

Contractions in Chinese fertility and savings: long run domestic and global implications*

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Abstract

Following three decades of rapid but unbalanced economic growth, China's reform and policy agenda are set to rebalance the economy toward consumption while maintaining a rate of GDP growth near seven per cent. Among the headwinds it faces is a demographic contraction that brings slower, and possibly negative, labour force growth and relatively rapid ageing. While the lower saving rates that result from consumption-oriented policies and rising aged dependency may contribute to a rebalancing of the economy, in the long run they will reduce both GDP growth and per capita income. Moreover, while an effective transition from the one-child policy to a two-child policy would help sustain growth and eventually mitigate the aged dependency problem, it would set real per capita income on a still lower path. These conundrums are examined using a global economic and demographic model, which embodies the main channels through which fertility and saving rates impact on economic performance. The results quantify the associated trade-offs and show that continuing demographic and saving contractions in China would alter the trajectory of the global economy as well.

1 Introduction

Between 1978 and 2008, China's real GDP grew at an average annual rate of 10.0%. During this period, domestic economic reforms coupled with opening up to the international economy to transform one of the world's poorest countries into a 'middle-income' country, the world's third largest economy (or second largest measured in PPP terms) and its third largest exporter (after Germany and the United States). The growth surge commenced with rural de-collectivisation and the consequent rise in agricultural productivity, which precipitated the world's largest ever rural-urban migration, enabling workers to be combined with capital and imported technology and yielding rapid productivity growth. The speed of growth, combined with lagging social institutions and industrial reform, also induced high and rising household and corporate saving rates, both of which financed extraordinarily high levels of investment. The policy framework to emerge necessarily fostered export- and investment-led growth and it not only dramatically transformed China's economy during this period, but the global economy as well.¹

These three decades also heralded dramatic demographic change in China. A substantial increase in population – from 978 million in 1980 to 1.34 billion in 2010 – occurred despite declining rates of population growth, underpinned by an ongoing decline in fertility that

¹ International consequences are surveyed by Tyers (2015, 2016).

commenced in the mid-1960s and accelerated by the introduction of the one-child policy in 1980 along with socioeconomic developments thereafter. Crucially, the 1980s saw the beginning of rapid drops in youth dependency, and a corresponding increase in the growth of the labour force relative to that of the total population, and hence in the working-age to non-working age population ratio, which peaked in 2010. This provided China with the much-celebrated ‘demographic dividend’, which accounted for between one sixth and one quarter of per capita GDP growth in this period according to some estimates.²

Yet this period was not without its problems. On the economic front, while the first decade and a half delivered ‘reform without losers’, from the mid-1990s onwards it became increasingly clear that this had shifted to ‘reform with losers’ (Lau, Roland and Qian 2000). By the mid-2000s, growth had become highly unbalanced, most evidenced by the fact that China produced more than it consumed and so exported more than it imported and saved at an unusually high rate, beyond domestic investment needs, thereby accumulating considerable foreign assets. Along with a number of associated imbalances, this contributed not only to growing social unrest on the domestic front, but also created tensions abroad, reflected in rising protectionist pressures and, in the extreme, accusations that China’s savings ‘glut’ had been a major contributor to the global financial crisis in 2008-09 (Bernanke 2005, 2011).

Since that time, China’s economic problems have reached new heights. At the National People’s Congress in March 2015, Premier Li Keqiang’s address on the ‘state of the nation’ was the most candidly pessimistic address in decades, acknowledging that ‘with the downward pressure on China’s economy building and the deep-seated problems in development surfacing, the difficulties we will encounter in the year ahead may be even more formidable than those of last year’ (Li 2015). Around the same time, Premier Li lowered the country’s official rate of growth of GDP to ‘around 7 per cent’, which is being touted as the ‘new normal’ rate of growth. While the official GDP growth estimate for 2015 came in right on target, at 6.9 per cent, and although this is still a remarkable rate of growth by international standards, there is growing anxiety both inside and outside of China about whether this ‘new normal’ rate of growth is either accurate (Wu and The Conference Board China Center, 2014) or sustainable, and what the domestic and global economies will look like in China’s ‘post-boom’ period.

On the demography front, while the one-child policy has always been controversial abroad, the economic benefits of rapid fertility decline received much attention in the past, not least by

² The demographic dividend is well researched, including by Cai and Wang (2005), Bloom et al. (2010), Wei and Hao (2010) and Golley and Tyers (2012b).

Chinese leaders themselves. In recent years, however, attention has shifted to both the negative and the longer-term consequences of that decline. The most obvious of these is the relatively rapid ageing of the Chinese population, with aged dependency projected to more than double between 2010 and 2030, and nearly double again by 2050 (United Nations, 2015). This, according to most analyses, will bring China's 'demographic dividend' to a rather sudden end, placing it in the unique position of being a transitional, developing economy facing what is primarily a developed country phenomenon, or 'growing old before growing rich' (Cai 2010, 2012). Rising gender imbalances, and their contribution to rising household savings have also become a focus of economic research, with some scholars going as far as to suggest that 'While China's sex ratio imbalance is not the sole reason for global imbalances, it could be a significant, but unrecognised factor' (Du and Wei, 2010: p.2).

The Chinese government has not stood idly by as these complex, and interconnected, economic and demographic pressures have escalated. In 2004, the Chinese government under president Hu Jintao began to emphasise the need for a more balanced growth strategy that would simultaneously alleviate rising income inequality within China, reduce the pressure on energy demand and the environment, promote employment growth and reduce the country's reliance on external demand (Lardy, 2006; Hu, 2007, Wang and Fang, 2015). Although only limited 'rebalancing' has occurred in the decade since, Xi Jinping remains committed to a reform agenda that should, if effective, lead the economy towards consumer-led growth in the decades ahead. A likely outcome of these reforms – and indeed a necessary one for rebalancing to succeed – is lower national saving rates in the future.

A more definitive decision came in late 2015, with the announcement that the one-child policy would be abolished and replaced with a nationwide two-child policy, effective as of 1 January 2016. The dominant reason for this change, as stressed in Chinese media reports, was that relaxing family planning policy would provide part of the solution to the ageing problem, with higher fertility expected to produce more than 30 million additional people in the labour force by 2050. The National Health and Family Planning Commission also reported that a two-child policy could increase the rate of economic growth by 0.5 percentage points via its impact on aged dependency.³ These calculations hinged on the assumption that a significant number of the fertile population will respond by actually having a second child – an assumption that is highly uncertain according to a string of demographic research on the topic, which suggests an alternative future in which China falls into a 'low-fertility trap', consistent with other countries

³ See, for example, http://www.chinadaily.com.cn/china/2015-12/21/content_22759611.htm

in the region, including Japan and Korea (Chen, Retherford, Choe, Li and Hu, 2009; Basten and Jiang 2015; Zhao 2015).

As 2016 commences, the economic and demographic strategies being pursued by the Chinese government are indicative of at least two (interrelated) conundrums that do not appear to have been given adequate attention, in either the policymaking or academic communities. The first is that rebalancing the economy towards domestic consumption will require a reduction in the high saving rates that provided a key source of finance for the investment-led growth of the past. It is far from clear that this reduction will actually occur and hence whether consumption will sustainably replace export demand, allowing growth to continue at the intended pace (Ma and Yi 2010, Yang et al. 2011). The second is that higher fertility rates would indeed contribute to higher rates of GDP growth, and likely to higher consumption as well. Yet, just as lower fertility brought about a ‘demographic dividend’ in the past in terms of per capita income, higher fertility would come at a per capita income cost, with negative welfare implications (in economic terms at least) for the average Chinese citizen. On this point, the Chinese leadership appears to be largely silent.

This paper assesses the seriousness of these conundrums using a dynamic global economic model that incorporates full demographic behaviour. This enables us to clarify how alternative trajectories for China’s fertility and savings rates will impact on China’s economic performance through to 2050, and, in turn, what these alternative trajectories will mean for economic performance in the rest of the world. We begin with a baseline scenario for the global economy through to 2050, in which continued high GDP growth is achieved through both the rising fertility that a two-child policy could potentially bring and an overall saving rate that declines only modestly. We then compare this with three alternative scenarios: a ‘low fertility’ scenario which fertility is assumed to decline along its present path without interruption by the two-child policy; a low-saving scenario in which Chinese savings are assumed to decline relatively rapidly toward levels common in the industrialised West; and a combination of these two – a ‘double contraction’. Our reason for this experimental structure is to emphasise the domestic and international implications of two potentially significant sources of a slowdown in Chinese growth in the decades ahead. The results offer numerical foundation to the anxieties relating to China’s ‘post-boom’ period and they show that the implications for the rest of the global economy could be considerable.

The paper proceeds as follows. Section 2 sets the scene with a discussion of some of the theoretical and practical links between demographic change, savings and economic growth in

China's context. Section 3 summarises our approach to modelling demographic change and economic performance in a global context. Section 4 presents the baseline and counterfactual scenarios, and their projected outcomes for GDP growth in the Chinese and global economies through to 2050. We then delve deeper into the channels through which lower fertility and savings impact on economic performance in China (in Section 5) and the rest of the world (in Section 6). Conclusions offered in Section 7.

2. The Context

2.1 Demographic change and economic growth

China's demographic transition commenced well before the one-child policy was introduced in 1980, with fertility rates declining from the 1950s onwards, and with particularly sharp drops in the 1970s coinciding with the introduction of the 'later, longer, fewer' policy – in this decade alone, the total fertility rate was halved, from 5.8 in 1970 to 2.7 in 1979 (Wang and Yong, 2010). The one-child policy solidified this decline and, according to official claims, averted 400 million births during its first three decades. More careful analysis by demographers indicates that this figure is a substantial overestimate, attributing many of the averted births instead to the socioeconomic changes accompanying rapid economic growth during this time – including urbanisation and new employment opportunities for rural migrants, improvements in female education, and the high parental cost of supporting children through an increasingly competitive education system (Wang, Yong and Gu, 2009). Regardless, there is no question that China's population growth slowed substantially since 1980, and that the one-child policy was a contributing factor to this slowdown.

The most direct economic impact of declining fertility and hence slower population growth is that it results in slower GDP growth but higher per capita income. This result is common to all models with diminishing returns to capital and labour, including the elemental model of Solow (1956) and Swan (1956).⁴ Chinese policymakers in the past appeared to accept this premise, with demographic goals set in February 1980 including a targeted population of 1.2 billion in 2000 and a population growth rate of zero by that time, specifically intended to support Deng Xiaoping's overall goal of quadrupling China's per capita income between 1980 and 2000 (Wang, Cai and Gu, 2012). While these demographic targets weren't quite met, the per capita

⁴ See Golley and Tyers (2012a) for a more detailed discussion on this point, about which most, but not all, economists agree. See also Solow (1956) and Swan (1956), and the detailed analytical review of offered by Pitchford (1974: Ch.4).

income goal was well and truly surpassed, and China's present leaders readily credit the one-child policy as being an important contributing factor. On the per capita income *costs* of the recent reversion to a two child policy (which we attempt to quantify below) they are, not surprisingly, less vocal.

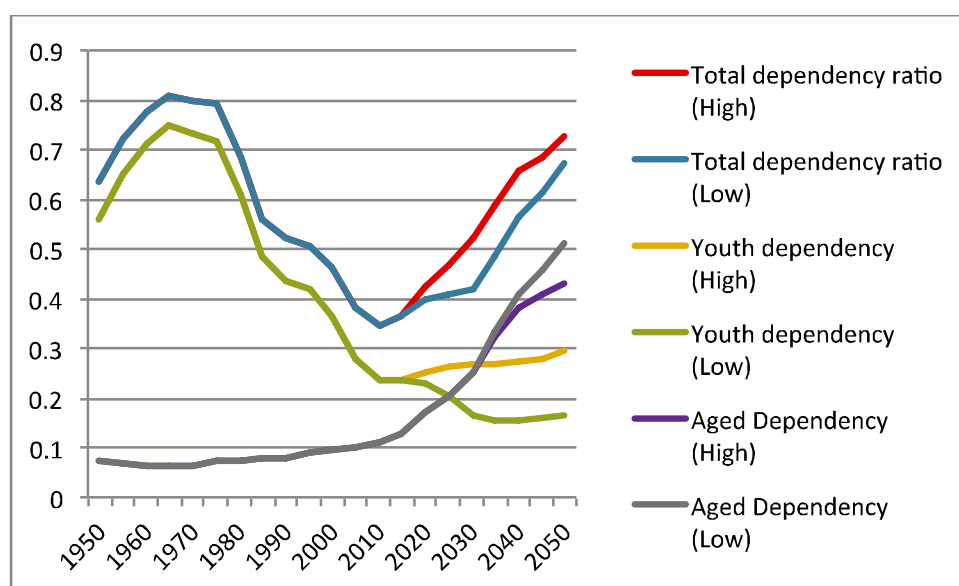
A second, the indirect impact of slower population growth, not accounted for in the Solow-Swan model, comes via the resulting change in the age distribution of the population, which alters average labour force participation rates and youth and aged dependency ratios. At first, declining fertility reduces youth dependency and raises the proportion of workers in the population. Income per capita is therefore boosted, strengthening the basic Solow-Swan result and giving rise to the 'demographic dividend'.⁵ In most related research, the proportions of dependents and workers in the population is proxied by simple age classifications: – 'youth' below the age of 15, 'working age' between 15 and 65 and 'aged' (over 65). These proxies are illustrated in Figure 1, which confirms the rapid decline in thus-measured total dependency (and its converse, the rapid rise in the working-age to non-working age population ratio) underpinned by declining youth dependency between 1980 and 2010.

