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## Financial Integration and China's Global Impact

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### Rod Tyers

Business School, University of Western Australia  
Research School of Economics, ANU and  
Centre for Applied Macroeconomics Analysis, ANU

### Abstract

Product and financial market integration determine the global implications of China's recent growth surge and its on-going transition from export led growth. These alter China's structural imbalance (its excess product supply and excess saving), which in turn shifts the international terms of trade, changing asset yields causing deflationary and then inflationary pressures abroad. The effects are here quantified using a global macro model with national portfolio rebalancing, in which asset differentiation is used to index financial integration. The growth surge is found to have conferred on the advanced economies gains in their terms of trade, incompletely offset by structural unemployment. By contrast, the global effects of the transition are shown to reverse some of these impacts and to be amplified by further financial integration, particularly for the US.

## **Keywords**

Financial integration, China, imbalances, saving, monetary policy, spill-overs

## **JEL Classification**

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## **Address for correspondence:**

(E) [cama.admin@anu.edu.au](mailto:cama.admin@anu.edu.au)

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# Financial Integration and China's Global Impact\*

Rod TYERS

Business School  
University of Western Australia,  
Research School of Economics  
Australian National University, and  
Centre for Applied Macroeconomic Analysis (CAMA)  
Crawford School of Government  
Australian National University

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Author best contact details:

Rod Tyers  
Winthrop Professor of Economics  
UWA Business School  
Crawley, WA 6009  
Australia  
rod.tyers@uwa.edu.au

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## Abstract

Product and financial market integration determine the global implications of China's recent growth surge and its on-going transition from export led growth. These alter China's structural imbalance (its excess product supply and excess saving), which in turn shifts the international terms of trade, changing asset yields causing deflationary and then inflationary pressures abroad. The effects are here quantified using a global macro model with national portfolio rebalancing, in which asset differentiation is used to index financial integration. The growth surge is found to have conferred on the advanced economies gains in their terms of trade, incompletely offset by structural unemployment. By contrast, the global effects of the transition are shown to reverse some of these impacts and to be amplified by further financial integration, particularly for the US.

## 1 Introduction

China's emergence over recent decades and its ultimate size presage major implications for the functioning of the rest of the global economy, and the advanced economies in particular.

Central to the question is the "unbalanced" nature of China's growth surge since the 1990s, which saw faster growth in its supply of merchandise than in its consumption. This had direct, and much analysed, effects on the terms of trade facing other regions.<sup>1</sup> Yet, in addition, by creating an excess supply of saving, this also changed the financial 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> These changes abroad were superficially beneficial, though the evidence to date suggests that the gains have been at least partially offset by structural unemployment.<sup>3</sup>

Since the global financial crisis (GFC), a decline in the level of imbalance in China's growth has become apparent. It is likely that we are seeing the beginning of the inevitable transition process whereby China's production structure diversifies away from export-oriented light manufacturing into services to better meet home consumption demand. But this foreshadows a

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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 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).

further global shock, combining continued growth in physical and human capital, and productivity, but also including relative growth in Chinese consumption and a decline in its excess saving. The international effects of the growth surge and the post GFC transition both depend on economic openness in the advanced regions and in China. Openness to trade has been shown to be extensive, especially in China, though financial openness has varied through time in China but also in the advanced economies. The sensitivity of the effects of Chinese shocks in the advanced regions to financial openness has not yet been widely studied, at least in an analytical framework, and so it is the focus of the research presented in this paper.

A parsimonious global macroeconomic model is introduced 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), which proves important because China's growth surge provided excess product supply in the rest of the world and was therefore deflationary, while its transition shock is, by contrast, inflationary abroad. In the presence of the advanced regions' nominal rigidities these shocks are, respectively, contractionary and expansionary, offering one explanation for the considerable monetary expansions undertaken by the slow-growing advanced regions during the pre-GFC growth surge period.

Overall, the results suggest that China's growth and transition have significant implications for the advanced regions, transmitted via changes in both financial flows and the international terms of trade. Given nominal rigidities, these changes also affect their levels of employment.<sup>4</sup> With compensation for the displaced and unemployed the results suggest that China's growth surge would have yielded net real income gains in advanced regions. The impending Chinese transition to more balanced growth also proves to be net beneficial on average though both are shown to be sensitive to the China's financial integration. Indeed, the effects are amplified by

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<sup>4</sup> Empirical analysis also reveals large macroeconomic effects, as found for example by Eickmeier and Kuehnlenz (2013). The results are contrary to those of N'Daye et al (2010) and Genberg and Zhang (2010), who find that the international effects of increased Chinese consumption are small. Their conclusions stem from the use of a model in which spill-over effects stem primarily from trade, and financial flows are only weakly represented.

integration that increases the flexibility with which China's collective asset portfolio is managed.

The section to follow offers a brief introduction to China's macroeconomic impacts abroad and their determinants. Section 3 then presents the model used for quantitative analysis and Section 4 offers numerical analysis of the foreign effects of China's growth surge and transition. Section 5 considers the sensitivity of these effects to financial integration and conclusions are offered in Section 6.

## **2. China's Global Impact**

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>5</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>6</sup> Such views are frequently 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

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<sup>5</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>6</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).

rival their own. After China's post-WTO accession, however, the growth surge was unprecedented and indisputably beneficial to the Chinese.

