China's Real Exchange Rate Puzzle

Rod Tyers and Jane Golley

College of Business and Economics
Australian National University

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Abstract

International pressure to revalue China's currency stems in part from the expectation that rapid economic growth should be associated with a real exchange rate appreciation. This hinges on the Balassa-Samuelson hypothesis under which economic growth, stemming from improvements in traded sector productivity, causes non-traded prices to rise. The puzzle is that, while evidence on China's productivity and prices supports this hypothesis, its real exchange rate has shown no long run tendency to appreciate. Resolution requires extension of the hypothesis to allow for effects on the real exchange rate due to non-traded productivity improvements or, in association with failures of the law of one price for traded goods, labour supply growth and growth-related demand switches due to changes in financial capital flows and trade distortions. The sensitivity of China's real exchange rate to these determinants is reviewed with the results confirming that financial and capital outflows are dominant depreciating forces in the short run. Along with WTO accession trade reforms, it is shown that the heretofore rising surplus of Chinese domestic saving over its investment has restrained the real exchange rate from appreciating since the late 1990s.

1 Introduction

It has been argued that the appreciation of the RMB since 2005 is just the beginning of a necessary upward trend, given the belief that the currency is currently undervalued, by margins ranging from 'small' to as high as 50%.[i] Expectations that China's underlying real exchange rate will appreciate in the future are based commonly on the Balassa (1964) – Samuelson (1964) hypothesis. This implies a positive relationship between economic growth and the real exchange rate, driven by productivity catch-up in developing countries' tradable sectors and, in association, rising prices in their non-traded sectors. Two suppositions are essential to the hypothesis. First, relative to foreign trading partners, productivity rises fastest in the traded goods sector and, second, due to associated wage pressure, there is relative inflation of non-traded service prices.

This paper offers evidence in support of these suppositions in the case of China, lending additional weight to the expectation that the real exchange rate should be appreciating. At the same time, however, it shows that there has been no significant long term appreciating trend from the early 1990s through 2006. Therein lays the puzzle. Its resolution requires the generalisation of the assumptions on which the Balassa-Samuelson hypothesis is based; in particular, the relaxation of the assumption that the law of one price applies for all traded goods. This generalisation greatly broadens the set of determinants of the real exchange rate

and it is to these that the paper then turns. It turns out that, while productivity changes are influential in the medium to long run, so also are labour force growth and trade reforms. In the short run movements in the real exchange rate prove to be dominated by financial flows on the balance of payments.[ii] Thus, the net effect of China's rapid economic growth on its real exchange rate depends on the sources of that growth and the consequent pattern of endowment changes and sectoral distributions of productivity growth and tradability. Of considerable importance in resolving the puzzle is the short run impact of China's widening current account surplus, which stems from its extraordinarily large yet still rising saving rate.

The next section briefly reviews the Balassa-Samuelson hypothesis and the evidence in support of its key suppositions, and then demonstrates its apparent inconsistency with the trend of China's real exchange rate. A more general treatment of real exchange rate determination is then offered in Section 3 and elasticities to various determinants are calculated using a simulation model of the global economy in Section 4. A final resolution of the puzzle is suggested in Section 5 and a discussion of the implications for Chinese macroeconomic policy is then provided in Section 6. General conclusions and policy implications are presented in Section 7.

2 Balassa-Samuelson: theory and evidence for China

If the nominal exchange rate, *E,* is defined as the number of units of foreign exchange obtained for a unit of the domestic currency, the real exchange rate, e^R, can be defined correspondingly as the rate of exchange between the home product bundle and corresponding bundles produced abroad. It follows that the bilateral real exchange rate for a focus (home) country with foreign trading partner *i* can be approximated as the common currency ratio of the gross domestic product (GDP) prices (deflators) of the two countries, $P^Y\left(p^N, p^T\right)$ and $P_i^Y\left(p_i^N, p_i^T\right)/E_i$, where p^T and p^N are indices over all the focus country's non-traded and traded goods and services, respectively.[iii]

$$(1) \qquad e_i^R = \frac{P^Y\left(p^N, p^T\right)}{P_i^Y\left(p_i^N, p_i^T\right)/E_i} = E_i \frac{P^Y\left(p^N, p^T\right)}{P_i^Y\left(p_i^N, p_i^T\right)}$$

This is the fundamental relationship between the real and nominal exchange rates. Consider the case in which prices at home and abroad are measured in a common currency, the share of

non-traded products in GDP, θ, is the same at home and abroad, prices are aggregated appropriately using a Cobb-Douglas index and the law of one price applies to all traded goods. The latter implies that trade is costless and undistorted, so that $p^T = p_i^T$. Under these conditions, the real exchange rate becomes

$$(2) \qquad e_R = \frac{\left(p^N\right)^\theta \left(p^T\right)^{1-\theta}}{\left(p_i^N\right)^\theta \left(p_i^T\right)^{1-\theta}} = \left(\frac{p^N}{p_i^N}\right)^\theta$$

From this, the key role of non-traded goods prices is clear. When prices are measured in a common currency, or relative to a common numeraire, it is the ratio of the home and foreign non-traded goods prices that matters in determining the real exchange rate.

To illustrate the associated dependence on productivity, imagine that labour is the single fixed factor and that the rates of output per worker in the home traded and non-traded sectors are A^T and A^N. In trading partner *i*, the corresponding rates are A_i^T and A_i^N. The relationships between the wage rate and product prices in the traded and non-traded sectors follow from equating the wage in both sectors with the values of the marginal products of labour in each: $W = A^T P^T = A^N P^N, W_i = A_i^T P_i^T = A_i^N P_i^N$, from which it follows that the divergence in wage rates between trading partners depends only on their tradable productivities: $W/W_i = A^T/A_i^T$.

If the non-traded productivity level is the same in all trading partners ($A^N = A_i^N \; \forall i$), we then have that

$$(3) \qquad \frac{P^N}{P_i^N} = \frac{A^T}{A_i^T} \text{ and } e_i^R = \left(\frac{A^T}{A_i^T}\right)^\theta .$$

By the Balassa-Samuelson hypothesis, if the focus country has higher tradable productivity growth, $\hat{A}^T > \hat{A}_i^T$, its real exchange rate must be appreciating. The hypothesis then implies that, if developing countries are poorer because their tradable labour productivity is lower, then comparatively rapid growth should cause real appreciations.

