



THE UNIVERSITY OF  
WESTERN AUSTRALIA  
*Achieve International Excellence*

---

# **ECONOMICS**

## **A SIMPLE MODEL TO STUDY GLOBAL MACROECONOMIC INTERDEPENDENCE**

**by**

**Rod Tyers**

**Business School  
University of Western Australia, and  
Research School of Economics  
Australian National University**

**DISCUSSION PAPER 13.23**

# **A SIMPLE MODEL TO STUDY GLOBAL MACROECONOMIC INTERDEPENDENCE\***

Rod TYERS  
Business School  
University of Western Australia, and  
Research School of Economics  
Australian National University

Working Papers in Economics  
UWA Business School, May 2013

Key words:  
Economic modelling, Macroeconomic coordination

## **DISCUSSION PAPER 13.23**

### **Abstract**

Insights into the international implications of China's entry to the large economy club and the four-region strategic behaviour that results can be derived from applications of the elemental multi-region, macroeconomic simulation model introduced in this paper. It has a global general equilibrium structure that embodies bilateral linkages between represented regions via *both* trade and investment. Its behaviour is illustrated with an application to monetary policy following a period of deflationary expectations. Unilateral expansions are shown clearly to have negative real implications for the other large economies whose central banks are forced to respond in kind.

\* Thanks for assistance with the construction of the database for this model go to Ying Zhang and Tsun Se Cheong.

## **1 Introduction**

Critical to understanding the behaviour of the global economy is the interaction between the macroeconomic policy regimes of the major economic regions, the US, the Western Europe and Japan, recently joined by China. These regions are all “large” in that the policies of each affect the others as a group as well as the world’s many smaller economies. Their behaviour is therefore highly inter-active and strategic. The rise of China and other Asian, heretofore developing, economies since the 1980s has not only underwritten global economic performance but high East Asian saving rates have contributed to what became known as the “Asian savings glut”.<sup>1</sup> Global real interest rates peaked in the mid-1980s and have fallen since, in part because of this relative increase in global savings supply. These changes have been regarded by critics as having been at the expense of both investment and employment in the US, Western Europe and Japan while proponents emphasise improvements in their terms of trade and reductions to the cost of financing that stem from China’s supply of light manufactures, its demand for Western capital and luxury goods as well as its high saving.

To capture the macroeconomic implications of the continued growth of China and the inherently strategic behaviour of macroeconomic policy in the “large economies club” this paper introduces a multi-region general equilibrium model that incorporates elemental macroeconomic behaviour. Importantly, the model embodies not only full matrices of trade flows but also bilateral relationships between savers one region and investment in others that allow for the mobility of investable funds but recognise the Goldstein-Horioka association between home saving and home investment. The section to follow offers a brief review of global macroeconomic issues and Section 3 details the model. The illustrative analysis of deflationary expectations is discussed in Section 4 and conclusions are offered in Section 5.

## **2. Global Macroeconomic Policy Interaction**

Global financial markets continue to be dominated by the US, which has sustained a structural current account deficit since the 1990s. Though much that has been unpalatable since 2007 has been blamed on the GFC, the broad pattern of international finances did not appear to be permanently changed by it. Critically, it brought about a reversion by the private sectors in the US, the EU and Japan to net saving positions while all three governments assumed net borrowing positions, as shown in Figure 1. It therefore replaced private debt, some of which

---

<sup>1</sup> See Bernanke (2005), Chinn and Ito (2007), Choi et al. (2008) and Ito (2009).

had been unsustainable, with sovereign debt, some of which is also unsustainable, leaving heightened global uncertainty as to sovereign financing (Figure 2).

A key change took place around 2005, before which the large US deficit had been financed by surpluses in Japan and the oil producing countries. Thereafter, however, the burden of this financing rested increasingly with China, as shown in Figure 3. By 2010 China had joined the club of major economies and was the dominant supplier of finance to the rest of the world while the regions other than it and the US were in comparative current account balance. The international financing game had become one between China and the US. After 2010, though, China's relative role as surplus financier began to diminish with the shifts in its domestic saving-investment balance associated with its transition from export led growth to a more inward-focussed regime. It remains a substantial buyer of US debt and equities, however, highlighting the potential for disruption in US financial markets should China's excess saving continue to decline (Tyers et al. 2013).

#### *Global finance over two decades*

Some insight into the macroeconomic events leading up to the GFC is offered by Figure 4, which shows the yields on short and long term US Treasury bonds since the beginning of the 1990s. Consistent with the market segmentation theory of the yield curve, imagine that the transaction cost of financing long via a succession of short contracts to be prohibitive, allowing short and long maturity instruments to trade at substantially different prices. Moreover, short bonds are instruments of conventional domestic monetary policy and they are traded little between countries, or at least between the major economic regions considered here. Long bonds, by contrast, are instruments of private saving and investment.<sup>2</sup> They are substitutes for equity holdings and are extensively traded internationally. Long bond yields are therefore more stable through time than short yields and reflect movements in the equilibrium between global saving and investment. Short yields, on the other hand, reflect monetary easing and tightening through business cycles that have often been specific to particular economies. Considering this, Figure 4 clearly shows the two large US cycles that preceded the GFC and the tightening that led up to it in 2004-5, when petroleum prices rose.<sup>3</sup> It was this tightening that exposed those investors who expected short rates to remain low, precipitating the GFC.

---

<sup>2</sup> While this is true as a rule of thumb, 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>3</sup> Its origins in petroleum markets are analyzed by Arora and Tyers (2011).

Beyond 2008, of course, the US entered a liquidity trap, as did Europe, and Japan had been in one for at a decade.

What is also notable from Figure 4 is the continuous and smooth downward trend in long bond yields. This is as clear an index as any of the Asian savings glut. After the 1980s the great majority of the world's incremental growth took place in Asia, where saving rates were, and continue to be, substantially higher than in the rest of the world. Long yields, which had risen prior to the mid-1980s, have fallen continuously since. Though it is not shown in the figure, this long run pattern is also observable in European, Canadian and Australian long bond yields. Importantly, and this is clear from the more recent data on yields represented in Figure 5, the downward trend in long yields persists beyond the GFC in all three economic regions. Yet the evidence is building that the Asian savings glut is over, led by declining net saving in both Japan and China. What, then, explains the continuing decline in long yields?

#### *Quantitative easing*

The most likely explanation is unconventional monetary policy, or “quantitative easing” (QE), whereby money expansions are achieved via the large scale purchase of long bonds, and related instruments, by central banks. For economies that have been stagnant in real terms since 2007, this has led to the substantial expansions in central bank asset holdings shown in Figure 6.<sup>4</sup> These raise the prices of long bonds and related instruments and suppress their yields. Unlike more conventional monetary policy, the QE focus on widely traded instruments projects the domestic monetary cycle beyond national borders with immediacy. In part for this reason, the policy is being matched across the three large blocs, causing financial outflows as investors seek out better yields abroad.<sup>5</sup> So what purpose does such unconventional monetary policy serve?

The three large economic regions have, each by their own historical standards, high unemployment and governments with extraordinary sovereign debt overhangs. Further fiscal expansion seems unwise yet their liquidity traps prevent conventional monetary expansions. QE offers an alternative stimulatory course, so long as private portfolio holders preoccupied with the prospect of deflation are prepared to hoard at least part of the money thus supplied. Under these conditions, acquisitions by central banks offer the convenience of additional

---

<sup>4</sup> It is notable that China's monetary base is large compared with the others, which is likely due to reduced money creation by China's commercial banks in response to such restrictions as high reserve to deposit ratios.

<sup>5</sup> Of course, one clear rationale for QE on the part of the US Federal Reserve is that the substitution will be away from US bonds to US equities. And this has happened too. Much less is said by the Fed about the international effects.

leeway for further government deficit spending. Governments continue to spend beyond their revenues and central bank acquisitions mask the decline in Asian demand for their bonds. Moreover, unless the expansions are fully matched abroad, the new abundance of regional currency depreciates the exchange rate and stimulates traded sectors. Of course all this is only sustainable so long as private portfolio-holders expect long term deflation and hence absorb the currency thus made available.