Given the relocation of much of the world's light manufacturing to China in this period it is not surprising that flip sides in the advanced regions should have arisen that contributed to high unemployment and slow or non-existent real wage growth. 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 net advantage to the advanced regions, albeit with some contribution to increased structural unemployment.<sup>7</sup>

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

A transition has become necessary, primarily because China's production and export volumes have become 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. The potential for considerable growth from this source exists, however (Song et al. 2011, Tyers 2014), and, along with reforms to social policy, there are already signs of a key new role for Chinese consumption growth. Indeed, recent studies question China's official statistics on consumption expenditure, suggesting that it is larger and growing more quickly than indicated (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 from 48 to 47 per cent.<sup>8</sup> This foreshadows a continuing decline in the relative size of China's current account surplus (Arora et al. 2014).

#### *Excess saving and 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

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<sup>7</sup> See the survey by Tyers (2015b).

<sup>8</sup> Huang et al. start with the official consumption share in 2000 and derive the GDP shares in remaining years using real GDP growth and their estimated consumption growth rates. 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 is expanding.

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>9</sup> This clearly had financial implications.

### *The global financial market*

Consistent with the segmentation theory of the yield curve (Johnson et al. 2010), long rates are not merely the commonly claimed (Borio and Disyatat 2011) expectational extensions of short policy rates. The transaction cost of financing long term investments via a succession of short contracts is prohibitive, allowing short and long maturity instruments to trade at prices and yields that differ beyond what would be expected from time preference and expectations forces (Shiller et al. 1983, He and McCauley 2013). Short bonds primarily serve domestic financial sectors and are instruments of conventional domestic monetary policy. Movements in their yields show their clear links to region-specific business cycles. Long bonds, by contrast, arbitrage with the major instruments of private saving and investment and are extensively traded internationally. Their yields tend therefore to be more stable through time than business-cycle driven short yields and reflect movements in the equilibrium between global saving and investment, as indicated in Figure 1.<sup>i</sup>

He and McCauley (2013) find evidence of “imperfect substitutability along the yield curve” and use it to explore monetary policy spill-over effects, which they see as enlarged by the global integration of long bond markets. Ito (2013: 8) offers support for this view. He argues that as a result of financial globalisation, domestic financial markets are more susceptible to international factors and that tends to decouple short-term and long-term rates. Consistent with Bernanke (2005), he concludes that the long-term interest rate is tied down by global saving imbalances and hence reflects the natural rate of interest. This reasoning, and that of Rey (2013), both imply that, when there is free capital mobility, there is inter-regional arbitrage at the long end of the yield curve whereas the short end of the yield curve is conventionally controlled by monetary authorities.<sup>10</sup> Support for this international arbitrage at the long end is

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<sup>9</sup> Ex ante shifts in saving supply and investment demand cannot be observed. See Tyers (2015b) for a discussion of this.

<sup>10</sup> I thank Paul Luk for clarifying this point.



suggested by the time paths of the advanced region long yields in Figure 2. It follows, then, that the rise in Asian saving is a possible explanation for the persistent downward trend in long term bond rates since the 1980s that is also apparent from Figure 2.<sup>11</sup>

### *Implications*

It can be concluded, first, that changes in China's excess saving, now that it has become "macroeconomically" large, do contribute to trends in the underlying Wicksellian interest rate at the global level and therefore to the yields in long bond markets which reflect it. It follows that the current transition in the pattern of Chinese growth, and its consumption behaviour, has important implications for global financial markets and economic performance in the developed regions, particularly as it is accompanied by gradual increases in China's financial integration. Second, the emergence of UMP implies that monetary policy in the large regional economies is also placing important demands on long bond markets and that this is interacting with changes in China in ways that make their impacts difficult to separate. One way to approach this is through the use of a global general equilibrium model of the type introduced in the section to follow. This approach also allows "counterfactual" analysis to illustrate the role of financial integration.

## **3. Modelling Macro Interdependence**

A multi-region general equilibrium structure is used that centres on the global financial capital market.<sup>12</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 this degree of differentiation. The scale of short run spill-over effects associated with growth performance, excess saving and monetary policy therefore depend on it.

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<sup>11</sup> The separation of the series for Japan is associated with its long term current account surplus and the major Yen appreciation shocks of the late 1980s and early 1990s, which established a negative risk premium amongst Japanese savers. In all regions, inflation rates were low throughout the period shown in the figure and so the trend of nominal long rates reflects that of corresponding real rates.

<sup>12</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 unconventional monetary, which sees monetary expansions directly affecting the markets for long maturity assets.

Although there is a tendency for financial flows to move the global economy toward interest parity, this differentiation leaves this process incomplete in the length of run considered. 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>13</sup> On the supply side of the money market, in regions with unconventional monetary policy, expansions raise demand for long maturity bonds, reducing their yields and hence reducing the opportunity cost of holding money.

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>14</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>15</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 after tax yields, generally implying high expected real gross rates of return,  $r^{ce}$ . This is calculated as:

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<sup>13</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 rate alignment.

<sup>14</sup> The EU is modeled as the full 26 and it is assumed that this collective has a single central bank.

<sup>15</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).

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

where  $P_i^K$  is the price of capital goods, which in this model are linked by an exogenous factor to  $P_i^P$ , the producer price of the region's generic good.<sup>16</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 ( $\varphi_{US} = 1$ ). 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 those regions 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 rate of return on installed capital,  $r_i^{ce}$  and a domestic market clearing bond yield or financing rate,  $r_i$ .

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

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>17</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

<sup>16</sup> The producer price level is the factory door price of the regional good, which differs in this model from the GDP price level due to indirect taxation. See Tyers (2015a: Appendix 1) for an explanation of this.

<sup>17</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, so the motivations for continuous short run rebalancing, other than the arrival of new saving, are not represented.