The supporting evidence for China:

The two key suppositions that are essential to the hypothesis are, first, that, productivity rises fastest in the traded goods sector and, second, due to associated wage pressure, that there is relative inflation of non-traded service prices. We examine these by estimating simple Solow residuals for the economy as a whole and for three sectors: 'Food', 'Industry' and 'Services'. In doing so, we adjust the officially published urban employment data for underestimation, as discussed in Cai and Wang (2006).[iv] The average annual changes in the Solow residuals for each sector that emerge from this analysis are given in Table 1. These show strong productivity performance by the Chinese economy since the mid 1980s, with a slow-down in the 1998–2001 period associated with the East Asian financial crisis. Consistent with the first supposition, and with other studies by Lu (2006) and Fogel (2006), productivity growth appears to have been strongest in the export orientated industrial sector and weakest in the largely non-traded service sector.[v]

The second supposition is also supported by the evidence, as shown in Figure 1. The prices of construction and other services have clearly risen faster than the GDP price since 1990. On the (accurate) presumption that China's productivity growth is higher than that of its trading partners, this strongly supports a simultaneous real appreciation. Yet, as shown in Figure 2, no such appreciating trend has emerged. It is this puzzle that we seek to resolve. We begin with a generalisation of the hypothesis via a relaxation of some of its key assumptions.

3 A Generalisation

The key assumptions of the Balassa-Samuelson hypothesis are indeed suspect. We offer a critique of each, as follows.

Tradable productivity gap: During some periods and in some developing countries, productivity growth has been observed to be higher in the non-tradable sector,[vi] leading to $\hat{A}^N > \hat{A}_t^N$ and tending to depreciate the real exchange rate. Modern transport, financial, health and education services offer considerable potential for productivity catch-up. Whatever the relative performance of China's services sector in the past, recent evidence suggests substantial potential for catch-up and accelerated productivity growth in the future (Ma 2006).

The law of one price for tradable goods: Failures of the law of one price have been observed for tradable goods in specific instances.[vii] Goods and services are not homogeneous across countries but are differentiated at minimum by country of origin.[viii] Supply and/or

demand side factors that raise the volume of tradable production move the home country down the global demand curves for its product varieties, reducing its supply prices and resulting in deterioration in the terms of trade and a depreciation of its real exchange rate. Factor endowment growth and changes in policy that lead to substitution in demand for home products depreciate real exchange rates and the magnitudes of their effects depend crucially on the degree of substitutability between the differentiated products.

Labour arbitrage: In most developing economies, the marginal product of industrial labour exceeds that of rural labour due to the more rapid accumulation of industrial capital. There is, therefore, a Harris-Todaro gulf between wages in the expanding and contracting sectors. If labour mobility between the rural and industrial sectors is inferior to that between the rural and service sectors (particularly the construction sector), then industrial productivity growth does not necessarily drive up service wages or service costs.[ix]

Closed capital account: The assumption that the real exchange rate depends only on interactions among countries associated with trade in merchandise is clearly violated in many of today's developing countries, and particularly in China. Its violation, in concert with failures of the law of one price for traded goods, means that any influx of payments (in the form of a foreign direct investment or portfolio capital flow) raises aggregate demand. Since traded goods are supplied more elastically via imports than are non-traded goods—which depend on home resources—such an influx must raise relative non-traded prices and therefore appreciate the real exchange rate. Conversely, effluxes will cause depreciation.

Not surprisingly then, wider empirical evidence in support of the Balassa-Samuelson hypothesis is mixed. Choudhri and Khan (2004), for example, find favourable evidence using a small sample of developing countries that does not include mainland China, Taiwan or Hong Kong. Bergin et al. (2006) find a positive association between price levels and real per capita income that is strong only in large samples of countries. Miyajima (2005) uses a sample of 15 Organisation for Economic Cooperation and Development (OECD) countries between 1970 and 2000 to establish that the hypothesis does not always hold during growth surges, which on numerous occasions were led by productivity growth in non-traded sectors. The East Asian evidence since 1980 also appears mixed. Only Japan showed a rapid real appreciation following the demise of the Bretton Woods system in 1972 and in association with its correspondingly rapid export-led growth. The same pattern is not observed for Korea, Taiwan or for any of the larger Southeast Asian economies.[x]

Taking a different approach, Rodrik (2006) measures the productivity associated with China's exports and shows it to be significantly higher than what would normally be expected for a country at China's income level. He also shows that this has been an important determinant of China's growth during the period 1992–2003. Relevant to the discussion here, he asks whether the Chinese economy will run out of steam once the convergence in export productivity nears completion, or whether it will be able to 'discover' new products on world markets and enable export-led growth to continue. While such speculation suggests future real appreciations based on productivity growth in the tradable sector, considerable future growth could stem from productivity catch-up in the service sector—a depreciating force. The fact that recent productivity growth in manufacturing has been associated with foreign direct investment (FDI) and that service FDI has begun to grow only recently, suggests that services productivity will be a major contributor to China's growth in the future. Clearly, the sectoral distribution of productivity gains is critical in determining the real exchange rate.

In turn, productivity differences across sectors will be affected by levels of education and training. Fogel (2006) predicts that investment in human capital has the potential to serve as China's key engine of economic growth for the next two decades, a point that is well recognised by China's leaders (as emphasised in the eleventh Five-Year Plan). He qualifies the impact of enhancing the quality of labour through education on the growth rate of per capita income and shows that increasing secondary and tertiary enrolment ratios has a sizeable impact on the growth of labour productivity and the per capita GDP growth rate.[xi] To the extent that services are skill intensive (as they are according to past data), this will boost performance in the service sector—again, tending to depreciate China's real exchange rate. Of course, to the extent that structural changes lead to rapid upgrading in the skill intensity of tradables in the process of economic growth in China, as it has in other countries; this relationship will operate in reverse.

Allowing for failures of the law of one price for tradable goods, there are numerous other forces tending to depreciate the real exchange rate in the long term. During the past two decades one such force has been China's 'demographic dividend', stemming from the high proportion of working-aged people in the total population. This, according to Cai and Wang (2005), accounted for about one-quarter of per capita GDP growth between 1980 and 2003.[xii] It has played a critical role in keeping wages and hence the real exchange rate low, thereby enabling the rapid expansion of labour-intensive manufactured exports. In the future,

however, the ageing of the population and the consequent decline in the labour supply will have the opposite effect, placing upward pressure on real wages and the real exchange rate.[xiii] Alternative population policies, such as the relaxation of the One Child Policy, clearly stand to affect economic growth via the labour supply, and therefore to impact on the real exchange rate as well.

The Balassa-Samuelson assumption that productivity gains translate into higher wages (Equations 1-3) is underpinned by the assumption of full employment and labour-market arbitrage. While Miyajima (2005) finds that this assumption is satisfied for his OECD sample, it is far from clear that it has also held for China in the past. Cai and Wang (2006) show that, during the period 1995–2002, average annual manufacturing wage growth was 11.6 per cent in China—below their estimate of productivity growth (12.2 per cent), a point that is also supported by Fan (2006). And if, as noted above, rural labour is more mobile into some services than into manufacturing, the wage cost effect on services might have been yet smaller. Thus, labour mobility into the non-rural sectors could have offset the appreciating forces in recent decades.

