyers et al. (2005) suggest a general ranking that has the labour force avenue most commonly the strongest with the saving rate avenue next and with the influence of age-specific consumption preferences comparatively small. This is indeed borne out. The labour force effect can first be seen through it impact on the non-working-aged dependency ratio. This ratio expands under all scenarios in China, as shown in Figure 6, but it grows least in the two-child policy case.[29]

Turning to the other avenues, age-specific consumption preferences can be expected to have little influence in the results presented here since product markets are aggregated into three broad sectors and the capturing of generational differences in preferences requires fine product detail. As to the saving rate, for reasons discussed previously the effects of Chinese fertility changes on average saving rates can be expected to be smaller than they are in the older industrialised regions. Beyond the dependency ratio, the dominant economic theme might therefore be changes in China's labour force that alter the productivity of its capital and therefore

[29] This result could have a number of economic implications that are not captured in our model, including that higher fertility would necessitate lower rates of distorting taxes to finance aged pensions and public health systems. Our scenarios maintain constant tax rates and fiscal deficits.

the return on Chinese investment. Greater population growth thereby attracts an increased share of the world's savings into Chinese investment and so China's capital stock grows more rapidly. China's GDP might therefore be expected to be boosted substantially by increased fertility, through its direct and indirect influence over the supply of the two main factors of production, labour and capital. In per capita terms, however, the Solow-Swan predisposition toward slower real wage growth, combined with the need to reward foreign capital owners, suggests that the average Chinese will not derive economic benefit from increased fertility.

These expectations are indeed borne out in our simulations, as indicated in Table 10. Higher fertility, relative to the base line, does raise the rate of return on installed capital in China and hence the level of investment. In turn, China's GDP is higher, as is also shown in Figure 7. Yet the higher fertility slows real wage growth, due to the increased relative abundance of labour and, in combination with the repatriation of an increased proportion of the income accruing to capital, this causes real per capita income also to grow more slowly. A further negative complication is the large-country effect – as China's trade with the rest of the world expands it turns its terms of trade against itself. This effect is small overall but of growing significance late in the period.[30] The corresponding dynamics of the real production wage and real per capital income are illustrated in Figure 8.

6. Faster GDP Growth by Reducing China's Interest Premium

Here we ask how different the economic changes would be were fertility to remain low, as in the base line, and were the GDP growth achieved under the two-child policy to be gained instead by a decline in China's interest premium. To find this out we change the closure of the model by setting China's GDP growth path as exogenous and making China's interest premium endogenous. Otherwise the simulation is identical with the base line. With this change in closure, the model tells us by how much China's interest premium would need to fall. This magnitude, and the other economic implications of achieving higher growth through a reduced premium, are summarised in Table 11.

The new simulation of the global economy approaches a steady state by 2030, in that the bond yield that equates global saving with global investment as adjusted by China's remaining interest premium converges with the net rate of return on installed capital in China. To achieve

[30] Empirical evidence for such terms of trade effects from growth is variable. In many cases, developing country expansions have not caused adverse shifts in their terms of trade because their trade has embraced new products and quality ladders in ways not captured by our model. See the literature on the developing country exports fallacy of composition argument, that includes Lewis (1952), Grilli and Yang (1988), Martin (1993), Singer (1998) and Mayer (2003).

GDP growth equivalent to the two-child policy case these rates need to be lower by almost a tenth. Considering that the yield ratio of Chinese to US Treasury 10-year bonds has been about 1.4, as shown in Figure 1, there is, ultimately, scope for a decline of 28 per cent, this change appears readily achievable with continued Chinese development and financial reform over three decades.[31]

This acceleration in growth occurs because the reduced premium lowers the cost of funds in China. Recall that investment depends positively on the net rate of return on installed capital and negatively on the bond rate. Cheaper funds therefore spur investment, which, by 2030, is larger than the base line by more than a third. This creates the principal distinction between this simulation and that for the two-child policy. The latter spurs China's GDP growth by raising its labour endowment, while this simulation does so by accelerating the growth in its capital stock. The two-child policy causes real wages to grow more slowly and for the increased labour abundance to raise capital returns. On the other hand, the financial reform simulation sees real wages accelerating and capital returns falling. Interestingly, although this alters the composition of China's imports and exports, the two simulations yield similar small deteriorations in China's terms of trade.

A key bottom line is the effect of each policy scenario on real income per capita. As illustrated in Figure 8, the two-child policy slows real per capita income growth for reasons discussed previously. The financial reform simulation achieves the same GDP growth without this loss in per capita welfare relative to the low-fertility base line. It does so despite the slower growth in capital returns that stem from the faster capital accumulation.[32]

Superficially, one might expect that the accelerated build-up of the capital stock might be at least partially financed from abroad and, therefore, that an increasing share of China's capital income would accrue to foreigners. A closer look shows that this is not the case. In all the scenarios considered here China is projected to maintain a capital account deficit, and hence a current account surplus, through 2030. This capital account deficit enlarges in the first half of the period, as suggested by the plots shown in Figure 9, and either stabilises or contracts thereafter. Small changes in saving rates, notwithstanding demographic change, and a high rate of income growth ensure that total Chinese saving continues to grow to an extent that varies little across the scenarios. As indicated earlier, it is the demographic effects on the labour force that make the most difference. These change capital returns so that the two-child policy draws in more

[31] See footnote 3.