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:

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

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>18</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:

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

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>18</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  $\sum_k i_{ik}^S = 1$ :

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

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 a modified (6):

#### *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>19</sup> Real money balances are measured in terms of purchasing power over home products.

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

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>20</sup> The money multiplier is  $\eta_i$  and  $M_i^B$  is the monetary base.<sup>21</sup> The monetary base,  $M^B$ , can be set as an exogenous policy variable or endogenous to a price level or exchange rate target.

#### *Regional financial market clearance*

<sup>19</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.

<sup>20</sup> For details of the specification of consumption and price aggregates, see Tyers (2015a, Appendix 1).

<sup>21</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 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:

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

The nominal values of imports and exports,  $M_i$  and  $X_i$ , are available from Tyers (2015a, Appendix 1). 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. 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. The implications of changes in China for the three advanced regions are emphasised here and the scale of these economies, as represented in the database, is indicated in Table 1. Of particular interest here are the financial flows between these regions and the pattern of these is suggested in Table 2, from which it is important to note the comparatively substantial share of the US in financial outflows from China.<sup>22</sup>

## **4. Effects of the Growth Surge and Transition**

Two sets of experiments are undertaken. The first examines the global effects of China's growth surge while the second assesses the effects of the subsequent transition. To construct these experiments a set of model closures is required, to be combined with two sets of shocks, representing the surge and the transition. The closures indicate underlying assumptions about the labour market, fiscal policy and monetary targeting. They represent standard Keynesian short run assumptions and are detailed in Table 3.<sup>23</sup> The growth surge shocks listed in Table 4 are built around the comparative performance of the Chinese economy in 2002-2007, approximately annualised.<sup>24</sup> That to consumption captures the observed decline in the share of consumption expenditure and the rise in the share of private savings in GDP. In the case of the transition, slower productivity and factor accumulation rates are combined with a single change in Chinese preferences that boosts consumption and reduces saving.<sup>25</sup> 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).

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<sup>22</sup> Further details as to the sources and construction of the database can be obtained from Tyers (2015a, Appendix 2).

<sup>23</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.

<sup>24</sup> The capital accumulation and productivity shares of China's recent growth are controversial (Krugman 1994). The numbers used here are broadly consistent with the meta-analysis by Wu (2011).

<sup>25</sup> The 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).

### *The growth surge:*

The numerical results are summarised in Table 5. The simulation is repeated for three different monetary policy settings for the US, the EU and Japan, as described in Table 3. The growth surge, combined with the imbalance between production and consumption in China, created excess supply in the advanced economies and so was deflationary in the absence of money supply adjustment.<sup>26</sup> In the simulation, US dollar appreciation ensures that consumer prices deflate by more than producer prices<sup>27</sup> and so the targeting of the consumer price level requires the largest monetary expansion. Unsurprisingly, this yields the best short run outcomes for the advanced economies. At the same time, however, the monetary expansions, which include UMP, place further demands on long bond markets and exacerbate the decline in their yields.

In the absence of monetary expansions in the advanced economies it is noteworthy that the decline in bond yields does not occur in all regions. The reason for this is that the deflation is contractionary, reducing home saving. This effect places upward pressure on domestic yields and, in the EU, it tends to dominate the opposing downward force that is dominant in the US, which is due to the financial influx from China. The effect is illustrated in Figure 3, which depicts the open economy financial market via a downward sloping excess demand curve for funds to finance home investment ( $I - S^D$ ) and an upward sloping excess supply of funds from abroad,  $S_{NF}$ .<sup>28</sup> This curve slopes upward because of the differentiation of domestic from foreign assets and hence the Mundell-Fleming requirement that a higher home yield is needed to attract increased foreign inflow. For all the advanced economies the deflation reduces output, employment and, therefore  $S^D$ , causing excess demand for funds to rise at any domestic bond yield, and so ( $I - S^D$ ) shifts right. The influx of Chinese investment also raises  $S_{NF}$ , shifting that curve to the right, but this flow is directed strongly toward the US rather than to the EU or Japan.<sup>29</sup> For this reason the net change in the domestic interest rate in the EU is positive in the absence of a domestic monetary expansion sufficient to avert the contraction.

Domestic investment rises in the advanced economies with the influx from China but this is not sufficient to sustain domestic labour demand unless the deflation is eliminated by monetary expansion. The net effects on real GDP depend on the level of employment, which declines

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<sup>26</sup> Another way to think of this is that lower interest rates raise the demand for money relative to goods, thus reducing the prices of goods in terms of money.

<sup>27</sup> This is because the consumption basket includes imported products not included in the calculation of the producer or GDP prices.

<sup>28</sup> The vertical axis is the home bond yield and the horizontal represents net flows on the capital and financial accounts of the balance of payments.

<sup>29</sup> The regional bias in Chinese financial outflows is evident from the 2011 database summarised in Table 2.



while ever the deflation is allowed to persist. Historically, deflation occurred only briefly in the US and Europe during the surge period but persistently in Japan. The results therefore suggest that China's growth surge contributed to the slow real GDP growth observed in the US and EU and the stagnation in Japan during this period. In more general terms, however, these regions experienced real appreciations relative to China which are the rough equivalent of terms of trade gains in this model. The welfare effect of these real income gains can be incorporated by deflating nominal GDP by the domestic consumer price level, to obtain the real purchasing power of home income at home consumer prices. This measure shows consistent net gains, suggesting that the overall effect of China's surge in the advanced economies was positive but that it was distributed in favour of capital-owners rather than workers and hence caused distributional stress.

