THE AUSTRALIAN NATIONAL UNIVERSITY

Working Papers in Trade and Development

Appreciating the *Renminbi*

Rod Tyers

and

Iain Bain

July 2007

Working Paper No. 2007/09

Division of Economics

Research School of Pacific and Asian Studies
ANU College of Asia and the Pacific

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Rod Tyers

College of Business and Economics
The Australian National University
Email: Rod.Tyers@anu.edu.au

and

Iain Bain

College of Business and Economics
The Australian National University

Corresponding Address :
Rod Tyers
College of Business and Economics
The Australian National University

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Rod Tyers and Iain Bain

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 an underlying real exchange rate appreciation. This hinges on the Balassa-Samuelson hypothesis, which sees growth as stemming from improvements in traded sector productivity and associated rises in wages and non-traded prices. Yet, while evidence on China's productivity and prices supports this hypothesis, its real exchange rate has shown no long run tendency to appreciate. The use of a global numerical model allows extensions of the hypothesis, including failures of the law of one price for tradable goods, which point to WTO accession trade reforms and China's high saving rate as key depreciating forces since the late 1990s. The same model is then applied to the implications of premature RMB appreciation. It is shown that, unless this is achieved in association with the repatriation of foreign reserves, which would require thus far unavailable financial depth in the Chinese economy, unilateral RMB appreciation would be destructive of both Chinese and global interests.

Key words:
Chinese economy, real exchange rate, economic growth, productivity

JEL codes:
C68, C53, E27, F21, F43, F47, O11

Appreciating the *Renminbi*

1 Introduction

China's apparently low *Renminbi* (RMB) is now very prominent in political debates over current account imbalances. This is particularly so in the US, where the Congress is considering a draft bill to penalise China unless it revalues.[i] In more scholarly circles, while a few, including McKinnon (2006), argue that a RMB appreciation would not address the imbalances of concern to the US, numerous studies have supported the view that the currency is undervalued, by margins ranging from 'small' to as high as 50%,[ii] and a number conclude that a unilateral appreciation of the RMB is essential.[iii] Expectations that China's underlying real exchange rate should be appreciating are based commonly on the Balassa (1964) – Samuelson (1964) hypothesis. This implies a positive relationship between economic growth and the underlying real exchange rate, driven by productivity catch-up in developing countries' tradable sectors and, in association, rising wages and prices in their non-traded sectors. Evidence in support of these suppositions in the case of China lends weight to the expectation that the real exchange rate should be appreciating.[iv] Yet, during the decade and a half to 2006, when the economy grew at between eight and ten per cent per year, there was no significant long term appreciating trend.

The resolution of this puzzle requires a number of generalisations of the Balassa-Samuelson hypothesis; most significant amongst which is the relaxation of the assumption that the law of one price applies for all traded goods. This greatly broadens the set of determinants of the real exchange rate. Although productivity changes are influential in the medium to long run, so also are factor endowment changes, such as relative labour force growth, and demand switching policy reforms, such as trade liberalisation. For similar reasons, short run movements in the real exchange rate prove to be dominated by financial flows on the balance of payments. 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 high total saving rate.

This paper summarises recent research on the reasons for China's stable real exchange rate, including modelling work that apportions changes since the 1990s amongst the strongest

appreciating and depreciating forces. The role of China's macroeconomic policy regime is then reviewed. It is argued that this regime is not mercantilist but rather averse to the exchange rate volatility that could stem from premature financial liberalisation while legal and institutional reforms to the commercial banking system are incomplete. Finally, the US pressure for an RMB appreciation is discussed and further global modelling is applied to the issue. A key issue is reserve accumulation, which is forced by high savings and the maintenance of capital controls which, in any case, constrain the interest of commercial banks in foreign currency. Were it possible to slow reserve accumulation, or to repatriate some reserves, an underlying real appreciation would make an orderly RMB revaluation relatively easy. Without this, however, a premature appreciation, brought about solely via a monetary tightening, would prove to be very contractionary in China and generally deleterious to the rest of the world. An alternative approach would be for China to use border distortions like an export tax on manufactures. This proves also to be contractionary in China and undesirable for its trading partners. Moreover, interestingly, it would not necessarily narrow China's current account surplus. The gradualism preferred by the Peoples Bank of China (PBC) is therefore supported.

The next section briefly reviews China's real exchange rate puzzle and its resolution. A more general treatment of real exchange rate determination is then offered in Section 3, where elasticities to various determinants are calculated using a simulation model of the global economy and this model is used to decompose the path of China's real exchange rate 1997-2006 in search of the strongest appreciating and depreciating forces. The role of China's macroeconomic policy is discussed in Section 4 and scenarios for short term appreciation of the RMB are offered in Section 5. General conclusions and policy implications are presented in Section 6.

2 China's real exchange rate puzzle

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.[v]

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

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

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

Under the assumptions of the Balassa-Samuelson hypothesis, then, an economy that is growing faster than its trading partners also has 1) faster tradable productivity growth

($\hat{A}^T > \hat{A}_i^T$), 2) faster wage growth ($\hat{W} > \hat{W}_i$), 3) relative service price inflation ($\hat{p}^N > \hat{p}_i^N$), and 4) an appreciating real exchange rate ($\hat{e}_R > 0$). The hypothesis then implies that, if developing countries are poorer because their tradable labour productivity is lower, then their comparatively rapid growth should be associated with real appreciations against their richer trading partners.