4 Modelling the determinants of China's real exchange rate

Here we examine quantitatively the relationship between shocks associated with China's economic growth and its real exchange rate. To do this effectively, a numerical model is required that is global in scope and that incorporates the generalisations of the Balassa-Samuelson assumptions discussed above. Recall that these included productivity growth in non-tradable as well as tradable sectors, departures from the law of one price for tradable goods, a more sophisticated representation of the labour market and an open capital account. With these generalisations, almost all shocks to the economy have implications for the real exchange rate.

We use a model that offers these generalisations. Adapted from Tyers and Shi (2007a, 2007b), it is a multi-region, multi-product dynamic simulation model of the world economy.[xiv] In the version used, the world is subdivided into 14 regions (Table 2). Industries are aggregated into three sectors: food (agriculture, including processed foods), industry (mining and manufacturing) and services (including construction)—the latter being little traded in comparison with the other two. Failures of the law of one price are represented by product differentiation, so that consumers substitute imperfectly between products from

different regions. As in other dynamic models of the global economy, the endogenous component of simulated economic growth is physical capital accumulation. Technical change is introduced in the form of exogenous productivity growth that is sector and factor specific, allowing the analysis of productivity performance that differs between tradable and non-tradable sectors. Consistent with the results indicated in Table 1 for China, baseline productivity in food sectors in most regions grows more rapidly than that in services. This allows continued shedding of labour by agriculture as part of the development process.[xv]

Regional capital accounts are open and investors have adaptive expectations about real regional net rates of return on installed capital. In each region, the level of investment is determined by a comparison of expected net rates of return on domestic installed capital with borrowing rates yielded by a global trust, to which each region's saving contributes, adjusted by calibrated region-specific interest premiums. Lagged adjustment processes ensure, however, that financial capital is not fully mobile internationally in the short term, but that the paths of domestic and global interest rates become parallel, separated only by exogenous premiums in the long term. In representing China, however, one caveat is that no explicit control is imposed on the outflow of private financial capital. General financial reform is represented by a diminution of the interest premium and this causes an unambiguous influx of financial capital to China.

To augment the model's characterisation of changes in labour supply and quality, it encompasses demographic and economic change. It tracks populations in four age groups, two genders and two skill categories: a total of 16 population groups in each of the 14 regions. The skill subdivision is between production labour (unskilled) and professional labour (skilled).[xvi] Each age–gender–skill group is represented as a homogeneous sub-population with a group-specific birth and death rate, labour force participation rate and rates of immigration and emigration. Because the non-traded sector is relatively intensive in skill, trends in skill composition prove to be particularly important. These depend on the rate at which each region's education and social development institutions transform unskilled (production-worker) families into skilled (professional-worker) families. Each year a particular proportion of the population in each production-worker age–gender group is transferred to professional status. The initial values of these proportions depend on the regions' levels of development, the associated capacities of their education systems and the relative sizes of their production and professional labour forces. Rates of transformation

change through time in response to corresponding changes in real per capita income and the skilled wage premium.[xvii]

The 16 age–gender–skill groups differ in their shares of regional disposable income, consumption preferences, saving rates and labour force participation behaviour. While the consumption–savings choice differs for each group, it is dependent for all on group-specific real per capita disposable income and the regional real lending rate. Governments are assumed to balance their budgets while saving and borrowing are undertaken by the private sector. The baseline scenario is a 'business-as-usual' projection of the global economy until 2030.

Our focus is on how shocks that enhance the rate of GDP growth impact on the real exchange rate.[xviii] The most significant of these are once-and-for-all productivity increases, skill transformation rate increases, interest premium *decreases* (*increases* in net financial inflows) and tariff *decreases* (*increases* in openness). In each case, we run a new simulation in which the determinant in question is shocked once and for all, as of 2005. We then extract the elasticity of China's real exchange rate to each shock, tracking the values through time to 2030. We focus on the bilateral real exchange rate, measured as in Equation (1), against the region 'North America', since this best parallels China's nominal exchange rate policy and the *renminbi* valuation debate. The results are summarised in Figure 3.

Productivity growth increase

We first shock total factor productivity separately in each sector. The elasticity is the percentage departure of the projected real exchange rate or growth rate for each percentage per annum increase in total factor productivity. The overall rate of economic growth proves to be quite sensitive to such productivity shocks 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 growth rate. Because 'industry' is by far the greatest contributor to China's trade its productivity is more significant for the real exchange rate than 'food'. The appreciating effects of tradable productivity increases are consistent with the Balassa-Samuelson hypothesis and are, as expected, due to wage growth and relative service price inflation. They are bolstered in the short term by increased investment and hence greater net inflows on the capital account. In the long term, however, the enlargement of the industrial capital stock reduces costs and hence offsets the real

exchange rate gains. Also, as expected from the dominance of non-traded sector prices in Equation (2), faster service productivity growth depreciates the real exchange rate—modestly in the early years but to a dominant extent in the long term, when it is reinforced by associated capital accumulation.

Skill acquisition rate increase

When the skill acquisition rate is increased in developing regions such as China, where the unskilled (or production) worker population is larger than its skilled (or professional) counterpart, the proportional boost to skilled workers is larger than the proportional loss of unskilled workers. The result is greater output and, other things being equal, a real depreciation. This tendency is enhanced by the fact that the services sector is comparatively skill intensive, so that the shock causes a relatively large boost to service output and hence a relatively large fall in the home service price (relative to North America). The result is a strong responsiveness of GDP growth to skill acquisition and a relatively large real depreciation in the long run. The elasticities in this case are percentage departures of the real exchange rate for each per cent of the production-worker (unskilled) population that is transformed each year. Defined this way, skill transformation places downward pressure on the real exchange rate of a magnitude similar to total factor productivity in services.

Interest premium decline (increased financial capital inflow)

In the short term, the decline in China's interest premium results in net capital inflows, which raises investment and therefore increases aggregate demand and the real exchange rate. A positive demand-driven effect is therefore expected in the first instance. In the long term, however, when the effect of the investment on the capital stock is realised, the supply side dominates. More abundant and hence cheaper capital reduces production costs, yielding a real depreciation. The elasticity-to-premium decline (financial capital inflow) is large and positive in the short term, with the lag to the switch in sign measuring at least 15 years.

Trade liberalisation (increased openness)

Trade liberalisation switches demand away from home-produced goods and services towards imported varieties. For a single region, the supply of goods and services from the much larger foreign market is more elastic than that of home varieties, constrained as they are by local

factor supplies and technology. The effect of the demand switch, then, is to reduce the relative prices of the home varieties and hence to depreciate the real exchange rate. The elasticity of openness is constructed by dividing the percentage change in the real exchange rate by the percentage point change in the import penetration ratio (the ratio of the value of imports to the total value of domestic consumption). The shock on which it is based is a phased removal of all China's merchandise trade barriers over five years.[xix] The elasticity, also shown in Figure 3, has the expected negative sign, and its magnitude grows through time.