#### *The transition:*

While both the surge and transition shocks indicated in Table 4 embody productivity and factor endowment changes, at their core is a reversal of the change in consumption behaviour that sees a rise in Chinese consumption expenditure and a decline in its saving. This reduces the structural imbalance substantially and so the transition's effects on global financial markets are opposite to those of the growth surge. Bond yields in the advanced economies rise as China's excess saving falls, 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. In the absence of monetary contractions in the advanced economies the shocks are modestly inflationary and this stimulates employment and real GDP growth. Real purchasing power of income at consumer prices 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>30</sup>

## **5. Sensitivity to Financial Integration**

Financial integration can be thought of in several ways, even within the confines of the model adopted here. One possibility is to regard more financial integration as indicating more ready substitution of assets across all regions, which might be reflected by a rise in all the regions'

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<sup>30</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.

elasticities of asset substitution,  $\sigma_i^l$ . Because Chinese financial development, like Chinese growth, has appeared more recently than the corresponding developments in the advanced economies, it is here represented as the progression of China's  $\sigma_i^l$  from small values to full parity, while holding the values for the advanced economies at values representing high levels of financial integration.<sup>31</sup> For low values of this parameter, China's financial outflows are restricted to adhere to the original pattern of these flows reflected in the 2011 database. As the values rise, the distribution of these outflows across regional assets is more responsive to relative yield changes. This includes greater flexibility in the share in China's collective portfolio of China's own domestic assets. To see the effect of this, first the surge shocks and then the transition shocks are repeated for different values of this parameter. The effects of the shocks on regional bond yields, real GDP and the real purchasing power of regional income at consumer prices are assessed for the advanced regions. Importantly, only the cases in which the advanced economies hold constant their money supplies are considered.

*The growth surge:*

More flexible Chinese portfolio management alters the effects of the growth surge in ways that can be seen from Figure 4. Not surprisingly, given that the shocks are to the Chinese economy only, the Chinese performance indicators are the most strongly affected by some distance. Increased integration makes investment abroad easier. Since the surge caused a substantial rise in excess saving, the more readily that saving can escape abroad the smaller is its tendency to suppress Chinese home bond yields. In the advanced regions, however, the effects of more Chinese integration on bond yields are small. The expected movement toward convergence of bond yields occurs between China and the US but, while Japan also sees its yield declining, the effects of integration are opposite in direction in both Japan and the EU relative to the US. This occurs for the reasons discussed in the previous section, namely that the initial flows from China to Europe and Japan are small relative to those destined for the US and the home bond markets in these regions are primarily affected by their domestic supply contractions. Even where proportional changes to initial shares of Chinese outflow to the EU and Japan are substantial, the small base tends to push most of the additional outflow to the US.

The effects of integration on China's real GDP and on the purchasing power of its income at home prices are to impair its short run performance. This is because greater integration causes more financial outflow from China and hence less domestic investment. This further depreciates China's real exchange rate, exacerbating the terms of trade shift against it. Even

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<sup>31</sup> The values of the substitution elasticity used in generating the results in the previous section are 15 for the US and EU, 10 for Japan and 5 for China. These values reflect numerical measures of comparative financial openness (Tyers 2015a, Appendix 2). Here the analysis sets them as constant at 20 for all the advanced economies and examines the effects of allowing China's elasticity to rise from 2 to 20.

so, the net Chinese effects of the surge shocks remain substantially positive. Abroad, the US focus of China's outflows tends to appreciate the US real exchange rate relative to the EU and Japan. On the one hand this worsens its employment contraction and hence the effect of the surge on US GDP. On the other, it increases the terms of trade gain and so enhances the real purchasing power of US income.

*The transition:*

The results from the transition shocks taken over a range of levels of Chinese financial integration have a pattern that is generally the opposite of the surge shocks. This time the reduction in excess saving ensures that the higher returns are available within China. At higher levels of integration its portfolio rebalances more fully in favour of domestic assets and away from foreign ones. Home yields end up lower and those in the US, from whence the rebalance is resourced, rise. More minor redistributions also favour the EU and Japan, whose yields fall slightly. Bringing expenditure back home improves both real GDP and the purchasing power of national income in China. Removing it mostly from the US reduces the US terms of trade gain and hence impairs the real purchasing power of US income. On the other hand, the higher US bond yield that stems from Chinese integration raises liquidity and still modest, yet higher, inflation improves employment, lifting real GDP. These effects are reduced in the EU and Japan by the effect Chinese integration has in reducing their bond yields. On the one hand this causes less inflation and less employment uptake but on the other it tends to appreciate their real exchange rates, conferring larger terms of trade gains.

## **6. Conclusion**

The pre-GFC growth surge and the subsequent structural transition in China both have important implications for the advanced economies. The economic effects on the advanced economies are made larger not only as China's economy grows but also by their transmission through financial channels that are gradually liberalising through time. Here a global macroeconomic model with rebalancing national portfolios of global assets and explicit representation of unconventional monetary policy is used to both evaluate the international effects of these major changes in China and to assess the implications of its greater financial integration for the scale of these effects.

Even though the growth surge caused considerable structural change in the advanced economies, as manufacturing employment relocated to China, contributing to increased

unemployment, this growth conferred on the advanced economies considerable terms of trade gains. The results from this analysis suggest that these gains outweighed the losses associated with increased unemployment. Had China been more financially integrated at the time, it is further shown that the financial influx, particularly into the US, would have been larger. This would have made the US terms of trade gain larger but its domestic bond yields would have been lower and the effects more deflationary, further reducing US employment and real GDP growth.