Support for the hypothesis requires, however, that all four of its predictions be observed. For the case of China, that about productivity is examined by Tyers et al. (2006) by deriving Solow residuals for the economy as a whole and for three sectors: 'Food', 'Industry' and 'Services'. They adjust the officially published urban employment data for its omission of the floating or non-*hukou* population, following Cai and Wang (2006).[vi] 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 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.[vii] When it is borne in mind that US productivity growth during the past decade has averaged no higher than three per cent per year (Gordon 2003, 2006, 2007), China's tradable productivity growth has clearly been comparatively high.

The second prediction, that of faster wage growth, is also supported by the data, as evidenced by the summary of sectoral real wage growth statistics in Garnaut and Huang (2007: Table 2.2). In 2000-2005, real wages grew on average by 9.9 per cent per year for rural workers and 12.5 per cent per year for manufacturing workers. The third, that of relative service price inflation, is also consistent with the BSH, as indicated in Figure 1. The prices of construction and other services have clearly risen faster than the GDP price since 1990. Yet, as shown in Figure 2, no such appreciating trend has emerged.

3 Determinants of the path of China's real exchange rate

The resolution of China's real exchange rate puzzle is to be found in the BSH assumptions. We begin with a critique of these and go on to analyse the wider determinants of real exchange rate movements using a numerical model of the global economy. Finally, we use that model to decompose the forces affecting it in the period 1997 to 2006.

Generalising the BSH assumptions

Tradable productivity gap: During some periods and in some developing countries, productivity growth has been observed to be higher in the non-tradable sector,[viii] leading to $\hat{A}^N > \hat{A}_i^N$ 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.[ix] Goods and services are not homogeneous across countries but are differentiated at minimum by country of origin.[x] 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.[xi]

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.[xii]

Another key potential driver of China's growth is education and training. Fogel (2006) emphasises this point, which is also well recognised by China's leaders (as in the eleventh Five-Year Plan). He shows that increasing secondary and tertiary enrolment ratios has a sizeable impact on the per capita GDP growth rate.[xiii] 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.

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.[xiv] 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.[xv]

Modelling the impacts of growth shocks on the 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 multi-region, multi-product dynamic simulation model of the world economy adapted from Tyers and Shi (2007).[xvi] It subdivides the world into 14 regions, with China defined to include Taiwan and Hong Kong.[xvii] 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.[xviii]

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).[xix] 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.[xx]

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.[xxi] 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), between China (including Taiwan and Hong Kong) and 'North America' (including Canada and Mexico), since this best parallels China's nominal exchange rate policy and the *renminbi* valuation debate. The results are summarised in Figure 3.

Sectoral total factor productivity: The elasticities shown represent the percentage departure of the projected real exchange rate for each percentage per annum increase in total factor productivity. Because manufacturing is by far the greatest contributor to China's trade industrial productivity is more significant for the real exchange rate than that of '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

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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.

Skilling of the labour force: 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 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.

Financial influx: This is induced by a decline in China's interest premium. It 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: This 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 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 marginal reduction

in all China's merchandise trade barriers.[xxii] The elasticity, also shown in Figure 3, has the expected negative sign, and its magnitude grows through time. The growth in the magnitude of the elasticity through time is due to increased investment and hence capital growth. This occurs because the industrial sector, while it suffers from reduced protection, benefits more from lower tariffs on imported intermediate inputs.[xxiii]

1997-2006 decomposition

While the analysis in Section 2 makes it clear that the Balassa-Samuelson appreciating force has been in action in China, our generalisations allow consideration of countervailing forces and it is these that must have prevented any significant real appreciation between the early 1990s and 2006. Strong depreciating forces that might have caused this include skill acquisition, which helps control wage costs in the skill-intensive services sector, trade reforms and financial flows on the balance of payments.

In terms of elasticities, Figure 3 confirms that financial flows dominate in the short to medium run. 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.[xxiv] 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_D is total domestic saving, 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.[xxv] 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 have surely been a 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.[xxvi]

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;[xxvii] 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 summarised in Table 2.

Higher Chinese productivity growth offers the expected appreciating force. 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 3. 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 current account imbalances prove to be, in combination, the most important depreciating forces during 1997-2006.

4 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'.[xxviii] 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 identity (4) which transforms as $\Delta R = S_D - I + S_{NF}$. 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. Through 2007 at least, 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 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 shown in 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. This concern has very recently been addressed, at least in part, with the issue of US$ 200 billion in government debt to be exchanged with the PBC for reserve assets, the latter to be maintained by the new state-run Foreign Exchange Investment Company. Second, and more important, if the path of the underlying real exchange rate remains 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. While inflation is running in the 3-4% per year range, any significant revaluation would have required a monetary tightening sufficient to risk a return to the growth-sapping deflation of the late 1990s. The June quarter 2007 inflation rate rose to 4.4%, however, suggesting an appreciation in the underlying real exchange rate, possibly due to speculative inflows in anticipation of a US-forced revaluation. This does offer the opportunity to accelerate the appreciation of the RMB.