[32] A caveat applies here, however. To the extent that the initial interest premium is due to risk rather than to market segmentation, the cost of this risk is not accounted for in our deterministic model. Were that initial burden of risk to be properly measured, average net capital returns might not fall as much as predicted by the model.

investment and the capital account deficit tends to close. Reducing the interest premium, however, has the most dramatic impact on China's external accounts. This financial reform scenario, with its accelerated capital accumulation, is seen to roughly close the capital account deficit by the end of the period.

7. Conclusion

China's economic growth has, hitherto, depended on its relative abundance of production labour and its increasingly secure investment environment. Within the next decade, however, China's labour force will begin to contract. This will set its economy apart from other developing Asian countries where relative labour abundance will increase, as will relative capital returns. This expectation is confirmed in this paper using a new global demographic model that is integrated with an adaptation of the *GTAP-Dynamic* global economic model in which regional households are disaggregated by age and gender. Unless there is a substantial change in population policy, the retention of China's large share of global FDI will require reduced interest premia and hence the successful continuation of financial reforms. A transition to a two child policy in China is shown to boost its GDP growth, enlarging the projected 2030 Chinese economy by about a tenth. Yet this would slow the growth rate of real *per capita* income, reducing the level projected for 2030 by a tenth.

The same GDP growth performance might be achieved with continued low fertility, if China's interest premium can be reduced gradually through 2030, sufficiently to contract the average domestic borrowing rate in 2030 by nine per cent. Considering that the yield ratio of Chinese to US Treasury 10-year bonds has been about 1.4, there is, ultimately, scope for a decline of 28 per cent, whihc appears achievable with continued Chinese development and financial reform over three decades. This confirms that continued financial reform should take priority over increased fertility.

Yet, even if financial sector reforms proceed smoothly, there is no guarantee that this will immediately either reduce the risks of investing, or increase the volume of investment. In the long-run, reforms should result in the allocation of funds to higher productivity sectors – particularly the private sector – yielding efficiency gains and raising the returns to investment. But in short-run, the shift away from a state-controlled banking system, in which the government has implicitly guaranteed bank loans to loss-making SOEs and also provided incentives to attract foreign investors, may actually *increase* the risks associated with investing in China. Perversely, this could worsen the investment environment, in the short-run at least. For domestic investors, the opening of the financial sector to foreign institutions will provide alternative investment opportunities, which may lead them to require greater returns from state-owned assets or to find new means of channelling their capital outside the country. Ultimately, successful financial reforms will be those that attract domestic savings to China's financial markets, while maitaining a high level of foreign investment.