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 tightening of global financial markets and some still-modest but increase inflation in the advanced economies, therefore 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 and the moderating investment could slow growth there. As measured by the purchasing power of national incomes at home consumer prices, the employment gains appear to outweigh the terms of trade losses, at least for Europe and Japan. Increasing Chinese financial integration is shown to exacerbate these effects, particularly for the US, since Chinese financial outflows have tended to be focussed on US asset markets.

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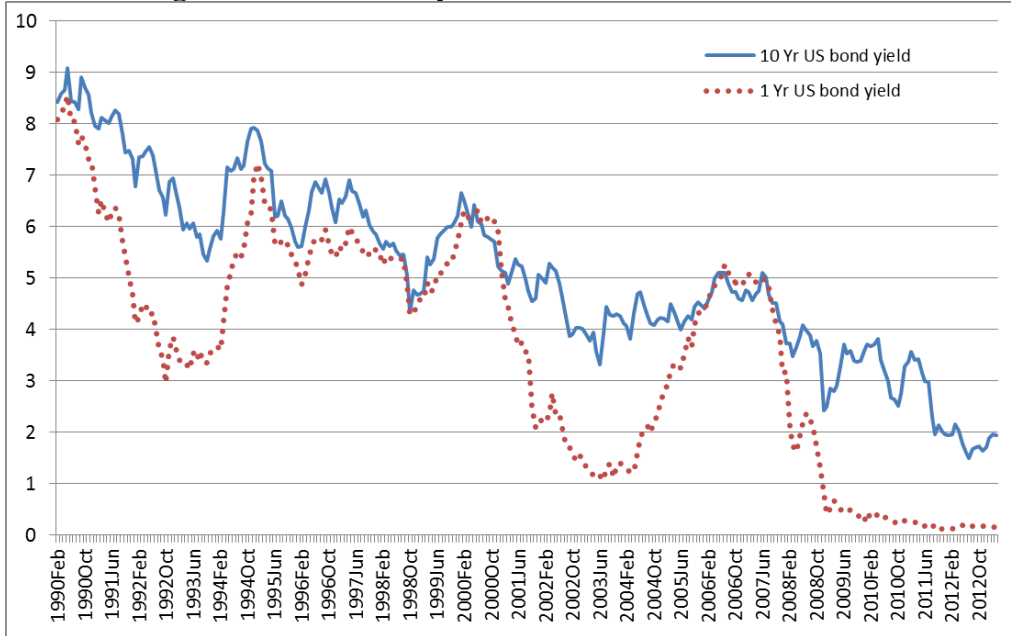
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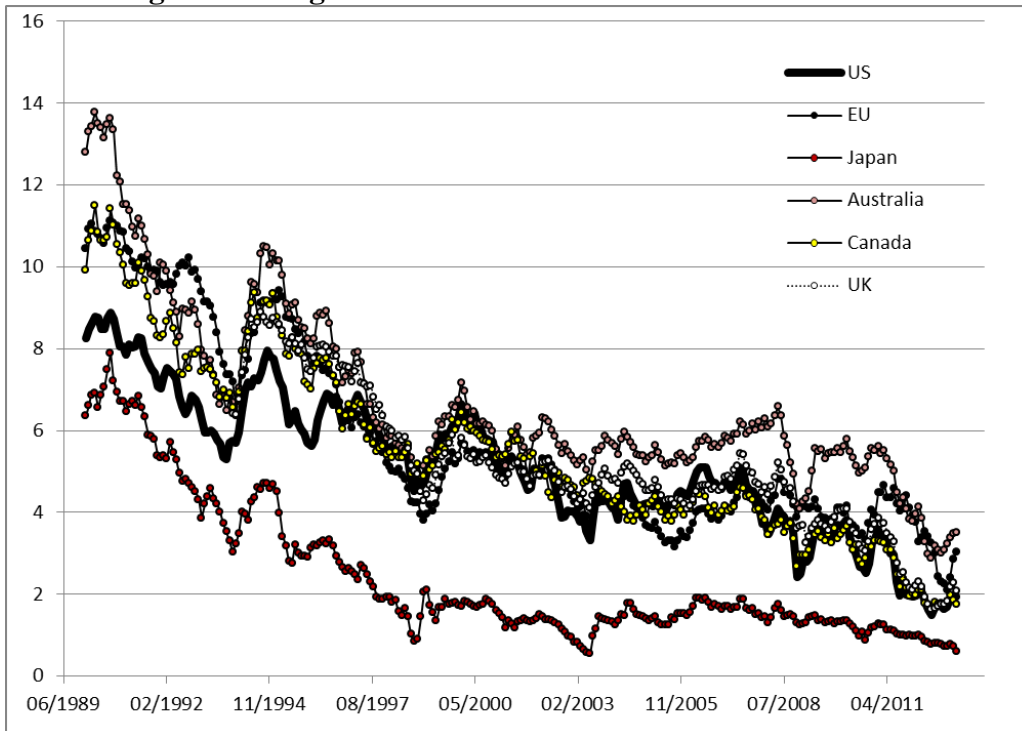


