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## Slower Growth and Vulnerability to Recession: Updating China's Global Impact

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### Abstract

Central to the global impacts of China's emergence has been its structural imbalance (its excess product supply and excess saving), but this has diminished considerably in the transition years since 2010. These imbalances are now reversed as its consumption expands faster than its GDP and so the global implications are qualitatively different. Moreover, higher income, slower growth, and therefore increasing similarity with the advanced economies, implies that consumer and business confidence are now more central to performance, rendering recession possible, and more likely as the growth slowdown raises the intensity of the domestic spotlight on political performance. The international effects of the transition and a possible recession are here quantified using a global macro model with national portfolio rebalancing. The transition to consumption-led growth is shown to foster employment abroad, particularly in the US, while a major Chinese recession is shown to be damaging to the advanced economies and particularly to the US, the more so if China's policy response is expansionary and includes floating the RMB.

## **Keywords**

China, imbalances, saving, monetary policy, spill-overs, recession

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## Abstract

Central to the global impacts of China's emergence has been its structural imbalance (its excess product supply and excess saving), but this has diminished considerably in the transition years since 2010. These imbalances are now reversed as its consumption expands faster than its GDP and so the global implications are qualitatively different. Moreover, higher income, slower growth, and therefore increasing similarity with the advanced economies, implies that consumer and business confidence are now more central to performance, rendering recession possible, and more likely as the growth slowdown raises the intensity of the domestic spotlight on political performance. The international effects of the transition and a possible recession are here quantified using a global macro model with national portfolio rebalancing. The transition to consumption-led growth is shown to foster employment abroad, particularly in the US, while a major Chinese recession is shown to be damaging to the advanced economies and particularly to the US, the more so if China's policy response is expansionary and includes floating the RMB.

## 1 Introduction

China's emergence over recent decades has seen the structure and functioning of its economy converge toward the large advanced regions of Europe, the US and Japan. Central to this trend has been its transition from growth led by investment and exports of light manufactures toward growth performance that is more dependent on home consumption. This transition has also been characterised, on the one hand, by a tendency toward financial liberalisation, suggested by the gradual relaxation of capital controls and domestic financial markets, and on the other, a rapid expansion in its services sector and the skilled workers required to operate it. These developments increasingly expose China to the forces that drive business cycles in the advanced regions, namely financial volatility transmitted from abroad or arising from domestically induced fluctuations in consumer and business confidence.

Prior to the GFC, the "unbalanced" nature of China's growth surge, which saw expanding excess supplies of products and savings, was the principal determinant of the impact of the Chinese economy abroad. This had direct, and much analysed, effects on the product terms of trade facing other regions.<sup>1</sup> The associated excess supply of saving also changed the financial

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<sup>1</sup> The literature on the terms of trade consequences for the advanced economies began in the 1990s with the debate over the poor performance of unskilled US workers (Bound and Johnson 1992, Wood 1994, Berman et al. 1994, and Leamer 1996) and extended into a more complex debate over the apparently declining performance of all but the most highly paid US workers (Haskell et al. 2012, Helpmann et al 2010, Autor et al. 2013). It has also included global modelling studies that kicked off with Krugman (1995) and proceeded to the decomposition studies by Tyers and Yang (1997) and Francois and Nelson (1998) with more detailed follow-up of labour effects

terms of trade faced in the rest of the world, contributing to the observed trend decline in asset yields over the same period.<sup>2</sup> The bulk of research on these topics concludes that the changes were collectively beneficial, though the evidence to date suggests that the gains, particularly in the US, were at least partially offset by structural unemployment.<sup>3</sup> The transition to growth more dependent on consumption commenced around 2010, at least according to official statistics. Since then the imbalances have declined and China's expanding demand has probably helped sustain employment in the large advanced economies.<sup>4</sup>

The emergence of business cycles during this transitional phase is to be expected, though any consideration of a Chinese downturn is necessarily hypothetical and no particular trigger can be pointed to. Yet the vulnerabilities are widely understood. They include 1) high levels of private and public debt compounded by a very high capital-output ratio, slowing growth and associated declines in expected rates of return on new investment,<sup>5</sup> 2) highly distorted domestic capital markets and excess volatility in equity and property markets, 3) weaker outward capital controls,<sup>6</sup> 4) adherence to a strong (stable) RMB when the underlying real exchange rate is declining,<sup>7</sup> 5) a demographic contraction that is partly responsible for a collapse in rural to urban migration, rising wage costs and lower expected rates of return,<sup>8</sup> and 6) the prospect of tightening global financial markets due to reduced excess saving in China and Japan and monetary normalisation in the US, with associated upward pressure on Chinese financing costs.<sup>9</sup>

It might also be argued that the one-party state is more fragile during uncertain times, considering that more open governance has flourished in surrounding economies, including Japan, Korea, Taiwan and Hong Kong. Of course there are two sides to this issue. A one-party state can avoid politically expedient but inferior economic policies and it can intervene unconventionally to simply close the avenues by which financial panic causes damage. The Chinese government has a positive record in this regard. On the other hand, where events such

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by Tyers and Yang (2000), Winchester and Greenaway (2007), Francois and Wignaraja (2008), Harris et al. (2011) and Harris and Robertson (2013), Levchenko and Zhang (2012) and Di Giovanni et al. (2013). Diversity in method notwithstanding, all the global modelling studies find net gains to the rest of the world transmitted via terms of trade effects.

<sup>2</sup> The terms of trade gain transmitted financially has been commonly referred to as the Asian "savings glut". See Bernanke (2005), Chinn and Ito (2007), Choi et al. (2008), Ito (2009), Chinn et al. (2012) and Arora et al. (2014).

<sup>3</sup> For a survey and analysis of the neoclassical and Keynesian effects abroad, see Tyers (2015b).

<sup>4</sup> See Tyers (2015a,c).

<sup>5</sup> See Wong (2013).

<sup>6</sup> See Li et al. (2015), Nixon et al. (2015), Cai et al (2015) and Chen and Qian (2015).

<sup>7</sup> See Ma (2015).

<sup>8</sup> See Wang and Fang (2015).

<sup>9</sup> See Fong et al. (2015).

as financial crises precipitate political change, the contractionary effects can be very large indeed, as in Indonesia in 1998.<sup>10</sup>

In this paper the focus is on international implications. The effects of Chinese transition shocks are first examined. Following this the global effects of a possible Chinese contraction are considered. In no sense is this consideration a prediction. Rather, it is designed to evaluate the scale of the downside risks for the global economy that are associated with China's emergence to economic modernity. A parsimonious global macroeconomic model is employed that incorporates bilateral linkages across six regions via both trade and financial flows. It includes a number of innovative elements. First, although it is deterministic, by allowing for asset differentiation it incorporates optimising financial portfolio management in each region that serves to direct saving from each into investments across all regions. Second, the degree of asset differentiation is quantified to reflect financial integration. Third, long maturity assets are focal and unconventional monetary policy (UMP) places direct demands on the global markets for these assets that are endogenous to chosen targets. This tends to enhance the spill-over effects of monetary policy (Chen et al. 2014).

In the presence of the advanced regions' nominal rigidities the Chinese transition is expansionary, with its consumption growth raising global demand and its reduced excess saving tightening financial markets but raising saving in the rest of the world by more than it contracts in China, thus raising investment. A significant Chinese contraction characterised by losses of consumer and investor confidence, insolvencies that lead to temporary domestic capital sequestration and a flood of product and savings abroad, would have the opposite effects, however. It would cause a significant contraction, particularly in the US, but also globally, the greater if it is accompanied by losses of confidence that spread outside China. The section to follow offers a brief introduction to China's macroeconomic impacts abroad. Section 3 assesses the vulnerabilities to a Chinese recession. Section 4 then presents the model used for quantitative analysis and Section 5 offers numerical analysis of the foreign effects of China's transition and Section 6 a hypothetical contraction. Conclusions are offered in Section 7.

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<sup>10</sup> See Azwar and Tyers (2015).

## 2. China's Growth Surge and Transition

Macroeconomic assessments of China's growth have been dominated by critics worried about the imbalances associated with excess saving (the "savings glut") and the "upstream" financial flows that stem from it.<sup>11</sup> China's particular contribution to these upstream financial flows has been variously attributed to capital market distortions, exchange rate management and myriad other interventions by the all-pervasive Chinese state to confer unfair advantage on Chinese firms and to raise exports and investment at the expense of household consumption.<sup>12</sup> In most cases, such views have been shown to be inaccurate or, at least, over-simplifications.

### *China's growth surge*

Adopting the standard "East Asian" growth model, China was able to move workers from rural poverty to urban locations where they could be combined with capital and imported technology, yielding rapid productivity growth. But the modest skills of these workers required the distortion of the product mix in favour of light (labour-intensive) manufactures, unbalancing it relative to consumption and investment demand and thus requiring a rapid expansion in trade. The speed of the growth, combined with lagging social institutions and industrial reform, also induced very high household saving rates and made state owned enterprises very profitable, leading to high corporate saving. This had modest effects on the developed regions prior to the last decade, before which the scale of China's economy did not rival their own. After China's post-WTO accession, however, the growth surge was unprecedented.

Given the relocation of much of the world's light manufacturing to China in this period it is not surprising that flipsides in the advanced regions should have arisen that contributed to high structural unemployment and slow or non-existent real wage growth (Haskel et al. 2012). Moreover, the excess saving and associated cheap credit arguably contributed to asset price booms that ultimately destabilised banking systems. Yet the bulk of the literature addressing this issue quantitatively finds improvements in product and financial terms of trade (cheaper

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<sup>11</sup> The literature asserting, and depending on, the "savings glut" hypothesis is now extensive. Contributions include Bernanke (2005, 2011), Caballero et al. (2008), Caballero (2009), Chinn and Ito (2007), Choi et al. (2008), Chinn et al (2012), Eichengreen (2004) and Lee and McKibbin (2007).

<sup>12</sup> The American literature critical of China's macroeconomic policies is also extensive. Bernanke (2005, 2011) offers the outline and Krugman (2010) declares that "China is making all of us poorer". The US macroeconomic position is put in more detail by, amongst others, Lardy (2006, 2012) and Bergsten et al. (2008). Similar advocacy of policy-induced "balance" in China's growth can be found, still more formally, in Blanchard and Giavazzi (2006), while it is also recognised that some of the US reaction is mercantilist (Ito 2009).

light manufactures and cheaper debt) that are large enough to yield net improvements in real incomes of the advanced regions.<sup>13</sup>

#### *The transition to inward focussed growth*

A transition became necessary, primarily because China's production and export volumes are very large and there is no longer the market in the comparatively slow-growing global economy for continued expansion in its light manufactured exports. Yet the necessary diversification of the pattern of production specialisation is neither automatic nor straightforward from a policy standpoint. Substantial comparative growth in heavy manufacturing and services is required and this is constrained by the tendency for these industries to be oligopolistic and, heretofore, to have accumulated considerable rents and entrenched interests.<sup>14</sup> The potential for considerable growth from this source exists, however (Song et al. 2011, Tyers 2014). The development of the private sector has seen company income flow to households, reducing corporate saving, and reforms to social policy have facilitated rises in household consumption that have been faster than those in GDP since 2010, as shown in Figure 1.<sup>15</sup>

#### *Excess saving and global yields*

As emphasised by the World Bank (2013), of the addition to global GDP since 1980, measured in US dollars at current exchange rates, a third is due to Asian growth. At the same time Asian economies have contributed about half of the corresponding increment to global saving, with China contributing fully a third of the increment since 1990. This is evidence that the shift in global growth toward high-saving Asia, which occurred in the 1980s, accelerated the rate at which the global savings supply curve shifted to the right. If, as the data suggest, the corresponding global investment demand curve shifted by less there would have been a decline in the Wicksellian (1898) "natural" rate of interest at the global level.<sup>16</sup> This clearly had financial implications and is demonstrably a contributing cause of the trend decline in long

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<sup>13</sup> See the survey by Tyers (2015b).