The figure also shows the sharp upturn in total dependency from 2010 onwards, driven by sharply rising aged dependency. Projections based on the United Nation's 'high' and 'low' fertility scenarios further illustrate that the higher fertility that might be derived from the two-child policy from 2015 onwards has only a minimal impact on reducing ageing by 2050. Indeed, this is more than offset by higher youth dependency, ensuring that total dependency is higher, not lower, under the high fertility scenario.

This paper builds on the work of Golley and Tyers (2012a, b), who argue that the use of age-based proxies for understanding the links between demographic change and economic growth in China (and indeed elsewhere) is misleading, because they fail to take into account the number of actual workers in the population – as opposed to those of 'working age'. Their more carefully calculated dependency ratios – described and used in the modelling exercise below – provide at least one piece of good news for China: in contrast with the alarming trend shown in Figure 1, total dependency measured more accurately may fall well into the future, under both high and low fertility assumptions.

⁵ See Bloom and Williamson (1998) for a generic discussion of the demographic dividend in developing countries, Bloom et al. (2000) for a detailed examination of the implications for Asia, and Cai and Wang (2005) for implications for China.

Figure 1. Age Distribution Based Dependency ratios in China, 1950-2050



Source: United Nations (2015).

Note: Youth and aged dependency defined respectively as the ratio of the population under 15 years of age and the population aged over 65 years to the population aged between 15 and 65. High and low refer to the United Nation's high and low fertility scenarios, on which projections from 2015 onwards are based. The labour force participation rates of each age group are not considered in the construction of these dependency ratios.

Beyond age structure, a slowdown in population growth has implications for the skill composition of the labour force, affecting the marginal product of capital and hence the level of investment, as well relative prices and competitiveness in different sectors of the economy. In China, this skill composition is predominantly shaped by the proportions of the rural (low-skill) and urban (high skill) populations. In the first three decades of reform, despite the relaxation of the one-child policy in most rural areas to allow a second child if the first was a girl, the predominantly rural population experienced yet more rapid fertility decline, and from higher initial fertility levels. This ensured that the bulk of China's demographic dividend stemmed from a surge in the *rural* working to non-working population ratio (Golley and Wei 2013). This, combined with agricultural reforms and the opening of the economy, gave rise to mass rural-to-urban migration, fuelling the rapid expansion of unskilled labour-intensive manufacturing that dominated China's export-led growth. From the mid 2000s onwards, however, slowing rural labour force growth fed into labour shortages in the major export producing cities of the past, prompting much debate on the timing and consequences of China reaching the Lewisian turning point (Lewis 1954, Cai 2010, Minami and Ma 2010, Golley and Meng, 2011). Future fertility trends, particularly as they differ between the skilled and unskilled populations, will continue to shape this debate, with implications for China's

competitiveness in all sectors. Our modelling exercise below allows for these fertility distinctions.

Although the dominant economic effects of fertility decline are the slowdown in labour force growth and the change in overall dependency associated with ageing, there are two further consequences that also have considerable economic importance, both of which also stem from ageing. The first is that there is a global tendency for saving rates to collapse in older age groups as retirees dis-save, so that ageing tends to reduce national average saving rates. The second is that ageing causes the scale and composition of final consumption to more strongly reflect the preferences of adults and the aged. At least at globally accessible levels of product disaggregation, the first of these causes only second order changes.⁶ Changes in corporate and household saving rates, and hence the distribution of total income between consumption and savings are important, however.⁷ This impact is formalised in Modigliani's (1976) life-cycle hypothesis (LCH), which predicts an inverted U-shaped saving-age profile, in which a rising proportion of (particularly middle-aged) workers in the population will underpin rising savings rates, in contrast with rising shares of youth and young workers or the aged, all of whom tend to be dis-savers. While evidence supporting the applicability of the LCH to China has been mixed in the past⁸, the expectation among most observers is that rapid ageing will contribute to lower aggregate household savings in the future.

Recent work by Choukhamane, Coeurdacier and Jin (2014) complicates the picture further, by introducing various micro-channels through which fertility decline affects individual household saving decisions. They show that exogenous fertility decline reduces total expenditure on children and hence raises household savings, despite the rise in educational investments for the only child. Compounding this the 'expenditure channel' is a 'transfer channel' through which parents save more in anticipation of reduced transfers from their child in the future, despite the higher wages that child earns resulting from human capital accumulation. In all, they attribute 60 per cent of the 20 percentage point rise in China's aggregate household saving rate between

⁶ A key exception is the rise in health expenditures with ageing, which is very difficult to represent in a global context because available databases have not separated out health expenditures from other services. This is a key area for future research on global modelling exercises such as this one. See Tyers and Shi (2007, 2012).

⁷ The reason the corporate saving rate is important in this way is that, when firms retain and invest earnings without returning dividends to owning households or the state, they deny households the choice between consuming and saving from that income. All of it goes to saving. China's corporate saving rates have been extraordinarily high, making overall performance quite sensitive to them (Tyers 2014).

⁸ For example, Modigliani and Cao (2004) (not surprisingly) find empirical support for it; Chamon and Prasad (2008) find an 'unusual U-shape', with high saving rates in the younger workers and older cohorts; and Horioka and Wan (2007) find that demographic variables have little impact on Chinese saving rates, arguing that high saving rates are likely to persist in China for some time, despite rapid ageing.

1982 and 2009 to the one-child policy, while their ‘two-child policy’ experiment indicates that the rise in China’s aggregate household saving would have been reduced by 6.5 percentage points.

Looking forward on these grounds, and compounding the LCH impact of ageing, the results from Choukhmane et al. (2014) suggest that higher fertility rates – or in other words, two-child policy ‘success’ – will lead to a reduction in the household saving rate. Although operating through a different channel, this is consistent with Du and Wei (2010, 2012), who attribute close to 60 per cent of the rise in household savings in recent decades to rising gender imbalances, themselves a consequence of the one-child policy, among other factors (Golley and Tyers, 2014). Their argument rests on the assumption of a ‘competitive marriage market’, in which single men (and their parents) save more in order to compete via wealth accumulation in the face of some 30 million ‘excess men’ of marrying age. The two-child policy is likely to reduce some of this pressure, albeit with a considerable lag, and this channel therefore offers a further possible reason for lower household savings in the future.

2.2 Savings, rebalancing and growth

Leaving aside the complex links between demographic change and household savings, there are a number of additional reasons why China’s savings rates are expected to decline in the future, which will not hinge on the effectiveness of the two-child policy at all but rather on the effectiveness of the government’s ‘rebalancing’ strategy, focused in particular on reducing China’s reliance on exports and investment and instead targeting consumption-led growth. While this strategy met with little success under Hu Jintao, Xi Jinping has already demonstrated greater commitment to reforming an economy that had, in the words of Hu’s Premier Wen Jiabao, become ‘unbalanced, uncoordinated and ultimately unsustainable’. Xi formally announced his reform agenda at the Third Plenum of the 18th Central Committee of the Communist Party of China in November 2013 and, despite still further criticism for its slow pace, there is undeniable progress in major areas of the economy that are likely to underpin rebalancing in the decades ahead. Prominent among these are reforms to agricultural land property rights, inter-governmental fiscal reforms, and steps toward addressing high corporate saving in the form of an increase in the share of SOE dividends to be transmitted back to the state in order to support the pension and other social welfare systems (Naughton 2014, Bloomberg 2014, Wong 2013).

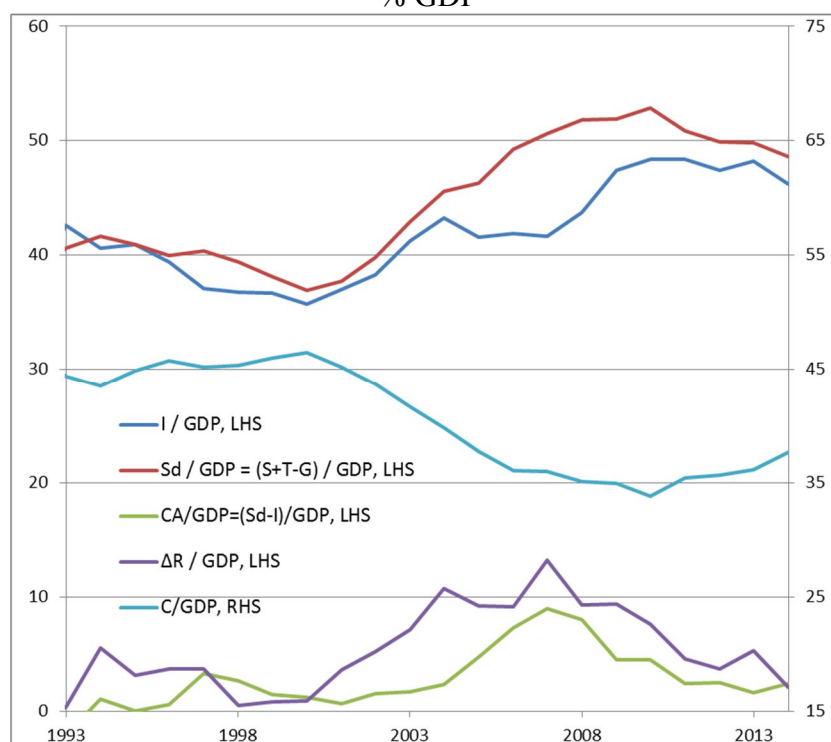
The collective impact of these and other reforms will vary across the different sources of savings – households, governments and the corporate sector – and across different age cohorts, creating much uncertainty regarding future trends in China’s national saving rate. Yet it is highly likely that the declining trend in saving rates since 2010 (evident in Figure 2) will continue in the same direction, with the further expectation that this will be matched by the rising share of consumption as a share of GDP (also evident in the official statistics represented in Figure 2).⁹ In recognition of this uncertainty, rather than making concrete predictions about these future trends we instead investigate alternative scenarios for changes in age-specific household saving rates.

While high saving rates have underwritten the key economic imbalance, they have also provided a key source of finance for the high and sustained rates of domestic investment that, along with rapid export growth, has been the dominant driver of Chinese growth in the last three decades. Furthermore, the excess of Chinese savings over investment (as seen in Figure 2) contributed a third of the rise in global saving since 1990 (World Bank 2013). While much attention has been given to the associated problems that this created across the globe – and particularly in the United States – in most cases, such assessments have been shown to be inaccurate or, at least, oversimplifications.¹⁰ Indeed, as discussed in detail in Tyers (2015), the bulk of the literature addressing this issue quantitatively finds improvements in terms of both product and financial terms of trade (cheaper light manufactures and cheaper debt) that were large enough to yield net improvements in the real per capita incomes of the advanced regions. The key question that remains is whether lower Chinese saving in the future will eliminate, or at least reduce, the perceived domestic and international problems associated with it, and at what cost? To answer this question, we rely on the global economic model introduced below, which is designed to address the interactions between demographic change, saving decline and economic growth touched upon here.

⁹ There is evidence that the rise in the consumption share of GDP began earlier than the official statistics suggest. See Huang et al. (2012) and Garner and Qiao (2013).

¹⁰ See, for example, the literature asserting and depending on the “savings glut” hypothesis, cited in the introduction and Arora et al. (2015). The American literature critical of China’s macroeconomic policies is also extensive. Bernanke (2005, 2011) offers the outline and Krugman (2010) declares that “China is making all of us poorer”. The US macroeconomic position is put in more detail by, amongst others, Lardy (2006, 2012) and Bergsten et al. (2008). Similar advocacy of policy-induced “imbalance” in China’s growth can be found, still more formally, in Blanchard and Giavazzi (2006).