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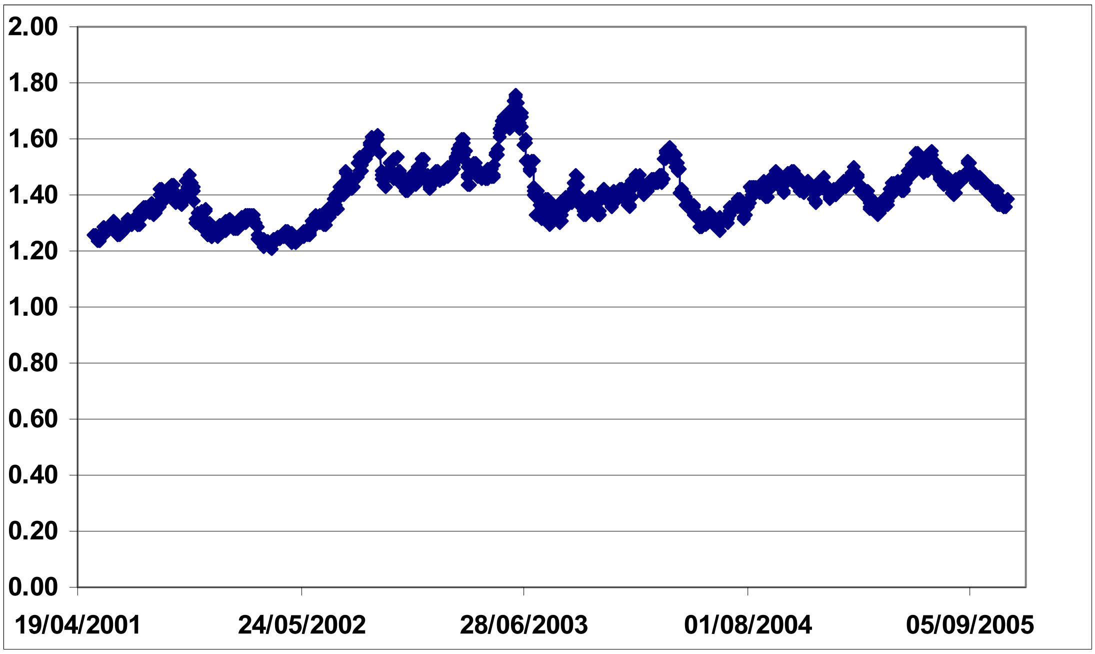
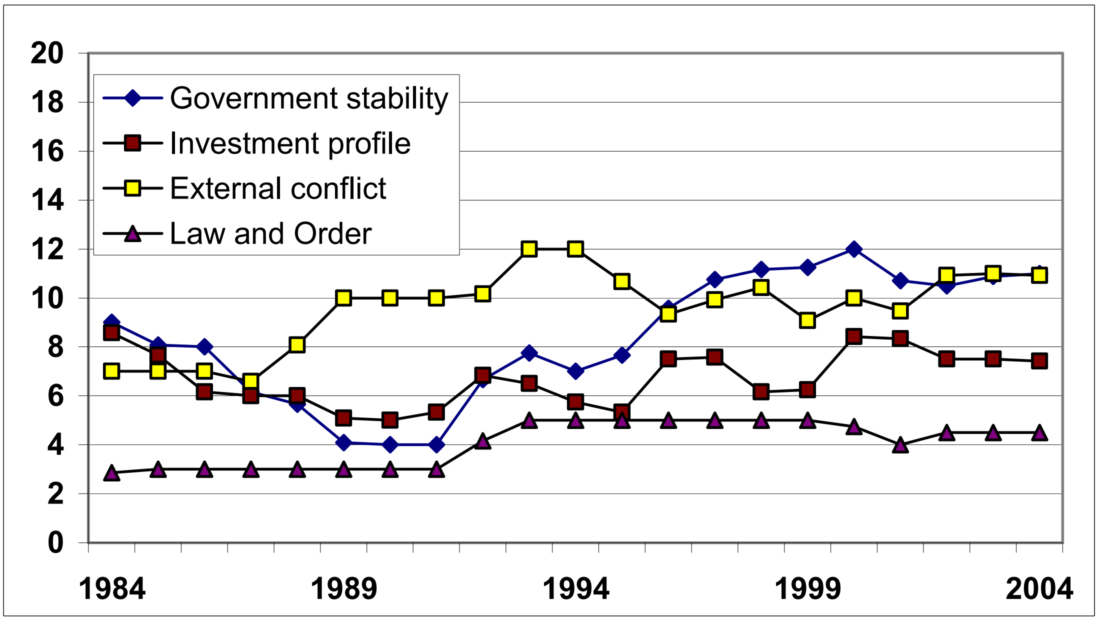
Figure 1: The Ratio of Chinese to US 10 Year Bond Yields[a]



a Chinese bond yields varied in this period between 5.5 and 7.0 per cent, while US bond yields varied between 3.0 and 5.5 per cent. The graph shows the yield ratio for daily quotations between May 2001 and November 2005.

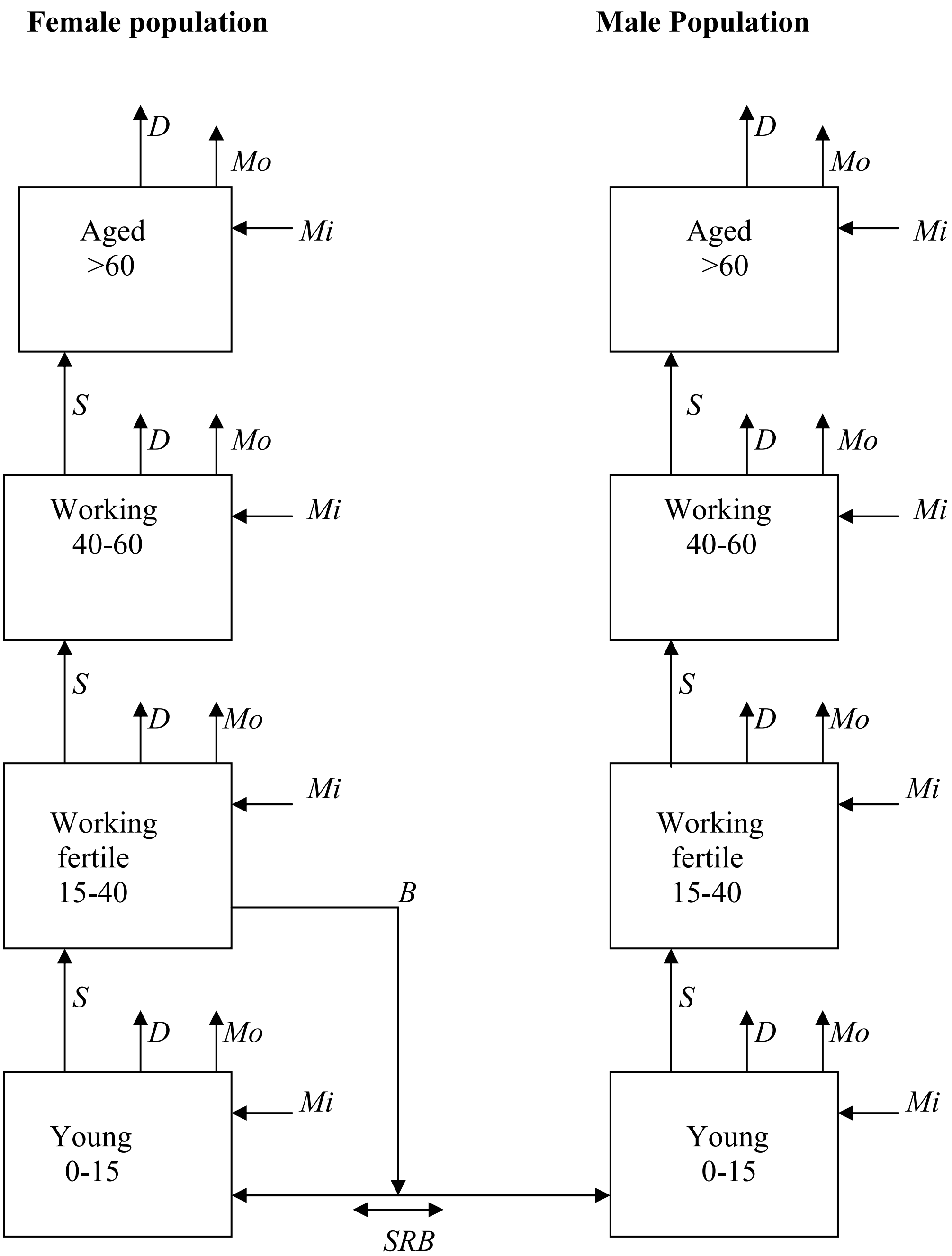
Source: *Datastream* on line database.