Eventually, as capital controls are relaxed, a key issue will be the extent of private outflows on the financial account. Prasad et al. (2005) point to the potential for this to create a depreciating force as Chinese private investors seek to diversify their portfolios. The scale of this force depends on whether the PBC's reserves are the equivalent of the private sector's desired foreign holdings. A crude assessment of this can be made by comparing the foreign shares of collective portfolios across developed and developing countries. Assets are many and various and net positions are poorly documented, however. For a sample of countries we have constructed a crude approximation to foreign shares in collective portfolios using estimates of capital stocks and recorded flows on balances of payments. The results require a sceptical eye, since capital stocks are measured differently across countries and foreign shares can be expected to be higher in smaller and more open economies irrespective of their levels of development, as in the cases of Hong Kong, Singapore and the UK.[xxix]

The resulting foreign asset shares are listed in Table 4. The countries are then ranked on their estimated foreign shares in Table 5. Most striking is that, large official foreign reserves notwithstanding, China ranks rather low on the list, even when compared with other Asian developing countries. Since 2002, however, its foreign share appears to have doubled and its ranking has risen. By 2005 it ranked above Japan, Korea, Thailand, India and Brazil but below the other developed countries and Malaysia, Taiwan and Chile. Its ranking above Japan and the other two of the world's very large developing countries, India and Brazil,

suggests its foreign share may be on the high side, though none of these economies is as open as China already is to foreign trade and ownership (Lardy 2006). On the other hand, its ranking below the developed countries suggests that continued growth, combined with comparative openness, will take its share higher. At the very least, these results do not lend clear weight to the thesis that financial liberalisation will automatically raise private inflows and appreciate the RMB. Moreover, a surge in private rebalancing outflows could prove a healthy outcome since the PBC could readily offset this by repatriating its reserves and sterilising the inflow by liquidating its "sterilisation bonds". This would both restore the PBC's balance sheet to something more conventional and stabilise the home capital market in the face of such a surge.

5 Unilateral appreciation scenarios

McKinnon's (2004) sage preference for an East Asian dollar standard notwithstanding, the bilateral pressure by the US for an RMB revaluation is understandable in one respect. The benefits accruing to the US economy from Chinese investment notwithstanding, its government perceives a substantial current account imbalance, a proportion of which stems from its bilateral trade with China, and it expects that a US$ depreciation will help to correct it (Woo 2006). The US$ floats against most of the world's currencies but, no matter how much it depreciates against those it cannot break free of the RMB. This is the more frustrating because the monetary authorities of other Asian trading partners are concerned not to allow significant appreciations against the RMB.[xxx] Not only does the inflexibility of the RMB rate frustrate the US government, inciting the critical rhetoric (Bernanke 2006) and the draft legislation to "punish" China (Callan 2007), but it also causes frustration in Europe, where the burden of appreciation against the US$ is greatest.[xxxi]

Ironically, while the refusal by some other Asian countries to appreciate their currencies against the RMB might well be motivated by "monetary mercantilism", as argued in Section 4, we believe that the sluggishness of China's appreciation against the US$ is motivated internally. The sticking point is a fear of financial (including exchange rate) volatility and a lack of faith in its immature commercial banking sector to manage large scale currency exchange with due prudence.[xxxii] Although the PBC has no wish to hold additional reserves, it continues to accumulate them in order to avoid unnecessary reliance on its commercial banks (RGE Monitor, 2007c). This bodes ill for the prospect of a partial repatriation of these reserves any time soon, since repatriation requires a significant home market for the exchange of foreign currencies for the RMB. Yet such an influx, or at least a reduction in the rate of

reserve accumulation, is an essential element of a healthy unilateral appreciation of the RMB. Short of this, the Chinese government has two options: a substantial monetary tightening and a return to distorted trade.

Appreciation by monetary contraction

Were a repatriation of reserves or an accumulation slowdown possible, the real exchange rate would appreciate (as discussed in Section 3) and the nominal exchange rate could then be allowed to appreciate without causing domestic deflation (Equation 1). In the absence of reserve repatriation, and without any substantial upward movement in the underlying real exchange rate, the PBC could simply declare a higher US$/RMB rate. This is the option advocated by Tung and Baker (2004), who suggest a 15% one-off revaluation and argue that the risk of consequent deflation is minimal, due to inflationary pressure from other sources. With inflation running at 3-4% in 2007, and some of that due to illegal inflows speculating on an appreciation, we believe this argument lacks foundation.

The defence of the higher rate would require a contraction of the domestic money supply (or a slowdown in its growth) and a boost to domestic interest rates and other financing barriers. If the revaluation were as large as 15%, the result would likely be a return to the deflation of the late 1990s and this would squeeze profitability in the tradable goods sectors, leading to a slow-down in employment growth or an increase in under- or unemployment. Income would decline (or grow more slowly), as would consumption and saving. Slower employment growth would reduce capital returns and, combined with higher financing costs, this would also contract investment (or reduce its growth), and so the implications for China's external imbalance would then depend on the relative size of the saving contraction. For external balance there are, therefore, two cases to consider.

First, if Chinese households are optimistic they expect that the contraction is temporary and unrestrained growth will be restored in the future. Faced with reduced current income they would then smooth consumption by reducing current saving. Even with such a reduction in the saving rate, however, our simulation shows that the effect of lower employment growth on capital returns causes a larger fall in investment than in saving. Total domestic saving is larger than investment, however, so the net effect is to reduce China's current account surplus. This result is indicated in the first column of Table 6. There is a real appreciation against North America and a slight reduction in the latter's current account deficit. In addition, there is a slight addition to North America's politically sensitive industrial

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employment, though this comes at the expense of a service sector employment contraction due to North America's real depreciation against China. Both China and North America suffer losses in overall GDP and real income per capita. The loss in China is substantial, however, amounting to almost a year's growth.[xxxiii]

A second possibility is that Chinese households are pessimistic and believe that the contraction is permanent. In response to the monetary contraction and reduced income they would then exhibit behaviour seen in Japan in the 1990s, smoothing their consumption forward and raising their saving rate.[xxxiv] As shown in the second column of Table 6, this exacerbates the contraction in Chinese economic activity and income. Moreover, because saving does not fall and investment does, China's current account surplus is raised. The additional financial outflow causes a real *de*preciation, suggesting that, to achieve a particular nominal appreciation target, the monetary contraction in this case would need to deliver a larger deflation than before (Equation 1). Internationally, this shock reduces global interest rates and raises North America's current account deficit. Even though there are small gains in North America's terms of trade real income, the exacerbation of current account imbalances and the associated decline in industrial employment would further frustrate the US politically. It is difficult to conclude other than that there is little to be gained from RMB appreciation by monetary contraction.