<sup>14</sup> While growth in the comparatively competitive light manufacturing sector has been largely Schumpeterian, with local innovations generating increments to productivity the rents from which are short-lived due to successive innovations by competing firms, in oligopolistic industries rents and associated vested interests tend to accumulate (Aghion et al. 2013, 2014).

<sup>15</sup> Indeed, recent studies question China's official statistics on consumption expenditure, suggesting that it is larger and began growing relative to GDP earlier (Ma and Yi 2010). Huang et al. (2012), for example, use the weighted average of consumption-related retail sales growth and service sales growth to project the consumption share of GDP. Their results suggest that it *climbed* from 49 to 54 per cent during 2008-2010, while China's NBS had it falling in that period. Using similar data, Garner and Qiao (2013) suggest that Chinese consumption expenditure is officially underestimated by US\$ 1.6 trillion, also concluding that its GDP share was expanding before 2010.

<sup>16</sup> Ex ante shifts in saving supply and investment demand cannot be observed. See Tyers (2015b) for a discussion of this.



bond yields in the advanced regions since the 1980s, at least until after the GFC, when unconventional monetary policy (UMP) brought central banks into long bond markets.<sup>17</sup>

China's contribution to Asian excess saving can be seen from Figure 2, which illustrates the surplus of saving over investment and the accumulation of official foreign reserves since the 1980s, the enlargement of its net financial outflows during the growth surge period, prior to the GFC, and their subsequent contraction during the transitional period from 2010. The contraction was initially due to a rise in (mainly public) investment post GFC. That this remains extraordinarily high is one of the sources of vulnerability to recession. Any decline implies a major contraction in China's very large construction sector, which mainly employs low-skill male "floating" workers many of whom would become "structurally" unemployed.

#### *Chinese monetary policy and its exchange rate*

China's monetary policy has attracted considerable controversy. The "impossible trinity" or "monetary policy trilemma" (Ito 2013) notwithstanding, there has been a tendency in China to separate monetary from exchange rate policy. The fact is that the exchange rate against the US dollar has been, and continues to be, the primary target of China's monetary policy. The combination of this *de facto* US dollar peg with a closed capital account was clearly successful, underwriting spectacular growth between 1994 and 2005. Consistent criticism that the nominal exchange rate was undervalued, constituting an export subsidy, was often mercantilist or focussed on transitional structural unemployment in China's trading partners.<sup>18</sup> At its serious end it was driven by unexpected increases in China's trade competitiveness, as indicated by the depreciating trend in the underlying real exchange rate during the period (Figure 3).<sup>19</sup>

The Balassa-Samuelson Hypothesis leads us to expect that this period's rapid manufacturing productivity growth and the associated rise in Chinese real wages would have induced a real appreciation (Balassa 1964). This did not occur, primarily because of trade reforms in the lead-up to the WTO accession and structurally high household and corporate saving that resulted in up to a tenth of China's income being directed abroad in the form of reserve

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<sup>17</sup> This argument depends on the segmentation theory of the yield curve (Johnson et al. 2010) and the notion that long rates are not merely the commonly claimed (Borio and Disyatat 2011) expectational extensions of short policy rates (Shiller et al. 1983, He and McCauley 2013). Because they arbitrage with the major instruments of private saving and investment and are extensively traded internationally, they offer prices in a highly integrated global financial market and therefore reflect the Wicksellian interest rate, suggesting in turn that Chinese excess saving has contributed to lower long yields, as has widespread UMP since 2008. See Arora et al. (2015).

<sup>18</sup> See, for example, Bergsten (2010), Krugman (2010).

<sup>19</sup> See Lardy (2006, 2012) and Bergsten et al. (2008). At the same time there were serious advocates of a continued fixed exchange rate regime for China. See McKinnon (2006).

accumulation.<sup>20</sup> The underlying real appreciation after 2004 was due on the one hand to rising wage costs in association with a surge in rural assistance and a general slowdown in worker relocation to cities, and on the other to the continuing productivity growth in manufacturing and therefore a return to prominence of Balassa-Samuelson behaviour (Tyers and Zhang 2011). Since the transition began, in 2010, there is evidence that monetary policy has been too tight. This is suggested in Figure 3, which shows the producer price level declining while further appreciations were allowed in the RMB. These ceased after 2012 and, since then, a tight rein has been kept on the currency, implying an approximate return to the US\$ peg. This is further demonstrated in Figure 4, which shows recent movements in the RMB-dollar rate. These have been very small, with a fine tendency toward depreciation since early 2014. The domestic deflation in the producer price level, the price level that matters for employment and production growth, indicates that money supply growth has been retarded excessively. The reason for this appears to be the taming of China's property boom and its shadow banking system. Combined with policies directed toward liberalisation of outward capital controls as part of its drive toward "internationalisation", this has created extraordinary volatility in its equity markets, leading the PBoC to control the RMB more tightly. It is also supported by the concern that there should be a slowing in the rate of overall capital growth as labour supply moderates.<sup>21</sup>

The extraordinary extent to which the RMB has been backed by foreign reserves, principally in the form of US Treasury bonds,<sup>22</sup> is indicated in the movements in the PBoC balance sheet shown in Figure 5. Attempts in the early 2000s to sterilise the effects of this on the monetary base via reductions in domestic credit and with the issue of PBoC sterilisation bonds have clearly been discarded. Money growth has since been controlled mainly through the management of commercial bank reserve requirements – the "required deposit reserve ratio (RRR)", was set at 13 per cent during the 1990s, fell into the range 6-8 per cent during the growth surge period and has been in the range 16-20 per cent since the GFC. This appears now to be changing, however, with reform of controls on the domestic yield curve and a recent full percentage point cut, which should yield some expansion to come (Jacobson 2015a).

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<sup>20</sup> For a decomposition analysis of the real depreciation, see Tyers et al. (2008) and Tyers and Zhang (2014).

<sup>21</sup> See, for a more detailed discussion, Ma (2015).

<sup>22</sup> See Beltran et al. (2012).

### *“Internationalisation” and the relaxation of capital controls*

The analysis of openness indices by Chen and Qian confirms a steady trend toward relaxation of capital controls. While this is consistent with the stated direction of Chinese policy, Figure 6 shows that, during the transition period since 2010, gross cross-border flows on both the current and capital accounts<sup>23</sup> as proportions of GDP have been on declining trends. It is true, however, that the opening of formal links between the financial sectors of Shanghai and Hong Kong (Nixon et al. 2015), combined with sanctioned “outward FDI” (Wang et al. 2015), including the establishment of the “new silk road fund”, the Asian Infrastructure Investment Bank (Kozal-Wright and Poon 2015), has seen capital account debits begin to exceed credits.<sup>24</sup> What changes have been made in capital account regulation in this period do appear to have resulted in an expansion in volatile, transitory capital exchanges with the US that have been motivated by yield arbitrage and currency speculation (Cai et al. 2015). It seems inevitable that, as capital control relaxation facilitates private financial outflows and to finance its “new silk road” initiative, China will come under pressure to gradually divest itself of its foreign reserve holdings. Should there be a domestic recession and capital flight, this need would be heightened, which would require the acquisition by the PBoC of domestic government debt on a substantial scale and an accelerated rise in US yields (Jakobsen 2015b, Arora et al. 2015).

### **3. Current Vulnerabilities**

The central source of vulnerability is the slowing of the economy from a historically unique period of rapid expansion. The slower growth is due to 1) a slow-down in the rate of migration of high-quality workers from rural areas, 2) the saturation of slow-growing global markets with Chinese light manufactures, and 3) slower progress in raising productivity in oligopolistic heavy industry and services, which do not enjoy the Schumpeterian growth force (Aghion et al. 2013, 2014) and which have conferred on a privileged minority, now central to Chinese policy making, considerable rents. The slowdown is further exacerbated by moderating foreign interests in Chinese investment and technology transfer. Foreign firms are present in China either to “outsource” production for their home markets, which depends on a ready supply of

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<sup>23</sup> The “capital account” is here referred to as the collective of flows outside the current account and so includes the “financial account” and reserve transactions.

<sup>24</sup> There is also a limited role for foreign banks in the domestic Chinese investment banking market which offers opportunity for cross border financial transactions, though this has expanded little in recent years (Le et al. 2015).

high quality workers in China, or to capture a share of China's domestic market expansion. These motivations are frustrated the slower growth in labour supply and slower domestic market expansion.

More proximate sources of vulnerability include, first, high levels of both private and (mainly provincial and local) government debt (Wong 2013), compounded by a very high capital-output ratio. The growth slowdown is therefore causing associated declines in expected rates of return on new investment. Second, slower investment growth will severely impact the huge construction sector, which supports vast numbers of lightly educated male floating workers (Wang and Fang 2015). Third, domestic capital markets remain highly distorted and arbitrary government interventions have exacerbated volatility in equity and property markets. Fourth, weaker outward capital controls will be difficult to reverse if there is a tendency to capital flight.<sup>25</sup> Fourth, adherence to a strong and stable RMB-dollar rate when the underlying real exchange rate is declining is contractionary (Ma 2015). Fifth, the underlying demographic contraction is partly responsible for the decline in the excess supply of quality workers from rural areas, rising wage costs and lower expected rates of return on capital (business confidence).<sup>26</sup>

These proximate vulnerabilities are compounded by the consequences of changes in China's interaction with the rest of the global economy. A financial tightening is expected in US and global financial markets due to the anticipated "normalisation" of US monetary policy and the long term trend toward reduced excess saving in China and Japan, with associated upward pressure on Chinese financing costs. The global fragility that is likely from this will be enhanced by China's growing public financial outflows associated with the "new silk road" policy and the need to withdraw from the US bond market in order to finance them (Jakobsen 2015b).

To add to these factors, there is the issue as to how much slower income growth and slower development of opportunities will redirect the domestic spotlight onto political performance, highlighting the lack of a participatory democracy in China. The Asian democracies to China's North and East are signposts to a political destination. On the other hand, many in China will see a slowdown and possible recession as a time for ceding power to the government to undertake the wholesale interventions that will "make things right". What is certain is that,

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<sup>25</sup> See Li et al. (2015), Nixon et al. (2015), Cai et al (2015) and Chen and Qian (2015).