### *The global game*

In an important sense, QE policies are part of a strategic game within the small club comprising the major economic regions, of which China is now a member. A substantial monetary expansion by one region requires a matching response from the others to avoid appreciations that would reduce competitiveness. In China, the other transitional economies and the resource exporting economies like Canada and Australia, outside the club, the result has been accelerating inflation, or more substantial nominal appreciations relative to the US.<sup>6</sup> The notable thing about movements in the major currencies since 2000, shown in Figure 7, is that the US\$ has gradually depreciated against all. Beyond that, the Yen, the Euro and the Yuan have tended to move together, particularly in the aftermath of the GFC, when they appeared to stabilise around their 2000 relativities, albeit all appreciating by a third against the US\$. Very recently, there has been a break from this pattern with Japan's more aggressive QE causing a substantial depreciation relative to the others. Since the Japanese economy is now the smallest of the economic blocs, it is possible that its departure from equilibrium could be sustained at minimum cost to the others.

## **3. The Model**

Representing a length of run within the gestation period of investment and hence over which capital use is constant, the model used offers comparative static analysis of shocks that cause departures from an underlying long run growth path of the global economy. The simulated economy is not in an initial steady state so that the real net rate of return on physical capital in any region generally departs from the real rate of return on bonds in that region.

---

<sup>6</sup> The A\$ is the resource currency of an outsider economy that is not a default risk and that has not engaged in aggressive monetary expansion. Return-seeking financial flows from the QE economies have therefore boosted its value.

Each region supplies a single product that, so far as all consumers are concerned, is differentiated from the products of the other regions. On the supply side, there are three primary factors with “production” labour ( $L$ ) a variable factor in the length of run under consideration. Capital ( $K$ ) and skill ( $S_K$ ) stocks are fixed. These are combined in Cobb-Douglas production technology. Total consumption depends on current and expected future disposable income, via an extended Keynesian consumption equation, and its value is then subdivided in a single CES structure between the products of each regions. Private savings are the residual from disposable income and these are combined with government savings and directed into asset portfolios that are fully bilateral. Allocations of saving to investment across regions depend on expected real rates of return relative to regional financing rates, which in turn depend on endogenous risk premia.

Six regions are identified: the US, the EU, Japan, China, Australia and the Rest of the World.<sup>7</sup> There are therefore six products and 12 financial assets: the home money of each region and bonds that are homogeneous within regions across the private sector and government but are differentiated between regions. The demand for money is driven by a cash in advance constraint applying across the whole of GDP, as embedded in a conventional demand for real money balances equation. For any one household, home money is held in a portfolio with long maturity bonds and the latter are claims over domestic government debt, which along with new money issues has first rights to domestic private saving, and physical capital across the regions.<sup>8</sup>

Expectations are exogenous in the model and are formed over the home price level, the rate of inflation, the real rate of return on physical capital and the real exchange rate.<sup>9</sup> The details are as follows.

### ***The supply side:***

***Production:*** Output is assumed to be Cobb-Douglas in the three primary factors, so that local output and marginal product of capital are:

---

<sup>7</sup> The EU is modeled as the full 26 and it is assumed that this collective has a single central bank.

<sup>8</sup> Short maturity bonds are conventional money market instruments the market for which is suppressed here. These instruments tend not to be held outside their issuing regions and so the scale of their market can be represented by their share of the backing for the monetary base. Note that collective portfolios are dominated by long maturity assets the yields on which are the opportunity cost of holding money.

<sup>9</sup> In this comparative static version, it is also assumed that net factor income flows from abroad,  $N$ , which appear on the current account, net to zero.

$$(1) \quad y = A^Y (\theta L)^{\beta_L} S_K^{\beta_S} K^{\beta_K} \quad \text{where } \beta_L + \beta_S + \beta_K = 1$$

$$(2) \quad MP_K = \beta_K \frac{y}{K} = \left[ A \beta_K S_K^{\beta_S} K^{\beta_K - 1} \right] (\theta L)^{\beta_L} = r^c$$

Equation (1) gives the real volume of output and we will distinguish between this volume,  $y$ , and nominal GDP,  $Y = P^Y y$ , where  $P^Y$  is the GDP price level (deflator). In a single product economy (2) gives the gross real rate of return on installed capital,  $r^c$ . Recall that the simulated economy is not in a steady state and so, in general, this rate does not equal the real rate of return on home bonds,  $r$ , to be formulated subsequently.

The product real wages of production and skilled workers depend on the corresponding marginal products.

$$(3) \quad w = \frac{W}{P^P} = MP_L = \beta_L \frac{y}{L}$$

$$(4) \quad w_S = \frac{W_S}{P^P} = MP_{S_K} = \beta_{S_K} \frac{y}{S_K}$$

Here the upper case wages are nominal and the lower case real. Here the price used is the producer price level,  $P^P$ , which as we will see is different from the GDP price,  $P^Y$ . The unemployment rate is calculated for all workers, where the labour force is  $F$ :

$$(5) \quad u = \frac{F - S_K - L}{F} .$$

### ***The demand side:***

Both direct and indirect tax revenues,  $T^D$  and  $T^I$ , play key roles in the formulation. GDP<sup>10</sup> at factor cost (or producer prices), GDP<sup>FC</sup>, is the total of direct payments to the collective household in return for the use of its labour and owned physical capital. So nominal GDP and GDP<sup>FC</sup> can be written:

$$(6) \quad Y = Y^{FC} + T^I, \quad Y^{FC} = C + T^D + S_P$$

This is the standard disposal identity for GDP, where  $C$  is the total value of final consumption expenditure, which includes indirect taxes paid, and  $S_P$  is private saving. The second equation is the collective household's budget, expressed in home currency.

---

<sup>10</sup> This is also GNP in this case, since there are no net factor income flows on the current account.



The GDP price,  $P^Y$ , and the producer price,  $P^P$ , would be the same were it not for indirect taxes. In their presence (6) becomes:

$$(7) \quad Y = P^Y y = P^P y + T^I, \text{ so that } P^Y = P^P + \frac{T^I}{y}.$$

This relationship is important if consumption taxes and trade distortions are to be represented in the model.

#### *Direct tax*

A constant marginal direct tax rate,  $t^W$ , is assumed to apply to all labour income, while the marginal tax rate on capital income is  $t^K$ . The corresponding “powers” of these rates are  $\tau^L(1+t^L)$  and  $\tau^K(1+t^K)$  and these appear in the coding of the model. There is no distinction between home output and home capital goods, so the capital goods price is  $P^P$ .

$$(8) \quad T^D = t^L(WL + W_S S_K) + t^K r^c P^P K,$$

where capital income for tax purposes is determined according to the actual gross rate of return rather than the market interest rate,  $r$ . Indirect tax revenue,  $T^I$ , depends on consumption and trade and so it will emerge later.

#### *Consumption*

Aggregate consumption,  $C$ , is a nominal sum but real consumption behaviour is motivated by real incomes and the real interest rate, so here the formulation is in terms of volumes. Real consumption,  $c$ , depends negatively on the real after-tax return on savings (the home bond yield,  $r$ ) and positively on both current and expected future disposable (post direct tax) real income.

$$(9) \quad c = \frac{C}{P^C} = A^C \left( \frac{r}{\tau^K} \right)^{-\varepsilon^{CR}} \left( \frac{Y^D}{P^C} \right)^{\varepsilon^{CY}} \left( \frac{Y^{De}}{P^{CE}} \right)^{\varepsilon^{CY}}.$$

Here an exogenous expected inflation rate of consumer prices is specified so that

$$P^{CE} = P^C (1 + \pi^e).$$

To capture the home household’s substitution between home and foreign products, real aggregate consumption in region  $i$  is a CES composite of region  $i$ ’s consumption of all six regional products:

$$(10) \quad c_i = \left( \sum_j \alpha_{ij} c_{ij}^{-\theta_i} \right)^{-\frac{1}{\theta_i}}$$

The home household then chooses its mix of consumed products to minimise consumption expenditure in a way that accounts for home indirect tax rates, foreign export taxes and differing foreign product prices and exchange rates:

$$(11) \quad C_i = P_i^C c_i = P_i^P \tau_i^C c_{ii} + \sum_j \tau_i^C \tau_i^M \tau_j^X c_{ij} P_j^P \frac{E_j}{E_i},$$

where  $\tau_i^C$ ,  $\tau_i^M$  and  $\tau_j^X$  are, respectively, the powers of region  $i$ 's consumption and import taxes and the region of origin,  $j$ 's export tax.  $E_i$  is region  $i$ 's nominal exchange rate, measured in US\$ per unit of home currency. The US\$ is the numeraire in the model.