Taxing trade

The other "unhealthy" approach to a unilateral appreciation is via trade distortions. We can dismiss a rise in import tariffs as fanciful, since China's WTO accession conditions offer very little room between applied and bound tariff rates. In any case, the returns from the resulting openness have been so considerable that it is difficult to imagine any policy reversal. Export restraints are possible, however, since these are not directly protectionist and hence would not attract mercantilist objections from abroad.[xxxv] In principle at least, like import tariffs, they might be expected to divert domestic demand from foreign to home products and thereby appreciate the real exchange rate, allowing the central bank to also appreciate the nominal exchange rate. The downside is that they would also be a tax on the most rapidly expanding sectors in the economy and so they would sacrifice growth in urban employment and income.

Our simulation is of the short run (2010) impacts of an export tax of 15% graduated over 2007-2009 and levied only on industrial exports. As previously we consider scenarios with both optimistic and pessimistic households. Surprisingly, as shown in the final two columns

of Table 6, in both cases China experiences robust real depreciations against North America. This is because China's current account surplus rises even in the optimistic case in which the saving rate falls temporarily. This contradicts the expected story because that emphasises substitution in *final* demand. The true story is about intermediate demand. China's export manufacturing sector relies to an extraordinary extent on imported components, mostly from Asian trading partners.[xxxvi] When the export tax contracts this sector, imports are similarly contracted. Total exports, in fact, contract by a smaller proportion because there is offsetting expansion in agricultural and service exports that are not intensive in imported inputs. The net effect is an expansion in China's trade surplus.

In North America the current account deficit rises and, as before, there are only small changes in real GDP and real per capita income. Importantly, however, China's export restraints do raise North American industrial employment, again at the expense of services employment, even though North America experiences a real appreciation against China that would otherwise advantage the services sector. In either case, at least in the short run, export restraints would not make it easier for the PBC to appreciate the RMB; in fact quite the opposite.

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 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 2007.

6 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, real wages have growth faster than in China's trading partners and there has been relative service price inflation. The flat trajectory of its real exchange rate between 1990 and 2006 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 and the rising number 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 motivated by concern about financial (and exchange rate) stability in the face of the relative immaturity of its commercial banking sector. While ever China's savings exceed its investment, the reserves and capital controls merely alter the public–private composition of external financial flows but need not significantly affect their magnitudes.

Until China's financial sector is perceived by its government as capable of managing high volumes of foreign exchange transactions with appropriate prudence, foreign reserves will remain abroad. Unless the saving rate falls and the real exchange rate rises as a consequence, there will be no "healthy" way to unilaterally appreciate the RMB. We show that unilateral appreciation by monetary contraction would be very costly to China, and it would most likely hurt the rest of the world by tightening capital markets and changing the terms of trade adversely. Moreover, if Chinese households were to react pessimistically to the shock, the current account surplus could be enlarged, backfiring on those who clamour for an

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appreciation to address global imbalances. The other conceptually feasible, but no more healthy, approach to a unilateral appreciation is via the imposition by China of a tax on manufactured exports. As it turns out, because China's export manufacturing sector relies so heavily on imported components, such a tax would actually exacerbate the trade surplus by cutting imports in proportion with manufactured exports while expanding other less import-dependent exports. This would increase China's current account surplus while sacrificing considerable growth. It would hurt the North American economy overall, though it would also raise the number of North American workers in politically sensitive industrial employment.

In the near term, since there is no scope for healthy unilateral appreciation of the RMB, international pressure would best be focussed on the remaining financial reforms and the openness of China's financial sector. In the medium term, continuing financial reforms should enable the relaxation of China's capital controls. Its saving rate must decline and this will reverse the net flow on its capital account, allowing non-speculative appreciating forces to dominate the path of its real exchange rate. In the long term, whether there is a sustained upward trend in China's real exchange rate will depend on the performance of its services sector. If that sector develops to be as open as the rest of China's economy and it realises the considerable scope that remains for productivity improvements, then services performance will provide a substantial depreciating force.