Figure 2: China's Saving Surplus and Consumption Share
% GDP



Sources: National Bureau of Statistics yearbook 2009-2014; IMF IFS data base.

3. Modelling the long-run impacts of Chinese demographic change

The approach adopted follows Golley and Tyers (2012a, b), in that it applies a complete demographic sub-model that is integrated within a dynamic numerical model of the global economy. The economic model is a development of *GTAP-Dynamic*, the standard version of which has single households in each region and therefore no demographic structure.¹¹ The version used here has multiple regional households, disaggregated by age group, gender and skill level, each with endogenous saving rates. Complete written details of the model's formulation and calibration are in appendices available in from the authors on request.

3.1 Demography

Populations are tracked in four age groups, two genders and two skill groups: a total of 16 population groups in each of 18 regions. The four age groups are the dependent young, adults of fertile and working age, older working adults and the mostly-retired over-60s. The further skill division of the population separates households according to their dependence on

¹¹ The *GTAP-Dynamic* model is a development of its comparative static progenitor, *GTAP* (Hertel et al. 1997). Its dynamics were initially developed by Ianchovichina and McDougall (2000) and presented comprehensively by Ianchovichina and Walmsley eds. (2012). Applications of the standard model with preliminary demography include those by Tyers and Shi (2007, 2012).

production (low-skill) labour and professional (high-skill) labour, based on the ILO's occupational classification (Liu et al. 1998). Each age-gender-skill group is a homogeneous sub-population with group-specific birth and death rates and rates of both immigration and emigration.

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 group-specific birth rates, sex ratios at birth, age and gender specific death, immigration and emigration rates and life expectancies at 60. Differences in birth rates by skill level in China and other developing countries are intended to reflect the more readily measured rural-urban dichotomy. Of more importance in the case of China is the sex ratio at birth. This is not experimented with here but is assumed to remain high, at 1.17 males per female throughout all scenarios, consistent with the starting point for the baseline scenario of Golley and Tyers (2014). Complete matrices of migration flows between regions are also represented for each age, gender and skill group, the origins of which are described by Tyers and Bain (2007). Immigration rates have base levels that depend on changes in group populations in destination countries but they are also responsive to inter-regional real wage comparisons, constrained by an elasticity parameter designed to represent the “gate keeping” roles of immigration policies in destination countries.¹² A further key parameter is the rate at which each region's education and social development structure transforms low-skill (production) worker families into high-skill (professional) worker families. Each year a group-specific proportion of the population in each low-skill worker age-gender group is transferred to professional (high-skill) status. These proportions depend positively on the regions' levels of development (proxied by per capita income), the proportion of low-skilled to high-skilled labour and the skilled wage premium.

Labour force projections:

To evaluate the number of “full-time equivalent” workers we first construct labour force participation rates, by gender and age group for each region from ILO statistics on the “economically-active population”. 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. Target rates are chosen from countries considered “advanced” in terms of trends in participation rates. We then investigate the proportion of participating workers that are part time and the hours they work relative to

¹² As emphasised in World Bank (2015), while migration surges during periods of conflict, flows through time are overwhelmingly motivated by differences in real per capita income and real wages.

each regional standard for full time work. The result is the number of full time equivalents per worker and the full time equivalent labour force, disaggregated by age, gender and skill level.

Dependency ratios:

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. As an indicator of how these are formulated, the following is the non-working aged dependency ratio, which is of wide policy interest:

$$(1) \quad R_{r,t}^{ANW} = \frac{\sum_{g=m}^f \sum_{s=sk}^{unsk} (N_{60+,g,sk,r}^t - L_{60+,g,sk,r}^t)}{\bar{L}_r^t},$$

where $N_{a,g,s,r}^t$ is the population in age group a , gender group g , skill group s and region r ,

$L_{a,g,s,r}^t$ is the labour force in age group a , gender group g , skill group s and region r , and $\bar{L}_r^t$ is the aggregate labour force in region r .

3.2 The Global Economic Model

We use a multi-region, multi-product dynamic simulation model of the world economy following the tradition of Dixon and Rimmer (2002). In it, the world is subdivided into 18 regions that include mainland China, Taiwan and Hong Kong. Industries are aggregated into seven sectors: agriculture, light manufacturing, heavy manufacturing, metals, energy, minerals and services. To reflect composition differences between regions, these products are differentiated by region of origin, meaning that the products supplied in one region are not the same as those in the corresponding category produced in others. Consumers substitute imperfectly between versions of such products, supplied from different regions. This structure has numerous benefits, including that it allows the representation of intra-industry trade.

Sources of growth

As in most other dynamic models of the global economy the main endogenous component of simulated economic growth is physical capital accumulation. Human capital accumulation occurs as well, via the skill transformation process built into the demography, but it tends to

have smaller growth effects in this model.¹³ 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, unskilled and skilled labour) in each of the seven sectors. 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 attracts higher shares of global investment and hence a double boost to its per capita real income growth rate. The factor productivity growth rates assumed here are based on an early survey.¹⁴

A consequence of the dominance of physical capital accumulation in the growth process is that, at least for the world as a whole, 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 – that is, the basic Solow-Swan effect.

Investment

What distinguishes the model from this simpler progenitor is its recursive multi-regional dynamics. Investors have adaptive expectations about the real net rates of return on installed capital in each region. Capital accounts are open so 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 a portion of each region's saving contributes. The standard global model takes no explicit account of financial market maturity or investment risk and so tends to allocate investment to regions that have high marginal products of physical capital, driven by rapid labour supply growth. These tend to be labour-abundant developing countries where we know that considerations of financial market segmentation, financial depth and risk 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 an interest premium variable is initially made endogenous. This creates wedges between the international and regional borrowing rates. They show high

¹³ For a model in which human capital accumulation plays a larger role, see Harris and Robertson (2013).

¹⁴ In particular, 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 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. For China, these shocks are informed by such surveys as that by Wu (2011). For other regions see the appendices available on request.

interest premia for the populous developing regions of Indonesia, India, Other South Asia, South America and Sub-Saharan Africa. Premia tend to fall over time in other regions, where labour forces are falling or growing more slowly. Once calculated in this way, the time paths of all interest premia are set as exogenous and regional investment is freed up in all regions. Investment is then retained as endogenous in the model's closure in all subsequent simulations.

Consumption and Saving

The 16 age, gender and skill groups differ in their consumption preferences, saving rates and their labour supply behaviour. Regional national income is first divided between government consumption and total private disposable income. The implicit assumption, stemming from the design of the original model to serve long run analysis, is that governments balance their budgets while private groups save or borrow.

In splitting each region's private disposable income between the eight age-gender groups, the approach is to construct a weighted subdivision that draws on empirical studies of the distribution of disposable income between age-gender groups for "typical" advanced and developing countries. Individuals in each age-gender group then split their disposable incomes between consumption and saving. A reduced form approach is taken to the inter-temporal 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 rate of return on the assets of the collective regional household. This equation is calibrated for each group and region based on a set of initial age-specific saving rates from per capita disposable income. A mechanism is then added to allow these group-specific saving rates to trend toward long run targets. Further details are in appendices available on request.

4. Constructing Scenarios

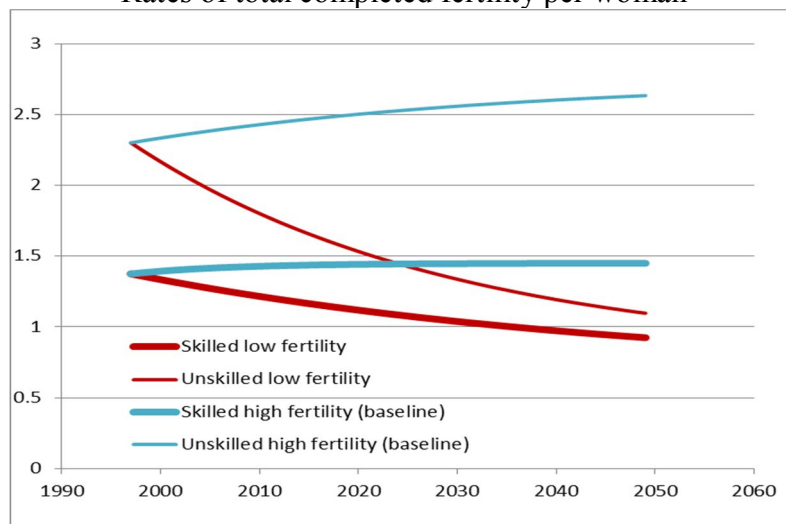
When substantial numerical models are used to analyse anticipated shocks a baseline projection into the future is required as a starting point. This projection is not a *forecast*, since there are many possible shocks that determine the paths of economies through time, most of which prove to be unanticipated. In modelling exercises such as this, baselines are normally chosen to reflect the outcomes perceived most likely by the modellers. We deviate from standard practice here by instead choosing a baseline in which fertility rates are projected to remain relatively high, and indeed rise through time, sufficiently to stabilise China's population in the long run. Similarly, our baseline savings are chosen to remain relatively high, declining over

time but at a slower rate than in an alternative lower saving scenario. As noted in the introduction, our motivation for this is to emphasise the implications of a growth *slowdown* in China, underpinned by a demographic contraction and saving rate declines that stem from welfare and industrial policy reforms and ageing.¹⁵

4.1 The Demographic Scenarios

Baseline fertility is designed to return China's average fertility rate to a stabilising level (2.1 children per woman) by 2050, underpinned by fertility increases for both skilled and unskilled women. This is consistent with the 'high' fertility scenario of the United Nations (2015), which sets China's total fertility rate at 2.13 for 2045-50. An alternative (and, we believe, more likely) second population scenario is then constructed in which China's fertility rates are assumed to fall asymptotically, toward one child per woman, similar to the rates observed in Japan and other neighbouring countries and consistent with the 'low fertility trap' discussed above. The fertility rate for low-skill Chinese women is projected to fall more substantially than for high-skill women, following the observed pattern in neighbouring regions. The average falls to a level just above one child per woman, which is in the vicinity of the UN "low" demographic projection for 2045-50. The two fertility rate scenarios are illustrated in Figure 3.

Figure 3: Fertility Scenarios
Rates of total completed fertility per woman

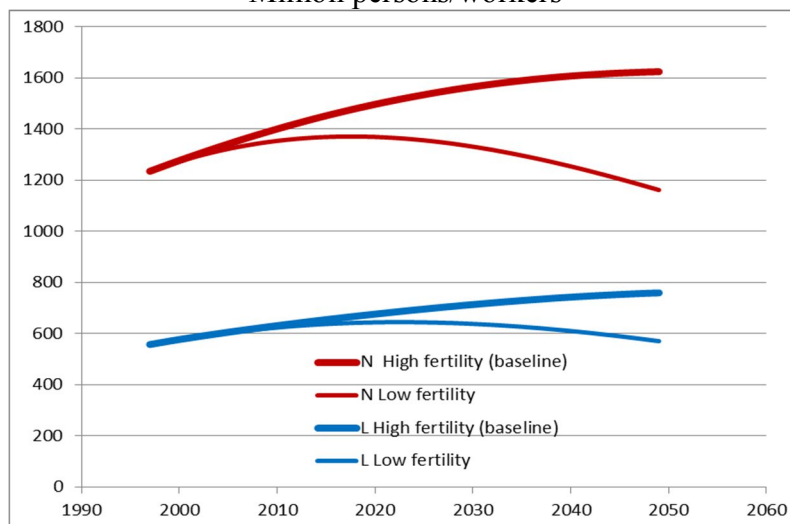


Source: Scenarios constructed as described in the text.

¹⁵ Our long run analysis does not address short run policy reform priorities that include financial reform and internationalisation of the currency (He et al. 2012).

China's population and labour force differ substantially under the two scenarios, with the high fertility scenario ensuring that both continue to rise through to 2050, while under the low fertility scenario these both decline in the coming decade, as seen in Figure 4. Note that fertility is modelled as declining in all other regions as well, consistent with the World Bank (2015). Population growth remains vigorous in South Asia, Africa and the Middle East because their 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, for example, rises by half. Compared with the rest of the developing world, then, the low-fertility scenario for China must be expected to constrain its labour supply and hence retard its overall economic expansion.