The rise in its (negative) magnitude through time occurs because, even though the industries most affected by trade liberalisation are capital intensive, the broad group "industry" in the model is benefited overall, raising the return on physical capital and attracting additional investment. This apparent anomaly occurs because the "industry" aggregate produces goods that are differentiated from competing imports with the degree of differentiation limiting the extent of demand switching. At the same time this industry group is a large importer of intermediate inputs that are also industrial products. It turns out that the gains to the sector from cheaper intermediates outweigh the losses from import competition in final demand.[xx] The effects on GDP are positive, with the raised investment and capital growth tending to reduce costs further and hence to enlarge the negative elasticity through time.

5 Resolution

There is no doubt that the Balassa-Samuelson appreciating force of Section 2 has been in action in China. Our generalisations of their hypothesis allow consideration of countervailing forces, however, and it is these that must have prevented any significant real appreciation between the early 1990s and 2006. Although services productivity is shown in the previous section to be a strong depreciating force, the evidence of Section 2 suggests the net effect of productivity changes across China's sectors is appreciating. Other strong depreciating forces include skill acquisition, which gives an endowment boost to the services sector, trade reforms and financial flows on the balance of payments.

In the short to medium run the latter is the dominant such force - the expansion of net inflows on the financial and capital accounts is strongly appreciating. From Figure 4, however, it is evident that, since the mid-1990s there has in fact been an expansion in net *outflows* on these accounts, and so the effect has been to apply *downward* pressure on China's real exchange rate. To see this, note that the equality of net flows on the capital account to the investment–

saving gap follows from the standard aggregate expenditure and disposal identities.[xxi] Defining net inflows as positive, the "capital account" surplus can be written as:

$$(4) \qquad KA = S_{NF} - \Delta R = I - S_D$$

where I is investment, S_{NF} (net foreign saving) is net private inflow on the financial account and ΔR is the annual addition to official foreign reserves. In the presence of capital controls, S_{NF} is roughly equal to inward FDI. Both sides of the equation are negative in the case of China, indicating net outflows. Extraordinarily, even though investment accounts for 45 per cent of China's GDP, more than half of its GDP is saved. While these outflows are likely to have supplied the strongest depreciating force, the other two candidates may also have been important. The recent surge in overall income growth and urbanisation has seen an acceleration of skill acquisition and a boost to the service economy. At the same time, the lead-up to China's WTO accession saw a substantial reduction in trade distortions.

To separate the effects of each of these forces on the real exchange rate we begin with the baseline model simulation over the decade 1997-2006. This simulation incorporates all measured changes in sectoral productivity, skill acquisition and trade liberalisation. The skill acquisition rates are calibrated using the model from wage and sectoral employment data, as described in Tyers and Bain (2007). Finally, the trade reform shocks associated with the WTO accession are from Rees and Tyers (2004: Table 3). The actual and simulated paths of the bilateral real exchange rate between China (incorporating Taiwan and Hong Kong) and North America (incorporating the US, Canada and Mexico) are illustrated in Figure 5. Note, first, that these paths differ from that of the bilateral real exchange rate between mainland China and the US shown in Figure 2. The real exchange rate depreciates further with these aggregations because Hong Kong and Taiwan experienced larger real depreciations against the US in this period and Canada and Mexico both experienced real appreciations against the US. The simulated real depreciation falls slightly short of that recorded, yet, as the figure shows, the model does reproduce the shape of the observed real depreciation through 2006.

The independent effect of each of the forces on the bilateral real exchange rate between China and North America is then discerned by making a number of additional model simulations over 1997-2006. The first is a "no forces" simulation, in which changes to all of the key forces determining the bilateral real exchange rate are removed. Saving rates are shifted to ensure that the ratios of total investment to total saving in China and North America are held

constant, restraining the expansion in net outflows on China's capital account and net inflows on North America's;[xxii] productivity growth rates in all sectors are set at North American levels throughout; no trade policy reforms occur; and skill acquisition rates are shifted to ensure that labour forces and skill shares grow in both regions at the North American rates for the period. Then this no-forces simulation is augmented by each of the individual forces separately, to evaluate their independent effects. The results are illustrated in Figure 6.

Higher Chinese productivity growth offers the expected appreciating force, consistent with the results illustrated in Figure 4. Also consistent with those results is that net financial outflows on China's balance of payments and inflows on the North American balance of payments (their current account 'imbalances') both tend to depreciate the Chinese real exchange rate. Similarly, skill acquisition and trade reform offer the expected depreciating forces. In combination, the current account imbalances in both China and North America contribute a depreciation of more than five per cent by 2006. Skill acquisition is a small force in the short run, consistent with the elasticities in Figure 4. Surprisingly significant, however, is the depreciating effect of WTO accession trade reforms, which contribute more than four per cent to the overall real depreciation. In the end, the balance of payments imbalances prove to be, in combination, the most important depreciating forces during 1997-2006.

6 Implications for China's macroeconomic policy and the *renminbi*

The exchange rate reforms launched by the Chinese authorities in July 2005 were intended to at least demonstrate a departure from the *de facto* fixed US dollar peg, nominally allowing the currency to fluctuate by up to 0.3 per cent a day. These reforms have, however, had a limited impact so far, yielding a cumulative bilateral appreciation of about 6 per cent to May 2007. Expressing a widely held view outside China, Lardy (2006:85) argues that: 'As the world's second largest surplus country, China must allow its currency to appreciate against the dollar and it must take steps to allow a transition to a growth path driven more by domestic consumption than by further increases in its external surplus.'

Since the gross outflows on its capital account take the form of reserve accumulation, China, in combination with other Asian economies that are also raising reserves, has been accused of 'monetary mercantilism'.[xxiii] It is implied that reserve accumulation is chosen freely in order to keep the real exchange rate low. That this is unfair criticism is evident from the identities.

By definition, from Equation (4) we have that $\Delta R = S_D - I + S_{NF}$. This indicates that, as long as total domestic savings exceed investment and capital controls prevent the matching of inward FDI by private outflows, ΔR must be positive. The monetary mercantilist critique of the rate of reserve accumulation is therefore better directed at the high saving rate and the capital controls.

The key to China's macroeconomic policy is the on-going program of reforms essential to financial and capital account liberalisation. The reason why the PBC sterilises foreign currency inflows net of import costs is because, short of these reforms, the Chinese commercial banks are not considered by the PBC to be yet capable of offering a *private* market on which those large volumes of foreign currency can be exchanged for *renminbi*. Hitherto, China's banking system has lacked derivative markets for currency and debt instruments to do the necessary hedging and it is not sufficiently distant from decades of soft budget constraints associated with the channelling of government subsidies to state-owned enterprises through accumulated debt. This has necessitated the placing of the PBC's US dollar receipts abroad. And, to avoid excess liquidity, these placements have been sterilised. PBC holdings of domestic credit have been insufficient for this sterilisation, however, so 'sterilisation bonds' have been issued on the debit side of the balance sheet (Table 3).