Optimum consumption is consistent with an elasticity of substitution between home and foreign products of  $\sigma_i = 1/(1+\theta_i)$ . The Marshallian demands are then:

$$(12) \quad c_{ii} = \alpha_{ii}^{\sigma_i} \frac{C_i}{P_i^C} \left[ \frac{P_i^P \tau_i^C}{P_i^C} \right]^{-\sigma_i}, \quad c_{ij} = \alpha_{ij}^{\sigma_i} \frac{C_i}{P_i^C} \left[ \frac{\frac{P_j^P E_j}{E_i} \tau_i^C \tau_i^M}{P_i^C} \right]^{-\sigma_i}, \quad i \neq j$$

Given these consumption volumes, the composite price of all consumption, or the consumer price level, emerges from the substitution of (10) and (12) in (11) as:

$$(13) \quad P_i^C = \tau_i^C \left[ \alpha_{ii}^{\sigma_i} (P_i^P)^{1-\sigma_i} + \tau_i^M \sum_{j \neq i} \alpha_{ij}^{\sigma_i} \left\{ \frac{P_j^P E_j}{E_i} \right\}^{1-\sigma_i} \right]^{\frac{1}{1-\sigma_i}}$$

#### *The global product balance*

Each region's product is differentiated from the others and so global product balance stems from a version of the expenditure identity:

$$(14) \quad y_i = \frac{I_i + G_i}{P_i^P} + \sum_j c_{ji},$$

where the final term is the sum of real consumption and real exports. Neither investors nor the government pay indirect taxes on their expenditure and so the price they face for the home product is the producer price,  $P^P$ . This equation solves indirectly for the producer prices.

### *Private savings*

Households receive income amounting to GDP at factor cost,  $Y^{FC}$ . Their disposable nominal income is this sum less direct tax (8), and private saving is what remains after consumption expenditure (9) is further deducted.

$$(14) \quad Y^D = P^P y - T^D, \quad S^P = Y^D - C$$

### *Indirect tax revenue*

This includes revenue from consumption, import and export taxes:

$$(15) \quad T_i^C = t_i^C \left( P_i^P c_{ii} + \sum_j \tau_i^M \tau_j^X c_{ij} P_j^P \frac{E_j}{E_i} \right),$$

$$(16) \quad T_i^M = t_i^M M_i, \quad M_i = \sum_{j \neq i} \tau_j^X c_{ij} P_j^P \frac{E_j}{E_i},$$

$$(17) \quad T_i^X = t_i^X X_i, \quad X_i = \sum_j c_{ji} P_i^P,$$

$$(18) \quad T_i^I = T_i^C + T_i^M + T_i^X.$$

### *Government saving*

This is government revenue less government expenditure, both measured net of direct transfers.

$$(19) \quad S^G = T^D + T^I - G.$$

To simplify the demand side, government spending is assumed to be directed only at home goods. It pays no taxes and so faces price  $P^P$ .

### *Total domestic saving*

This is the sum of private and government savings in the home economy, a value in home currency.

$$(20) \quad S^D = S^P + S^G$$

### *The direction of saving to investment*

The approach taken to bilateral investment flows is a simplification of the optimisation result obtained for similar use by Tyers and Cheong (2013). Data on regional saving and investment for 2011 is combined with that on international financial flows to construct an initial matrix that allocates total saving to investment in each region. From this is derived a corresponding

matrix of initial shares of region  $i$ 's saving allocated to investment in region  $j$ ,  $s_{ij}^{SO}$ . When the model is shocked, the new shares are calculated so as to favour investment in regions,  $j$ , with comparatively high expected real rates of return,  $r^{ce}$ , and/or low financing interest rates,  $r$ .<sup>11</sup> Expected real rates of return depend on the technology and on expected real appreciations:

$$(21) \quad r_i^{ce} = r_i^c + \hat{e}_i^e = MP_i^K + \hat{e}_i^e = r_i^c \gamma_i^e,$$

Where  $\gamma_i^e$  is an expectational factor applied exogenously or solved for model consistency.

$$(22) \quad s_{ij}^S = \frac{s_{ij}^{SO} \left( \frac{r_j^{ce}}{r_i} \frac{\tau_i^K}{\tau_j^K} \right)^{\varphi_i}}{\sum_k s_{ik}^{SO} \left( \frac{r_k^{ce}}{r_i} \frac{\tau_i^K}{\tau_k^K} \right)^{\varphi_i}}$$

where  $\varphi_i$  is an elasticity that reflects the return-seeking behaviour of region  $i$ 's portfolio manager but also the differentiation of regional bonds from one another due to differences in legal structures, property rights security, price level and exchange rate stability and sovereign risk. Note that the tax rate on capital income would not enter this relationship were investment to be financed in the destination region, since it is assumed the tax would apply to all types of capital earnings at the same rate. The assumption here is that it is financed in the region of origin and so, considering that tax rates differ across regions, these differences are accounted for by the added quotients. Total investment spending in region  $j$ , in local currency, is then:

$$(22) \quad I_j = \sum_i \left( s_{ij}^S S_i^D \frac{E_i}{E_j} \right).$$

This approach captures Feldstein-Horioka (1980) home preference while allowing regional redistribution of investment spending at the margin to a magnitude that depends on the return-seeking elasticity,  $\varphi_i$ .

### *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:

---

<sup>11</sup> The ratio,  $r^{ce}/r$ , is akin to Tobin's Q since current asset value depends on expected future rates of return and the replacement cost depends on the current financing rate.

$$(23) \quad X_i - M_i + \sum_{j \neq i} \left( s_{ji}^S S_j^D \frac{E_j}{E_i} \right) - \sum_{j \neq i} (s_{ij}^S S_i^D) = 0, \quad \forall i \neq "US"$$

Balance in the US is implied by balance in all the other regions. These equations determine the exchange rates and, since these are defined relative to the US\$, that for the US is always unity,  $E_{US} = 1$ .

#### *Global financial equilibrium and real financing interest rates*

The sum of investment spending worldwide must equal the sum of domestic saving worldwide.

$$(24) \quad \sum_i I_i E_i = \sum_i S_i^D E_i .$$

This condition determines a global interest rate to clear financial markets,  $r^W$ . Regional financing yields are then set relative to this rate using an interest premium factor,  $\lambda_i$ , that is defined relative to  $r_{US}$ , so that  $\lambda_{US} = 1$ , and depends on relative fiscal balance:

$$(25) \quad r_i = r^W \lambda_i, \quad \lambda_i = \lambda_i^0 \left[ \frac{\left( \frac{G_i}{T_i} / \frac{G_{US}}{T_{US}} \right)}{\left( \frac{G_i^0}{T_i^0} / \frac{G_{US}^0}{T_{US}^0} \right)} \right]^{\phi_i}, \quad \forall i \neq "US",$$

Where  $\phi_i$  is an elasticity that determines the sensitivity of the premium to relative fiscal balance.

#### *Regional money market equilibrium*

A cash in advance constraint is assumed that generates 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 bonds. Real money balances are measured in terms of purchasing power over home products.

$$(26) \quad m_i^D = a^{MD} (y_i)^{\epsilon^{MT}} \left( \frac{r_i (1 + \pi_i^e)}{\tau_i^K} \right)^{-\epsilon^{MR}} = \frac{M_i^S}{P_i^Y} .$$

The monetary base and the nominal money supply are linked by a standard money multiplier:

$$(27) \quad \frac{M_i^S}{M_i^B} = \frac{1 + \mu_i}{\rho_i + \mu_i} ,$$

where  $\rho_i$  is the reserve to deposit ratio and  $\mu_i$  is the cash to deposit ratio.

### *Real exchange rate*

Each region has a real exchange rate relative to the US that is the rate of exchange between regional product bundles. With the regions specified as single product economies this measure parallels the terms of trade. Both real and nominal exchange rates are expressed according to the financial convention, so that an appreciation is a rise in value.

$$(21) \quad e_i = \frac{P_i^Y}{\left( \frac{P_{US}^Y}{E_i} \right)} = E_i \frac{P_i^Y}{P_{US}^Y} .$$

### **The database and parameters**

The model database is built on national accounts, international trade and financial data for the global economy in 2011. The relative sizes of the four major economic regions, the US, the EU, Japan and China are indicated in Table 1, from which it is clear that China's economy (even measured without PPP adjustment) is not the smallest of them and it matches the largest in investment, exports and saving.