Figure 4: Chinese Population and Labour Force
Million persons/workers

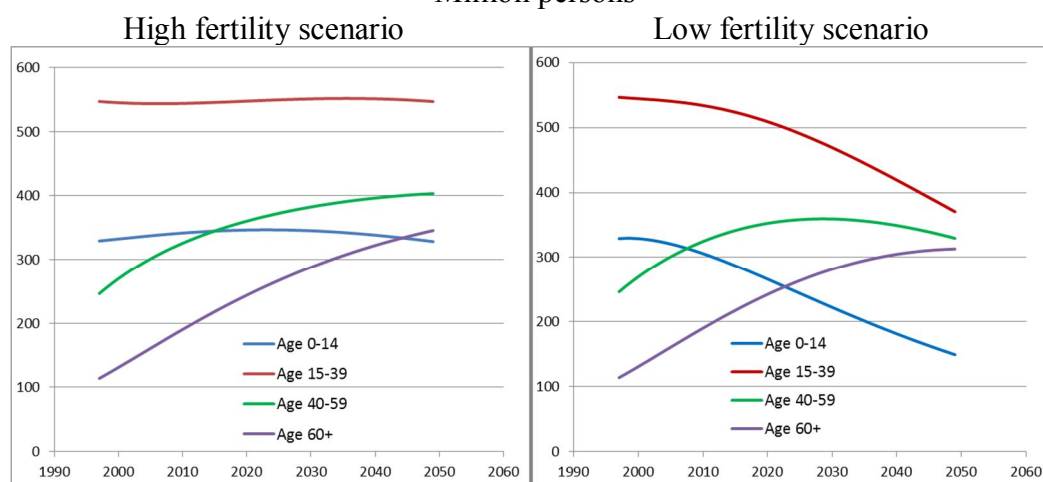


Source: Simulations of the model described in the text.

The impact of these two fertility scenarios on the age structure of the population is illustrated in Figure 5. The baseline restoration of higher fertility stabilises the populations of children and young adults, while the initial age structure of the overall population ensures that the numbers of older working aged and retirees continue to rise. By comparison, the low-fertility scenario sees an accelerating decline in the numbers of children and young adults. Interestingly, the numbers of older workers and retirees do not rise to the heights achieved in the baseline, because smaller populations in the younger age groups cause lower survival rates into these older age groups, which become influential after 2020.

Figure 5: Changes in China's Age Distribution

Million persons



Source: Scenarios constructed as described in the text.

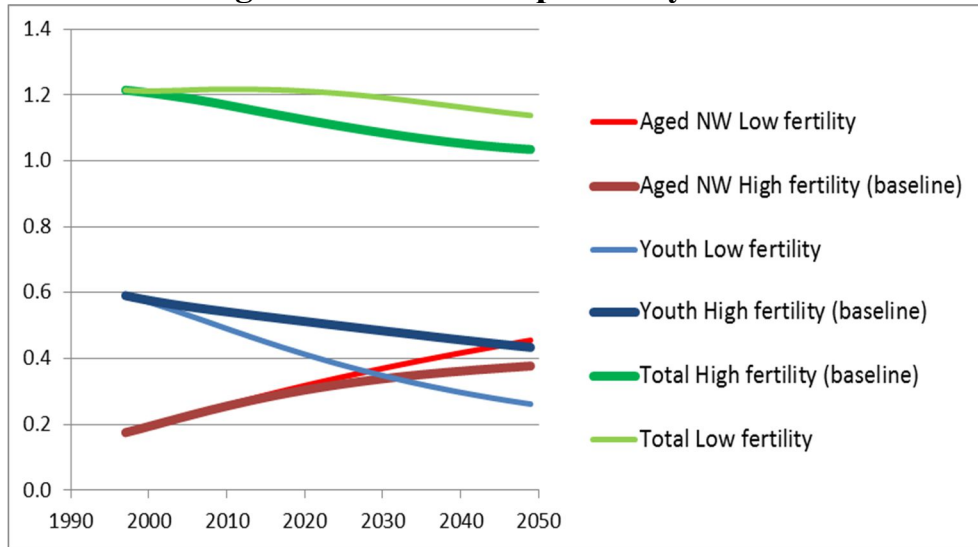
Associated with these changes in the age structure are dependency ratios. Recall that these are *non-working* dependency ratios and so they account for the different labour force participation rates across groups and hence dependents include not only children and retirees but also non-working adults of working age. The ratios are illustrated in Figure 6. In both scenarios youth dependency continues to fall through to 2050, most strikingly in the low-fertility scenario. The ageing built in to the initial age distribution continues to push up non-working aged dependency, to 0.39 and 0.42 for the high- and low-fertility scenarios by 2050 respectively. While these youth and aged dependency trends are in the same direction as the United Nations' projections, our more precise definitions of dependency have crucial implications. In particular, while the United Nations' total dependency ratio starts to rise in 2010 (as seen in Figure 1), our projections result in declining total dependency all the way through to 2050. According to these projections, then, ageing may not be as catastrophic as many claim it to be, and the end of China's demographic dividend era may still be a long way off.¹⁶

4.2 The saving rate scenarios

Based on the earlier discussion, we offer two Chinese saving rate scenarios, illustrated in Figure 7. The baseline assumes 'high-saving', in which the rate of decline in group level saving rates is slow enough that China's overall rate does not fall to advanced country levels until it achieves real per capita income parity, well beyond 2050. Note that, because age-

¹⁶ This point is discussed at length in Golley and Tyers (2012a,b).

Figure 6: Chinese Dependency Ratios

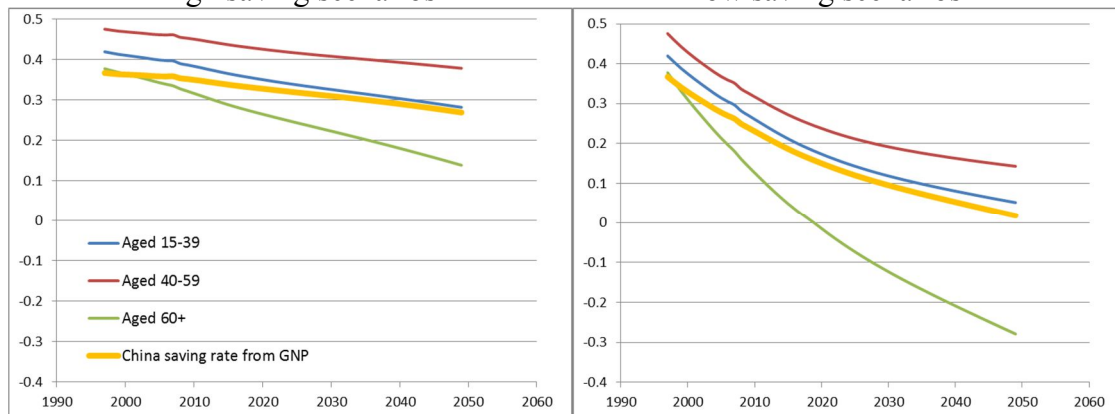


Source: Simulations of the model described in the text.

specific saving rates differ, the average national rate from GNP shown in Figure 7 applies only to the baseline. The average level actually depends on changes in the age distribution indicated, as in Figure 5, with low fertility seeing reduced youth consumption and hence a slightly higher average than shown. Against these high saving cases we compare a ‘low-saving’ scenario in which age-specific rates of saving decline quite rapidly, particularly for retirees (60+), so that the rising population of the aged by 2050 is dis-saving at rates similar to those observed in advanced regions. In both cases these changes in age-specific rates are constructed by specifying long run exponential declines toward specified targets, while allowing for short run intertemporal change in response to real per capita income and real interest rate shocks.

Figure 7: Saving Rate Scenarios

Age-specific saving rates over disposable private income
High saving scenarios Low saving scenarios



Source: Scenarios constructed as described in the text.

4.3 Projected Overall Performance

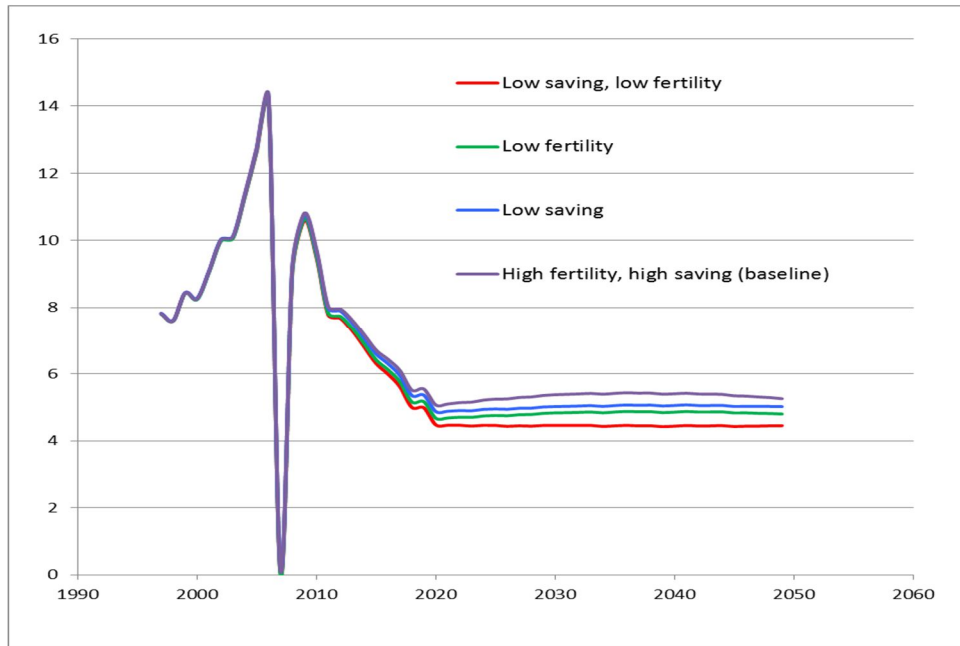
Besides the high fertility baseline scenario, three projections are made to 2050. These are “high fertility, low savings” (henceforth low savings), “low fertility, high savings” (henceforth low fertility) and “low fertility, low savings” (or ‘double contraction’). In the following section we discuss the implications of these deviations from the baseline for China. We note that the ‘low savings’ one is consistent with ‘dual policy success’: fertility is assumed to remain high in response to the two-child policy, while rebalancing policies bring the average saving rate down. In the discussion on the international implications (in Section 6) we concentrate on the low-fertility and low-fertility, low-savings scenarios, to emphasise what is of most concern worldwide: a slowdown of China’s GDP growth in the future, brought about by one or both of these contracting forces.

The future growth of all the modelled economies depends on three endogenous behaviours, labour force growth, capital accumulation and skill transformation, and on two sets of exogenous projections, productivity growth and investor security (interest premia). Capital accumulation depends on saving rates and each country’s comparative performance in attracting investment from abroad. To a lesser extent, demographic change also depends on comparative performance, through its effects on migration incentives. The underlying productivity projections remain crucial, however, in driving regional growth and accumulation relative to other regions. A consequence of this is that the fertility and saving contractions have comparatively small (but always negative) effects on the *growth rate* of China’s real GDP. This can be seen from the simulated paths of this *growth rate* illustrated in Figure 8. Importantly, the baseline shows stable growth from the present through 2050, which helps maintain the focus of the analysis on demographic and saving rate shocks.

5. The Domestic Effects of More Rapid Declines in Fertility and Saving

Here, we discuss the domestic effects of more rapid declines in fertility and saving in terms of the labour force, real wages and real per capita income changes, the implications for rebalancing, and the changes in sectoral composition. At their most aggregated level, the effects of the contractions on the Chinese economy are indicated in Figure 9. While the real GDP growth rate deviations appear modest in Figure 8, they yield large departures from the baseline in the *levels* of real GDP and real GNP by 2050. The shortfall in real GNP is comparatively large in the low saving case because this scenario has greater foreign investment

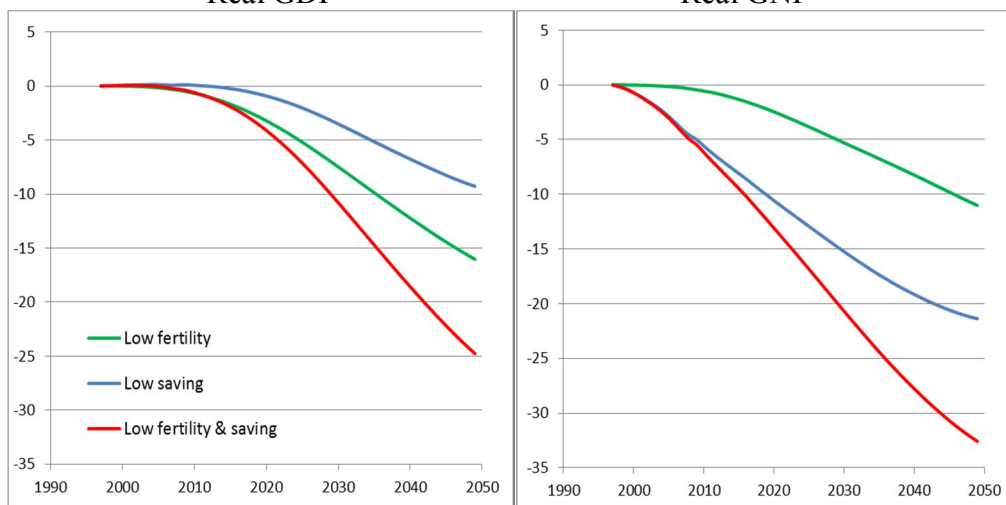
Figure 8: Projected Chinese Real GDP Growth Rates
% per year



Source: Simulations of the model described in the text.

and therefore greater repatriation of capital income. The contraction scenarios have significant implications for the global economy as well: relative to the baseline, world GDP in 2050 is lower by 3% with a Chinese demographic contraction, by 6% with more rapid savings decline, and by 9% for a ‘double contraction’.