<sup>26</sup> See Wang and Fang (2015).

should political change accompany a downturn, it will greatly worsen the outcome within China.

The approach taken here is neither to focus on the genesis of a Chinese recession, nor on its domestic effects, but rather to examine the implications for the global economy should one occur. For this purpose the following section describes a global model that is used to examine the international effects, first, of the Chinese transition, and then of a significant recession. The latter is crudely constructed to parallel that of Indonesia during the AFC, which was unique in that it comprised a commercial capital flight that was made much worse by a coincident political transition.

#### **4. Modelling Macro Interdependence**

A multi-region general equilibrium structure is used that centres on the global financial capital market.<sup>27</sup> It is assumed that the financial products of each region are differentiated and that portfolio managers assign new net saving across regions so as to maximise expected portfolio returns given this differentiation. This retains Feldstein-Horioka (1980) home bias while allowing significant redirections in financial flows at the margin. It also allows the level of global financial market integration to be parameterised by varying the degree of differentiation. The scale of short run spill-over effects associated with growth performance, excess saving and monetary policy therefore depend on it.

Although there is a tendency for financial flows to move the global economy toward interest parity, in the length of run considered asset differentiation leaves this process incomplete. At the same time, regional rates of return on equity investments depart from regional bond yields, the former reflecting expected rates of return on installed capital and the latter short run equilibrium in regional financial markets between savers, indebted governments and investors. Within each region the demand for money is driven by a “cash in advance” constraint applying across the whole of GDP. For any one household, home money is held in a portfolio with long maturity bonds, which are claims over physical capital and government debt across the regions.<sup>28</sup> On the supply side of the money market, in regions implementing UMP, expansions

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<sup>27</sup> The model used is a more advanced variant on that used in Tyers (2015a). That model assumed a perfectly integrated global bond market and so tended to generate unrealistically large spill-over effects. Here, all financial products, including government bonds, are represented as regionally differentiated and so there is no perfectly integrated global market for any asset class. Also, this model introduces UMP explicitly.

<sup>28</sup> Expectations are exogenous in the model and are formed over future values of home nominal disposable income, the rate of inflation, the real rate of return on home assets and bilateral real exchange rates.

raise demand for long maturity bonds, reducing their yields and hence reducing the opportunity cost of holding money.<sup>29</sup>

Six regions are identified: the US, the EU, Japan, China, Australia and the Rest of the World, though the focus of this paper is on the first four.<sup>30</sup> Each region supplies a single product that is also differentiated from the products of the other regions. On the supply side, there are three primary factors with “production” labour ( $L$ ) a partially unemployed variable factor while the stocks of physical capital ( $K$ ) and skill ( $S$ ) are fixed and fully employed. Collective households are net savers with reduced form consumption depending on current and expected future disposable income and the home interest rate. Aggregate consumption is subdivided via a single CES structure between the products of all the regions. The following offers detail on the aspects of the model central to this analysis.<sup>31</sup>

### *Financial markets*

Here the modelling departs from convention by incorporating explicit portfolios of assets from all regions. Data on regional saving and investment for 2011 is first combined with that on international financial flows to construct an initial matrix to allocate total domestic saving in each region to investment across all the regions. From this is derived a corresponding matrix of initial shares of region  $i$ 's net (private and government) saving that are allocated to the local savings supply that finances investment in region  $j$ ,  $i_{ij}^{S0}$ . When the model is shocked, the new shares are calculated so as to favour investment in regions,  $j$ , with comparatively high expected after tax yields, implying high expected real gross rates of return,  $r^{ce}$ .

$$(2) \quad r_i^{ce} = r_i^c + \hat{e}_i^e = \frac{P_i^P MP_i^K}{P_i^K} \left( \frac{\varphi_i^0}{\varphi_i} \right) + \hat{e}_i^e ,$$

where  $P_i^K$  is the price of capital goods, which in this model is  $\gamma_i P_i^P$ , where  $\gamma_i$  is the price of capital goods relative to that of output,  $P_i^P$ , the producer price of the region's generic good.<sup>32</sup>

The (exogenous) expected proportional change in the real exchange rate is  $\hat{e}_i^e$ . A further adjustment is made using an interest premium factor,  $\varphi_i$ , that is defined relative to the US (

<sup>29</sup> By contrast, conventional monetary policy involves trade in short term instruments which has no direct impact on the market for long term bonds.

<sup>30</sup> The EU is modeled as the full 26 and it is assumed that this collective has a single central bank.

<sup>31</sup> The more routine components of the model are shared with an earlier version that uses a somewhat less developed financial structure. See Tyers (2015a, Appendix 1).

<sup>32</sup> The producer price level is the factory door price of the regional good, which differs in this model from the GDP price level,  $P^Y$ , due to indirect taxation and from the consumer price,  $P^C$ , which includes imported products. See Tyers (2015a: Appendix 1) for further explanation of this.

$\varphi_{US} = 1$ ). This permits consideration of the effects of changes in sovereign risk in association with the fiscal balance. Increments to regional sovereign risk cause investments in regions with increasing fiscal deficits to be less attractive.

$$(3) \quad \varphi_i = \varphi_i^0 \left[ \left( \frac{G_i}{T_i} / \frac{G_{US}}{T_{US}} \right) \right]^{\phi_i}, \quad \forall i \neq "US",$$

where  $\phi_i$  is an elasticity indicating sensitivity to sovereign risk.

In region  $i$ , then, the demand for investment financing depends on the ratio of the expected real rate of return on installed capital,  $r_i^{ce}$  and a domestic market clearing real bond yield or financing rate,  $r_i$ . It is real investment that responds to these real rates but the model tracks nominal investment expenditure. For this reason an adjustment is also needed for change in the price of capital goods.

$$(4) \quad \frac{I_i^D}{I_i^0} = \frac{P_K}{P_K^0} \left( \frac{r_i^{ce}}{r_i} \right)^{\varepsilon_i^I},$$

where  $\varepsilon_i^I$  is a positive elasticity enabling the relationship to reflect Tobin's Q-like behaviour.

This investment demand is then matched in each region by a supply of saving that incorporates contributions from all regional households.

Region  $i$ 's portfolio manager allocates the proportion  $i_{ij}^S$  of its annual (private plus government) saving to new investments in regions  $j$ , such that  $\sum_j i_{ij}^S = 1$ .<sup>33</sup> Because the newly

issued equity is differentiated across regions based on un-modelled and unobserved region-specific properties, their services are combined via a constant elasticity of substitution (CES) function specific to each regional portfolio manager. Thus, region  $i$ 's household portfolio management problem is to choose the shares,  $i_{ij}^S$ , of its private saving net of any government deficit,  $S_i^D = S_i^P + T^D + T^I - G$ , which are to be allocated to the assets of region  $j$  so as to maximise a CES composite representing the value of the services yielded by these assets:

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<sup>33</sup> The manager does not re-optimize over *total* holdings every year. This is because the model is deterministic and risk is incorporated only via exogenous premia. The motivations for continuous short run rebalancing, other than the arrival of new saving, are therefore not represented.

$$(5) \quad \max_{i_{ij}^S} U_i^F = S_i^D \left[ \sum_j \alpha_{ij} (i_{ij}^S)^{-\rho_i} \right]^{\frac{1}{\rho_i}} \quad \text{such that } \sum_j i_{ij}^S = 1.$$

Here  $\alpha_{ij}$  is a parameter that indicates the benefit to flow from region  $i$ 's investment in region  $j$ . The CES parameter,  $\rho_i$ , reflects the preparedness of region  $i$ 's household to substitute between the assets it holds. To induce rebalancing in response to changes in rates of return the  $\alpha_{ij}$  are made dependent on ratios of after-tax yields in destination regions,  $j$ , and the home region,  $i$ , via:<sup>34</sup>

$$(6) \quad \alpha_{ij} = \beta_{ij} \left( \frac{r_j / \tau_j^K}{r_i / \tau_i^K} \right)^{\lambda_i} \quad \forall i, j, \quad \lambda_i > 0 \quad \forall i.$$

Here,  $\tau_i^K$  is the power of the capita income tax rate in region  $i$ . This relationship indicates the responsiveness of portfolio preferences to yields, via the (return chasing) elasticity  $\lambda_i$ . The allocation problem, thus augmented, is:

$$(7) \quad \max_{i_{ij}^S} U_i^F = S_i^D \left[ \sum_j \beta_{ij} \left( \frac{r_j / \tau_j^K}{r_i / \tau_i^K} \right)^{\lambda_i} (i_{ij}^S)^{-\rho_i} \right]^{\frac{1}{\rho_i}} \quad \text{such that } \sum_j i_{ij}^S = 1.$$

Solving for the first order conditions we have, for region  $i$ 's investments in regions  $j$  and  $k$ :

$$(8) \quad \frac{i_{ij}^S}{i_{ik}^S} = \left( \frac{\beta_{ij}}{\beta_{ik}} \right)^{\frac{1}{1+\rho_i}} \left( \frac{r_j / \tau_j^K}{r_k / \tau_k^K} \right)^{\frac{\lambda_i}{1+\rho_i}}.$$

This reveals that region  $i$ 's elasticity of substitution between the bonds of different regions is  $\sigma_i^I = \lambda_i / (1 + \rho_i) > 0$ , which has two elements. The return-chasing behaviour of region  $i$ 's household ( $\lambda_i$ ) and the imperfect substitutability of regional bonds, and therefore the sluggishness of portfolio rebalancing ( $\rho_i$ ). For the purposes of this analysis the values of  $\sigma_i^I$  are seen as indicating the extent of each region's integration with global financial markets.

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<sup>34</sup> Note that region  $i$ 's market bond yield,  $r_i$ , is determined concurrently and indicates the replacement cost of capital in region  $i$  and therefore the opportunity cost for region  $i$ 's household of investment in region  $j$ .



The optimal share of the net domestic saving of region  $i$  that is allocated to assets in region  $j$  then follows from (8) and the normalisation condition, that  $\sum_k i_{ik}^S = 1$ :<sup>35</sup>

$$(9) \quad i_{ij}^S = \frac{1}{\sum_k \left( \frac{\beta_{ik}}{\beta_{ij}} \right)^{\frac{\sigma_i^I}{\lambda_i}} \left( \frac{r_k / \tau_k^K}{r_j / \tau_j^K} \right)^{\sigma_i^I}} .$$

Since, in a Chinese recession, it is very likely that foreign reserves would be repatriated and that this would significantly alter the flows between China and both the US and EU, a means is required by which the parameters determining bilateral flows can be shocked to represent such effects. It turns out that this is readily done by rendering particular shares,  $i_{ij}^S$ , exogenous in the model closure, while the corresponding parameters,  $\beta_{ij}$ , are made endogenous. This removes the necessity to calculate the shocks to the  $\beta_{ij}$ s that would lead to target shifts in the flows.