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## Figure 1 Chinese sectoral price indices, 1995–2005[a]
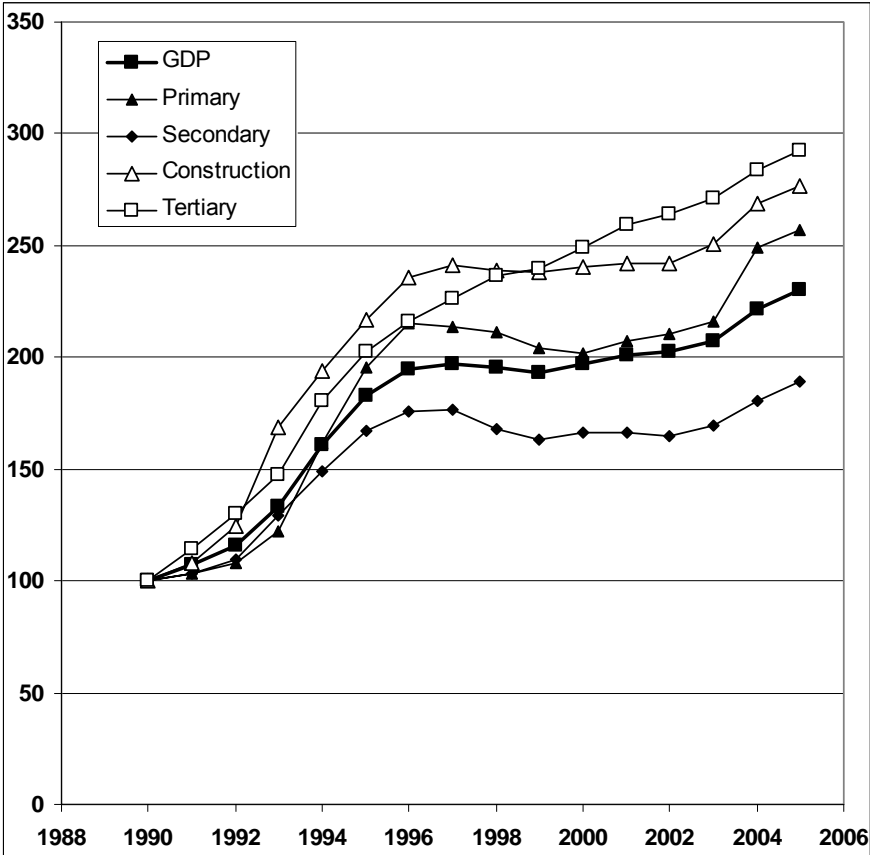
[a] These are sectoral price indices for 'Primary industry', which is mainly agriculture; 'secondary industry', which is primarily manufacturing and construction; and 'tertiary industry', which is other services.
Source: The price indices are implied by volume and value data from the National Bureau of Statistics of China (2007).

Figure 2 Mainland China's real exchange rate against the US[a]
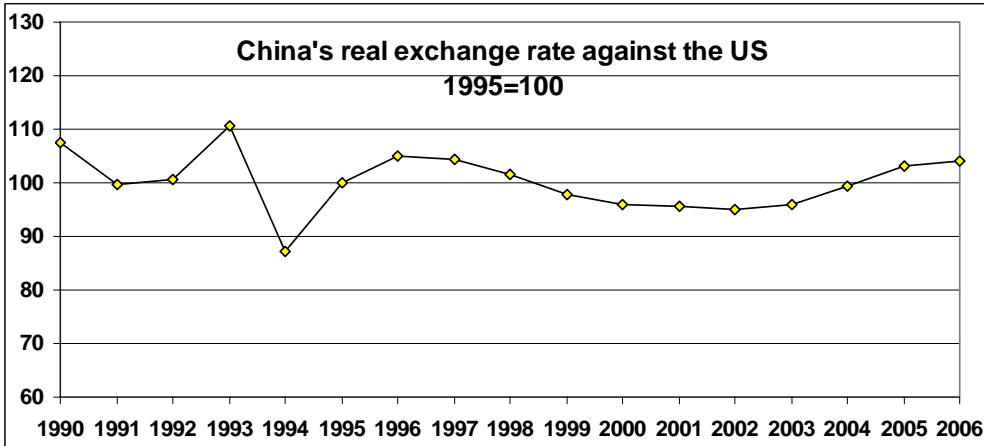
a. These are indices of nominal bilateral rates between mainland China and the US, deflated according to
$e_R = E \cdot P_Y / P_Y^{US}$, where E is the nominal exchange rate in US$ per unit of local currency, P_Y is the local GDP price and P_Y^{US} is the corresponding US GDP price.
Source: IMF, *International Financial Statistics* (2007).

Figure 3 Elasticities of the projected real exchange rate to its key determinants[a]
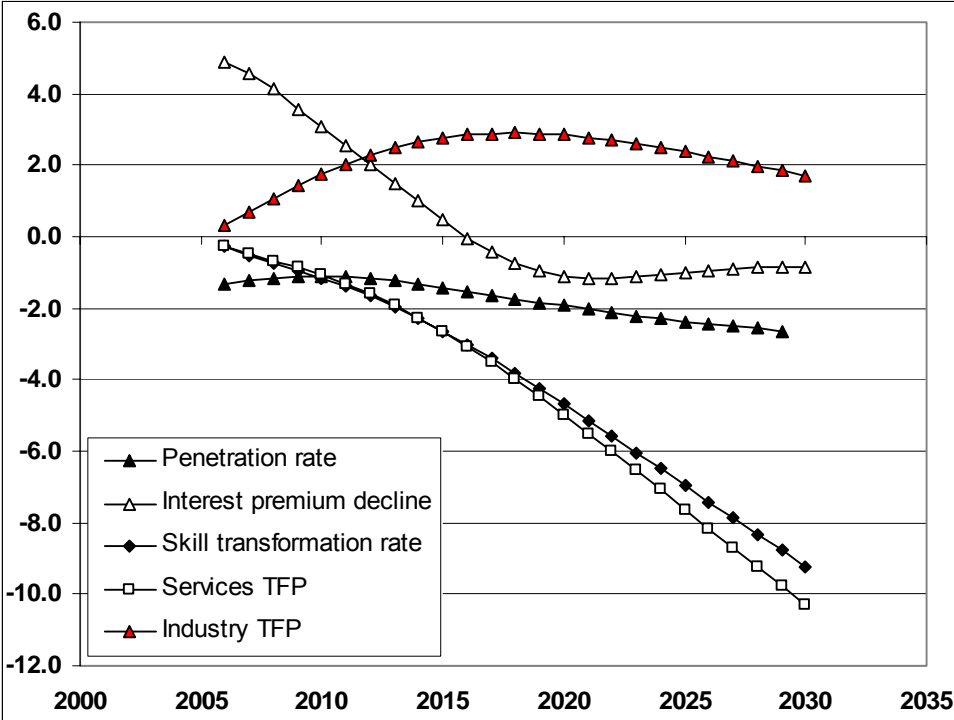
[a] This is the percentage departure of the projected real exchange rate for each percentage increase in the overall import penetration ratio, *M/C*, caused by tariff reductions that began in 2005.
Source: Simulations using the model described in the text.