Figure 2: Sources of Chinese Political Risk[a]



Source: The International Country Risk Guide (2005).

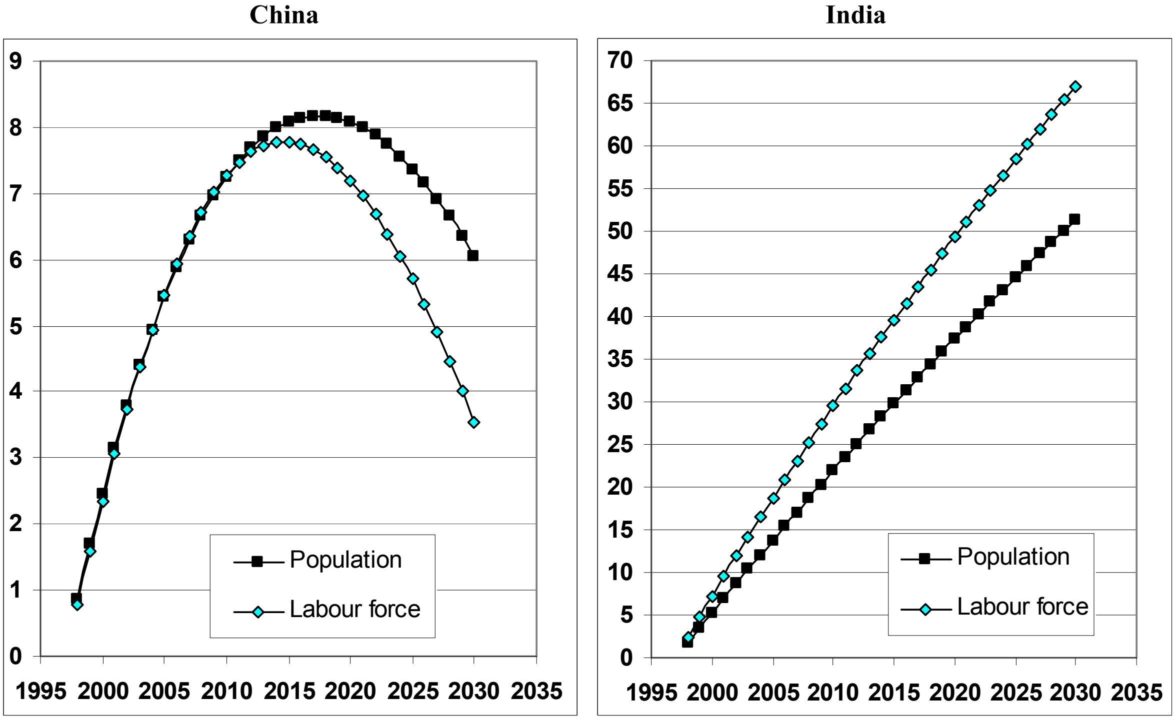
Figure 3: The Demographic Sub-Model



Glossary:

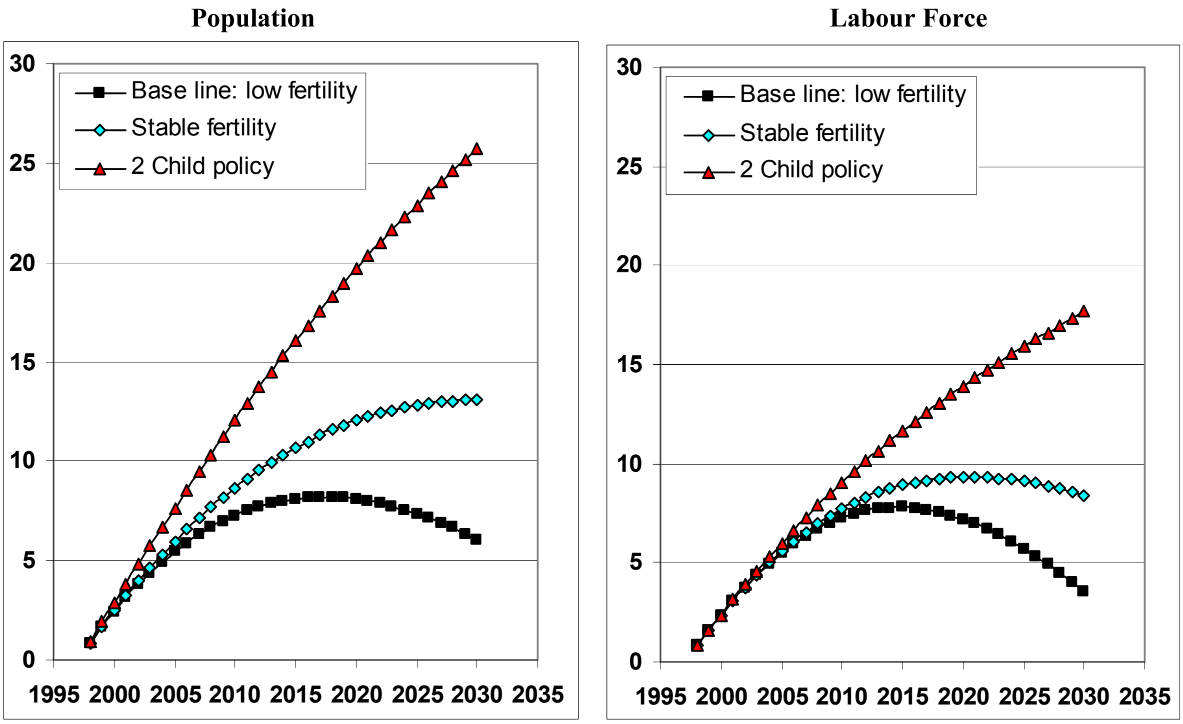
D	Deaths
S	Survival
B	Births
Mi	Immigration
Mo	Emmigration
SRB	Sex ratio at birth

Figure 4: China's and India's Projected Populations and Labour Forces[a]



a These are cumulative % departures from the base year 1997, drawn from the base line simulation in which China's fertility is projected to decline faster than India's and in which India commences with a much younger population.

Figure 5: Three Growth Scenarios for China's Population and Labour Force[a]



a These are cumulative % departures from the base year 1997.

Figure 6: Three Scenarios for the Chinese Non-Working-Aged (60+) Dependency Ratio[a], %