**Figure 1: US Treasury Bond Yields over Two Decades**



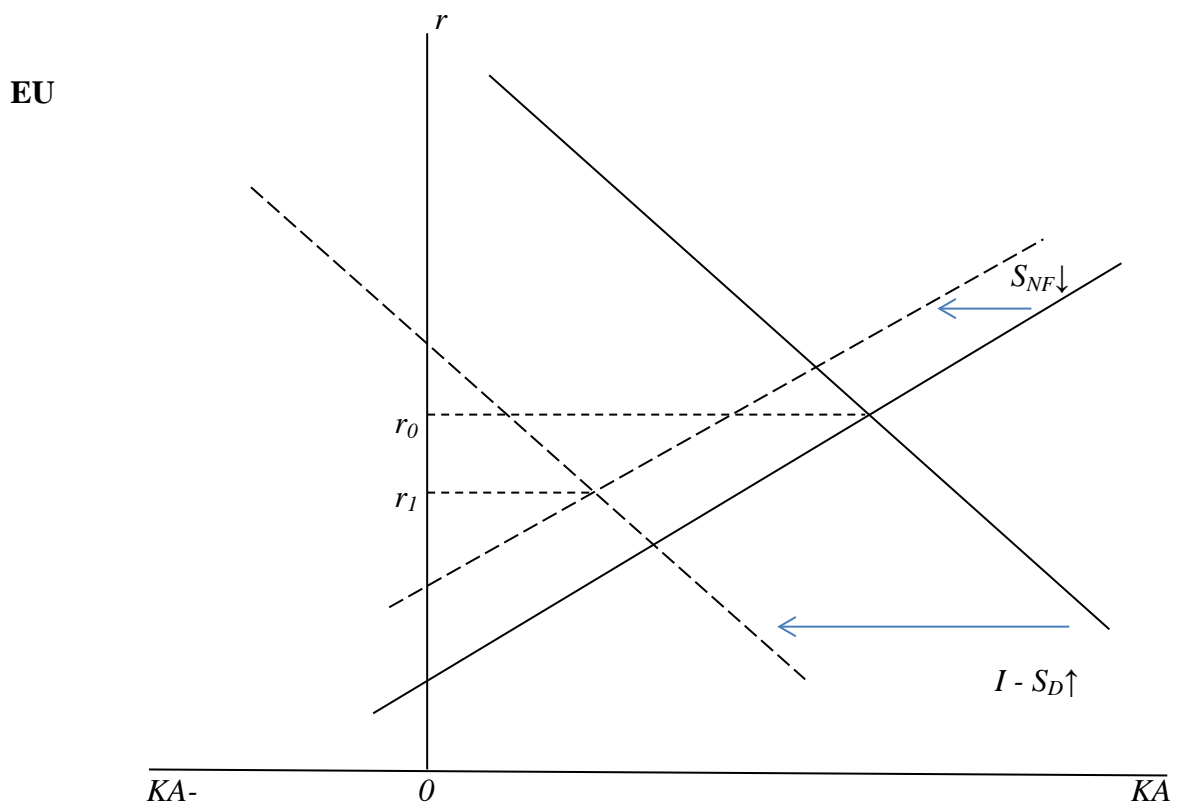
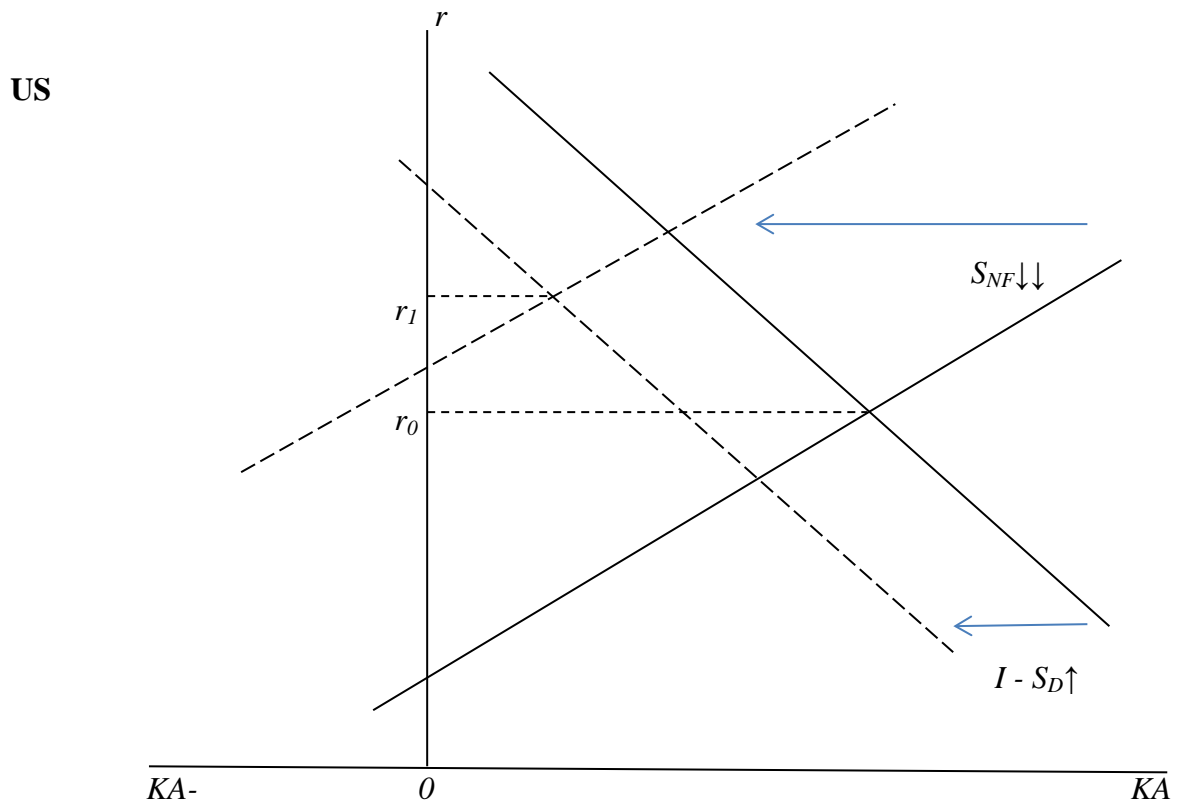
Source: US Treasury.