Just as the reserves have come to dominate the asset side of the balance sheet, sterilisation bonds have assumed significance on the debit side. In effect, the PBC has acted as a conduit for domestic savers who might otherwise acquire foreign assets but are restricted from doing so by capital controls. The current pressure from abroad to revalue therefore places the PBC in a difficult position for two reasons. First, since the assets of the PBC are primarily in US dollars and its liabilities are in *renminbi*, too prompt an appreciation of the *renminbi* would result in substantial losses that would need to be covered in *renminbi* from the government budget.[xxiv] Second, and more important, if the path of the underlying real exchange rate is flat (as in Figure 2), then from Equation (1), any decision by the PBC to revalue would require further monetary tightening and a reduction in the inflation rate. To May 2007, however, this rate was running at about 3% annually. Any revaluation larger than this would risk a return to the growth-sapping deflation of the late 1990s.

A larger role for the nominal exchange rate must await the fruits of continuing financial reforms and capital market deepening. In the meantime, the control of 'external imbalances'

will continue to depend on the management of liquidity growth via limits on base money growth (sterilisation bond issues) and bank reserve requirements, supplemented by more traditionally Chinese instruments, including the rate of public land release, changes in export facilitation and, at least in prospect, the reduction of import tariffs on some luxury products. Financial reforms are proceeding quickly, however, so that some increased exchange rate flexibility is being offered by the PBC, as suggested by the extension of the daily *renminbi*–US dollar rate fluctuation bounds from 0.3 per cent to 0.5 per cent as of late May.

7 Conclusion

The Balassa-Samuelson hypothesis is borne out for China, in that productivity has apparently grown faster in the tradable than in the non-tradable sectors and there has been relative service price inflation. The flat trajectory of its real exchange rate is therefore a puzzle, the resolution of which requires the generalisation of the hypothesis to incorporate failures of the law of one price for tradable goods and a more sophisticated representation of the labour market. This opens the way for depreciating forces that have been offsetting the Balassa-Samuelson effect, including net financial outflows on the balance of payments, trade and other microeconomic reforms, the rising labour force and the rising share of skilled workers.

To examine these forces, a dynamic model of the global economy is used to construct a baseline business-as-usual simulation to 2030. The principal determinants of China's economic growth are then shocked separately and their independent effects on the real exchange rate observed over time. In the short term, the key determinant is net financial capital influx, which appreciates the real exchange rate, or efflux, which depreciates it. In the medium term, scope does emerge for Balassa-Samuelson real appreciation, if services lag sufficiently behind industrial productivity. In the long term, however, if services remain relatively skill intensive on average, their performance will be bolstered by both direct productivity improvements and skill acquisition, and the result will be a substantial depreciating force.

The model is then used to decompose the flat trajectory of the real exchange rate 1997-2006. The results suggest that the strongest of these forces is the rise of China's total savings relative to its investment and the associated expansion of net outflows on its capital account, with a significant contribution from WTO accession trade reforms. While much attention is paid in the literature to the "undervaluation" of the *renminbi*, blaming this on China's

monetary policy and, in particular, to the PBC's accumulation of foreign exchange reserves, in our view the PBC's monetary stance is necessitated by financial immaturity. In particular, while China's savings exceed its investment, the reserves and capital controls merely alter the public–private composition of external flows but need not significantly affect their magnitudes.

In the long term, since Chinese productivity growth has been higher than that of its trading partners for more than a decade, and considerable scope remains for productivity catch-up in services, the latter could bear down on the real exchange rate. It is difficult to ignore the fact that the majority of the growth-related shocks examined—including overall (and particularly services) productivity growth, professional training and further trade reform—all cause the real exchange rate to depreciate in the long term. Yet, whichever productivity pattern dominates, the future path of the real exchange rate will also depend heavily on financial flows and hence on China's domestic savings relative to its investment. Eventually, its saving rate must fall. When it does, net flows on the capital account will be reversed, resulting in a strong appreciating force. The long-term outcome will then depend on the extent to which this force is offset by continued skill acquisition and services productivity growth.

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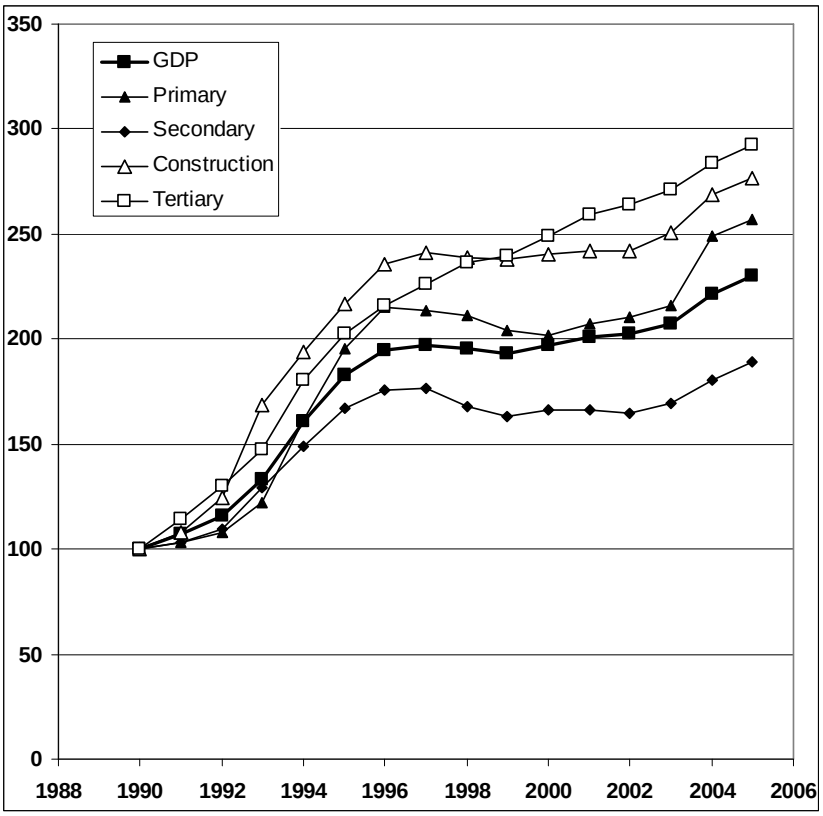
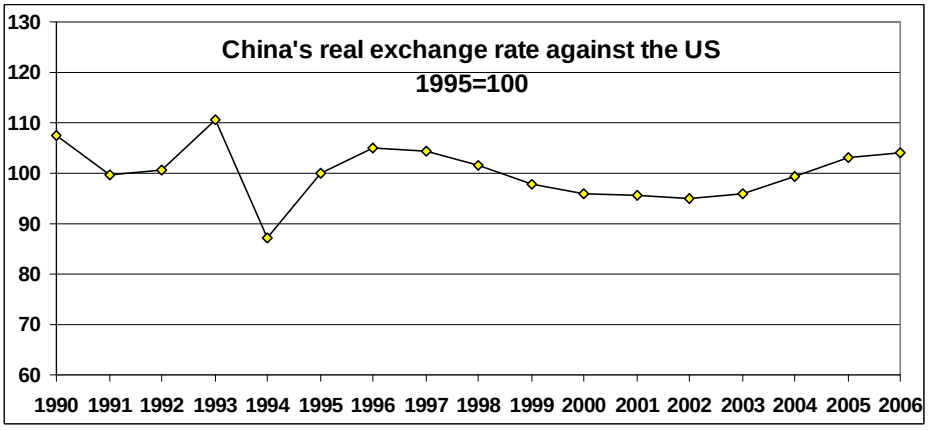
Figure 1 Chinese sectoral price indices, 1995–2005[a]