Figure 9: Chinese Real GDP and GNP
% Differences from Baseline (high fertility, high saving)



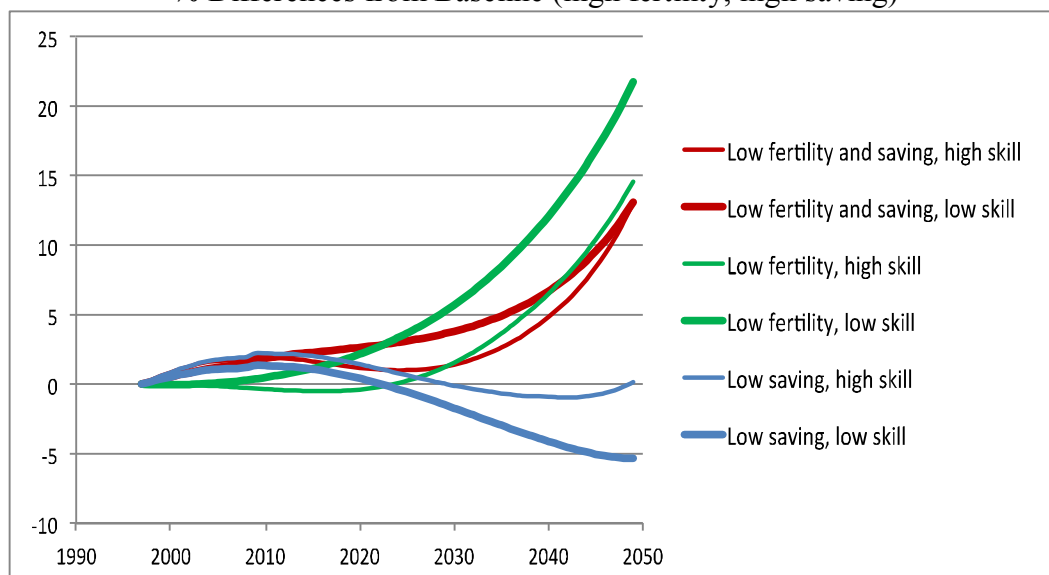
Source: Simulations of the model described in the text. Here GDP is measured relative to the Chinese GDP price index while real GNP is measured relative to China's CPI.

5.1 Labour force, real wage and real per capita income changes

Other things equal, it is obvious that lower fertility should increase real wage growth, due to a reduction in the relative abundance of labour. As simulated, this is particularly pronounced for unskilled labour, as shown in Figure 10, because the proportional fertility decline is larger for the low-skill population. This causes real per capita income to grow more rapidly, raising its 2050 level by 21% compared with the baseline (as shown in Figure 11). This confirms that the average Chinese derives *economic* benefits from lower fertility, in contrast with the projected GDP growth reduction that it brings.

Lower saving also impacts negatively on projected GDP growth rates, primarily through its impact on Chinese investment, as can also be seen in Figure 11. Its impact on real wages is complicated in the short term by historical capital market dynamics, but for low-skilled workers (by far the dominant proportion of the workforce) the overall impact is negative, ensuring that per capita income is 15% lower by 2050 compared with the baseline. In contrast, slower capital accumulation boosts the value added share of services, which favours high-skill workers, whose real wage is slightly higher than the baseline through to around 2025.

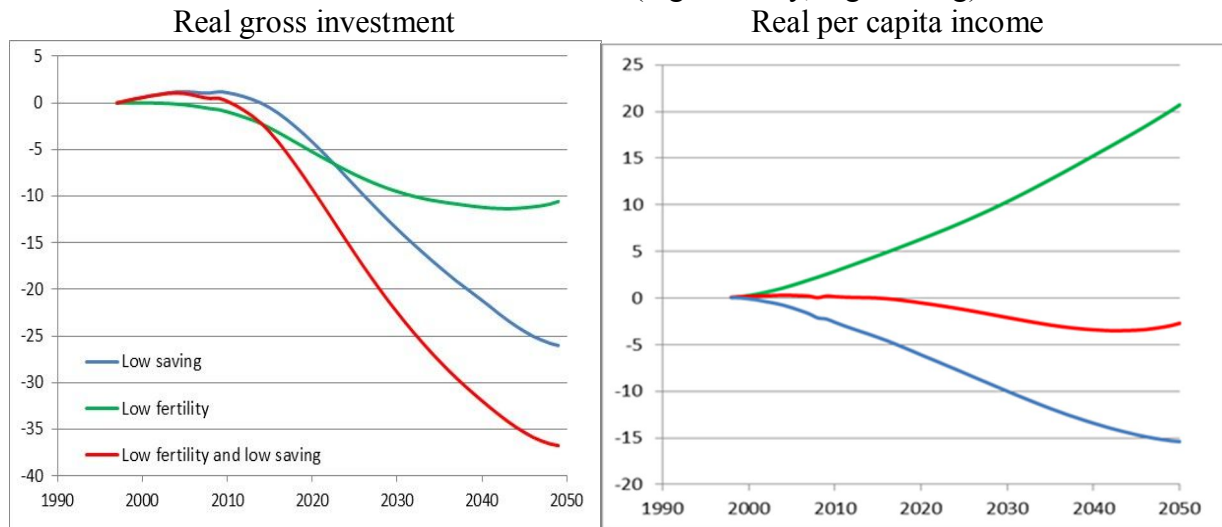
Figure 10: Chinese Real Wages
% Differences from Baseline (high fertility, high saving)



Source: Simulations of the model described in the text.

Figure 11: Real Chinese Investment and per capita income

% Differences from Baseline (high fertility, high saving)



Source: Simulations of the model described in the text.

A further implication of low fertility is a reduction in the skilled wage premium in the first two decades, stemming from the relatively rapid fertility decline for low-skill females and the relatively large contraction of the low-skill labour force as a consequence. While a lower skilled wage premium and a lower proportion of low-skill workers both *slow* the transformation rate from unskilled to skilled labour, the higher per capita income that lower fertility brings *speeds* that transformation up (as discussed in Section 3.2 above). As modelled, this combination of effects results in a rise in the skill share in China's population by 2.8 percentage points by 2050, as seen in Figure 12.

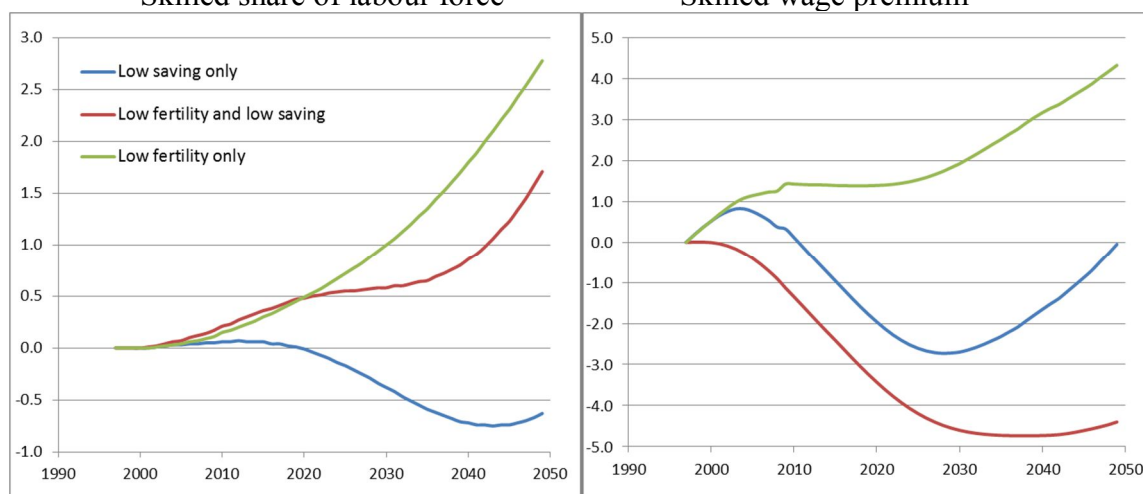
By contrast, the low-saving scenario sees a *rise* in the skill-wage premium relative to the baseline, particularly after 2030 (which becomes a key driver in rising costs and an appreciating exchange rate, discussed further below). The transformation of low-skill into high-skill workers is accelerated by this but again, as modelled, the effect is more than offset by lower real per capita income, so the net effect is a *decline* in the skill share of the labour force. Thus, if we think of the high fertility, low saving scenario as the case of 'dual policy success' the results offer contradiction, both in terms of real per capita income and the skilling of the labour force. And if fertility does continue to decline, along the lines of the low fertility, low saving scenario, there is a secondary blow to real per capita income.

5.2 Saving and economic rebalancing

Turning to the rebalancing of the economy, saving rates decline in all the scenarios, including the baseline, but low fertility shifts expenditure away from children, who do not save, toward

Figure 12: Chinese Skill Share and Skilled Wage Premia

% Point differences from Baseline (high fertility, high saving)
Skilled share of labour force Skilled wage premium



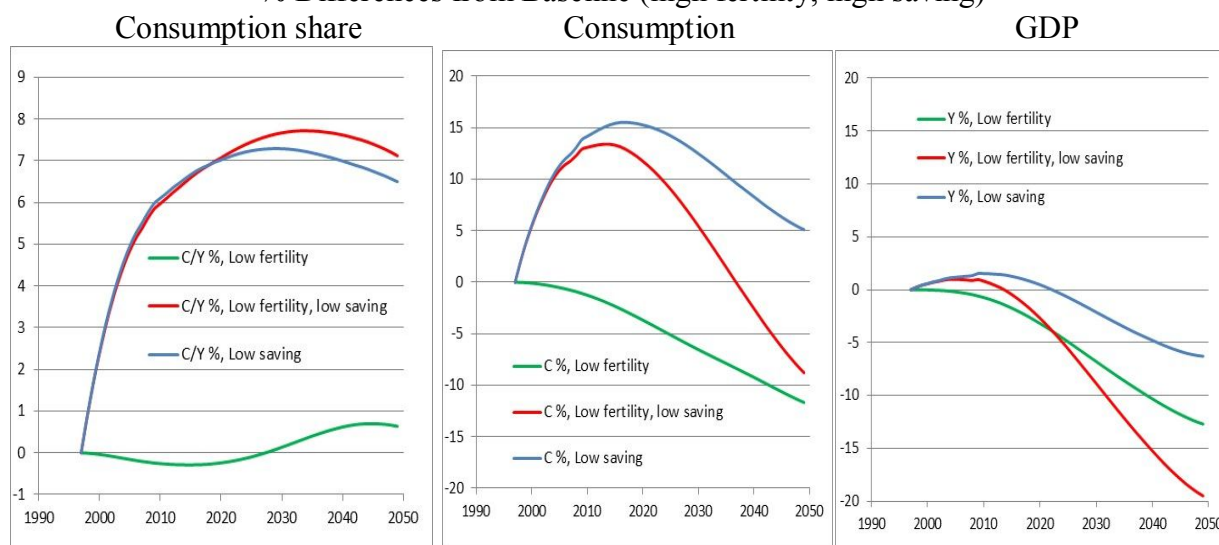
Source: Simulations of the model described in the text.

retirees who save less than other adults but more than children. This scenario, therefore, offers average national saving rates that are *larger* than the baseline and hence *lower* consumption shares. The corresponding shift in the *low saving* scenario is, by construction, toward much higher consumption shares, at least initially. To follow the implications for the consumption share of GDP, note that real consumption depends primarily on current real disposable per capita income. In the case of China, price level effects are small so this relationship generalises, approximately, to expenditures and income, and household income is linked most closely to GNP, the paths of which differ from those of GDP, as indicated in Figure 9. Now consider the low fertility scenario. The population falls relative to the baseline, as does real GNP, but the net effect is a rise in real per capita income. But the average saving rate is higher than the baseline with the loss of children's consumption. The net effect in the early decades is a slight fall in the consumption share of GDP that reverses in the later years the relative influence of the low-saving aged rises. These changes are indicated in Figure 13.