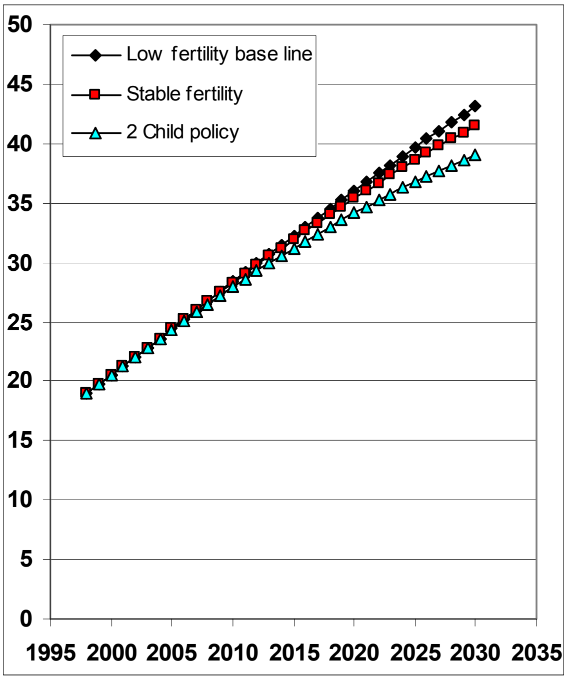


Figure 7: Chinese Real GDP, Departures from the Base Line[a], %

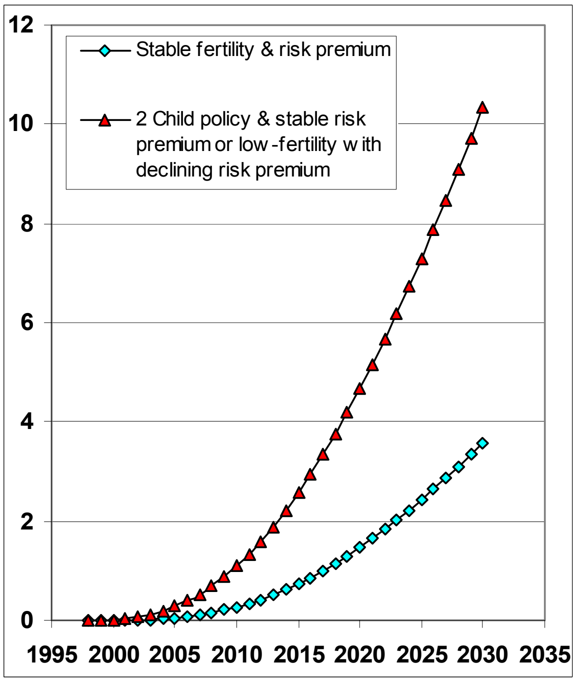
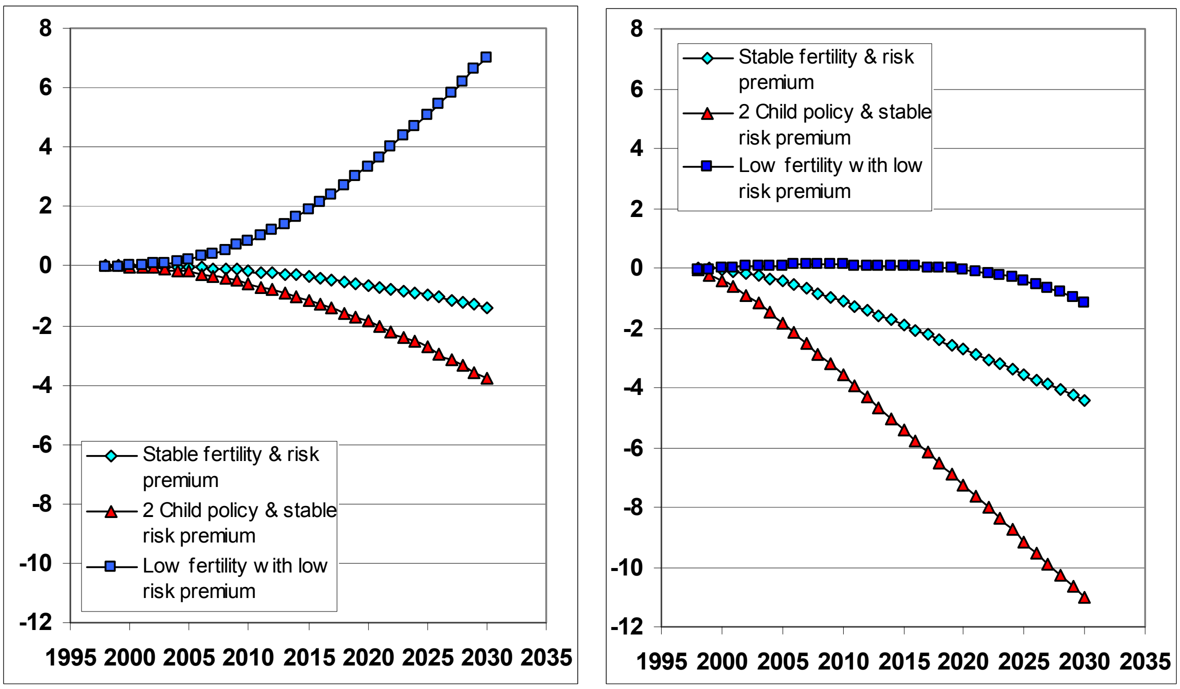


Figure 8: Chinese Real Wage and Per Capita Income, Departures from the Base Line[a], %

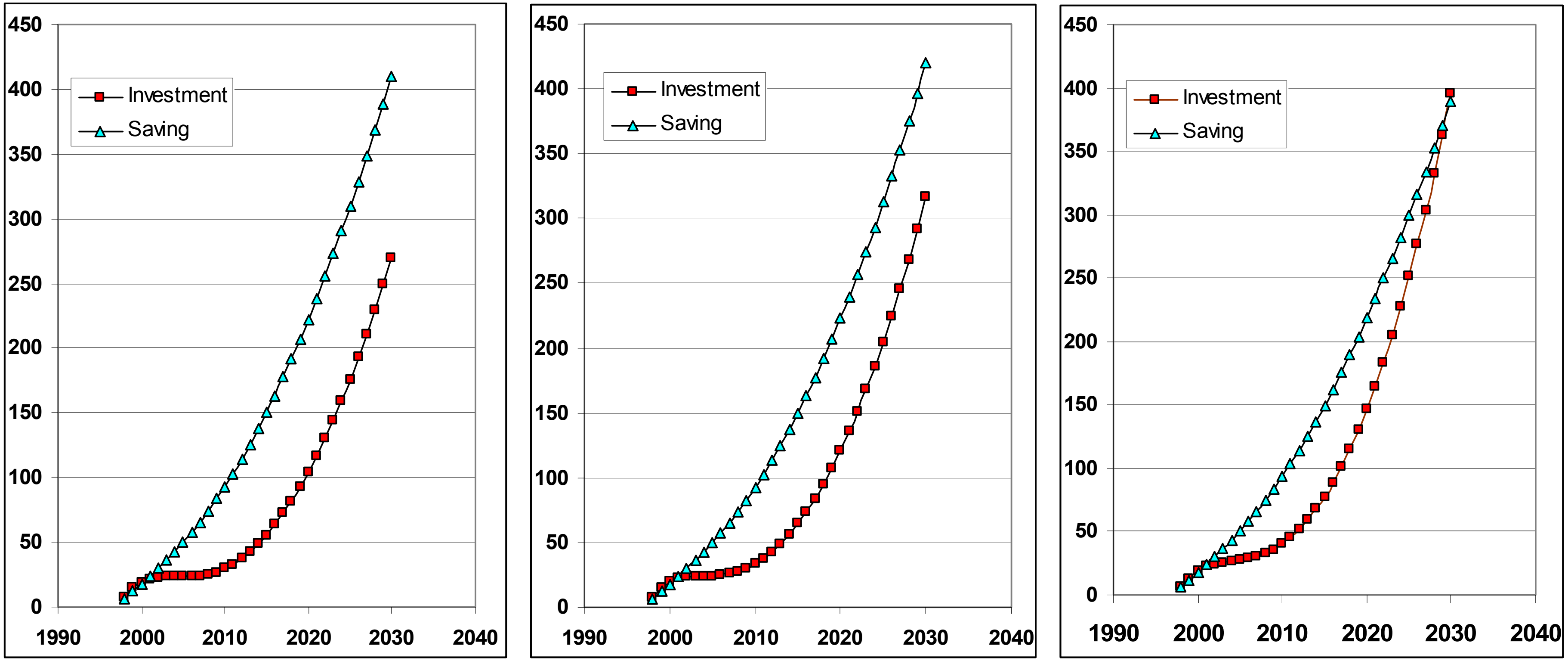
Real Production Wage **Real Income Per Capita**