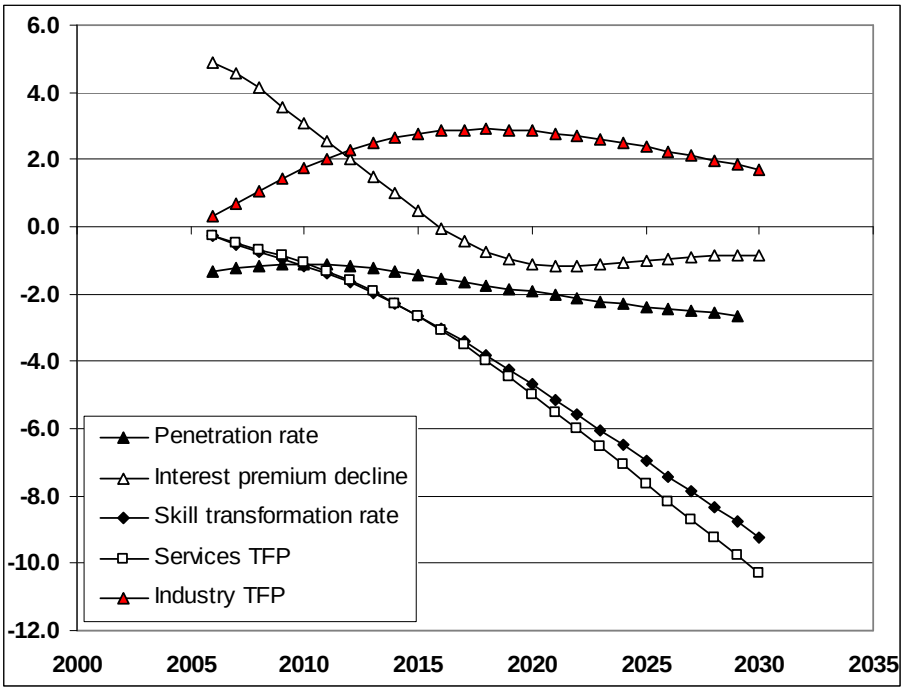
[a] These are sectoral price indices for 'Primary industry', which is mainly agriculture; 'secondary industry', which is primarily manufacturing and construction; and 'tertiary industry', which is other services.
Source: The price indices are implied by volume and value data from the National Bureau of Statistics of China (2007).

Figure 2 Mainland China's real exchange rate against the US[a]



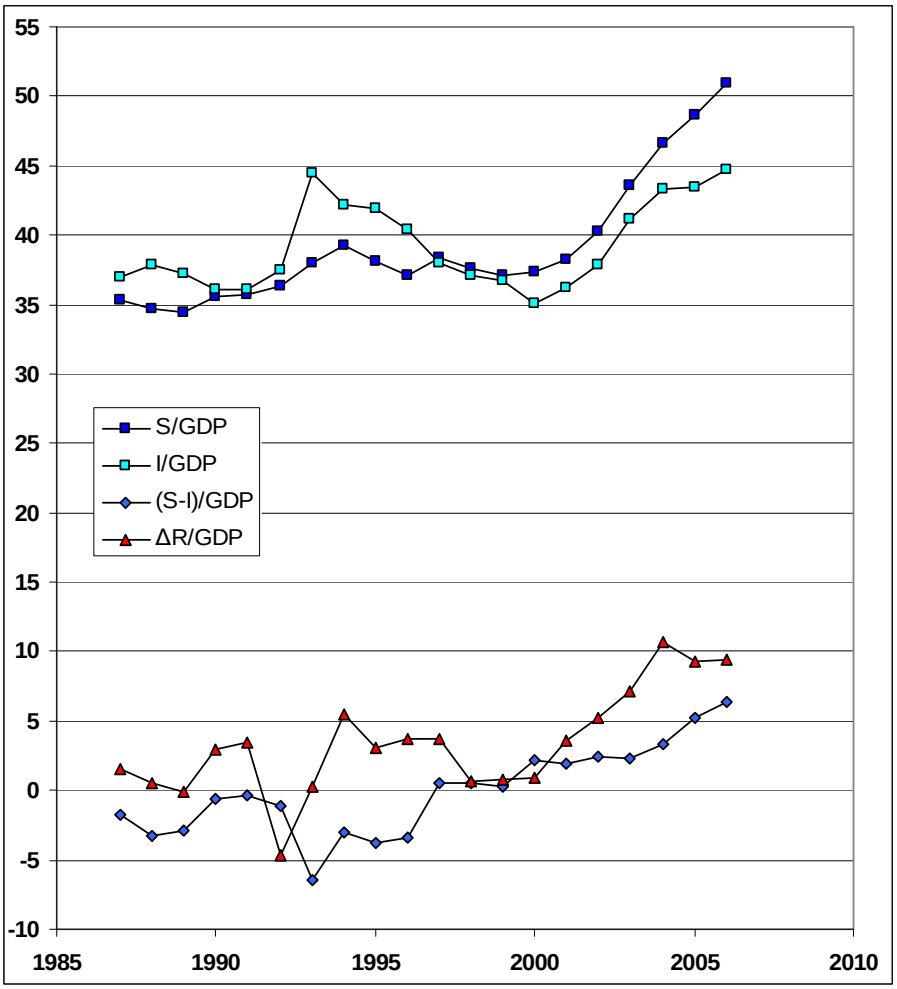
a. These are indices of nominal bilateral rates between mainland China and the US, deflated according to $e_R = E \cdot P_Y / P_Y^{US}$, where E is the nominal exchange rate in US$ per unit of local currency, P_Y is the local GDP price and P_Y^{US} is the corresponding US GDP price.
Source: IMF, *International Financial Statistics* (2007).