The structures of the regional economies are indicated in Table 2. They differ in important ways. The US has a high consumption share of GDP, China a low one. Necessarily, then, the US has a low saving share while China has a high one. Some regions are more dependent on indirect taxes than others, which makes a difference to the proportion of GDP made up of factor cost and hence the size of the household budget and the gap between producer and GDP prices. The EU is relatively dependent on indirect taxes, for example. Since these taxes (at least those accounted for in the model) fall most heavily on consumption, changes in saving behaviour have strong implications for fiscal deficits and, indirectly, for interest premia. Investment is larger in some than in others, being extraordinarily high in China. And then, of course there are the fiscal deficits that are largest in the US and Japan, and the current account surpluses or capital-financial account deficits in Japan and China, at least partly funding the very substantial deficit in the US.

Interactions between these large economies through trade are captured in the consumption expenditure matrix shown in Table 3. It is derived from the combination of national accounts with a matrix of trade flows. The flows are expenditures inclusive of indirect taxes, converted into the shares of total expenditure on goods and services by each country. Implicit, and

consistent with the one-good per region model, is the assumption that investment and government spending make demands on the markets for home goods only. As it turns out, this assumption has important implications for the representation of China in the model. Since its consumption is comparatively low and its investment high, home products are mostly absorbed by investment and government spending and so China's consumption is distributed more evenly across regional goods than for the other economies. This suggests a case for an import-dependent capital goods industry in the model.

The financial interactions between the regions are indicated by the saving-to-investment flows in Table 4. These show the expected Feldstein-Horioka (1980) behaviour but also that there are substantial financial interactions between the US, the EU and Japan in particular. The share of excess saving directed to the US might be expected to change due to the recent decline in reserve accumulation by China and its substitution with outward FDI that, most recently, has not been directed to the US (Tyers et al. 2013). Finally, a complete list of the behavioural parameters used in the model is provided in Table 5.

#### **4. Analysis: Deflation Expectations and Monetary Policy**

Comparative static analysis using the model requires that a set of shocks be applied to exogenous policy variables or behavioural parameters. These "levers" are listed in Table 6. Multiple shocks can be applied simultaneously, though it should be recalled that the further from the initial equilibrium the software is forced to look for a solution the more difficult it is to find one and the less accurate is the solution obtained. Associated closure choices available in the model are listed in Table 7.

Central banks in the US, Europe and Japan have found themselves in liquidity traps (effectively zero yields on short term money market instruments) because, for reasons discussed earlier, private agents have anticipated deflation and hence "hoarded" money. For this application, imagine that the US, EU and Japan are in liquidity traps and hence cannot use conventional monetary policy to further target their price levels. If portfolio holders expect deflation then money hoarding will continue, raising the price of money relative to goods and hence bringing the expectation to fruition. The shocks and closures for an analysis of this are listed in Table 8 and the results are given in Table 9. The resulting deflation is largest in the US and so the US\$ appreciates against the other currencies. For firms, the deflation raises labour and skill costs relative to total revenue and workers are laid off in all three regions.

Real output falls as does real investment. By assumption, government spending is fixed in nominal terms, so it rises in real terms.

Now imagine that the US Fed is the first central bank to engage in QE as a means of controlling the deflation and it does so sufficiently to restore the GDP price to its original value. Assume that portfolio holders maintain their negative expectations, failing to trust the capacity of the new monetary approach to eliminate deflation permanently. The US is therefore the “first mover” in a monetary game. Even while private expectations remain pessimistic, the results in Table 9 show that the negative effects for the US are largely erased. Strikingly, however, the currencies of the EU and Japan appreciate against the US\$ and their deflations are almost doubled, as are the real contractionary effects. This shows clearly why it then becomes necessary for the other large regions to match the US with their own QE. If they all do so, and they get the magnitudes right, the negative real effects disappear, at least temporarily. Of course, in the longer run the negative expectations, combined with this policy response, retard investment everywhere as the results show, and this impairs future growth. Moreover, the management by central banks of the unconventional assets acquired via QE is uncharted territory with the possibility looming of a sharp rise in yields when expectations change, excess liquidity rises and central banks have to respond.

## **5 Conclusion**

The global macroeconomic game between the four largest economies is reviewed, showing its strategic nature, particularly since the graduation of China. A model is proposed for capturing the short run elements of this game. The model has conventional structure, though it embodies complete bilateral matrices of both trade and investment flows and a variety of direct and indirect tax instruments. It is applied comparative statically.

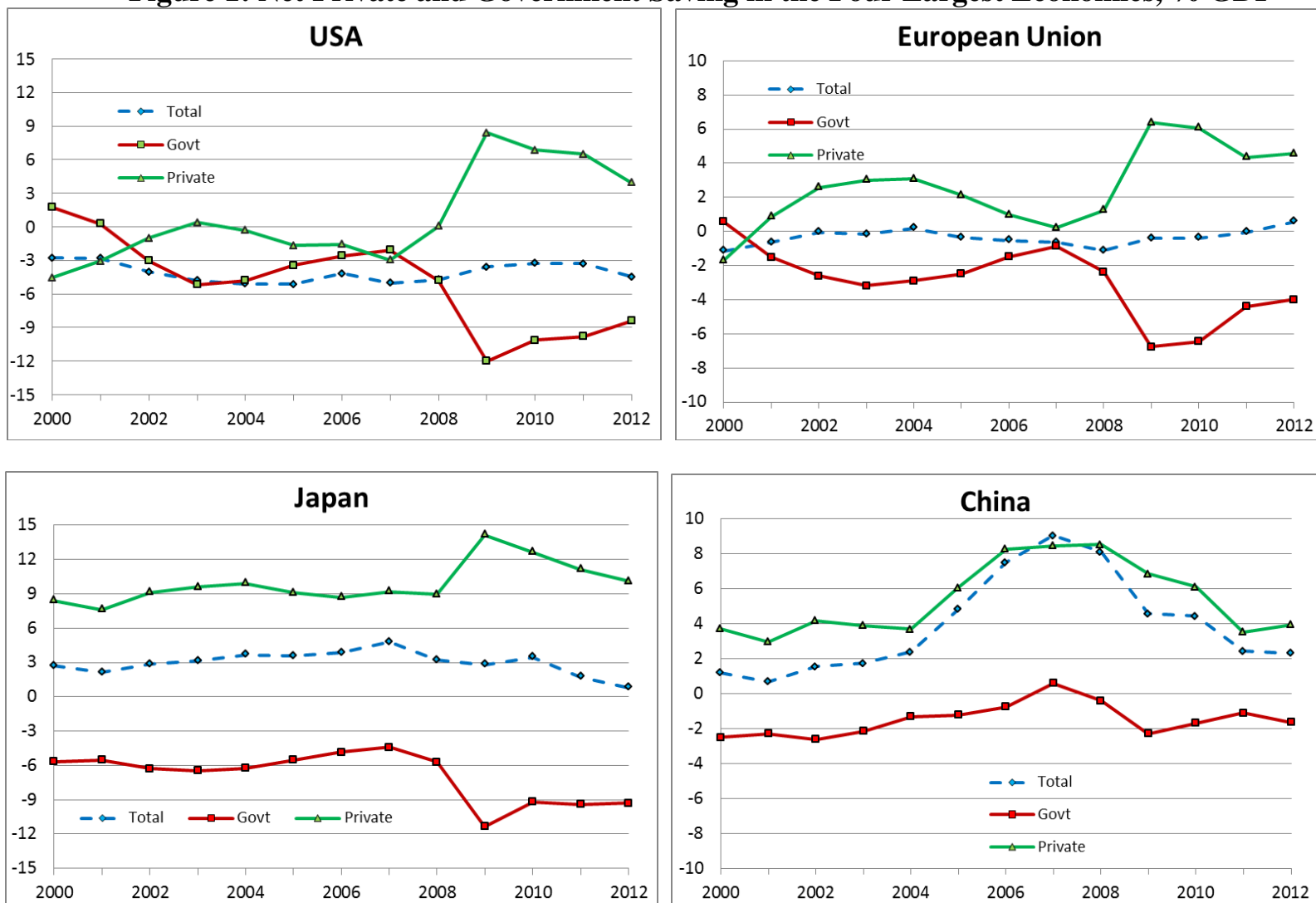
The model is illustrated with an application to deflationary expectations and monetary policy responses. If portfolio holders anticipate continued deflation in the US, the EU and Japan, and their central banks are hamstrung by liquidity traps and so are effectively targeting the money supply, then actual deflation occurs and there are substantial negative real effects in all three regions. If the US Fed undertakes further monetary expansion via QE it greatly advantages the US relative to the other large economies, which suffer amplified real negative effects. There is no alternative for them but to match the US monetary expansion.