Figure 4 China's investment–saving and external balances (percentage of GDP)[a]
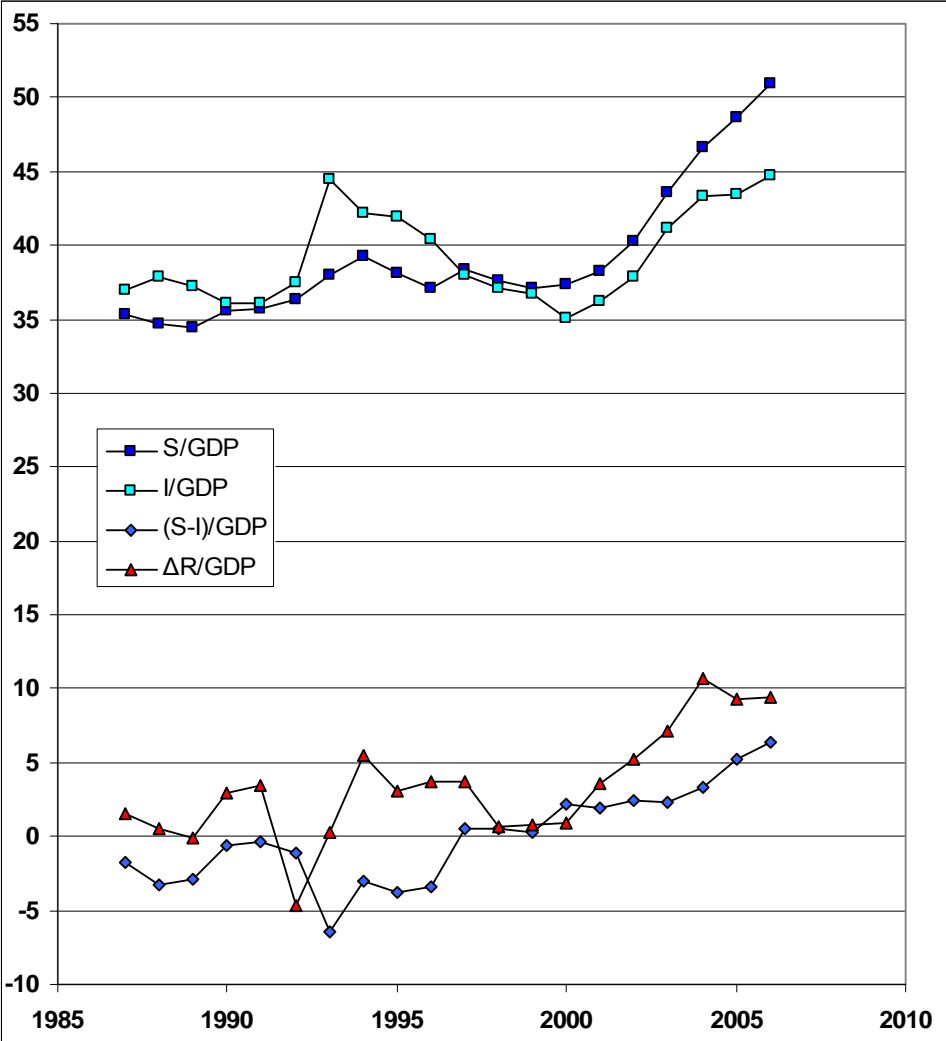
[a] Since errors and omissions are large, we have adjusted the least accurately measured items in each sub-account (usually net factor income and net private flows on the financial account) to ensure balance.
Sources: International Monetary Fund (IMF), 2007a. *International Financial Statistics*, April, 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]
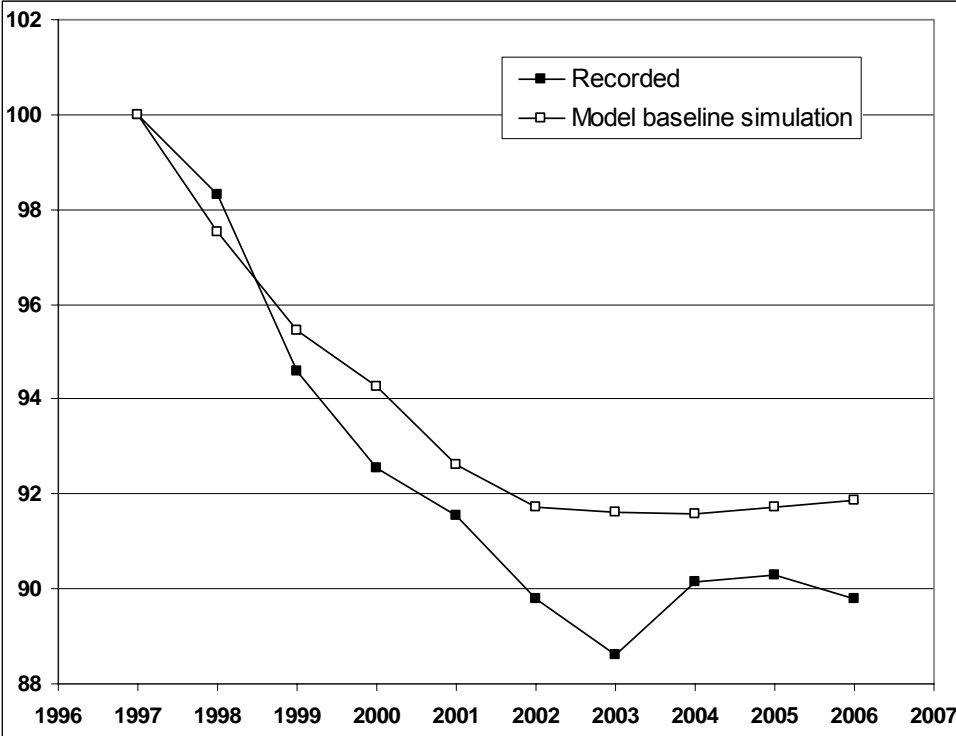
a Indexed departures from 1997, where China includes Taiwan and Hong Kong and North America includes Canada and Mexico. The recorded series represents indices of $e_R = P_Y / P_Y^{NAm}$, where P_Y is the China regional GDP price and P_Y^{NAm} is the corresponding North American average GDP price, both 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.