Figure 3 Elasticities of the projected real exchange rate to its key determinants[a]



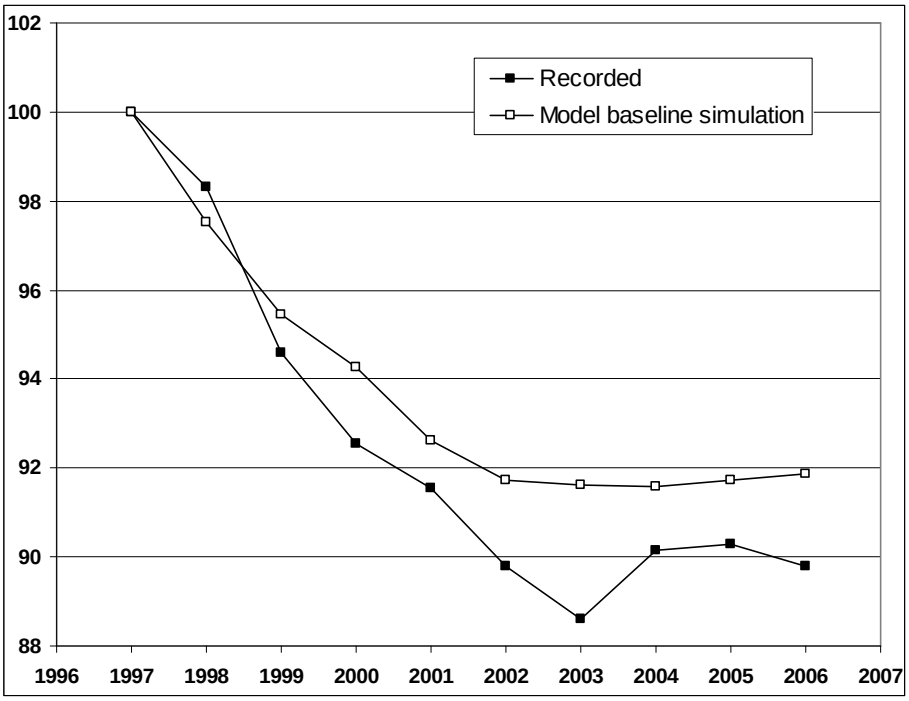
[a] This is the percentage departure of the projected real exchange rate for each percentage increase in the overall import penetration ratio, *M/C*, caused by tariff reductions that began in 2005.
Source: Simulations using the model described in the text.

Figure 4 China's investment–saving and external balances (percentage of GDP)[a]



[a] Since errors and omissions are large, we have adjusted the least accurately measured items in each sub-account (usually net factor income and net private flows on the financial account) to ensure balance.
Sources: International Monetary Fund (IMF), 2007a. *International Financial Statistics*, April, International Monetary Fund, Washington, DC. International Monetary Fund (IMF), 2007b. *World Economic Outlook Database*, April, International Monetary Fund, Washington, DC. Some 2006 figures are derived from data from the Chinese National Bureau of Statistics, 2007. Economist Intelligence Unit, Chinese National Bureau of Statistics.

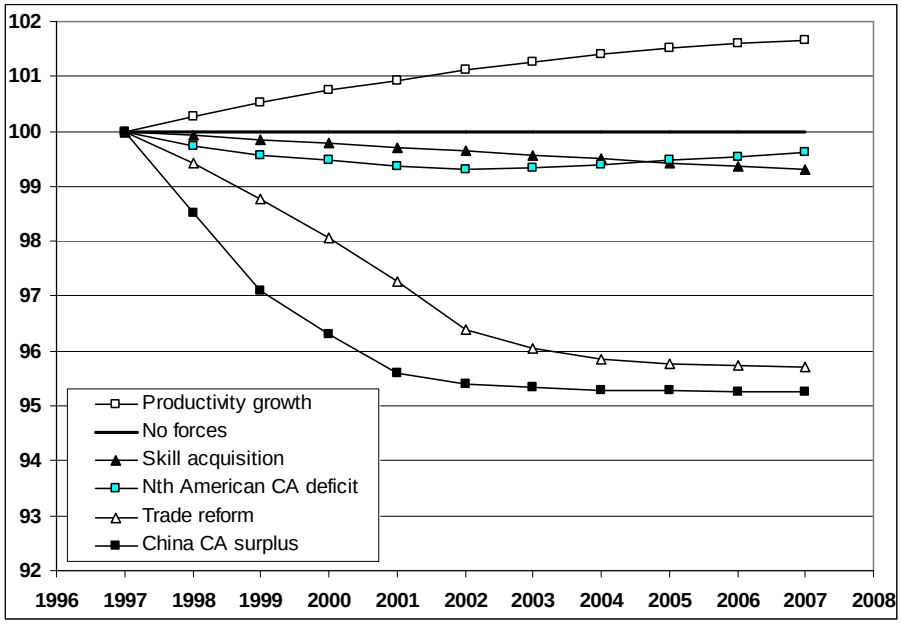
Figure 5 Actual and simulated real exchange rates between China and North America[a]



a Indexed departures from 1997, where China includes Taiwan and Hong Kong and North America includes Canada and Mexico. The recorded series represents indices of $e_R = P_Y / P_Y^{NAm}$, where P_Y is the China regional GDP price and P_Y^{NAm} is the corresponding North American average GDP price, both evaluated in US$ as the quotients of nominal and real regional GDP.

Source: IMF, *International Financial Statistics* (2007) and, for Taiwan, from Central Bank of the Republic of China (Taiwan) http://www.cbc.gov.tw/foreign/fx/minfo_07_4.asp; GDP Deflator; from Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. (Taiwan); http://www.dgbas.gov.tw/public/data/dgbas03/bs4/nis93/np31.xls.

Figure 6 Scale of real exchange rate forces, China vs North America[a]



a Indexed departures from 1997, where China includes Taiwan and Hong Kong and North America includes Canada and Mexico.

Source: Model decomposition simulations described in the text.

Table 1: Estimated Chinese Total Factor Productivity Growth by Sector

% per year	Whole economy	Food	Industry	Services
1986-1989	3.5	1.4	3.8	3.8
1990-1994	5.0	1.6	7.7	2.3
1995-1997	5.7	5.5	3.7	3.2
1998-2001	4.1	-0.2	8.9	-0.5
2002-2005	6.0	5.4	6.3	4.6

Sources: Analysis of Chinese statistics described in Tyers et al. (2006). Original sources are, for output, *China Statistical Year Book* (2005), *China Industrial Economic Statistical Year Book* (every year after 1985) and *China Statistical Abstract* (2006). Employment data are from *China Statistical Year Book* (2005), *China Industrial Economic Statistical Year Book* (every year after 1985) and *China Labor Statistical Year Book* (every year after 1985). China's capital stock, in 2000 prices, is taken from Holtz (2006). Sectoral price indices are from *China Statistical Abstract* (2006). Urban employment is enlarged based on underestimation proportions from Cai and Wang (2006).