#### *Regional money market equilibrium*

A cash-in-advance constraint is assumed to generate transactions demand for home money across all components of GDP. The opportunity cost of holding home money is set at the nominal after-tax yield on home long term bonds.<sup>36</sup> Real money balances are measured in terms of purchasing power over home products.

$$(10) \quad m_i^D = a_i^{MD} (y_i)^{\varepsilon_i^{MY}} \left( \frac{r_i (1 + \pi_i^e)}{\tau_i^K} \right)^{-\varepsilon_i^{MR}} = \frac{M_i^S}{P_i^Y} = \frac{\eta_i M_i^B}{P_i^Y} .$$

<sup>35</sup> The key matrix for calibration is  $[\beta_{ij}]$ . These elements are readily available, first, by noting that only relative values are required and hence, for each region of origin,  $i$ , one value can be set to unity, and second, by making the assumption that the initial database has the steady state property that the net rates of return in regions  $j$  are initially the same as the market bond yield,  $r_j$ . Then, since in the base data  $r_{ij}^{e0} = r_j^0$ ,  $r_{ik}^{e0} = r_k^0$ , the  $\beta_{ij}$ s are available from (6).

<sup>36</sup> Thus, it is assumed here that the opportunity cost of holding money is measured by the long bond yield, which is the dominant determinant of non-money portfolio yields. Short rates, at least as they have a role in conventional monetary policy, are here embedded in the determination of the monetary base. While housing investment can be sensitive to short rates in economies where most mortgage contracts have variable rates, the assumption that investment financing depends on the long maturity market is accurate in a comparative sense and it is a useful abstraction.

Here  $y$  is real regional GDP,  $P^Y$  is the GDP price and  $\pi_i^e$  is the expected inflation rate of the consumer price level,  $P^C$ , defined as a CES aggregate of home and imported consumer prices.<sup>37</sup> The money multiplier is  $\eta_i$  and  $M_i^B$  is the monetary base.<sup>38</sup> The monetary base,  $M^B$ , can be set as an exogenous policy variable or as endogenous to a price level or exchange rate target.

### *Regional financial market clearance*

The home financial market in each region clears separately. For region  $i$ , the nominal value of domestic investment,  $I_i^D$ , represents the sum total of all domestic long bond issues. This is then equated with demand for those bonds from home and foreign (net private and government) savings, along with demands for home long bonds that arise from the “quantitative easing” components of monetary expansions by both home and foreign central banks.

Total investment spending in region  $i$ , in  $i$ 's local currency, is then:

$$(11) \quad I_i^D = \sum_j \left( \left[ i_{ji}^S S_j^D + \theta_{ji}^{QE} s_j^{QE} \Delta M_j^B \right] \frac{E_j}{E_i} \right), \quad \forall i,$$

where  $E_i$  is the nominal exchange rate of region  $i$  relative to the US\$, which is the numeraire in the model ( $E_{US}=1$ ). The “quantitative easing” component of the current period’s expansion of the monetary base by region  $j$ 's central bank,  $s_j^{QE}$ , and the share of this expansion that takes the form of acquisitions of region  $i$ 's long bonds,  $\theta_{ji}^{QE}$ , both determine central bank demand. These flows are originally in foreign currency and are therefore converted at the appropriate cross rates. The regional real bond yields (interest rates,  $r_j$ ) emerge from this equality. Their convergence across regions is larger the larger are the elasticities of asset substitution,  $\sigma_j^I$ .

### *Balance of payments*

The sum of net inflows of payments on the current account and net inflows on the capital and financial accounts, measured in a single (home) currency is zero:

$$(12) \quad X_i - M_i + \sum_{j \neq i} \left( \left[ i_{ji}^S S_j^D + \theta_{ji}^{QE} s_j^{QE} \Delta M_j^B \right] \frac{E_j}{E_i} \right) - \sum_{j \neq i} \left( i_{ij}^S S_i^D + \theta_{ij}^{QE} s_i^{QE} \Delta M_i^B \right) = 0, \quad \forall i \neq "US"$$

<sup>37</sup> For details of the specification of consumption and price aggregates, see Tyers (2015a, Appendix 1).

<sup>38</sup> In this study the money multiplier is held constant. In applications to financial shocks, however, it falls as confidence in financial institutions declines and those institutions hold more liquid reserves.

The second two terms in (12) are financial inflows and outflows. The first parenthesised term represents acquisitions of region  $i$ 's home-issued long bonds by foreign savers and by foreign central banks, the latter associated, as above, with the “quantitative easing” component of the current period’s expansion of the monetary base in each region. These net saving and central bank flows are originally in foreign currency and so are converted at the appropriate cross rates. The second represents acquisitions of foreign-issued long bonds by region  $i$ 's home savers and its own central bank.<sup>39</sup> A balance of payments in the US is implied by balance in all the other regions. These equations determine the nominal exchange rates and, since these are defined relative to the US\$, that for the US is always unity ( $E_{US} = 1$ ).

#### *Model database, parameters and operation*

The model database is built on national accounts as well as international trade and financial data for the global economy in 2011. As indicated previously, the scale of the Chinese and advanced economies is indicated in Table 1. Of particular interest here are the financial flows between these regions, the pattern of which is suggested in Table 2. It is noteworthy that, while the share of China’s trade in goods is larger with Europe than the US, the share of the US in its bilateral financial flows is comparatively high while that of Europe is low.<sup>40</sup> These differences prove important in the results that emerge from the modelling.

## **5. Effects of the Transition to Consumption-Led Growth**

The experiment presented here assesses the effects of the transition to consumption led growth that occurred around 2010. To construct it a model closure is required, to be combined with shocks that are roughly the size of the annual changes in drivers of Chinese growth and structure in the transition period. Closures indicate underlying assumptions about the labour market, fiscal policy and monetary targeting. In this case the standard Keynesian short run assumptions are represented with the exchange rate against the US dollar as the monetary target. Details as to this and alternatives are given in Table 3.<sup>41</sup> A selection of the variables declared exogenous in the closure are then shocked by the proportions indicated in Table 4. In the case of the transition, these shocks comprise the primary drivers of economic performance

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<sup>39</sup> The nominal values of imports and exports,  $M_i$  and  $X_i$ , are formulated in Tyers (2015a, Appendix 1).

<sup>40</sup> Further details as to the sources and construction of the database can be obtained from Tyers (2015a, Appendix 2).

<sup>41</sup> Keynesian and neoclassical assumptions about behavioural in responses to the Chinese shocks are compared using a similar model by Tyers (2015b). While there are key differences in financial market structure as between the two models, the contrasts that emerge are similar to those that would stem from the model used here.

after 2010, approximately annualised.<sup>42</sup> That to consumption behaviour captures a change in Chinese preferences that boosts consumption and reduces saving. The preference shock might be thought of as stemming from the combination of life cycle changes and the social and industrial reforms discussed in earlier sections and it is set at a level sufficient to raise the consumption share of GDP by about a tenth (from 45 to near 50 per cent). Thus, while the transition shocks indicated in Table 4 embody productivity and factor endowment changes, central to their international effects is this reversal of consumption behaviour.

A summary of the simulated effects on the advanced regions is provided in Figure 7 while further detail as to the effects on those regions, and on China, are offered in Table 5. The global structural imbalance is reduced substantially, with a contraction in China's current account surplus and movements toward surplus in the advanced regions. Reduced Chinese excess saving causes bond yields in the advanced economies rise, but these rises are not as large as the yield rise within China and so the simulated change in international financial flux is reversed, reducing Chinese net outflows and favouring Chinese investment at the expense of investment in the advanced regions. In the absence of monetary contractions in the advanced economies the shocks are modestly inflationary and this stimulates employment and real GDP growth in all three regions. The real purchasing power of income at consumer prices, one measure of short run welfare impact, is boosted in the EU and Japan but not in the US. This is because the transition shocks cause the advanced economies to suffer terms of trade losses which are more than fully offset by increased employment only in the EU and Japan.<sup>43</sup>

Overall, there are gains to the advanced regions from post-transition Chinese growth and, by contrast with the pre-GFC growth surge period, gains in the real purchasing power of their incomes are not partly offset by losses of employment. Distributional stresses from this pattern of Chinese growth should therefore be minimal. As China's economic structure converges on that of the advanced economies terms-of-trade effects and associated structural unemployment are therefore expected to decline. Because this pattern of growth is comparatively "harmonious", it is important that conditions be maintained outside China that will reduce the likelihood of a Chinese business cycle initiated downturn.

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<sup>42</sup> The capital accumulation and productivity shares of China's recent growth are broadly consistent with the meta-analysis and more recent work by Wu (2011). The productivity slowdown assumed here is consistent with the analysis by Feng and Yang (2013), though this is not to deny that considerable potential remains for further productivity growth, even in China's manufacturing sector (Hsieh and Klenow 2009).

<sup>43</sup> These results differ in detail, though not in bottom-line magnitudes of net effects, from the Keynesian outcomes of the analysis by Tyers (2015b). This is because the assumption of a fully-integrated global bond market made in that paper yields considerably larger financial spill-over effects than obtained with the model adopted here.

## 6. Effects of a Significant Chinese Recession

The focus of this analysis is neither on the genesis of a possible Chinese recession nor on its domestic effects, but rather the implications for the global economy. For this purpose a significant downturn is constructed, of a type that could emerge were there to be a commercial capital flight combined with political fragility. In that case the changes within China might mirror those in the affected countries during the 1998 AFC, the key elements in that case being the loss of confidence that caused the flight, an associated collapse in domestic investment, insolvencies, the consequent temporary sequestering of physical capital and unemployment of both production and professional workers. These are represented here by a substantial contraction in productivity, combined with shocks to expectations over domestic investment returns, price levels, the size of nominal disposable income and real exchange rates against major trading partners. These shocks are detailed in the second block in Table 4. The Chinese expectations shocks are constructed by assuming consumers and financial agents are forward-looking and so accurately anticipate the changes in these variables. They do so, however, only for one particular scenario, under which the *de facto* US dollar peg is sustained by monetary contraction and with the aid of foreign reserves repatriated from the US and the EU. An eventual floating of the RMB and further fiscal and monetary policy changes are not anticipated in China, nor are changes in foreign expectations or macroeconomic policy.