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: Contributions to China's Real Exchange Rate Change, 1997-2006

Faster tradable productivity growth – Balassa Samuelson	+1.6%
Faster skill growth	-0.6%
WTO accession trade reforms	-4.2%
Influx on the financial/capital account of North America	-0.4%
Efflux on the financial/capital account (high saving rate)	-4.8%
Net effect over 1997-2006	**-8.1%**

Source: Comparison of baseline with counterfactual simulations of the model described in the text.

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

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

a As of mid-2007 the Chinese government issued new debt worth US$200 billion and exchanged it with the PBC for the equivalent from its stock of reserves. The result was a substitution on the asset side of about 8% of GDP from reserves to domestic credit.

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

Table 4 Estimates of the Foreign Share of Total Assets, Selected Countries[a]

Country	Ratio of Foreign to Total Assets, %					
	2000	2001	2002	2003	2004	2005
China	10	9	9	12	14	18
Hong Kong	55	56	55	59	60	64
Japan	9	12	12	14	14	17
Taiwan	11	14	17	21	22	24
Korea	11	13	13	15	17	16
Malaysia	22	27	28	38	36	41
Singapore	48	50	51	57	57	58
Thailand	18	20	19	19	17	17
India	6	9	9	11	12	11
Australia	15	17	17	18	19	21
US	22	19	18	22	25	35
EU15	30	33	30	34	36	47
UK	63	63	52	54	54	68
Brazil	5	6	8	8	7	5
Mexico	7	8	7	8	9	9
Chile	21	23	22	26	25	25

a Shares are approximated as the quotient of foreign financial and physical assets and total financial and physical assets. The numerator is the stock of capital owned abroad plus official foreign reserves. The denominator is official foreign reserves plus the home capital stock plus the stock of capital owned abroad less that part of the home capital stock that is foreign owned plus M2 plus gold stocks. International capital ownership is approximated, in turn, by dividing current account net factor income flows by long term bond rates.

Sources: For most countries, foreign reserves, money supplies, gold stocks, net factor income flows on current account balances and long term bond rates are from the IMF, *International Financial Statistics*, various issues. For Taiwan these are from the *Taiwan Statistical Data Book, 2006*. For Chile the money supply is from the Central Bank of Chile; for Australia it is from the Reserve Bank of Australia and for Singapore it is from the Monetary Authority of Singapore. For China and India, bond rates are from *Datastream* and, for the EU15, Malaysia and Chile the bond rates are from the Economist Intelligence Unit. All capital stock estimates are from the GTAP global database.

Table 5 Country Rankings on Foreign Shares of Total Assets

2000	2001	2002	2003	2004	2005
UK	UK	Hong Kong	Hong Kong	Hong Kong	UK
Hong Kong	Hong Kong	UK	Singapore	Singapore	Hong Kong
Singapore	Singapore	Singapore	UK	UK	Singapore
EU15	EU15	EU15	Malaysia	Malaysia	EU15
Malaysia	Malaysia	Malaysia	EU15	EU15	Malaysia
US	Chile	Chile	Chile	US	US
Chile	Thailand	Thailand	US	Chile	Chile
Thailand	US	US	Taiwan	Taiwan	Taiwan
Australia	Australia	Australia	Thailand	Australia	Australia
Korea	Taiwan	Taiwan	Australia	Korea	**China**
Taiwan	Korea	Korea	Korea	Thailand	Japan
China	Japan	Japan	Japan	**China**	Thailand
Japan	**China**	India	**China**	Japan	Korea
Mexico	India	**China**	India	India	India
India	Mexico	Brazil	Brazil	Mexico	Mexico
Brazil	Brazil	Mexico	Mexico	Brazil	Brazil

Source: Rankings on the foreign asset shares in Table 4.