a These are % departures from the base line simulation for each year. Note that the base line assumes declining fertility in China and a stable risk premium.

Figure 9: Chinese Saving and Investment – Growth over 1997[a], %

Low Fertility Base Line | **2-Child Policy with Stable Risk Premium** | **Low Fertility with Low Risk Premium**



a These are cumulative percentage departures from the base year, 1997. The gap between saving and investment shown in the graphs does suggest, however, a widening of China's capital account deficit (current account surplus) during the first half of the period.

Table 1: Base Line Birth Rates in China and Japan[a]

	China		Japan	
Sex ratio at birth, males/females	1.10		1.06	
	Birth rate[b]	Fertility rate[c]	Birth rate[b]	Fertility rate[c]
Base year, 1997	76	1.90	59	1.48
2010	62	1.55	58	1.45
2020	59	1.48	57	1.43
2030	58	1.45	57	1.43

a Birth rates are based on UN estimates and projections as represented by the US Bureau of the Census. The latter representation has annual changes in rates while the UN model has them stepped every five years. Initial birth rates are obtained from the UN model by dividing the number of births per year by the number of females aged 15-39. These rates change through time according to annualised projections by the US Bureau of the Census.
b Birth rates are here defined as the number of births per year per thousand women of fertile age. They are modified to allow for the modelling simplification that the fertile age group spans 15-39.
c Fertility rates are the average number of children borne by a woman throughout her life.
Source: Aggregated from United Nations (2003), US Department of Commerce- U.S. Bureau of the Census "International Data Base", as compiled by Chan and Tyers (2006).

Table 2: Base Line Age and Gender Specific Death Rates in China and Japan[a]

Deaths per 1000	China		Japan	
	Males	Females	Males	Females
0-14				
Initial (1997)	1.10	0.90	1.20	1.00
2030	0.54	0.49	0.72	0.66
15-39				
Initial (1997)	0.80	0.30	0.70	0.40
2030	0.57	0.19	0.55	0.77
40-59				
Initial (1997)	3.90	2.00	3.50	2.00
2030	2.81	1.78	2.60	1.39

a Projections of these parameters to 2020 assume convergence on target rates observed in comparatively "advanced" countries, as explained in the text. Only the end point values are shown here but the model uses values that change with time along the path to convergence.
Source: Values to 1997 are from United Nations (2000b) and WHO (2003).

Table 3: Life Expectancy at 60 in China and Japan

Years	China		Japan	
	Males	Females	Males	Females
Initial (1997)	16	18	22	26
2030	17	21	27	33

a Projections of these parameters to 2020 assume convergence on target rates observed in comparatively "advanced" countries, as explained in the text. Only the end point values are shown here but the model uses values that change with time along the path to convergence.
Source: Values to 1997 are from United Nations (2000b).

Table 4: Base Line Population Structure in China

	Population, millions	% Female	% 60+
Initial (1997)	1,252	48.5	9.7
2010	1,311	48.7	14.8
2020	1,321	48.8	18.4
2030	1,296	49.0	21.5

Source: Projection using the base line simulation of the model described in the text.

Table 5: Base Line Labour Force Structure in China[a]

	Labour force, millions	% Female	% 40+
Initial (1997)	585	37.6	33.8
2010	628	37.1	41.1
2020	627	36.7	44.4
2030	606	36.5	46.6

a Measured in full time equivalent workers.
Source: Projection using the base line simulation of the model described in the text.