The shocks for each of three scenarios are detailed in Table 4 and the simulation results presented in Figures 8, 9 and 10 and Table 6. The first scenario simply subjects the global economy to the raw shocks, on the assumption that China defends its US dollar peg with a significant monetary contraction, but does nothing else. The second assumes that the RMB is floated, reserves are repatriated and that China implements a money-financed fiscal expansion equivalent to five per cent of its initial GDP. No tightening of China's outward capital controls is assumed,<sup>44</sup> implying the assumption that the capital account liberalisations undertaken to date would be very difficult to reverse in the event of a wholesale capital flight. Finally, in the third scenario, "model consistent" expectations are formed in the US, EU and Japan over capital returns, price level changes and movements in exchange rates. Again, these are formed only for the case in which China defends its US dollar peg and repatriates reserves. US, EU

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<sup>44</sup> Solutions to such a scenario were attempted but feasible and accurate results combining restricted Chinese outflows with reserve repatriation proved difficult to find. This is the subject of further research.

and Japanese households and financial agents do not anticipate either the eventual floating of the RMB and the Chinese fiscal expansion, or the effects of their own pessimism.<sup>45</sup>

*Effects of the raw Chinese recession shocks*

The key effect of the raw shocks on China is to cause collapses in domestic consumption and investment. Real national income and saving both contract but not by as much as investment and so the current account surplus expands and there is a flood of Chinese exports, rather like what happened during the AFC.<sup>46</sup> The export surge is linked to a financial outflow that is directed primarily to the US. This appreciates the US\$ relative to the RMB as well as to the Euro and the Yen. Reduced Chinese investment demand causes global real bond yields to drop and investment to rise in the advanced regions. China's increased excess supply is deflationary in the advanced economies and, without further monetary stimulus there, this reduces employment and GDP. Thus, while the raw shocks yield quite small effects on the advanced economies, such a major Chinese recession would nonetheless be unfavourable. The loss in employment in the advanced regions emerges at about three million jobs, more than half of which would be lost in the US.

*Adding a Chinese policy response:*

The floating of the RMB, combined with the reserve repatriation and fiscal expansion tend collectively to increase the size of the global externality from China's recession. This is because they restore China's employment and reduce the contraction in its GDP, raising the net outflow on China's current account by three per cent of its initial GDP. Because they also restore some of China's saving, while domestic investment remains shunned, global financing rates fall further. The increased excess supply into the advanced economies, combined with the appreciation of their currencies, ensures that their deflations are larger. While the flight of Chinese saving and the lower financing rates do raise the advanced regions' investment, particularly in the US, their loss of employment is larger also, again particularly in the US. Indeed, the loss in employment in the advanced regions rises to 4.4 million jobs, more than half of which are lost in the US.

*Adding pessimism shocks in the advanced economies:*

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<sup>45</sup> More complete expectations on the part of agents in advanced economies were simulated. The further effects on employment and real GDP levels in those regions are not large, though this further scenario does direct the international effects more strongly toward the US.

<sup>46</sup> See Azwar and Tyers (2015).

The final scenario imagines that the Chinese recession causes pessimism in the advanced regions about future disposable incomes, rates of return on investment and price levels. It shows that the effects would be larger, with a redirection of global saving more focussed on the US and hence a larger shift in the US toward current account deficit. The US dollar would appreciate more against all currencies and this would cause greater deflation there, whilst easing the deflationary effects in the EU and Japan. Investment demand would rise by more in the US as its financing interest rate falls further while there would be little new investment in the EU and Japan. The excess supply from China, now more focussed on the US market, would displace more employment there and reduce real GDP further. Overall, the loss of employment in the advanced regions would be 4.9 million jobs, of which 3.9 would be in the US. At the same time, somewhat anomalously, the real purchasing power of US national income over home consumer goods would rise in the short run, simply because the US dollar appreciation would cause the CPI deflation to be larger than that in the GDP price by sufficient to offset the decline in real GDP. This gain would, of course, be transitory.

The loss of Chinese and global income due to China's recession causes a contraction in global saving supply (by US\$ 2.25 trillion), which is more than double the excess saving leaving China due to its capital flight. While the net outflow is offset in part by reserve repatriation, amounting to a quarter of a trillion US dollars, gross inflow from both China and abroad, to China's financial market still drops by US\$ 1.4 trillion. This is primarily due to a decline in *retained* Chinese saving. There is a fall in total Chinese saving by US\$ 0.44 trillion and the redirection abroad of almost a trillion US dollars. Financial inflows to the US hold steady while those to the other advanced regions fall, which is what causes the US dollar to appreciate further against the RMB, as well as against the Euro and the Yen.

The negative effects on the US economy could be offset by a return to UMP, though this is a path the US Fed might be reluctant to follow given its objective to "normalise" monetary policy. Japan and Europe are now using UMP, though an accelerating in Japan would be comparatively difficult as long bond yields there approach zero.<sup>47</sup> The US-focus of the recessionary effects might offer some relief, particularly to Japan, in this respect. Global asset prices are already inflated by excess liquidity. A Chinese recession would clearly exacerbate this.

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<sup>47</sup> This simulation has also been carried out. It shows that the negative short run effects on employment and real GDP in the US, the EU and Japan could be eliminated with monetary expansions of 4.4, 2.0 and 2.5 per cent, respectively. That is, so long as agents in those regions continue to anticipate only the successful defence of China's US dollar peg, the repatriation of reserves and no changes in Chinese or other monetary policies.

## 7. Conclusion

China's on-going structural transition is relaxing its prior consumption repression and this is likely to continue to reduce its excess saving over time. The result is a trend toward the tightening of global financial markets and some still-modest but increased inflation in the advanced economies, tending to restore employment there. On the other hand, reduced financial outflows from China depreciate real exchange rates in the advanced regions and redistribute investment toward China. This brings terms-of-trade losses in the advanced world the growth of which could be further slowed by moderating investment. The employment gains in the advanced regions appear to outweigh the terms-of-trade losses, most significantly for Europe and Japan. Overall, however, this more balanced Chinese growth path continues to confer net benefits on the advanced economies and, compared with the pre-GFC growth surge, the effects accompany less distributional stress.

As the structure of China's economy approaches those of the advanced regions it is increasingly likely that business cycle behaviour will strengthen and that a real contraction could eventuate. Vulnerabilities that include rising government debt, financial volatility and a slowing labour supply and investment further increase this likelihood. Now that China is "macro-economically large", it is of interest to assess the scale of the possible implications of a recession. It is shown that a real Chinese downturn, driven by business and consumer confidence and a consequent capital flight, would be contractionary in the advanced economies to an extent that would depend on the Chinese policy response and the spread of pessimism beyond its borders. Expansionary Chinese macroeconomic policy would help to sustain its employment level through the recession, though it would not directly address the causes of the capital flight. The result would be an exacerbation of the excess supply of goods and saving that would appreciate the currencies of the advanced economies relative to the RMB and create deflationary pressure at a time when such pressure is already pervasive. Without further resort to UMP in the US and accelerated monetary expansion in Europe and Japan, the results suggest the loss of employment in the advanced regions could be as high as between four and five million jobs, the majority of which would disappear in the US. These negative effects suggest the value of deeper cooperation between China, Europe and the US in the formation of economic policy to ensure that, if and when a Chinese recession occurs, it is not so large as to cause these substantial externalities.



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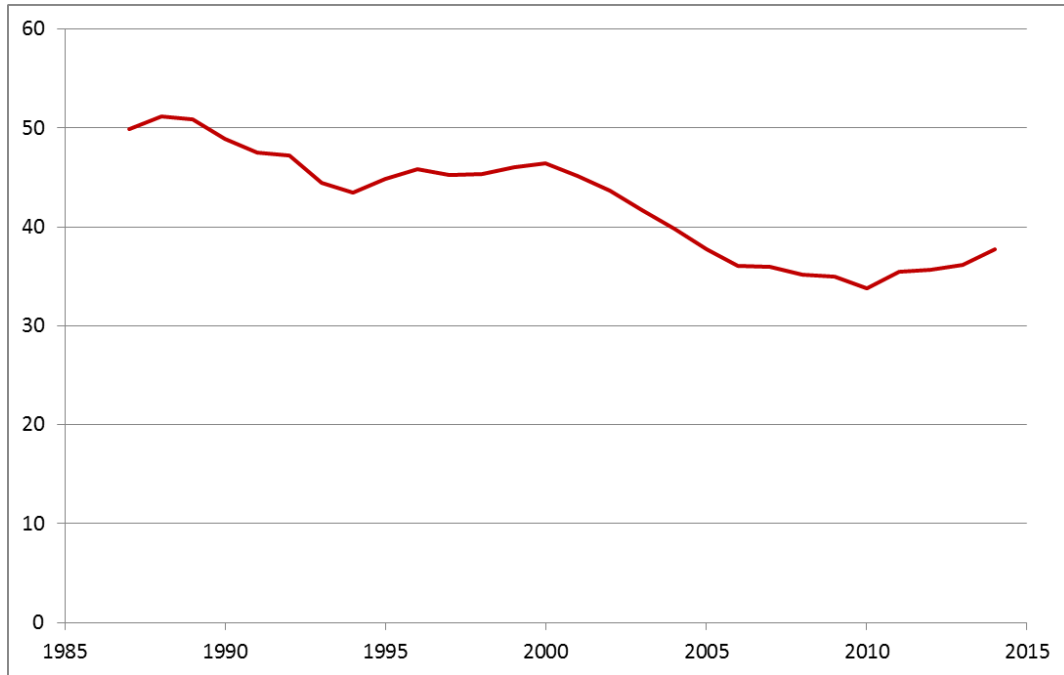
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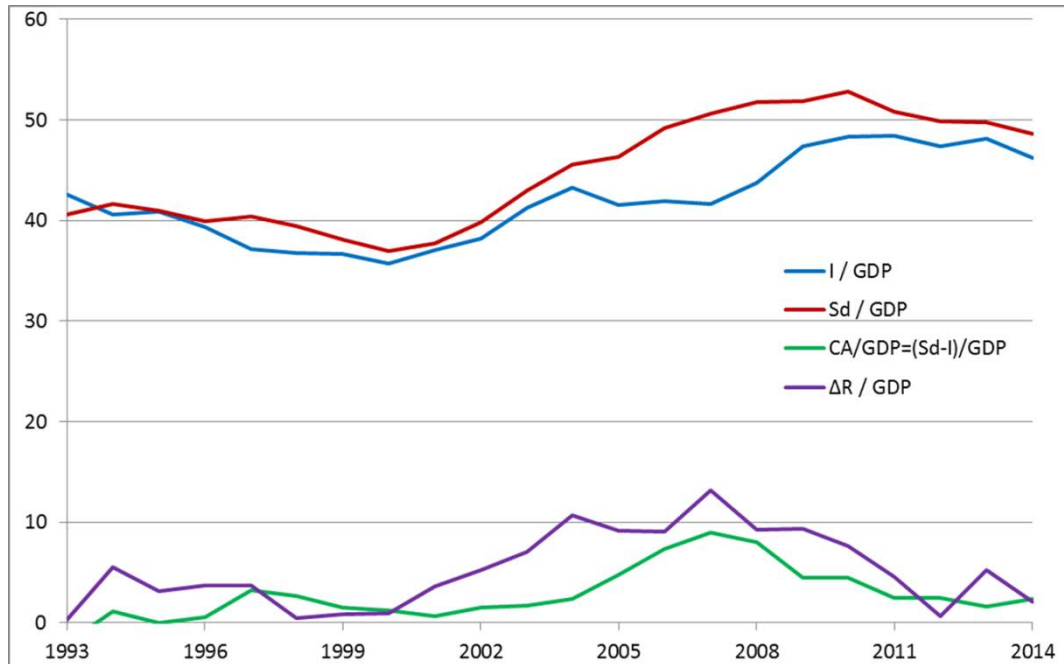
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**Figure 1: The Emergence of Consumption After 2010**  
% GDP