Table 6 Short Term Real Effects of a Chinese Monetary Contraction and an Export Tax[a]

% departures from baseline	Monetary contraction[b]		Export tax[c]	
	Optimistic	Pessimistic	Optimistic	Pessimistic
China				
Investment	-13.3	-17.8	-17.2	-25.4
Saving	-10.1	0.0	-12.1	0.0
Consumption	0.0	-14.2	0.0	-15.5
Current account surplus	-8.4	48.0	2.5	62.8
Terms of trade	1.1	-0.7	3.8	0.5
Real GDP	-7.5	-8.0	-5.0	-3.5
Real GNP/capita	-7.3	-5.8	-2.4	1.1
Real exchange rate, e_R	1.8	-1.3	-4.8	-9.3
North America				
Current account deficit	-2.1	7.3	0.1	9.9
Terms of trade	-0.15	0.1	-0.6	-0.2
Real GDP	-0.04	0.13	-0.10	0.12
Real GNP/capita	-0.04	0.05	-0.14	-0.02
Employment in "industry"	0.14	-0.19	1.04	0.71
"services"	-0.04	0.09	-0.20	-0.07

a The shocks are implemented over the period 2007-2010 and the 2010 departures from the baseline simulation are shown. Both shocks are implemented under two different assumptions about household intertemporal decision making. The optimistic case has backward smoothing with a short run saving contraction while the pessimistic case has forward smoothing with a short run contraction in consumption. In both cases investment is driven by the same adaptive expectations over capital returns, except that, in the optimistic cases, the annual rate of decline in China's investment premium, which diminishes through time in the baseline scenario, is held constant for the three years of the shocks to reflect greater optimism on the part of financial investors.
b The monetary contraction is assumed *not* to be unaccompanied by reserve repatriation, so that it is deflationary. It is sufficient to reduce employment by a cumulative 5% per year for three years 2007-2010.
c The Chinese export tax is applied only to industrial products and it accumulates linearly to a total of 15% over 2007-2010. No associated employment contraction is included with the export tax.
Source: Simulations using the model described in the text.

[i] The bill has sponsorship from Senators Baucus, Grassley, Schumer and Graham and, as of early July 2007, co-sponsorship was extended to include presidential front-runners Hilary Clinton and Barack Obama. The Senate Finance Committee approved the bill on a vote of 20 to 1 on 26 July. See Callan (2007). The US politics that lies behind this bill is reviewed by Woo and Xiao (2007).

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

[iii] See, for example, Cline, W. (2005).

[iv] See Tyers et al. (2006).

[v] 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.

[vi] 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.

[vii] 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).

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

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

[x] 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).

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

[xii] 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.

[xiii] 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.

[xiv] See Bloom and Williamson 1998 for a generic discussion of the demographic dividend in developing countries.

[xv] Golley and Tyers 2006 confirm this, finding that the non-working aged dependency ratio could rise to 43 per cent.

[xvi] 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).

[xvii] The regions are Australia, North America (Canada, US, Mexico), Western Europe, Central Europe and the former Soviet Union, Japan, China, Indonesia, Other East and Southeast Asia, India, Other South Asia, Latin America, Sub-Saharan Africa, North Africa and the Middle East and the rest of the world.

[xviii] 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.

[xix] 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).

[xx] 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.

[xxi] Here we mirror simulations carried out by Tyers et al. (2006).

[xxii] 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).

[xxiii] This effect is discussed in detail in Rees and Tyers (2004).

[xxiv] 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 $CA = X - M + N$.

[xxv] China's capital controls have been leaky but, as Ma and McCauley (2007) find, remain very effective.

[xxvi] The skill acquisition rates are calibrated using the model from wage and sectoral employment data, as described in Tyers and Bain (2007).

[xxvii] 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.

[xxviii] 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.

[xxix] Moreover, contrary to our assumptions, net factor income flows on current accounts comprise more than asset returns and the rates of return on these assets are likely depart from long bond rates.

[xxx] There is evidence of monetary mercantilism in India and Southeast Asia, where appreciation against the RMB is seen as undesirable. See RGE Monitor, 11 May 2007. This link between China and other countries in Asia underlies the potential "domino effect" of an RMB appreciation, noted by Bergsten (2004).

[xxxi] See RGE Monitor, 2007a. European rhetoric also represents this view, as in a speech by Pascal Lamy, then EU Trade Commissioner, on 23 December 2003.

[xxxii] McKinnon (2006) offers a case for the avoidance of floating that depends on the negative interest premium China's savers apply to foreign assets – they tolerate a low home interest rate to avoid exchange rate risk. This risk only arises because of the declared departure from the US$ peg but it has the potential to drive the home interest rate low enough to cause a liquidity trap.

[xxxiii] The simulations described here are indicative only, since the model lacks a complete macroeconomic closure with forward looking expectations. Even with full forward-looking macroeconomics, however, the self-fulfilling nature of expectations leads to some arbitrariness as to the selection of futures by the modeler. Here we try to capture the range of possible impacts by simulating optimistic and pessimistic scenarios.

[xxxiv] Ito (2001: Ch 11, 329-333) shows that, in the post Plaza Accord period the Yen appreciated substantially against the US$ and Japan's current account surplus rose at the same time, even while real investment also rose.

[xxxv] Of course, the Lerner symmetry theorem suggests that a tax on exports is also a tax on imports, though this theorem is weakened in this case by open capital accounts.

[xxxvi] An important empirical literature is developing around China's role as an assembler of components made in other Asian countries. Part of the reason for China's bilateral trade surplus with the US is that this intra-Asian trade is reducing the bilateral surpluses of other Asian economies with the US while it exacerbates that of China. See, for example, Athukorala (2005, 2007).