Table 6: Initial Saving Rates from Personal Disposable Income by Age Gender Group, %

Per cent	0-14		15-39		40-59		60+	
	Male	Female	Male	Female	Male	Female	Male	Female
Australia	0	0	7	7	31	31	-5	-5
North America	0	0	14	14	19	19	-30	-30
Western Europe	0	0	10	10	39	39	-20	-20
Central Europe, FSU	0	0	4	4	18	18	-6	-6
Japan	0	0	24	24	28	28	22	22
China	**0**	**0**	**35**	**35**	**40**	**40**	**31**	**31**
Indonesia	0	0	23	23	34	34	23	23
Other East Asia	0	0	36	36	40	40	32	32
India	0	0	19	19	28	28	19	19
Other South Asia	0	0	7	7	10	10	7	7
South America	0	0	7	7	17	17	6	6
Mid East Nth Africa	0	0	8	8	19	19	7	7
Sub-Saharan Africa	0	0	2	2	6	6	2	2
Rest of World	0	0	5	5	23	23	-5	-5

Source: Compiled from studies of consumption behaviour on particular countries, including Mexico: Attanasio and Szekely (1998); Japan: Kitamura et al. (2001); New Zealand: Gibson and Scobie (2001); US: Attanasio et al. (1999).

Table 7: Base Line Factor Productivity Growth in China

Regional average %/yr	Sector	Primary factor: Land	Production labour	Skilled labour	Capital	Natural resources	Sectoral average
2.09	Food	3.5	3.0	0.5	1.5	0.0	2.76
	Industrial products	0.0	3.0	1.0	1.5	0.5	2.05
	Services	0.0	2.5	1.5	1.5	0.0	1.84

a Productivity growth is specified by primary factor. For display, sectoral averages are weighted by factor cost shares in each sector and regional averages by sectoral value added shares in each region.
Source: Tyers et al. (2005).

Table 8: Base Line Real GDP and per Capita Income Projections to 2030

	% change 2030 over 1997		Implied *average* annual growth rate, %/yr	
	Real GDP	Real per capita income	Real GDP	Real per capita income
Australia	262	178	4.0	3.1
North America	253	171	3.9	3.1
Western Europe	159	178	2.9	3.1
Central Europe & FSU	205	210	3.4	3.5
Japan	166	217	3.0	3.6
China	**340**	**378**	**4.6**	**5.0**
Indonesia	490	390	5.5	4.9
Other East Asia	529	373	5.7	4.8
India	565	291	5.9	4.2
Other South Asia	430	127	5.2	2.5
South America	293	149	4.2	2.8
Mid East & Nth Africa	280	104	4.1	2.2
Sub-Saharan Africa	360	114	4.7	2.3
Rest of World	336	159	4.6	2.9

Source: The (low fertility) base line projection described in the text.

Table 9: The Chinese Population under Alternative Demographic Scenarios[a]

Millions	Base line: low (declining) fertility 1.90 to 1.45	Stable fertility (1 child policy): 1.90-1.80		Transition to 2 child policy: 1.90-2.30	
		State Council[b]	Our model	State Council	Our model
2000	1,252	1,270	1,253	1,270	1,257
2010	1,311	1,344	1,328	1,369	1,369
2020	1,321	1,393	1,369	1,466	1,462
2030	1,296	1,396	1,382	1,518	1,536

a The base year for our simulations is 1997, when China's fertility rate was approximately 1.91.
b The comparable simulation for stable fertility by the State Council of China holds the one child policy constant as at present – the corresponding projection by Sharping is entitled "tight rule, fraud as usual".
Source: Sharping (2003), Development Research Centre of the State Council of China (2000) and simulations using the model described in the text.

Table 10: Economic Effects of Faster Chinese Population Growth to 2030

(% Departures of the 2-Child Policy from the Low Fertility Base Line)

		Investment	GDP	Real GNP per capita	Real production wage	Rate of return on installed capital	Terms of trade
2010	Stable fertility	0.7	0.3	-1.1	-0.2	0.1	0.0
	2 Child policy	2.7	1.1	-3.6	-0.6	0.4	0.0
2020	Stable fertility	2.9	1.5	-2.7	-0.6	0.2	-0.1
	2 Child policy	8.8	4.7	-7.3	-1.9	0.6	-0.5
2030	Stable fertility	5.3	3.6	-4.4	-1.4	0.3	-0.6
	2 Child policy	14.7	10.3	-11.0	-3.8	0.6	-1.6

Source: The base line, stable fertility and 2-Child Polity projections from the model described in the text.

Table 11: Economic Effects of Achieving the Same GDP Growth as Yielded by the 2 Child Policy via a Risk Premium Reduction[a]

(% Departures of the Low Risk Premium Simulation from the Base Line)

	Investment	GDP	Real GNP per capita	Real production wage	Rate of return on installed capital[b]	Terms of trade
2010	7.9	1.1	0.1	0.8	-1.0	0.1
2020	21.4	4.7	-0.1	3.3	-4.4	-0.4
2030	36.6	10.3	-1.2	7.0	-8.9	-1.8

a Here the low-fertility base line is compared with a corresponding low-fertility simulation in which risk premium reductions are calculated to achieve the same GDP growth as would be achieved were the 2-Child Policy to be invoked as in Table 10.

b The fall in the domestic rate of return is associated with declines in the risk premium of between 0.3 and 1.4 percentage points.

Source: The base line and low risk premium projections from the model described in the text.