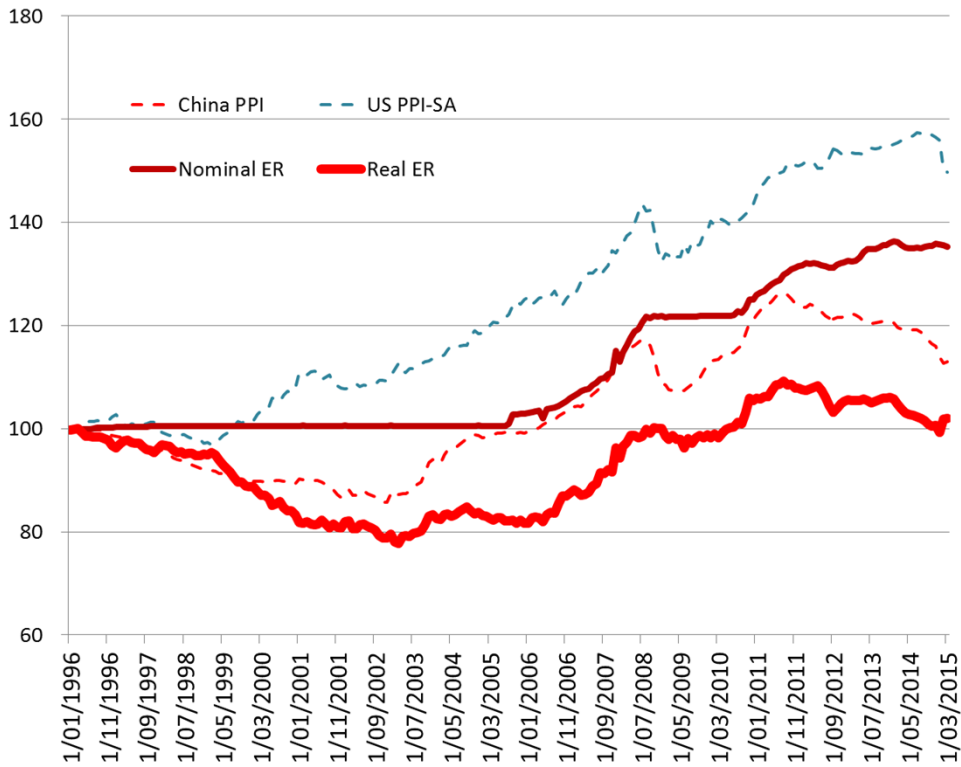
Sources: National Bureau of Statistics yearbook 2009-2014; IMF IFS data base..

**Figure 2: China's Saving Surplus**  
% GDP



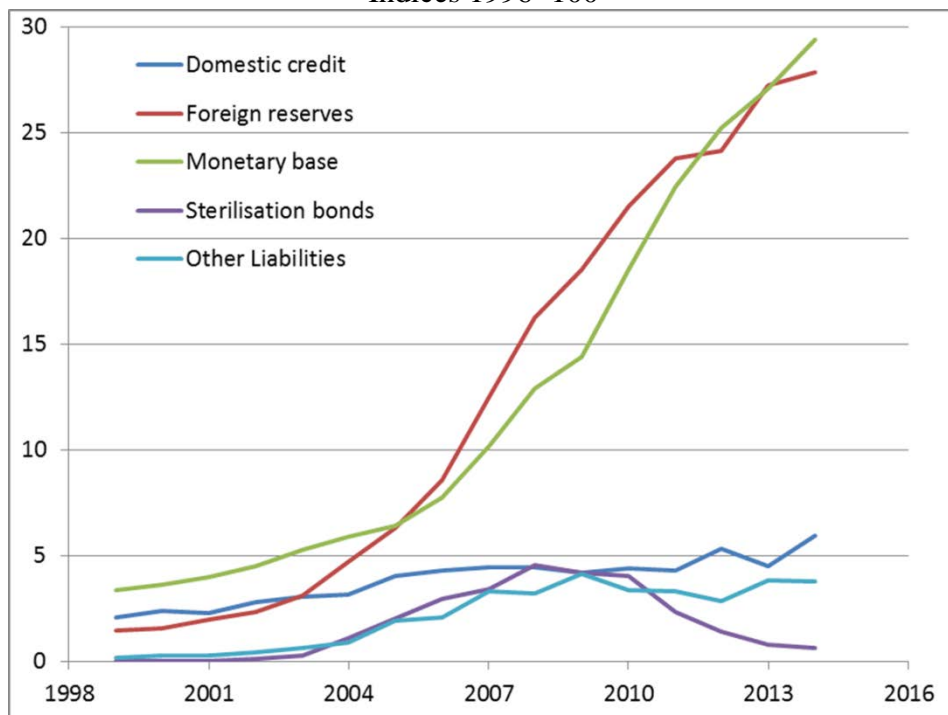
Sources: National Bureau of Statistics yearbook 2009-2014; IMF IFS data base..

**Figure 3: China's Real Exchange Rate vs the US on Producer Prices**  
Indices 1996=100



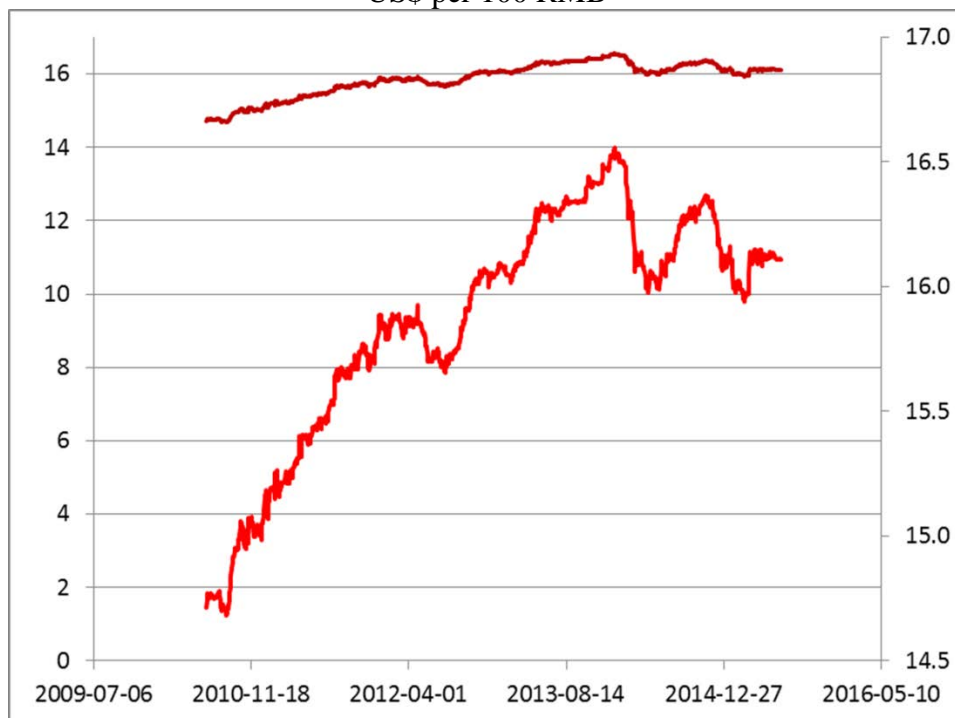
Sources: Peoples Bank of China.

**Figure 4: Components of the PBoC Balance Sheet**  
Indices 1996=100



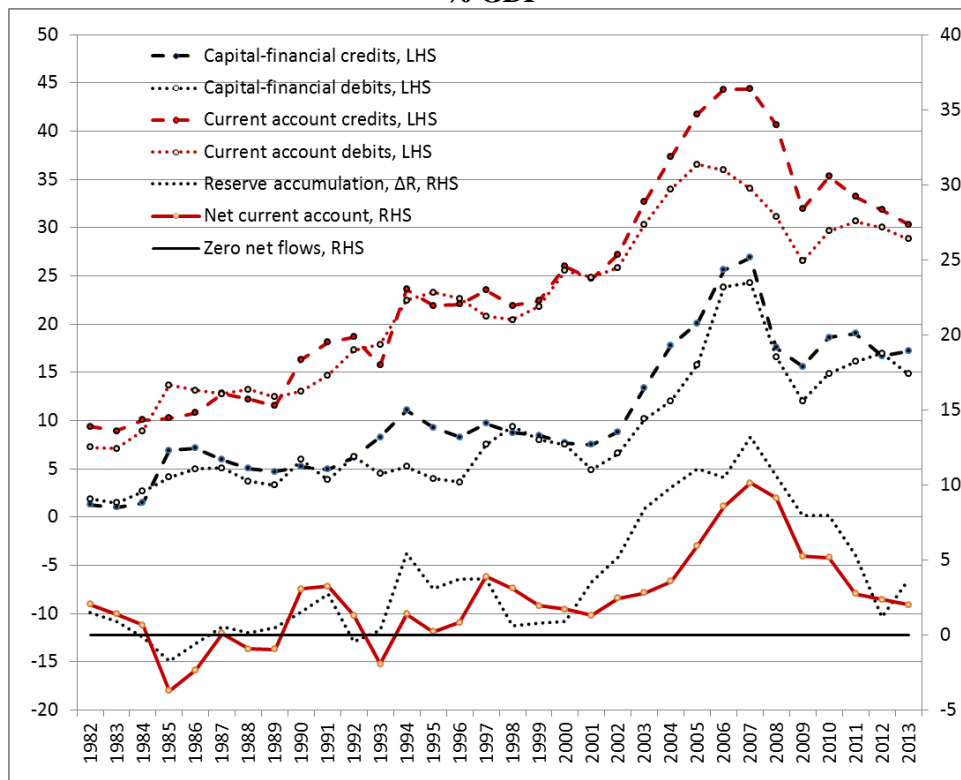
Sources: Peoples Bank of China (PBoC).