**Figure 2: Long Term Bond Yields in Advanced Economies**

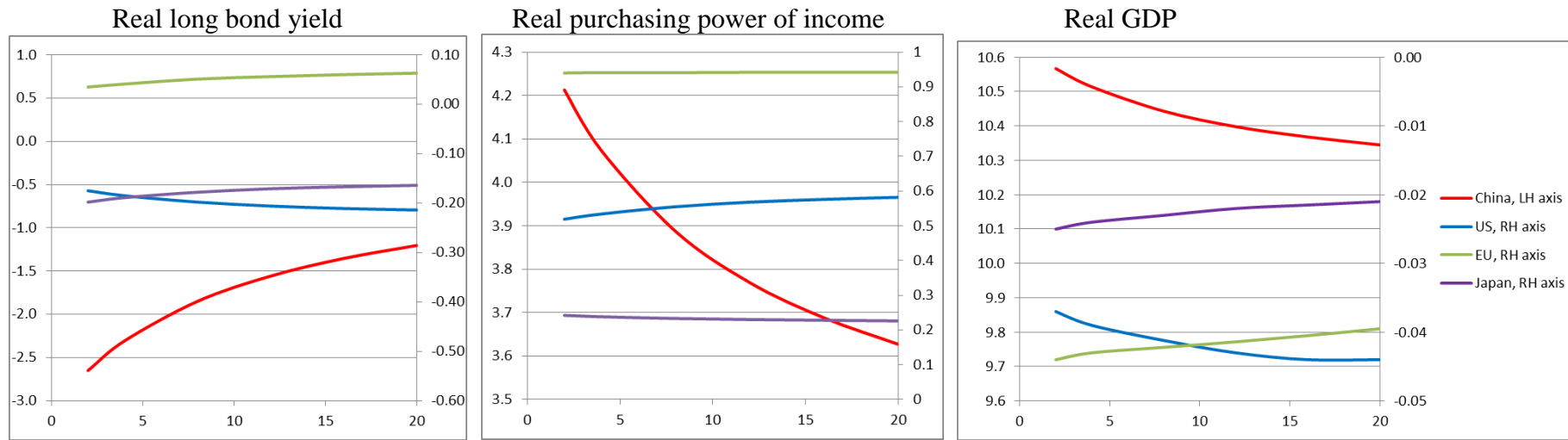


Sources: Bank of Canada, Bank of England, European Central Bank, Reserve Bank of Australia, US Federal Reserve.

**Figure 3: Effects on Bond Yields in the US and EU**

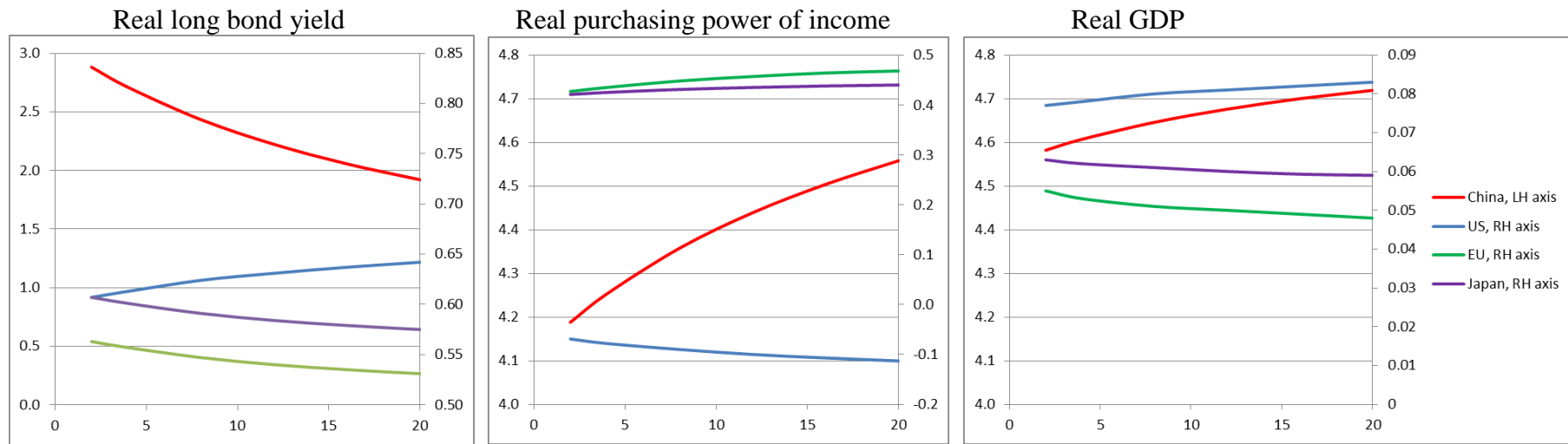


**Figure 4: Effects of the Growth Surge: Sensitivity to China's Financial Integration**  
(per cent changes)



Source: Simulations of the model described in the text.

**Figure 5: Effects of the Transition: Sensitivity to China's Financial Integration**  
(per cent changes)



Source: Simulations of the model described in the text.