## References

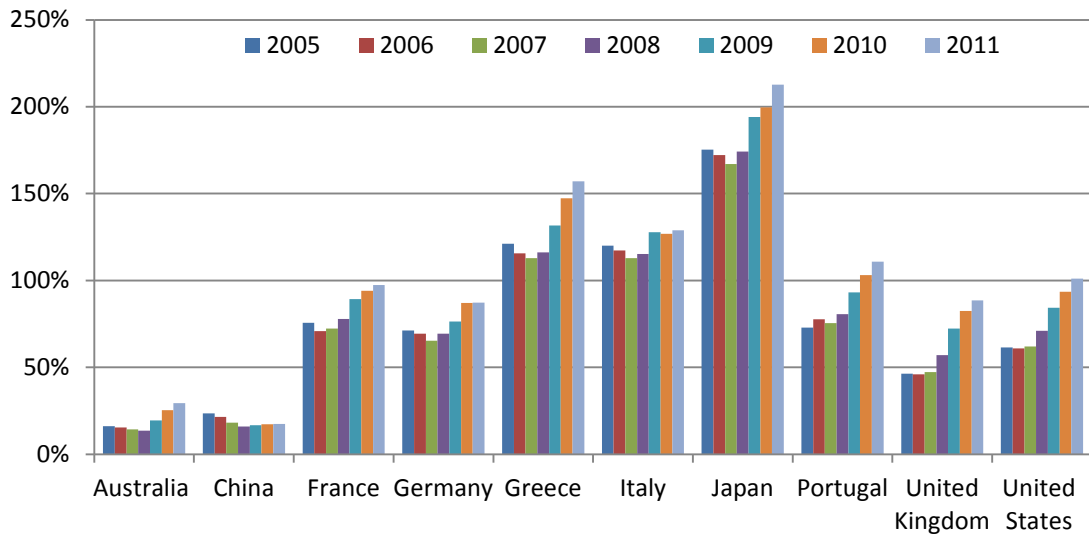
- Arora, V. and R. Tyers (2011), "Asset arbitrage and the price of oil", *Economic Modelling*, 29(2): 142-150, March.
- Bernanke, B.S. (2009), "The crisis and the policy response", Stamp Lecture, London School of Economics, London, England, January 13.
- Chinn, M.D., B. Eichengreen and H. Ito (2012), "Rebalancing global growth", in O. Canuto and D. Leipziger (eds), *Ascent after Descent: Regrowing Economic Growth after the Great Recession*, Washington DC: World Bank: 35-86.
- Chinn, M.D. and H. Ito (2007), "Current account balances, financial development and institutions: assaying the world 'saving glut'", *Journal of International Money and Finance*, 26: 546-569.
- Dooley, M.P., D. Folkerts-Landau and P. Garber (2004), "Direct investment, rising real wages and the absorption of excess labor in the periphery", NBER Working Paper 10626 (July), Cambridge MA: National Bureau of Economic Research.
- Feldstein, M. and C.Y. Horioka (1980), "Domestic Saving and International Capital Flows," *Economic Journal*, Royal Economic Society, 90(358): 314-29, June.
- Fleming, J.M. (1962), "Domestic financial policies under fixed and under flexible exchange rates", *International Monetary Fund Staff Papers*, 9: 369-379.
- Choi, H., N.C. Mark and D. Sul (2008), "Endogenous discounting, the world saving glut and the US current account", *Journal of International Economics*, 75: 30-53.
- Horioka, C.Y. and A. Terada-Hagiwara (2012), "The determinants and long term projections of saving rates in developing Asia", *Japan and the World Economy*, 24: 128-137.
- Ito, H. (2009), "US current account debate with Japan then, and China now", *Journal of Asian Economics*, 20: 294-313.
- McKibbin, W.J. and A.B. Stoeckel (2011), 'Global Fiscal Consolidation', *Lowy Institute for International Policy, Working Papers in International Economics*, vol. 1, no. 11.
- Mundell, R.A. (1963), "Capital mobility and stabilisation policy under fixed and flexible exchange rates", *Canadian Journal of Economics and Political Science*, 29: 475-485.
- Tyers, R. (2012), "Japan's economic stagnation: causes and global implications", *The Economic Record*, 88(283): 459-607, December.
- Tyers, R. and T.C. Cheong (2013), "A Dynamic Global Model for Macroeconomic Analysis: Government debt, Reserves, Bilateral Asset Holdings and Sector Specificity", for presentation at the 16<sup>th</sup> Conference on Global Economic Analysis, Shanghai 12-14 June 2013, and CAMA Working Paper, February.
- Tyers, R., Y. Zhang and T.S. Cheong (2013), "China's saving and international economic performance", UWA Business School Economics Discussion Paper 13.20, May.

**Figure 1: Net Private and Government Saving in the Four Largest Economies, % GDP**



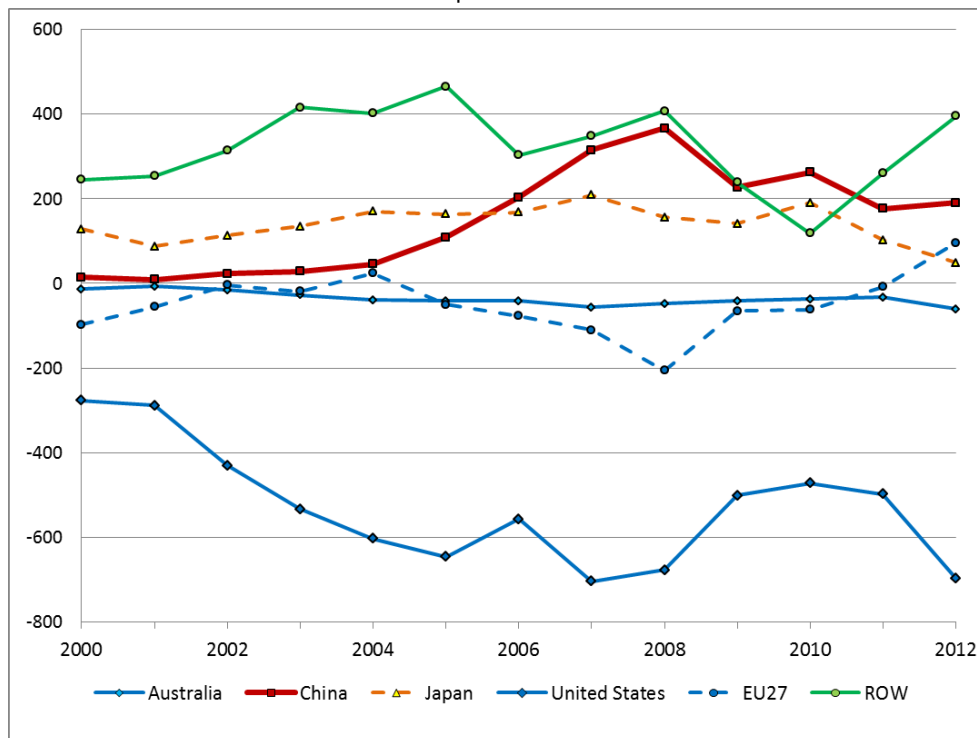
Sources: IMF IFS data base; Australia, ABS; China (Mainland, for 2012 authors' estimate is used for net factor income), NBS; USA, Bureau of Economic Analysis; Japan, BOJ; EU, Eurostat.

**Figure 2 Sovereign Debt to GDP ratios for selected countries**



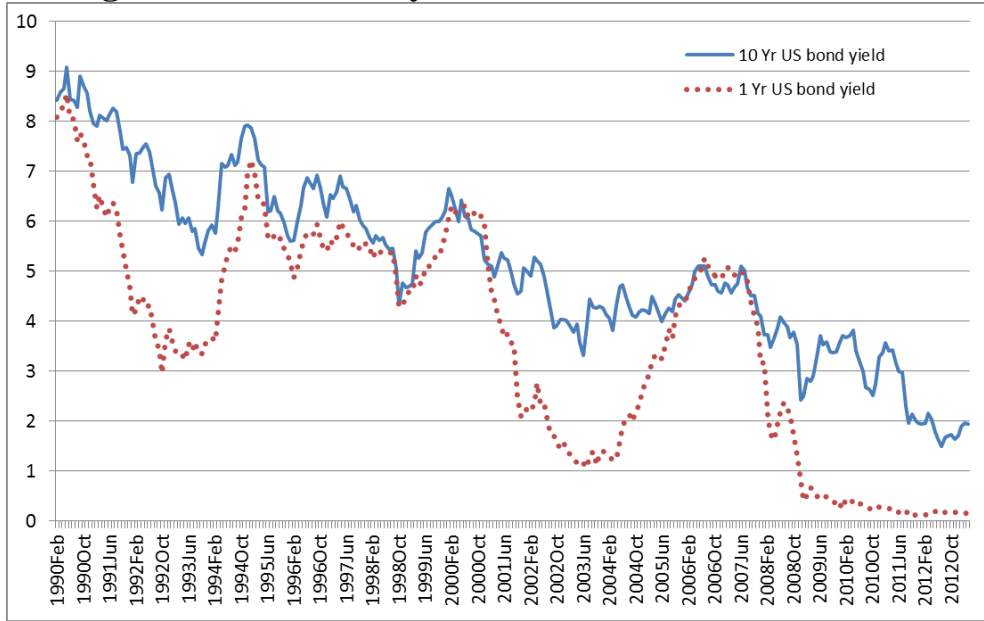
Source: OECD Economic Outlook 89 database and *The Economist*.