Table 2: Regional Composition in the Global Model

Region	**Composition of aggregates**
Australia	
North America	Canada, Mexico, United States
Western Europe	European Union, including Switzerland and Scandinavia but excluding the Czech Republic, Hungary and Poland
Central Europe and the former Soviet Union	Central Europe includes the Czech Republic, Hungary and Poland
Japan	
China	Includes Hong Kong and Taiwan
Indonesia	
Other East Asia	Republic of Korea, Malaysia, the Philippines, Singapore, Thailand and Vietnam
India	
Other South Asia	Bangladesh, Bhutan, Maldives, Nepal, Pakistan and Sri Lanka
South America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Peru, Venezuela, Uruguay
Middle East and Nth Africa	Includes Morocco through the Islamic Republic of Iran
Sub-Saharan Africa	The rest of Africa
Rest of World	Includes the rest of Central America, the rest of Indochina, the small Island states of the Pacific, Atlantic and Indian Oceans and the Mediterranean Sea, Myanmar and Mongolia, New Zealand and the former Yugoslavia

Source: The *GTAP Global Database*, Version 5.

Table 3 The balance sheet of the People's Bank of China, ca. 2006

Assets	Liabilities
Domestic credit, DC Central bank claims on depository and other financial corporations and on the central government 20 per cent GDP	***The monetary base, M_B*** Currency and bank reserves 37 per cent GDP
Official foreign reserves, R 41 per cent GDP	***Sterilisation bonds, SB*** Debt to the Chinese public 14 per cent GDP
	Other liabilities, OL Includes government ownership 10 per cent GDP

Source: People's Bank of China, 2006. *Balance Sheet of Monetary Authority*, People's Bank of China, Beijing.

[i] See, for example, Frankel (2004), Wang (2004), Goldstein (2004), Coudert and Couharde (2005) and Tyers et al. (2007).

[ii] This work draws on some results from Tyers et al. (2006).

[iii] Here we imagine that, rather than the continuum of tradability that is observed across goods and services, traded and non-traded goods are separated starkly as *T*, *N*.

[iv] The 'Food' sector is defined as Primary Industry plus Food Processing; 'Industry' as Secondary Industry minus Construction and Food Processing; while 'Services' is defined as Tertiary Industry plus Construction. See Tyers et al. (2006) for further details.

[v] Moreover, it must be borne in mind that services output volumes and prices are measured more poorly than those in merchandise sectors in all countries. These comparative measures therefore carry large error margins. Lu (2006) estimates labour productivity in China's manufacturing and service sectors between 1978 and 2004. He describes the evolution of China's manufacturing labour productivity after 1978 as a two-stage process: during the first stage (1978–90) it was only 1.9 per cent per annum, compared with a per capita GDP growth rate of 7.5 per cent; while during the second stage (1991–2004) it increased dramatically, averaging 13.1 per cent—significantly higher than the official per capita GDP growth rate of 8.2 per cent. Labour productivity in the service sector averaged 4.3 per cent per annum for the entire period. Fogel (2006) disaggregates per capita income growth between 1978 and 2002 and shows that 69 per cent of growth was due to increases in labour productivity, which grew most rapidly in industry (6.2 per cent per annum), nearly as high in agriculture (5.7 per cent) and lowest, but still substantial, in services (4.5 per cent).

[vi] For example, the Cold War infrastructure investments in Korea and Taiwan reduced service costs at early stages in their periods of rapid expansion.

[vii] See, for example, Bergin et al. (2006); Crucini et al. (2005); and Drine and Rault (2005).

[viii] This is a standard assumption in the most widely used numerical models of open economies and global trade. See, for example, Dixon et al. (1982); McKibbin and Sachs (1991); Hertel (1997); and Dixon and Rimmer (2002).

[ix] Evidence for this is offered by Chang and Tyers (2003).

[x] Japan is a special case in the East and Southeast Asian experience. It was the first to develop rapidly but its economy, and particularly its services sector, remained far more closed than for its neighbours, and particularly relative to China.

[xi] For example, he calculates that if the tertiary enrolment ratio rose from six to 25 in the next 20 years (putting China where the Western European nations were in 1980), the growth rate of labour productivity would rise by 4.4 per cent between 2000 and 2020, and that this would account for more than 60 per cent of the per capita GDP growth target set in 2002. With the tertiary ratio increasing from 12.5 per cent to 19 per cent between 2000 and 2004, if anything, his estimates could be too conservative.

[xii] See Bloom and Williamson 1998 for a generic discussion of the demographic dividend in developing countries.
[xiii] Golley and Tyers 2006 confirm this, finding that the non-working aged dependency ratio could rise to 43 per cent.
[xiv] The model has its origins in *GTAP-Dynamic*, the standard version of which is a derivative of its comparative static progenitor, *GTAP* (Hertel 1997). Its dynamics are described in Ianchovichina and McDougall (2000).
[xv] In the case of China, Wang and Ding (2006) recently estimated that there were 40 million surplus workers in China's agricultural sector. While underemployment is not explicit in our model, the assumption of high labour productivity growth in agriculture implies that agriculture is capable of shedding labour without consequence for its output as workers are drawn away by urban capital accumulation.
[xvi] The subdivision between production workers and professionals and para-professionals accords with the International Labour Organisation's occupation-based classification and is consistent with the labour division adopted in the GTAP Database. See Liu et al. (1998).
[xvii] China's skill share is projected to rise through time while that in its real exchange rate comparator, North America, remains static. The contrast is due to North America's higher initial skill share, its high rate of unskilled immigration and its higher fertility rate.
[xviii] Here we mirror simulations carried out by Tyers et al. (2006).
[xix] The elasticity is insensitive to the scale of the liberalisation though not to the composition of China's protection. For the levels of protection embodied in the database for 1997, see Dimaranan and McDougall (2002).
[xx] This effect is discussed in detail in Rees and Tyers (2004).
[xxi] The right hand side of this identity stems from the combination of aggregate expenditure on GDP, $Y = C + I + G + X + M$; the fact that GNP is $Y_N = Y + N$, where N is net factor income from abroad; the GNP disposal identity, $Y_N = C + T + S$, and the balance of payments, $BoP = 0 = KA + CA$, where the current account is $CA = X - M + N$.
[xxii] In each region the model has 16 age-gender-skill groups each of which has endogenous saving, driven by real disposable income and the real interest rate. Each group consumption equation has a region-wide shifter that is here adjusted to ensure that total saving accords with the imposed path of the current account deficit.
[xxiii] The works mounting the monetary mercantilist position are reviewed by Aizenman and Lee (2006), who conclude in the end that China's substantial reserves are more likely to be precautionary.
[xxiv] This concern has very recently been addressed via the exchange between the government and the PBC of a large quantity of domestic bonds in return for foreign bonds, the latter to be maintained by the government as the assets of a state-run Foreign Exchange Investment Company.