**Figure 5: Recent Movements in China's Exchange Rate vs the US**  
US\$ per 100 RMB



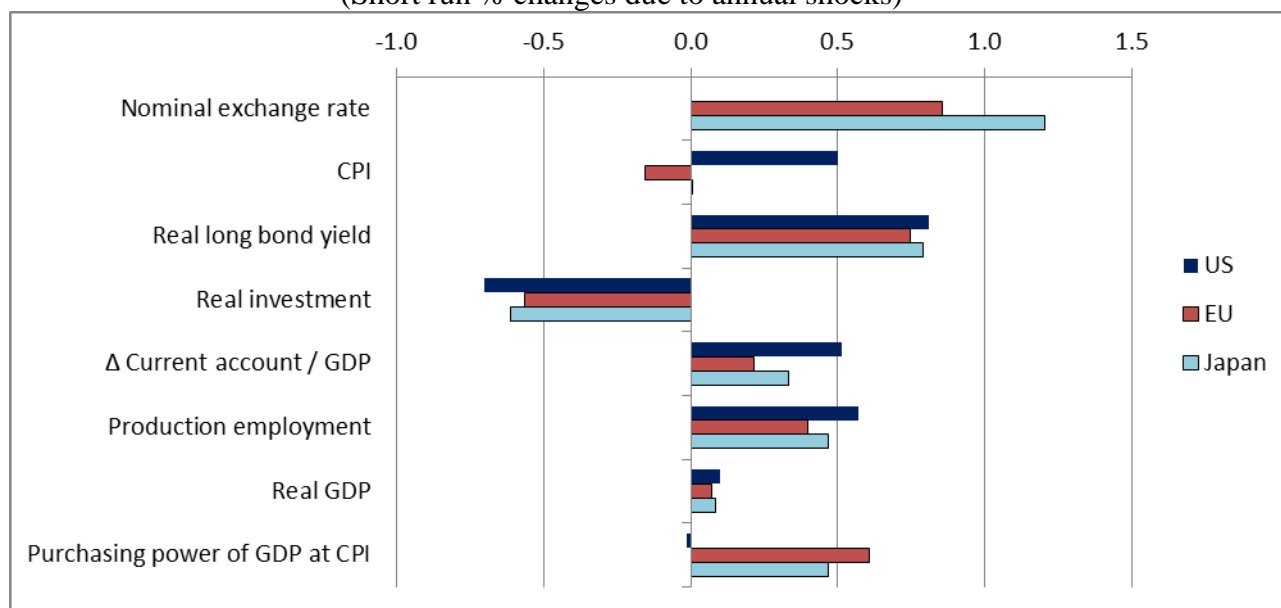
a The rate in levels is the dark red line (LH axis) while more detailed recent movements are represented in the lighter colour (RH axis).  
Sources: Peoples Bank of China.

**Figure 6: Gross and Net Flows on China's Balance of Payments**  
% GDP



Sources: China SAFE: "the balance of payments table", <http://www.safe.gov.cn/>.

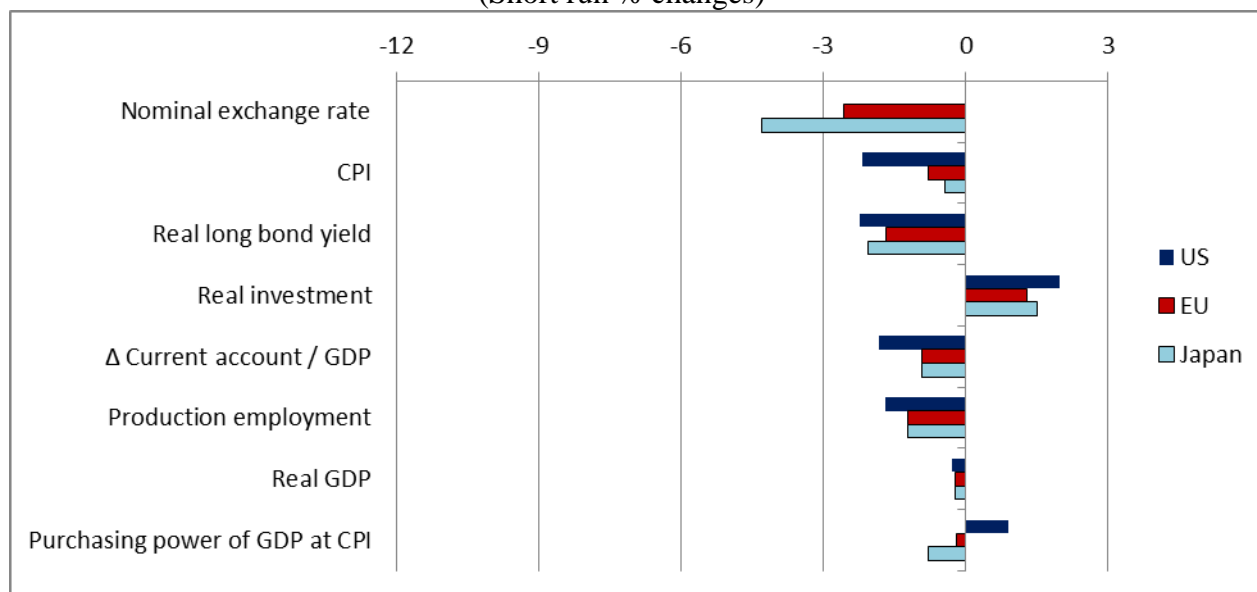
**Figure 7: International Effects of China's Transition<sup>a</sup>**  
(Short run % changes due to annual shocks)



<sup>a</sup> Assuming no policy responses outside China, including no changes in money stocks. Exchange rate changes are relative to the US\$.

Sources: Simulations of the model presented in the text.

**Figure 8: International Effects of Raw Chinese Recession Shocks<sup>a</sup>**  
(Short run % changes)

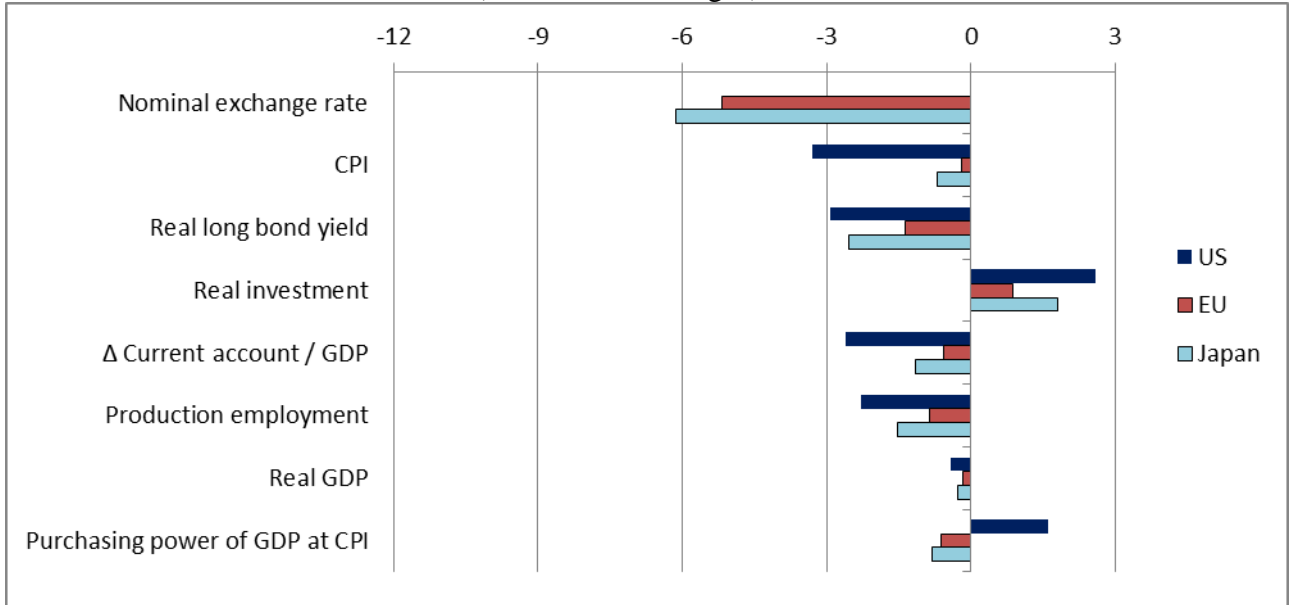


<sup>a</sup> Assuming no policy responses inside or outside China, which retains its US\$ peg and other regions do not change money stocks. Exchange rate changes are relative to the US\$.

Sources: Simulations of the model presented in the text.

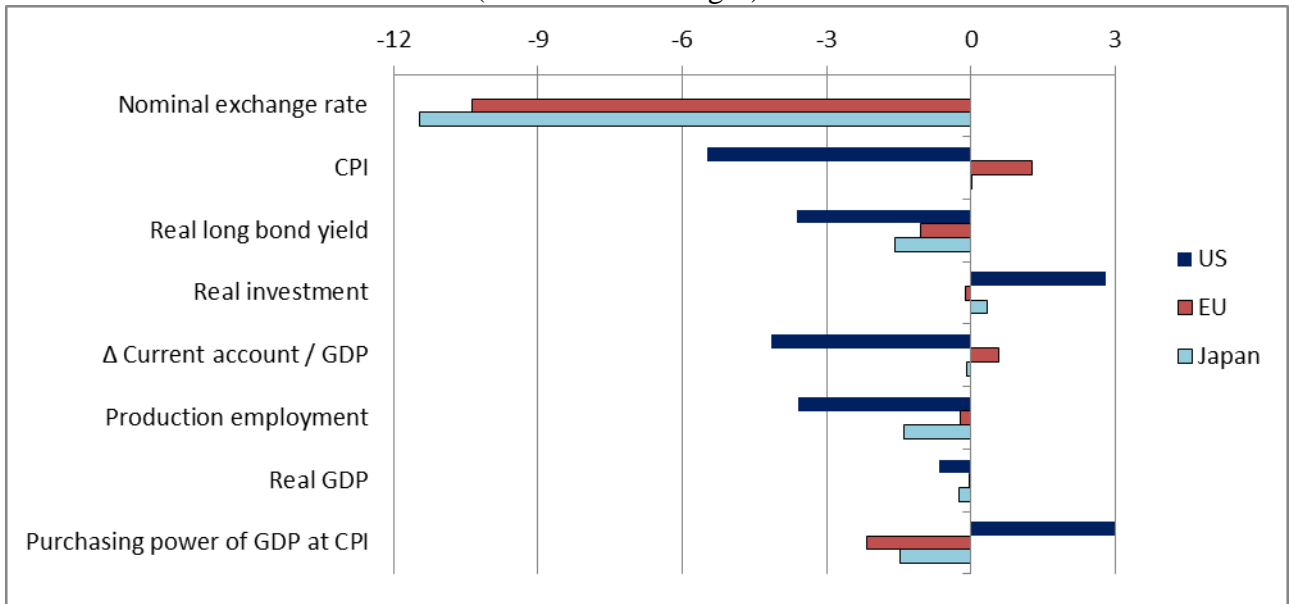


**Figure 9: International Effects of Chinese Recession Shocks with Home Policy Response<sup>a</sup>**  
(Short run % changes)



<sup>a</sup> Here Chinese policy responds by floating the RMB, repatriating foreign reserves and by implementing a money-financed fiscal expansion of 5% of GDP. Exchange rate changes are relative to the US\$.  
Sources: Simulations of the model presented in the text.

**Figure 10: International Effects of Chinese Recession Shocks with Home Policy Response and Induced Pessimism Shocks in the Advanced Economies<sup>a</sup>**  
(Short run % changes)



<sup>a</sup> Here Chinese policy responds by floating the RMB, repatriating foreign reserves and by implementing a money-financed fiscal expansion of 5% of GDP. At the same time, associated pessimism shocks are applied in the US, EU and Japan. Exchange rate changes are relative to the US\$.  
Sources: Simulations of the model presented in the text.