**Figure 3: Excess Annual Saving (Current Account Balances) by Key Region, US\$ billions**



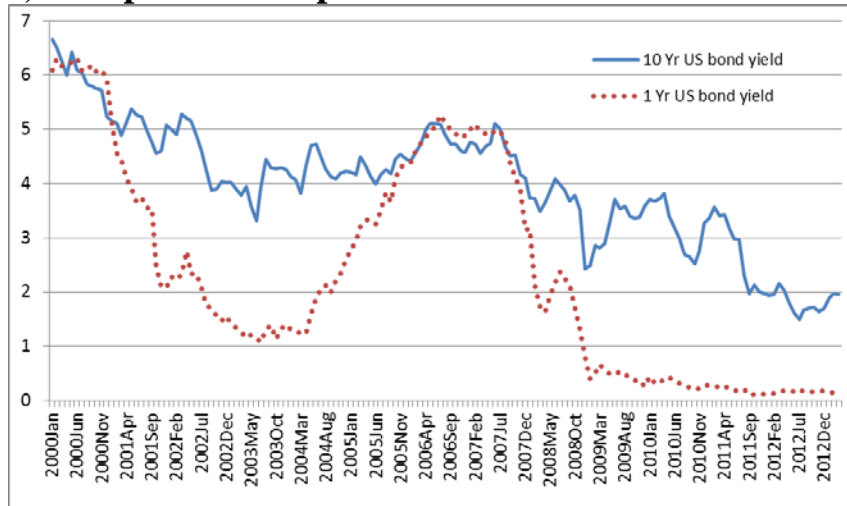
Sources: IMF IFS data base; China NBS; Japan, BOP and Ministry of Finance; EU27, Eurostat; US, Bureau of Economic Analysis

**Figure 4: US Treasury Bond Yields over Two Decades**

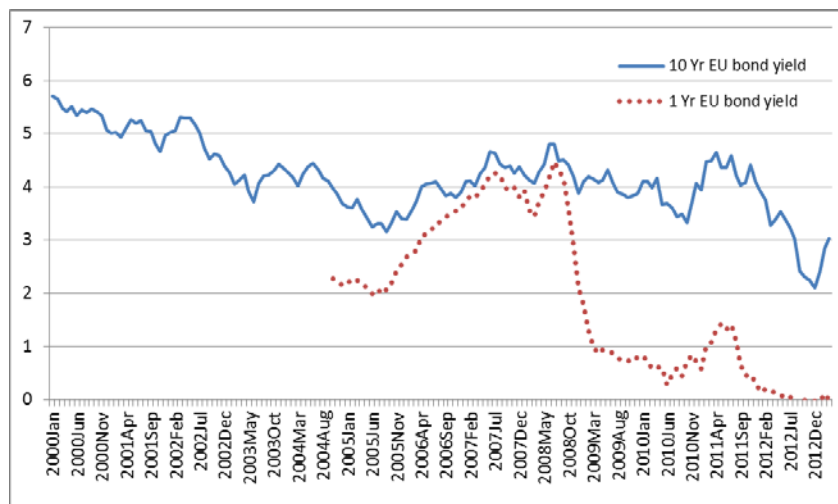


Source: US Treasury.

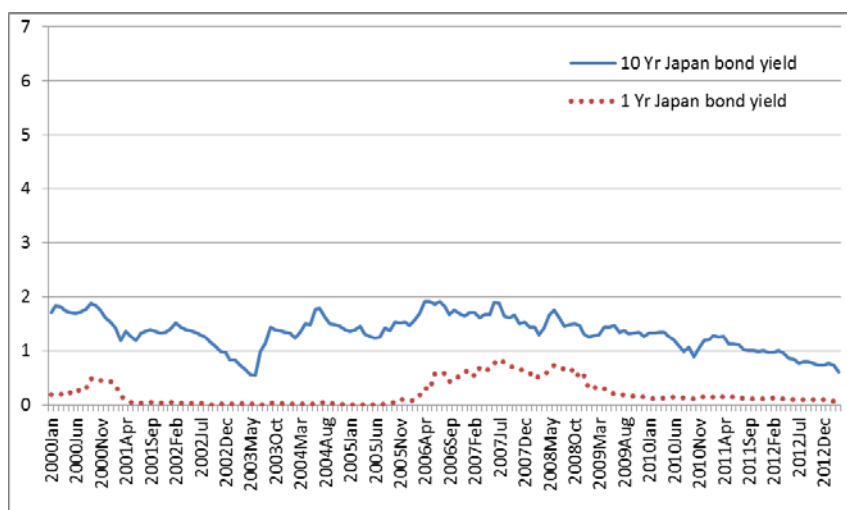
**Figure 5: US, European and Japanese Government Bond Yields Since 2000**



Source: US Treasury.

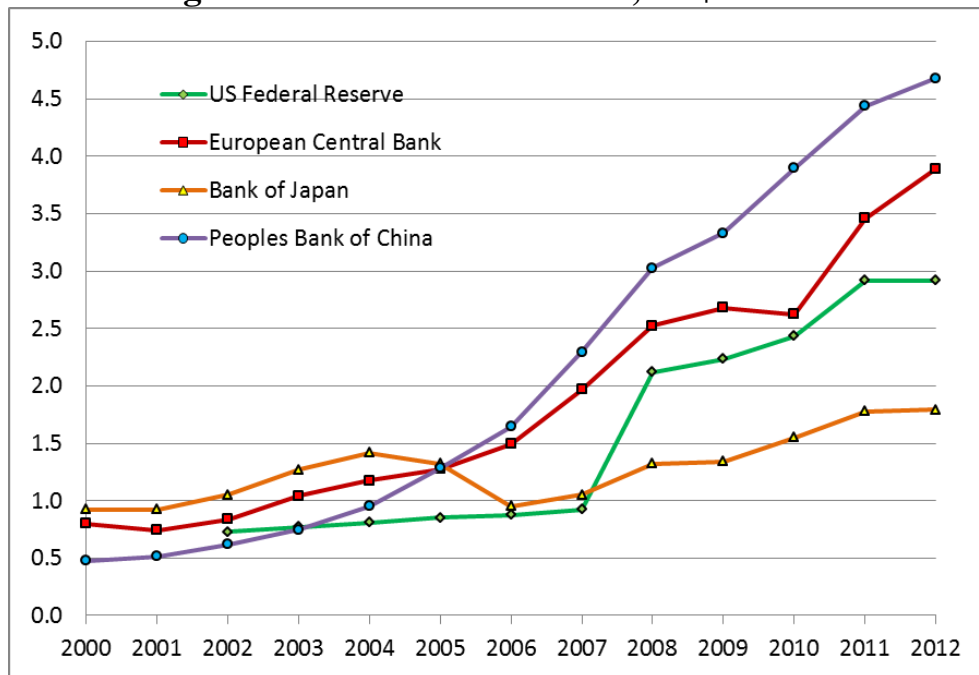


Source: European Central Bank.