**Table 1: Relative Economic Sizes of China and the Other Large Regions, ca 2011:**

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

**Table 2: Shares of Total Domestic Saving Directed to Investment in Each Region, 2011<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>Labour market:</b>	Exogenous nominal production (unskilled) wage with endogenous production employment
<b>Fiscal policy:</b>	Exogenous nominal government spending and endogenous government revenue at fixed rates of tax on income, consumption and trade
<b>Monetary policy targets<sup>b</sup></b>	China and the Rest of the World: Fixed exchange rates against the US\$ <sup>c</sup> US, EU and Japan: <ol style="list-style-type: none"><li>1. Fixed monetary bases<sup>d</sup></li><li>2. Producer price level targets</li><li>3. Consumer price level targets</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.

**Table 4: Experimental Shocks<sup>a</sup>**

Scenario	Shocks, %
<i>1. Growth surge</i>	
	Productivity, $A^Y$ 3
	Consumption constant, $A^C$ -10
	Capital stock, $K$ 8
	Skill stock, $S$ 10
<i>2. Transition</i>	
	Productivity, $A^Y$ 1
	Consumption constant, $A^C$ 15
	Capital stock, $K$ 3
	Skill stock, $S$ 10
	Nominal wage, $W^b$ 4

a All shocks are to the Chinese economy only.

b The Chinese nominal wage is shocked with the transition case only to allow for accelerated relative production wage growth in the transition, fostering consumption.

**Table 5: Effects of the Growth Surge with Moderate Financial Integration<sup>a</sup>**

% changes	US, EU, Japan monetary target	US	EU(26)	Japan	China
Real bond yield, $r$	Monetary base	-0.21	0.07	-0.20	-2.43
	Producer price level	-1.23	-0.82	-1.22	-3.33
	Consumer price level	-3.23	-2.84	-3.15	-4.94
Consumer price level, $P^C$	Monetary base	-0.20	-0.16	-0.12	-6.19
	Producer price level	0.00	0.00	0.00	-5.74
	Consumer price level	0.31	0.64	0.19	-5.02
Producer price level, $P^P$	Monetary base	-0.67	-0.81	-0.37	-1.58
	Producer price level	-0.39	-0.74	-0.21	-1.17
	Consumer price level	0.00	0.00	0.00	-0.59
Exchange rate vs US\$, $E$	Monetary base	0.00	-0.32	-0.83	0.00
	Producer price level	0.00	0.03	-0.63	0.00
	Consumer price level	0.00	-0.24	-0.28	0.00
Real investment, $I/P^P$	Monetary base	0.36	0.11	0.2	10.86
	Producer price level	0.54	0.83	0.32	11.63
	Consumer price level	1.05	2.19	0.65	13.09
Production employment, $L$	Monetary base	-0.24	-0.19	-0.14	3.68
	Producer price level	0.00	0.00	0.00	4.35
	Consumer price level	0.38	0.78	0.23	5.44
<b>Real output (GDP), <math>Y/P^Y</math></b>	Monetary base	-0.04	-0.03	-0.03	10.52
	Producer price level	0.00	0.00	0.00	10.71
	Consumer price level	0.07	0.14	0.04	11.01
<b>Real income <math>Y/P^C</math></b>	Monetary base	0.55	0.86	0.25	4.15
	Producer price level	0.48	0.99	0.24	4.35
	Consumer price level	0.44	0.89	0.25	4.77

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: 15, EU: 15, Japan: 10, China: 5, Australia: 15, Rest of World: 5.

Source: Simulations of the model described in the text.



**Table 6: Effects of the Transition with Moderate Financial Integration<sup>a</sup>**

% changes	US, EU, Japan monetary target	US	EU(26)	Japan	China
Real bond yield, $r$	Monetary base	0.62	0.54	0.63	3.05
	Producer price level	2.61	2.22	2.69	4.94
	Consumer price level	2.00	1.63	1.89	4.42
Consumer price level, $P^C$	Monetary base	0.37	0.23	0.31	-1.47
	Producer price level	0.00	0.00	0.00	-2.36
	Consumer price level	0.07	0.15	0.28	-2.19
Producer price level, $P^P$	Monetary base	0.46	-0.15	-0.03	0.65
	Producer price level	-0.07	-0.16	-0.47	-0.13
	Consumer price level	0.00	0.00	0.00	-0.07
Exchange rate vs US\$, $E$	Monetary base	0.00	0.84	1.31	0.00
	Producer price level	0.00	0.00	1.22	0.00
	Consumer price level	0.00	-0.06	0.45	0.00
Real investment, $I/P^P$	Monetary base	-0.91	-0.62	-0.78	2.64
	Producer price level	-1.18	-1.99	-0.81	1.25
	Consumer price level	-1.03	-1.59	-1.11	1.67
Production employment, $L$	Monetary base	0.45	0.28	0.37	-0.93
	Producer price level	0.00	0.00	0.00	-2.15
	Consumer price level	0.08	0.19	0.34	-1.91
<b>Real output (GDP), <math>Y/P^Y</math></b>	Monetary base	0.08	0.05	0.07	4.57
	Producer price level	0.00	0.00	0.00	4.23
	Consumer price level	0.01	0.03	0.06	4.29
<b>Real income <math>Y/P^C</math></b>	Monetary base	-0.08	0.47	0.41	4.10
	Producer price level	0.05	0.15	0.49	3.70
	Consumer price level	0.06	0.16	0.34	3.89

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: 15, EU: 15, Japan: 10, China: 5, Australia: 15, Rest of World: 5.

Source: Simulations of the model described in the text.