The low-saving scenarios show more dramatic declines in saving by construction, and are therefore expected to yield more substantial short-run rises in consumption and in the consumption share of GDP. In turn, these lead to shifts in the current account toward deficit. The simulated patterns prove a little more complex than this, however, again because consumption behaviour depends on real per capita income. In particular, the low-saving scenario results in a very substantial short-run rise in consumption and in the consumption share, as consumption spending rises relative to the baseline in the early years but falls again subsequently as GDP grows more slowly (Figure 13) and incomes (linked to GNP) grow more

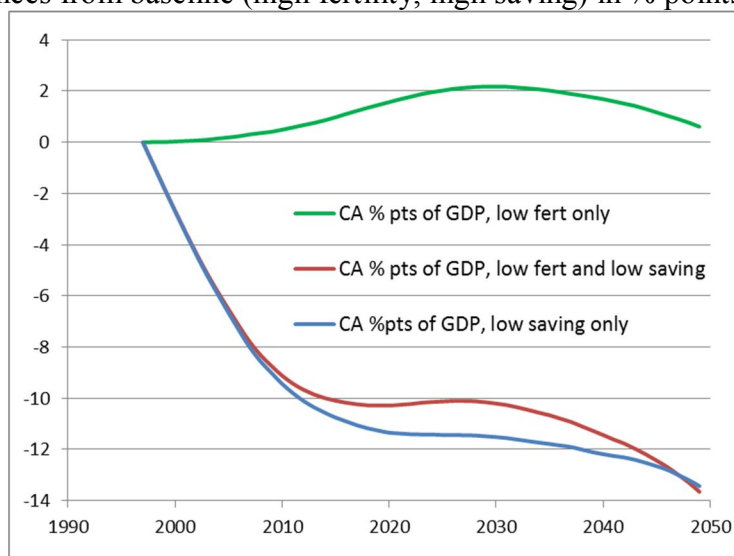
slowly still (Figure 9). This result stems from two opposing forces. A falling saving rate advances consumption but the resulting decline in real per capita income retards it, with the latter force coming to dominate around 2040. The net effects on China's current account surplus are shown in Figure 14. The low-saving scenario sees a substantial shift toward current account deficit, ultimately by 14 percentage points of GDP.

Figure 13: Chinese Consumption and GDP
% Differences from Baseline (high fertility, high saving)



Source: Simulations of the model described in the text. Expenditures on consumption and overall GDP are here measured in % departures from the baseline where the level measures are relative to the global numeraire.

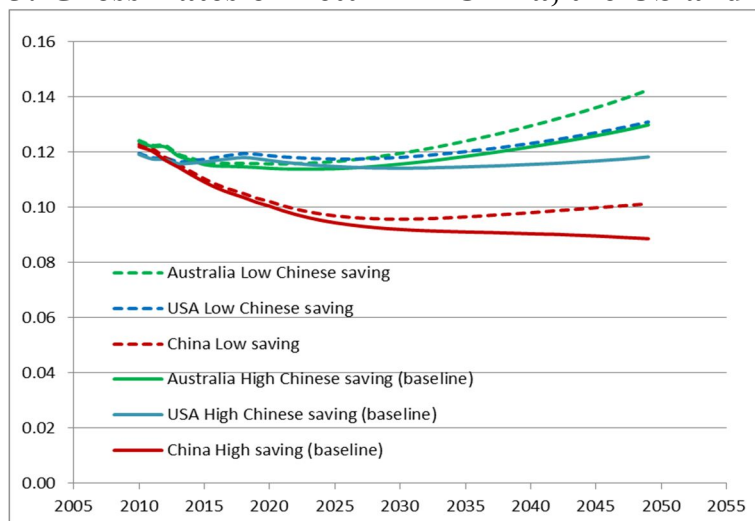
Figure 14: China's Current Account
Differences from baseline (high fertility, high saving) in % points of GDP



Source: Simulations of the model described in the text.

These changes under the low saving scenario effectively reverse the imbalance that has been the primary international concern since the 1990s. They have the effect of tightening global financial markets and contracting global investment, as suggested by the yield scenarios for China and abroad in Figure 15.

Figure 15: Gross Rates of Return in China, the US and Australia



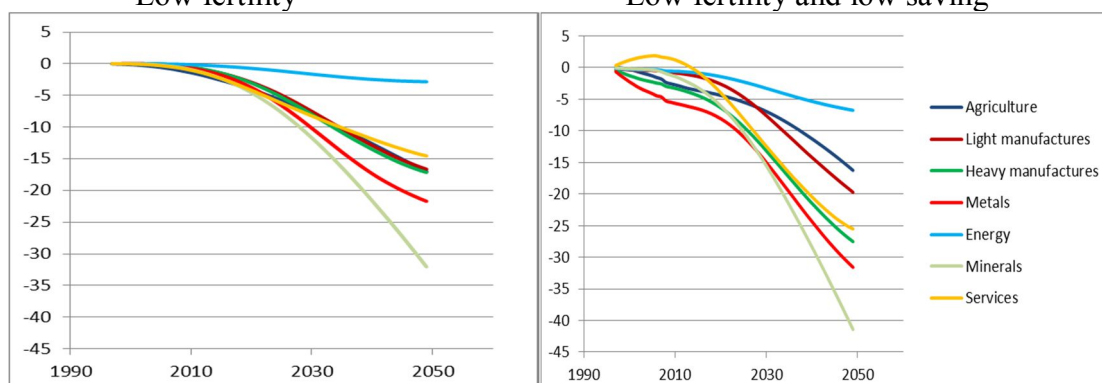
Source: Simulations of the model described in the text.

5.3 Sectoral implications of China's demographic and saving contractions

Relative to the baseline, the overall contractions in real GDP due to demographic decline and reduced saving are accompanied by contractions in the output generated in all seven of the industries considered. The primary drivers of these changes are reduced endowments of labour and skill for the demographic contraction and reductions in accumulated capital for the low saving scenario. When these variable factors are reduced relative to the fixed factors, land and natural resources, the relatively advantaged sectors are agriculture and energy. The resulting output contractions relative to the baseline are indicated in Figure 16, for the low-fertility and low-fertility, low-saving scenarios, which shows that the energy and agriculture do indeed contract least, while the greatest contractions are in the sectors most intensive in labour and capital, namely metals, minerals and manufactures. As expected, the contractions are larger when fertility decline is coupled with low saving. This is because, while the rate of capital accumulation is reduced with demographic contraction alone, it is much more affected by savings decline.

Figure 16: Real Output by Sector

Changes in volume of output relative to the high fertility, high saving baseline
 Low fertility Low fertility and low saving

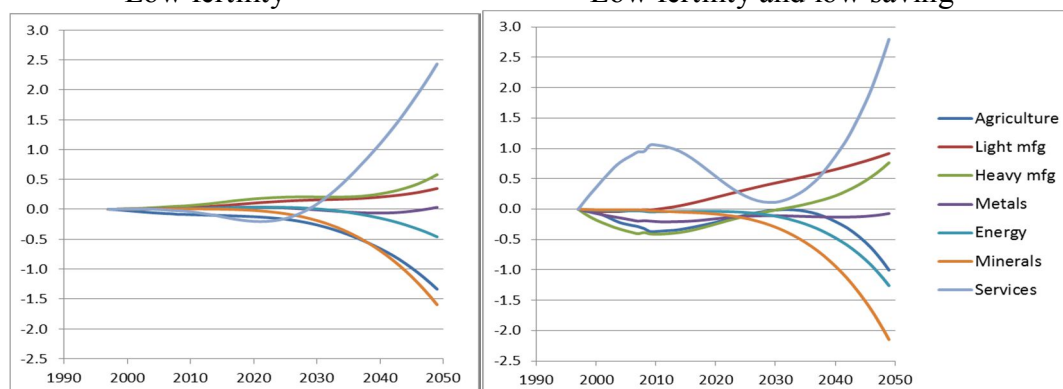


Source: Scenarios constructed as described in the text.

By comparison with the baseline, the contraction scenarios raise domestic labour and capital costs, tending to boost value added in some industries even while their output volumes contract. The pattern of change in value-added shares is therefore slightly different from those in final output volumes. This is shown in Figure 17. The value-added shares of manufacturing and services expand while those of minerals, metals and agriculture contract. Significantly, after 2030, when the demographic contraction is strongest, there is a substantial increase in the share of services. This is a price effect associated with the rising comparative costs of labour, skill and capital, the factors on which services depend exclusively. The fact that services are little traded then causes their product price to rise more than others and so causes a real appreciation. Moreover, their comparative intensity in high-skill labour tends to raise the skill premium, as we have seen.

Figure 17: Value Added Shares by Sector

Changes in value added shares in % points, relative to the baseline
 Low fertility Low fertility and low saving

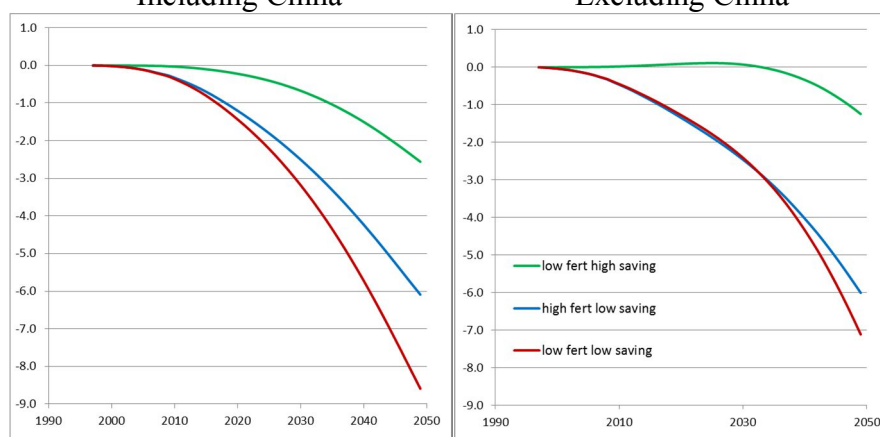


Source: Scenarios constructed as described in the text.

6. The View from Abroad

The impacts of lower Chinese fertility and saving on foreign regions are transmitted through finance on the one hand and trade on the other. While demographic change alone has modest effects on global financial markets, reduced Chinese saving tightens them substantially, by amounts that vary across regions but which amount to approximately 100 basis points in China, the US and Australia. This reflects the loss of Chinese saving that otherwise, in the baseline scenario, finances new investment globally. Tighter financial markets and a smaller Chinese labour force turn out to have considerable effects on global growth, as discussed above: in the worst-case scenario of a double contraction, world GDP in 2050 is 9% lower than the baseline, or 7% lower if China is excluded (Figure 18).

Figure 18: Global GDP with and without China
% departures from the high fertility, high saving baseline
Including China Excluding China



Source: Scenarios constructed as described in the text.

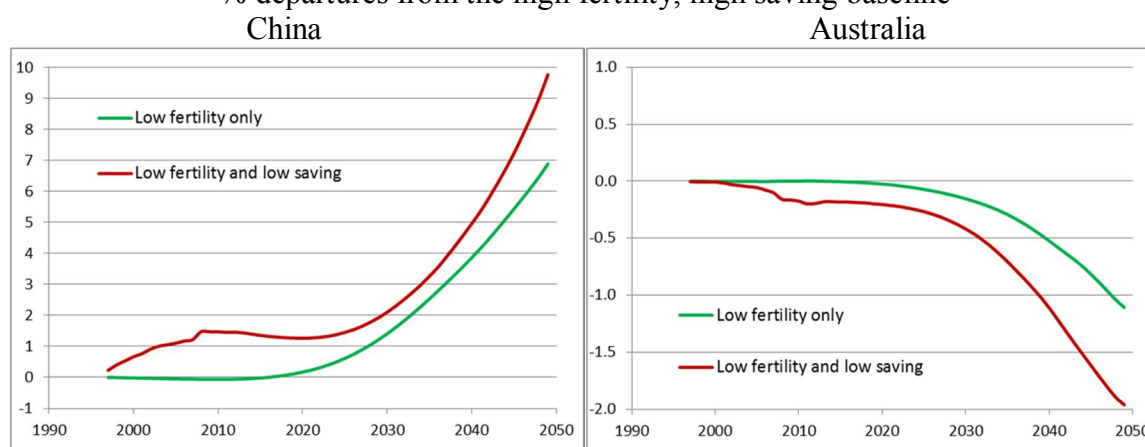
Clearly, by 2050, China's economic performance will be very significant for global welfare. The distribution of effects on other regions depends on the level of China's financial integration, region by region, and on the direction and composition of its trade flows. The analysis assumes a high level of financial integration and so little financial discrimination across regions.¹⁷ It retains considerable momentum in the direction of trade flows, however, and so Chinese shocks might be expected to significantly affect regional welfare via idiosyncratic changes in real exchange rates and the terms of trade. The product-specific effects are discussed in the next sub-section. Before doing so, however, it is useful to consider changes in real exchange rates.