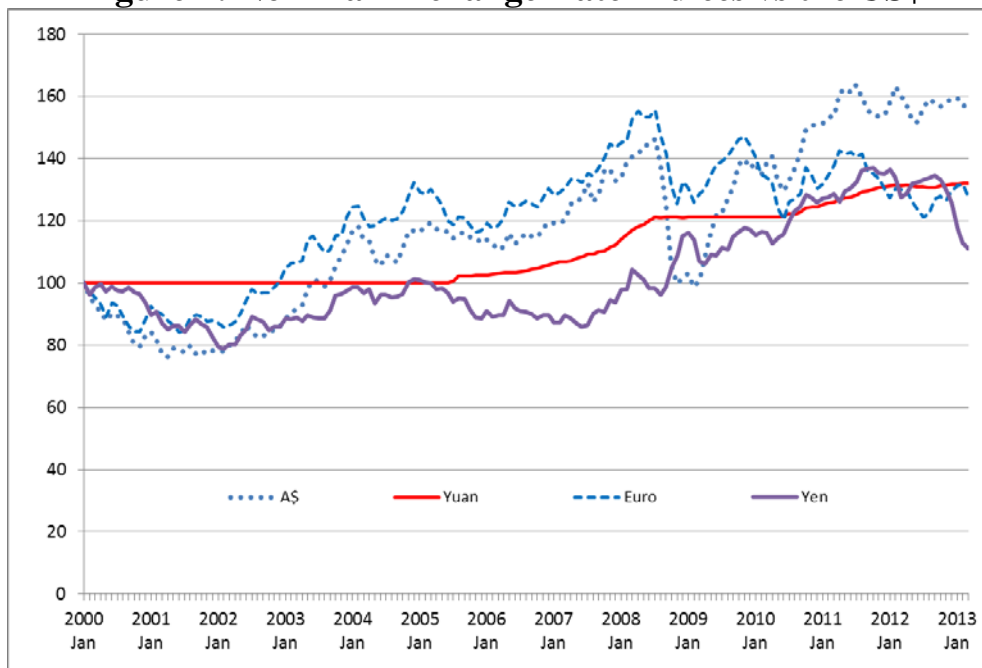
Source: European Central Bank, Reuters.

**Figure 6: Central Bank Assets, US\$ trillions**



Sources: EU, ECB; United States, Japan: St. Louis Federal Reserve Database; China, National Bureau of Statistics.

**Figure 7: Nominal Exchange Rate Indices vs the US\$**



Source: IMF IFS and Eurostat.

**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, $C$	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.

**Table 2: Regional Economic Structure, 2011:**

% of GDP	US	EU(26)	Japan	China	Australia	RoW
$C$	0.712	0.580	0.605	0.450	0.536	0.550
$I$	0.155	0.191	0.200	0.410	0.275	0.240
$G$	0.171	0.217	0.204	0.114	0.177	0.199
$X$	0.139	0.175	0.151	0.285	0.217	0.200
$M$	0.177	0.163	0.161	0.259	0.204	0.189
Indirect tax rev, $T^I$	0.144	0.235	0.047	0.125	0.070	0.130
Direct tax rev, $T^D$	0.017	0.015	0.124	0.035	0.093	0.061
Total tax rev, $T$	0.161	0.250	0.171	0.160	0.163	0.191
Private saving, $S^P$	0.127	0.169	0.224	0.390	0.301	0.259
Govt saving, $S^G$	-0.010	0.034	-0.034	0.046	-0.013	-0.008
Total saving, $S^D$	0.155	0.191	0.200	0.410	0.275	0.240
Monetary base, $M^B$	0.133	0.114	0.220	0.411	0.134	0.250
Capital stock, $K$	3.317	3.414	4.239	2.740	4.027	2.000

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 3: Shares of Consumption by Region of Origin, 2011<sup>a</sup>**

% of row consn expenditure	US	EU(26)	Japan	China	Australia	RoW
US	65.9	10.3	2.3	6.1	0.5	14.9
EU(26)	12.0	43.9	2.9	11.2	0.6	29.4
Japan	4.7	5.1	69.1	6.5	2.3	12.3
China	10.4	18.2	11.2	17.6	4.5	38.1
Australia	8.1	12.8	3.8	9.2	53.7	12.5
Rest of world	14.4	22.0	3.9	10.6	1.0	48.1

<sup>a</sup> These shares sum to 100 horizontally. They are based on the 2011 matrix of trade flows combined with consumption expenditure data in each region. The resulting matrix is inconsistent as between data sources and so a RAS algorithm is used to force consistency of bilateral elements with national accounts data.

Sources: Implied trade flows are for 2011, drawn from the World Trade Organisation database.

**Table 4: 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>c</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 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.



**Table 5: Parameters**

	US	EU(26)	Japan	China	Australia	RoW
Production shares <sup>a</sup>						
Labour, $\beta^L$	0.18	0.18	0.18	0.26	0.18	0.24
Skill, $\beta^S$	0.47	0.47	0.47	0.24	0.47	0.21
Capital, $\beta^K$	0.35	0.35	0.35	0.50	0.35	0.55
Income tax rates <sup>b</sup>						
$t^L = t^S = t^K$	0.02	0.02	0.13	0.04	0.10	0.07
Indirect tax rates <sup>c</sup>						
$t^C$	0.20	0.40	0.05	0.20	0.10	0.15
$t^M$	0.15	0.43	0.11	0.19	0.11	0.31
$t^X$	0.00	0.00	0.00	0.00	0.00	0.00
Money parameters <sup>d</sup>						
Interest premium, $\lambda^0$	1.00	0.97	0.78	1.73	0.82	2.61
Reserve ratio, $\rho$	0.05	0.05	0.05	0.15	0.05	0.10
Cash ratio, $\mu$	0.08	0.10	0.17	0.21	0.10	0.20
Elasticities						
C to $r$ , $\varepsilon^{CR}$	0.10	0.10	0.10	0.10	0.10	0.10
C to $Y^D$ , $\varepsilon^{CY}$	0.94	1.03	0.82	0.93	1.25	0.88
$C_{ij}/C_{ik}$ , $\sigma_i$	2.00	2.00	2.00	2.00	2.00	2.00
Saving $s_{ij}^S$ to $r^e/r$ , $\phi_i$	2.00	2.00	2.00	2.00	2.00	2.00
Premium to $G/T$ , $\phi_i$	1.00	1.00	1.00	1.00	1.00	1.00
$m^D$ to $y$ , $\varepsilon^{MY}$	1.00	1.00	1.00	1.00	1.00	1.00
$m^D$ to $r+\pi^e$ , $\varepsilon^{MR}$	0.60	0.60	0.60	0.60	0.60	0.60

a Production shares are based on demographic and occupational data from Tyers and Bain (2006), as well as estimates of factor incomes and capital stocks from the GTAP Database.

b These income tax rates are lower than observed because direct transfers and sovereign debt service are deducted from income tax revenue so that observed fiscal balances are consistent with  $T-G$ , where  $G$  includes only expenditure on goods and services.

c Although export taxes appear in the modelling, no values are applied since such taxes are usually very indirect. To infer the rates for other indirect taxes, approximate rates are initially chosen for the consumption tax rate and the import tax rate is then determined for consistency with the data on indirect tax revenue. In regions where other indirect taxes are major contributors to revenue, this tends to inflate the values of  $t^C$  and  $t^M$ .

d The money parameters are crude characterisations, made on the assumption that the EU behaves as if it had a single central bank to cover all 26 members. Money demand parameters stem from a survey of estimates used in other models (including McKibbin and Wilcoxon 1995, Knell and Stix, 2003 and Teles and Zhou 2005).

e Consumption elasticities are consistent with a variety of estimates in use in other models, both of marginal propensities and elasticities (including McKibbin and Wilcoxon 1995 and Jin 2011).

**Table 6: Exogenous Variables for Experimentation**

Policy	Instrument	
Tax rates	Labour income tax	$t_L$
	Capital income tax	$t_K$
	Consumption tax (GST)	$t_C$
	Import tariff	$t_M$
	Export tax	$t_X$
Fiscal policy	Government spending or the fiscal surplus, <i>US\$ trillion</i>	$G, S_G$
Monetary policy	Monetary base, <i>US\$ trillion</i>	$M_B$
	Reserve ratio	$\rho$
Expectations factors	Consumer price inflation	$\pi^e$
	Real appreciation	$\gamma^e$
	Nominal disposable income	$Y^{De}$
Productivity	TFP	$A^Y$
Saving	Preference shifter	$A^C$

**Table 7: Closure Choices and Policy Regimes**

	In each case, holding fixed or exogenous one of:	
Labour market	Nominal wage	$W$
	Labour use	$L$
Government	Nominal expenditure	$G$
	Fiscal surplus	$T-G$
Monetary target	Monetary base	$M^B$
	Consumer price level	$P^C$
	GDP price level	$P^Y$
	Producer price level	$P^P$
	Exchange rate	$E$
	Nominal GDP	$Y$

**Table 8: Closure and Shocks<sup>a</sup>**

Closure	Shocks
<b>! Labour market closure:</b>	<b>No monetary response</b>
p_LF	Shock p_INFE("US") = -5;
p_WN("US")	Shock p_INFE("EU") = -5;
p_WN("EU")	Shock p_INFE("Japan") = -5;
p_WN("Japan")	Shock p_YDNE("US") = -5;
p_WN("China")	Shock p_YDNE("EU") = -5;
p_LD("Australia")	Shock p_YDNE("Japan") = -5;
p_LD("RoW")	<b>Monetary response in US only</b>
<b>! Fiscal policy closure:</b>	Shock p_INFE("US") = -5;
p_GN("US")	Shock p_INFE("EU") = -5;
p_GN("EU")	Shock p_INFE("Japan") = -5;
p_GN("Japan")	Shock p_YDNE("US") = -5;
p_SGN("China")	Shock p_YDNE("EU") = -5;
p_SGN("Australia")	Shock p_YDNE("Japan") = -5;
p_SGN("RoW")	Shock p_MB("US") = 3.10;
<b>! Monetary policy targets:</b>	<b>Monetary response in US, EU, Japan</b>
p_MB("US")	If MB raised to target PY in all three
p_MB("EU")	the model finds the initial equilibrium.
p_MB("Japan")	
p_PY("China")	
p_PY("Australia")	
p_MB("RoW")	

<sup>a</sup> These are commands required for solution by Gempack. Here the Rungem freeware is used.