**Table 1: Relative Economic Sizes of China and the Other Large Regions**

% of world	China	US	EU(26)	Japan
GDP	11	22	26	9
Consumption, $C$	8	27	26	9
Investment, $I$	20	15	22	8
Government spending, $G$	7	20	30	10
Exports, $X$	17	17	25	7
Imports, $M$	15	21	23	8
Total domestic saving, $S^D$	19	13	20	9

Sources: National accounts data supply most of the elements though adjustments have been required to ensure that current accounts sum to zero globally, as do capital/financial accounts. The IMF-IFS database is the major source but there is frequent resort to national statistical databases. All data are for 2011.

**Table 2: Shares of Domestic Saving Directed to Investment in Each Region<sup>a</sup>**

% of row total saving	US	EU(26)	Japan	China	Australia	RoW
US <sup>b</sup>	68.0	13.3	6.4	6.4	1.5	4.4
EU(26) <sup>c</sup>	12.9	80.1	2.3	2.3	0.9	1.5
Japan <sup>d</sup>	14.0	3.3	72.2	6.2	0.7	3.6
China <sup>e</sup>	9.2	0.6	0.9	81.1	0.1	8.0
Australia <sup>e</sup>	13.0	4.8	2.3	2.1	77.3	0.4
Rest of world	3.4	3.9	2.6	2.8	0.1	87.2

a These shares sum to 100 horizontally. They are based on 2011 investment flows. The original flow matrix is inconsistent with data on saving and investment from national accounts and so a RAS algorithm is used to ensure that row and column sums are consistent with other data. The row sums of the original flow matrix are total saving by region and the column sums are total investment by region. These sums are sourced from the IMF-IFS database and the World Bank database.

b USA: values are based on official statistics, BEA.

c EU and China: indirect information from USA, Australian and Japanese statistics.

d Japan: estimated based on FDI data, assuming investment outflow=FDI\*1.6. The ratio 1.6 is that of USA reported inward investment from Japan divided by Japanese reported outward FDI to the USA.

e Australia: Australian Bureau of Statistics "International Investment Position, Australia: Supplementary Statistics, 2011".

f ROW is a residual. Its saving is inferred from national accounts estimates and its investment abroad is determined to balance the matrix of financial flows.

Sources: As per the notes above.

**Table 3: Simulation Closures<sup>a</sup>**

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Closure	
<b><i>Labour market:</i></b>	Exogenous nominal production (unskilled) wage with endogenous production employment
<b><i>Fiscal policy:</i></b>	Exogenous nominal government spending and endogenous government revenue at fixed rates of tax on income, consumption and trade
<b><i>Monetary policy targets<sup>b</sup></i></b>	US, EU, China and Japan: choice of <ol style="list-style-type: none"><li>1. Fixed monetary base<sup>d</sup></li><li>2. Fixed exchange rate vs US</li><li>3. Producer price level target<sup>e</sup></li><li>4. Consumer price level target<sup>e</sup></li></ol>

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a Since the model is a system of non-linear simultaneous equations and more variables are specified than equations in the system, there is flexibility as to the choice of those to make exogenous. This choice mirrors assumptions about the behaviour of labour markets, fiscal deficits and monetary policy targets.

b Money supplies can be set to target any of the three price levels (consumer, producer and GDP), nominal exchange rates against the US\$ or nominal GDP levels.

c Australia is a small region also identified in the model. Its monetary policy targets the producer price level, which ensures no change in employment.

d No changes in commercial bank reserve behaviour are assumed so that money multipliers remain constant.

e The analysis is short run comparative static and can be thought of as representing short run departures from a trend. In this case there is no substantive difference between price level and inflation targeting.

**Table 4: Applied Shocks by Scenario<sup>a</sup>**

Scenario	% changes, unless otherwise indicated	
Scenario	Variable	Shock
<b><u>China transition: slower relative growth with higher consumption</u></b>	Productivity, $A^Y$	2
	Consumption constant, $A^C$	15
	Capital stock, $K$	5
	Skill stock, $S$	10
	Nominal production wage, $W^b$	7
	Monetary target, $E$	
<b><u>China contraction: core domestic shocks and maintained US\$ peg<sup>c</sup></u></b>	Productivity, $A^Y$	-20
	Expected rate of return, $r_c^e$	-30
	Expected nominal disp income, $Y_D^e$	-30
	Expected CPI inflation, $P_C^e$	3
	Expected $P_Y$ inflation, $P_Y^e$	2
	Expected real exchange rate vs US, $e^e$	-2
	Monetary target, $E$	
<b><u>China policy responses to contraction: float, reserve repatriation, money financed fiscal expansion</u></b>	Monetary target, $M^B$	12
	Government consumption, $G$	43
	Reserve repatriation, $S_{Di}^S(\text{US,China})$	0.22 US\$trillion
	Reserve repatriation, $S_{Di}^S(\text{EU,China})$	0.20 US\$trillion
<b><u>Expectation shocks in US, EU and Japan<sup>d</sup></u></b>	Expected rate of return, $r_c^e$	-0.25,-0.04,-0.18
	Expected nominal disp income, $Y_D^e$	-1.41,-0.23,-1.01
	Expected CPI inflation, $P_C^e$	-1.70,-1.06,-0.05
	Expected $P_Y$ inflation, $P_Y^e$	-0.88,-0.50,-0.85
	Expected real exchange rate vs US, $e^e$	0.00,-3.45,-4.03
	Expected real exchange rate vs China, $e^e$	1.14,-2.31,-2.89

a Monetary policy in all regions except China is neutral – maintaining constant monetary bases.

b The representative Chinese nominal wage shock in the transition allows for accelerated relative production wage growth in the transition, fostering consumption.

c The Chinese expectation shocks are formed as “model consistent” with a simulation in which the Chinese government responds to the negative productivity shock only by defending its US\$ peg and repatriating reserves.

d The expectation shocks to the US, EU and Japan are derived, as are those for China, from the scenario in which China defends its peg and repatriates reserves but takes no further policy action. For this reason the expected real exchange rate shocks are smaller than what emerges when the RMB is floated.

**Table 5: Effects of the Transition<sup>a</sup>**

% changes	US	EU(26)	Japan	China
Current account/ $Y_0$	0.52	0.21	0.33	-2.60
Real bond yield, $r$	0.81	0.75	0.79	2.00
Monetary base, $M^B$	0.00	0.00	0.00	2.95
Consumer price level, $P^C$	0.50	-0.16	0.01	0.54
Producer price level, $P^P$	0.47	0.33	0.39	-3.09
Exchange rate vs US\$, $E$	0.00	0.86	1.21	0.00
Real investment, $I/P^P$	-0.70	-0.56	-0.61	1.13
Production employment, $L$	0.57	0.40	0.47	-4.32
<b>Real output (GDP), <math>Y/P^Y</math></b>	0.10	0.07	0.08	5.65
<b>Real income <math>Y/P^C</math></b>	-0.01	0.61	0.47	3.57

a These results are from the model described in the text with the closures and shocks listed in Tables 3 and 4. The “moderate” financial integration parameters referred to are values of the elasticity of substitution between assets for each region,  $\sigma_i^I$ . These are US: 20, EU: 20, Japan: 15, China: 10, Australia: 20, Rest of World: 10.

b Nominal exchange rates are expressed relative to the US dollar, which is the model numeraire. Source: Simulations of the model described in the text.

**Table 6: Effects of a Significant Chinese Recession<sup>a</sup>**

% changes	Simulation	US	EU(26)	Japan	China
Current account/ $Y_0$	Raw Chinese shocks	-1.8	-0.9	-0.9	9.7
	With Chinese policy	-2.6	-0.6	-1.1	13.5
	With foreign expectations	-4.2	0.6	-0.1	12.9
Real bond yield, $r$	Raw Chinese shocks	-2.2	-1.7	-2.0	-11.1
	With Chinese policy	-2.9	-1.4	-2.5	-18.5
	With foreign expectations	-3.6	-1.0	-1.6	-18.5
Monetary base, $M^B$	Raw Chinese shocks	0.0	0.0	0.0	-22.1
	With Chinese policy	0.0	0.0	0.0	12.0
	With foreign expectations	0.0	0.0	0.0	12.0
Consumer price level, $P^C$	Raw Chinese shocks	-2.2	-0.8	-0.4	-3.7
	With Chinese policy	-3.3	-0.2	-0.7	28.3
	With foreign expectations	-5.5	1.3	0.0	28.1
Producer price level, $P^P$	Raw Chinese shocks	-1.4	-1.0	-1.0	-1.4
	With Chinese policy	-1.9	-0.7	-1.3	27.2
	With foreign expectations	-3.0	-0.2	-1.1	27.2
Exchange rate vs US\$, $E$	Raw Chinese shocks	0.0	-2.6	-4.3	0.0
	With Chinese policy	0.0	-5.2	-6.1	-26.5
	With foreign expectations	0.0	-10.4	-11.5	-29.4
Real investment, $I/P^P$	Raw Chinese shocks	2.8	1.3	1.5	-47.7
	With Chinese policy	2.6	0.9	1.8	-40.1
	With foreign expectations	2.8	-0.1	0.3	-40.2
Production employment, $L$	Raw Chinese shocks	-1.7	-1.2	-1.2	-27.6
	With Chinese policy	-2.3	-0.9	-1.5	2.4
	With foreign expectations	-3.6	-0.2	-1.4	2.5
<b>Real output (GDP), <math>Y/P^Y</math></b>	Raw Chinese shocks	-0.3	-0.2	-0.2	-26.6
	With Chinese policy	-0.4	-0.2	-0.3	-19.5
	With foreign expectations	-0.6	0.0	-0.2	-19.5
<b>Real income <math>Y/P^C</math></b>	Raw Chinese shocks	0.9	-0.2	-0.8	-26.8
	With Chinese policy	1.6	-0.6	-0.8	-24.1
	With foreign expectations	3.0	-2.2	-1.5	-24.0

a These results are from the model described in the text with the closures and shocks listed in Tables 3 and 4. The “moderate” financial integration parameters referred to are values of the elasticity of substitution between assets for each region,  $\sigma_i^l$ . These are US: 20, EU: 20, Japan: 15, China: 10, Australia: 20, Rest of World: 10. The raw Chinese shocks embody expectations that are “model consistent” with a scenario in which China defends its US\$ peg and repatriates reserves but is unable to tighten capital controls, nor does it take any other policy action. The expectation shocks to the US, EU and Japan are derived from the same scenario. For this reason the expected exchange rate shocks are smaller than the changes that emerge when the RMB is floated.

b Nominal exchange rates are expressed relative to the US dollar, which is the model numeraire.

c The expectation shocks to the US, EU and Japan are derived, as are those for China, from the scenario in which China defends its peg and repatriates reserves but takes no further policy action. For this reason the expected exchange rate shocks are smaller than what emerges when the RMB is floated.

Source: Simulations of the model described in the text.