¹⁷ This is a consequence of the characterisation of international capital flows as via an intermediary "global trust", which receives investment, rewards it at a globally common rate and distributes it across destination regions according to rates of return. A full bilateral representation of financial flows is under experimentation.

These are modelled bilaterally against the US. Since a single global numeraire is used, against which all prices and values are measured, real exchange rates are indicated by comparisons of average product prices in each region, measured as GDP prices. So a bilateral real exchange rate against the US is simply the ratio of the regional GDP price with that of the US. These bilateral rates are then combined with trade shares to calculate trade-weighted indices, or real effective exchange rates for each region. The results are illustrated for China and Australia in Figure 19. For China, they show that regional shocks contracting essential factors of production, like labour and physical capital, tend to raise comparative costs and therefore to appreciate the region's real effective exchange rate. For China, relative to the baseline, the combined shocks see real appreciations up to a tenth by 2050.¹⁸ In smaller regions that depend on exports to China, such as Australia, the Chinese contractions reduce global demand for their products and so lower their prices relative to the products of other regions. Thus, they cause real depreciations.¹⁹

Figure 19: China's and Australia's Real Effective Exchange Rates

% departures from the high fertility, high saving baseline



Source: Scenarios constructed as described in the text. Real effective exchange rates are trade-weighted indices of GDP price ratios.

6.1 Effects on the volume and composition of China's exports and imports

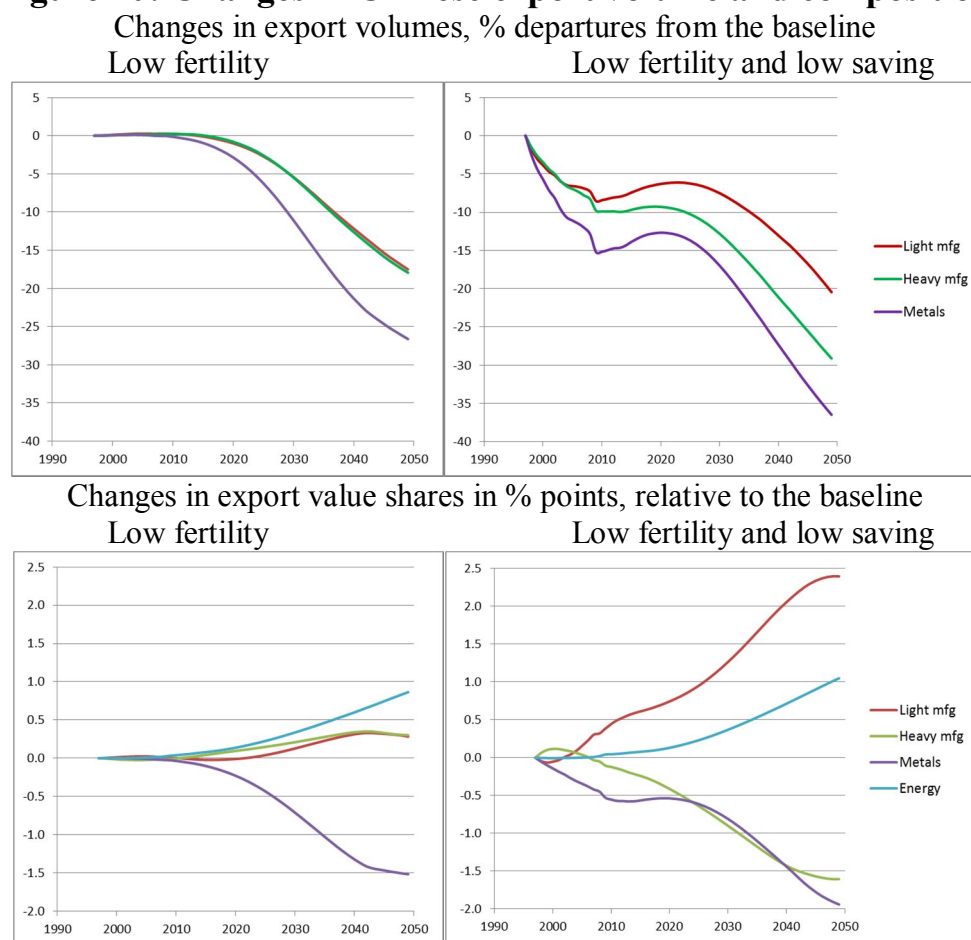
That China's total trade should take a lower growth path relative to the baseline is no surprise. Its variable factors of production shrink and, at least in the short-run low-saving scenarios raise home consumption expenditure, which can be expected to reduce exports and boost imports. In the long run, slower population growth and more rapid saving decline reduce Chinese

¹⁸ For comprehensive surveys of the determinants of China's real and nominal exchange rates, see Tyers and Zhang (2011, 2014).

¹⁹ The historical effects of China's pre-GFC growth surge on Australia's real effective exchange rate were larger than indicated in Figure 19. The model used here is long run in orientation (physical capital is mobile between industries) and so it under-represents the very sharp spikes in commodity prices in this period.

economic activity and so trade flows also take a slower path. Figure 20 illustrates the declining trend in real trade volumes relative to the baseline for the low-fertility scenario and, when the low-saving shock is included, the short-run decline due to temporarily higher consumption expenditure (Figure 14). Of particular interest abroad, however, are the product compositions of China's import and export values. The shares of product-specific exports, as simulated in 2050, are listed in Table 1. It is understandable that, in the baseline case, the rise of the skilled labour force, combined with continued rapid capital accumulation should see expanded exports of heavy manufactures. While these come to dominate China's trade, exports of metals assume a significant role. This is a figment of the exogenous productivity shocks embodied in the baseline, from which most of our analysis is independent. In this instance, however, the rise of metals exports does affect both the initial export shares and the changes that take place in them. This characterisation reflects the experience of both Japan and Korea, which became exporters of processed metals as the growth in their domestic use subsided.

Figure 20: Changes in Chinese export volume and composition



Source: Scenarios constructed as described in the text. Changes smaller than 1% are not shown.

More broadly, the shares might be expected to respond to changes in China's pattern of comparative advantage, due to the new trajectories of its factor endowments and its real exchange rate. While the simulated pattern is consistent with these underlying forces, the actual departures from the baseline are surprisingly small, as shown in Table 1 and Figure 20. The low-fertility scenario has the shares of total exports devoted to energy and manufactures expanding relative to the baseline, while the metals export share contracts. When the savings contraction is added the effects are larger, with the baseline trend toward heavy manufactured exports reversed in favour of a return to dependence on light manufactured exports. Again, the share of metal exports falls and that of energy exports expands.

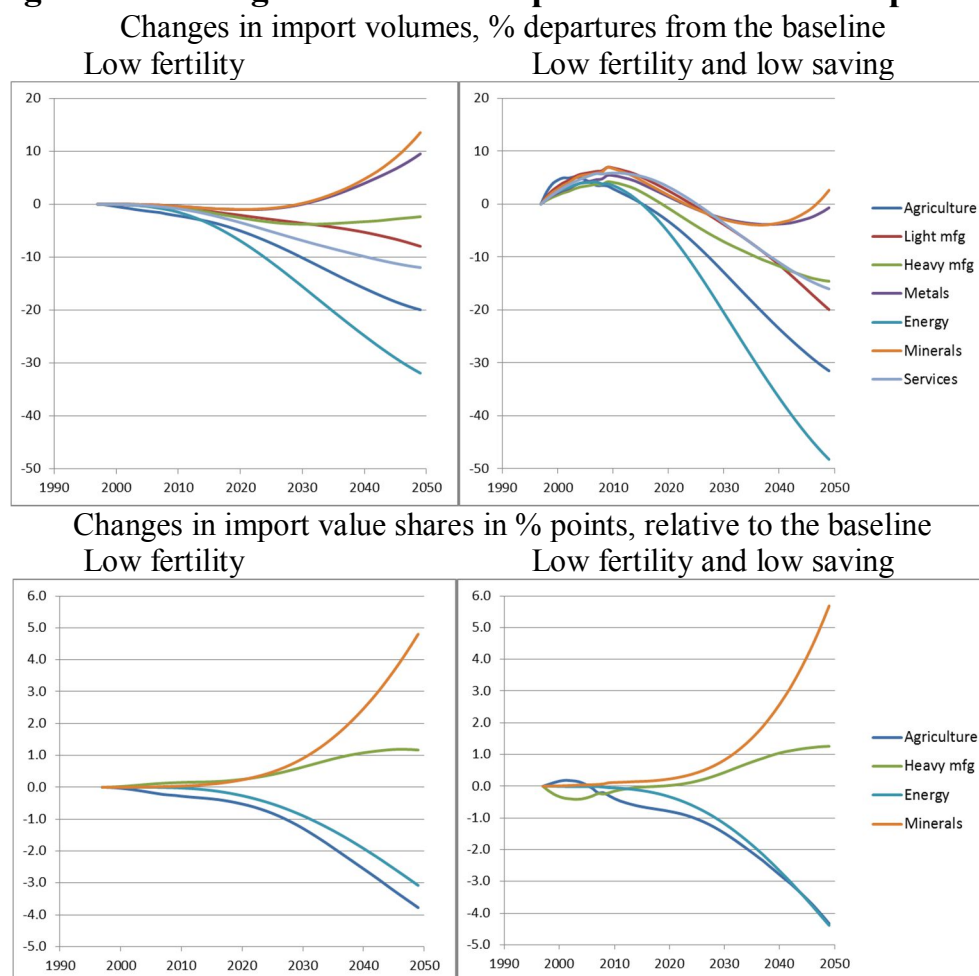
Table 1. Shares of Chinese Export Values in 2050, %

	Baseline	Low fertility, high saving	Low fertility, low saving
Agriculture	0.1	0.1	0.1
Light manufacturing	26.6	26.9	29.0
Heavy manufacturing	56.0	56.3	54.4
Metals	15.0	13.5	13.0
Energy	1.3	2.1	2.3
Minerals	0.1	0.0	0.0
Services	1.0	1.1	1.1
Total	100	100	100

Source: Scenarios constructed as described in the text.

On the import side there is considerable diversity in outcomes relative to the baseline. Most conspicuous in Figure 21 is the short-run increase in imports that results from higher consumption expenditure in the low-saving scenario. Beyond 2020, however, the effect of slower capital accumulation and labour force growth on domestic income comes to dominate and the trend of imports relative to the baseline contracts. The changes in import composition turn out to be more robust to the type of shock delivered, as indicated in the second row of Figure 21. Relative to the baseline, whether the scenario is slower population or slower saving growth, the share of imported minerals rises while the shares of energy and agricultural products contract. Metal exports constitute 15% of export revenue in the baseline, suggesting that China will follow Japan and Korea in becoming an exporter of steel and other metal products. With contracting population and savings, metal production contracts relative to the baseline and metal exports contract in share. But the relative decline in overall imports sees the share of this eventually export-oriented industry's mineral inputs expand.

Figure 21: Changes in Chinese Import Volume and Composition



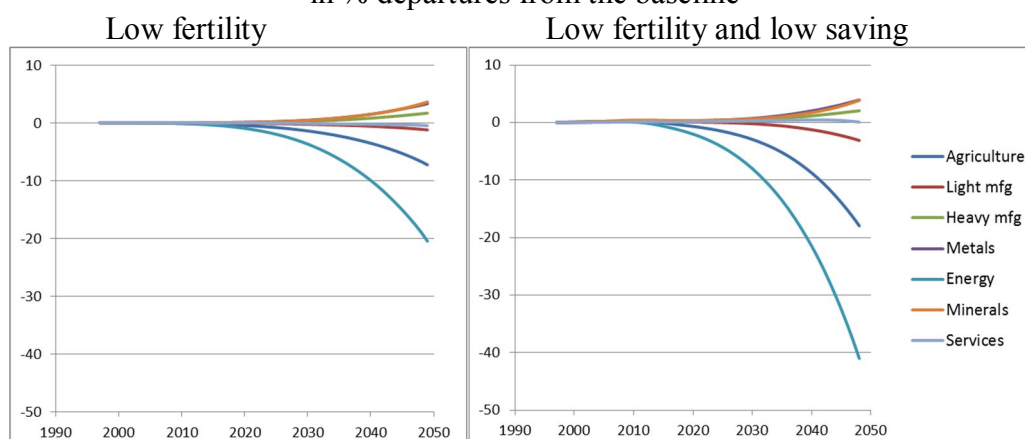
Source: Scenarios constructed as described in the text. Changes smaller than 1% are not shown.

6.2 Changes in international prices and real per capita income abroad

These changes in China's trade lead to corresponding changes in international trading prices and hence in the terms of trade faced by other regions. These prices are shown, relative to the US GDP price, in Figure 22. For the products that dominate world trade, namely manufactures, the changes due to China's low fertility and low saving are small. But the effects are very large for agriculture and energy products, most particularly in response to slower Chinese saving growth. The results suggest that a slowing Chinese economy will continue to have a significant negative effect on energy markets.

Figure 22: World Trading Prices

Changes in average world prices (relative to the US GDP deflator)
in % departures from the baseline

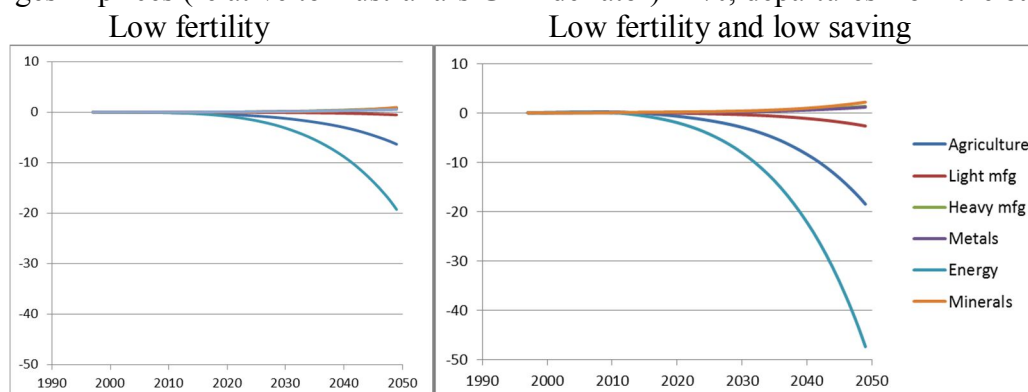


Source: Scenarios constructed as described in the text. These are bilateral trade-weighted trading prices by product, recognising that the model treats regional products as differentiated and so prices can differ by trading route.

Because the model characterises products as being differentiated by region of origin, international prices differ by trading route. This recognises that the composition of product groups in exports differ across trading routes. In Australia's case, energy exports are projected to continue through 2050 but implicit in the behaviour embodied is that those energy exports are dominated by coal. A demographic contraction alone affects Australia's export prices less than the global average but, when a saving reduction is added, Australia's energy exports are more affected than the others and so Australia's energy export price falls by more than the global average, relative to the baseline, as shown in Figure 23. Quite clearly, Australia is little affected by a Chinese demographic contraction alone but it is affected very substantially by a decline in China's savings and hence in the capital intensity of its future growth and its products.

Figure 23: Australian Export Prices of Tradable Products

Changes in prices (relative to Australia's GDP deflator) in %, departures from the baseline

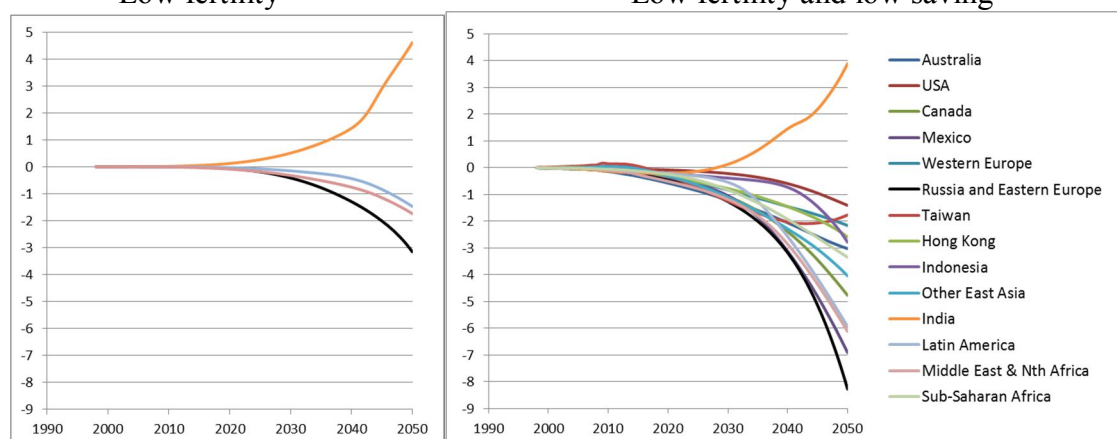


Source: Scenarios constructed as described in the text.

Perhaps the best bottom line measure of the international welfare effects of low Chinese fertility and saving is the change in regional real per capita income.²⁰ The results by this measure are illustrated in Figure 24. The results show the negative net effects on the rest of the world that are evident from the changes in ex-China global GDP in Figure 18. Two regions stand out as being most affected by the Chinese slowdown. The first is India, which benefits, most especially from the demographic contraction. It is the alternative large and populous economy and, as modelled at least, its low real wages, comparatively rapid population growth and rising share of workers in the population²¹ leave it poised to take over the industrial path of China. The comparative slowness of its economic policy reforms and the bias against manufacturing that is embodied in its labour laws are not accounted for in this analysis. Thus, the simulations suggest that slower Chinese growth benefits it by making energy and food cheaper and by creating room for a growing Indian manufacturing industry. At the other end of the spectrum is the composite region, Russia and Central Europe. As a large energy exporter this region suffers a substantial decline in its terms of trade, most especially when there is both a demographic and a savings contraction in China.

Figure 24: Real per Capita Income outside China

Changes in real per capita income in %, relative to the baseline (high fertility, high saving)
 Low fertility Low fertility and low saving



Source: Scenarios constructed as described in the text. Note that regions affected by less than a per cent are excluded from the figure.

Most other regions are also net losers from the loss of Chinese economic activity, though mainly from the loss of Chinese saving and therefore the higher cost of capital each must bear.

²⁰ Real per capita income is defined conventionally as household income divided by the population and deflated by the consumer price index, all of which are carried by the model.

²¹ For details on India's pending 'demographic dividend', see the comparative analysis with China by Golley and Tyers (2012a, b).

The bottom-line effects for real per capita income across the globe in 2050 are detailed in Table 2. In Australia's case, the net effect of the deterioration in the financial terms of trade in the low-saving case combines with a marginally negative product terms of trade change, leaving it on the debit side. A stronger negative terms of trade effect is avoided by the combination of the lower agricultural export prices with the comparative stability of Chinese mineral import volumes, at least as modelled.

Table 2. Effects of low fertility and low saving on real per capita income in 2050 (% departures from the baseline (high fertility, high saving))

	Low fertility, high saving	High fertility, low saving	Low fertility, low saving
Australia	-0.1	-2.9	-3.0
USA	-0.3	-1.1	-1.4
Canada	-1.5	-3.5	-4.8
Mexico	-0.8	-6.2	-6.9
Western Europe	-0.9	-1.4	-2.2
Russia and Eastern Europe	-3.2	-5.2	-8.3
Japan	-1.0	0.8	-0.4
China	20.7	-15.4	-2.7
Taiwan	-0.7	-1.0	-1.8
Hong Kong	-1.3	-1.4	-2.6
Indonesia	-0.1	-2.9	-2.8
Other East Asia	-0.6	-3.6	-4.0
India	4.6	-0.3	3.9
Other South Asia	0.8	-1.6	-0.8
Latin America	-1.5	-4.7	-5.9
ME and Nth Africa	-1.7	-4.7	-6.1
Sub-Saharan Africa	-0.9	-2.7	-3.3
Rest of world	-1.6	-3.2	-4.7

Source: Simulations of the model described in the text.

7. Conclusions

This paper sets out to assess the importance, both within China and abroad, of a number of conundrums facing Chinese leaders as they embark on a new phase of development, in which slower GDP growth is being portrayed as the 'new normal'. Using a dynamic global economic model with full demographic behaviour to project through to 2050, a quantitative perspective is offered for many, if not all, of the complex linkages between China's demographic change, savings rates and economic performance, with implications for both the Chinese and global economies. The results support the following points.

First, fertility levels rising toward population sustainability levels would indeed contribute to higher rates of GDP growth, a rise in the proportion of children and a reduction in the proportion of aged people in China in the decades ahead, as well as providing a modest source of higher domestic consumption. Yet our analysis confirms not only that these impacts would be small – amounting to less than half a per cent per year of GDP growth and a reduction in aged dependency by 0.03 percentage points, but further that they would come at a significant cost in terms of per capita GDP, reducing its level by 21 per cent in 2050 compared with the low-fertility alternative.

Second, we consider the case in which fertility rises toward population sustainability levels but there is more rapid savings decline, induced by a range of policy reforms and the net effects of partially offsetting demographic factors. We think of this as the “dual policy success” scenario. It would result in a rebalancing of the domestic economy towards consumption, while shifting China’s external balance away from surplus and toward deficit. Yet, on the basis of our modelling exercise, the associated decline in China’s rate of capital accumulation and a relative increase in foreign ownership of home capital would see this coming at a significant cost to China’s future income. Its GDP would be lower and its GNP lower by more. Indeed, its real household income per capita would be lower by fully 15 per cent in 2050. And this reduction in per capita income would translate into *lower* consumption in the longer term, with the slowdown being substantial enough to bring about a fall in consumption as a percentage of GDP from around 2035. Moreover, the lower growth path of per capita income resulting from both lower savings and higher fertility would cause the skilled share of the labour force to decline relative to the other scenarios, impeding China’s ongoing efforts to upgrade its industrial structure.

Third, the final scenario considered has declines in both fertility and saving rates, according most accurately with our expectations, notwithstanding considerable uncertainty about both changes. We refer to this as the “double contraction” scenario and it is the one where the implications for the global economy prove to be most apparent. Not surprisingly, it yields slower population and labour force growth and a significantly lower growth path for all Chinese economic activity. While the boost to China’s domestic consumption from lower savings is shown to boost imports in the short term, beyond 2020 this outcome is reversed in all but minerals, which as modelled, feeds a domestic metals industry that becomes export oriented following the experience of Korea.

Within specific sectors, the double contraction scenario sees a lower growth path for the supply of the factors that are variable in the long run and hence a decline in the relative performance of manufacturing and services relative to the industries dependent on land and natural resources. Higher costs see an appreciation of its real exchange rate, with savings decline being the dominant driver of these changes. This said, the output effects are not large for manufacturing, but they result in substantial reductions in imports of agricultural and energy products.

Australia and India provide two extreme examples of how the double contraction would impact on regions with different demographic and economic structures. For Australia, the terms of trade changes are mixed, with gains due to China's continued imports of minerals and losses associated with declining Chinese energy demand. The savings contraction contributes 2.9 of the 3.0 per cent net reduction in real per capita income through to 2050. For India, which has high fertility and is advantaged by slower Chinese manufacturing exports, its real per capita income is boosted by Chinese fertility decline alone, to the tune of 4.6 per cent. The contraction in Chinese savings has comparatively little impact on India, which is the only region in the world to actually benefit from a double contraction in China. The greatest loser from China's double contraction is the region "Russia and Central Europe", the consequences for which are driven by the associated collapse in China's energy imports and world energy trading prices.

Finally, our results do *not* imply that we *do not* support the Chinese government's decision to abolish the one-child policy: the non-economic benefits of this shift are, quite simply, immeasurable. Rather, they call for recognition that a two-child policy – were the people to respond to it – is not a first-best policy option for tackling either China's growth slowdown or its ageing problem. The fact that the bulk of recent demographic research indicates that China's fertility rates will not, in fact, rise to the levels implied by our baseline adds further weight to this call. Likewise, our results *do not* imply that rebalancing the Chinese economy is necessarily a bad idea. Rather, this paper highlights the need for alternative sources of growth if China is to fend off the negative outcomes that its current 'dual policy objective' implies. Raising the productivity of all factors of production (labour, land, capital and natural resources) and speeding up the pace of skill transformation (or human capital acquisition) seem like the obvious places to look for replacing the physical capital accumulation that has been the dominant driver of growth in the past, and that will inevitably decline in the future. Increasing labour force participation rates – by simple measures such as the recent extension of retirement

ages to 60 years for women and 65 years for men, and by more complex reforms to the welfare and *hukou* systems – would directly tackle China’s ageing problem and provide an additional source of growth as well (Golley and Tyers, 2012a,b). Exploring the positive effects that these could have, in combination, on both the Chinese and global economies, remains the task of another paper.

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