**Table 9: Deflation Expectations: Simulation Results**

% change	US	EU(26)	Japan	China	Australia	RoW
<i>No monetary response</i>						
Consumer price level, $P^C$	-1.51	-1.40	-1.12	0.12	0.19	0.79
Producer price level, $P^P$	-1.53	-1.58	-1.17	0.03	0.03	1.02
GDP price level, $P^Y$	-1.35	-1.30	-1.14	0.00	0.00	0.91
Nominal exch rate v US, $E$	0.00	-0.13	-0.47	-1.59	-1.87	-2.20
Real exch rate v US, $e$	0.00	-0.08	-0.26	-0.25	-0.53	0.04
Labour use, $L$	-1.85	-1.92	-1.42	0.05	0.00	0.00
Real GDP, $Y/P^Y$	-0.33	-0.34	-0.25	0.01	0.00	0.00
Real investment, $I/P^P$	-5.95	-4.55	-3.79	-0.11	-0.23	1.61
Real govt spending, $G/P^P$	1.55	1.61	1.19	-0.26	-0.18	-0.55
<i>Monetary response in US</i>						
Consumer price level, $P^C$	0.18	-2.65	-1.86	-0.06	0.05	-0.37
Producer price level, $P^P$	0.03	-2.71	-1.80	-0.01	0.00	-0.24
GDP price level, $P^Y$	0.00	-2.08	-1.73	0.00	0.00	-0.18
Nominal exch rate v US, $E$	0.00	3.12	2.44	0.50	0.29	0.80
Real exch rate v US, $e$	0.00	0.97	0.67	0.50	0.29	0.61
Labour use, $L$	0.03	-3.28	-2.18	-0.01	0.00	0.00
Real GDP, $Y/P^Y$	0.01	-0.59	-0.39	0.00	0.00	0.00
Real investment, $I/P^P$	-1.51	-7.91	-5.81	-0.41	-0.63	-0.77
Real govt spending, $G/P^P$	-0.03	2.78	1.83	0.08	-0.03	0.27

a These results are generated by the Gempack-Rungem software from the closures and shocks listed in Table 8.

Editor, UWA Economics Discussion Papers:  
 Ernst Juerg Weber  
 Business School – Economics  
 University of Western Australia  
 35 Sterling Hwy  
 Crawley WA 6009  
 Australia

Email: [ecoadmin@biz.uwa.edu.au](mailto:ecoadmin@biz.uwa.edu.au)

The Economics Discussion Papers are available at:

1980 – 2002: <http://ecompapers.biz.uwa.edu.au/paper/PDF%20of%20Discussion%20Papers/>

Since 2001: <http://ideas.repec.org/s/uwa/wpaper1.html>

Since 2004: <http://www.business.uwa.edu.au/school/disciplines/economics>

<b>ECONOMICS DISCUSSION PAPERS</b>		
<b>2011</b>		
<b>DP NUMBER</b>	<b>AUTHORS</b>	<b>TITLE</b>
11.01	Robertson, P.E.	DEEP IMPACT: CHINA AND THE WORLD ECONOMY
11.02	Kang, C. and Lee, S.H.	BEING KNOWLEDGEABLE OR SOCIABLE? DIFFERENCES IN RELATIVE IMPORTANCE OF COGNITIVE AND NON-COGNITIVE SKILLS
11.03	Turkington, D.	DIFFERENT CONCEPTS OF MATRIX CALCULUS
11.04	Golley, J. and Tyers, R.	CONTRASTING GIANTS: DEMOGRAPHIC CHANGE AND ECONOMIC PERFORMANCE IN CHINA AND INDIA
11.05	Collins, J., Baer, B. and Weber, E.J.	ECONOMIC GROWTH AND EVOLUTION: PARENTAL PREFERENCE FOR QUALITY AND QUANTITY OF OFFSPRING
11.06	Turkington, D.	ON THE DIFFERENTIATION OF THE LOG LIKELIHOOD FUNCTION USING MATRIX CALCULUS
11.07	Groenewold, N. and Paterson, J.E.H.	STOCK PRICES AND EXCHANGE RATES IN AUSTRALIA: ARE COMMODITY PRICES THE MISSING LINK?
11.08	Chen, A. and Groenewold, N.	REDUCING REGIONAL DISPARITIES IN CHINA: IS INVESTMENT ALLOCATION POLICY EFFECTIVE?
11.09	Williams, A., Birch, E. and Hancock, P.	THE IMPACT OF ON-LINE LECTURE RECORDINGS ON STUDENT PERFORMANCE
11.10	Pawley, J. and Weber, E.J.	INVESTMENT AND TECHNICAL PROGRESS IN THE G7 COUNTRIES AND AUSTRALIA
11.11	Tyers, R.	AN ELEMENTAL MACROECONOMIC MODEL FOR APPLIED ANALYSIS AT UNDERGRADUATE LEVEL
11.12	Clements, K.W. and Gao, G.	QUALITY, QUANTITY, SPENDING AND PRICES
11.13	Tyers, R. and Zhang, Y.	JAPAN'S ECONOMIC RECOVERY: INSIGHTS FROM MULTI-REGION DYNAMICS

11.14	McLure, M.	A. C. PIGOU'S REJECTION OF PARETO'S LAW
11.15	Kristoffersen, I.	THE SUBJECTIVE WELLBEING SCALE: HOW REASONABLE IS THE CARDINALITY ASSUMPTION?
11.16	Clements, K.W., Izan, H.Y. and Lan, Y.	VOLATILITY AND STOCK PRICE INDEXES
11.17	Parkinson, M.	SHANN MEMORIAL LECTURE 2011: SUSTAINABLE WELLBEING – AN ECONOMIC FUTURE FOR AUSTRALIA
11.18	Chen, A. and Groenewold, N.	THE NATIONAL AND REGIONAL EFFECTS OF FISCAL DECENTRALISATION IN CHINA
11.19	Tyers, R. and Corbett, J.	JAPAN'S ECONOMIC SLOWDOWN AND ITS GLOBAL IMPLICATIONS: A REVIEW OF THE ECONOMIC MODELLING
11.20	Wu, Y.	GAS MARKET INTEGRATION: GLOBAL TRENDS AND IMPLICATIONS FOR THE EAS REGION
11.21	Fu, D., Wu, Y. and Tang, Y.	DOES INNOVATION MATTER FOR CHINESE HIGH-TECH EXPORTS? A FIRM-LEVEL ANALYSIS
11.22	Fu, D. and Wu, Y.	EXPORT WAGE PREMIUM IN CHINA'S MANUFACTURING SECTOR: A FIRM LEVEL ANALYSIS
11.23	Li, B. and Zhang, J.	SUBSIDIES IN AN ECONOMY WITH ENDOGENOUS CYCLES OVER NEOCLASSICAL INVESTMENT AND NEO-SCHUMPETERIAN INNOVATION REGIMES
11.24	Krey, B., Widmer, P.K. and Zweifel, P.	EFFICIENT PROVISION OF ELECTRICITY FOR THE UNITED STATES AND SWITZERLAND
11.25	Wu, Y.	ENERGY INTENSITY AND ITS DETERMINANTS IN CHINA'S REGIONAL ECONOMIES

**ECONOMICS DISCUSSION PAPERS  
2012**

<b>DP NUMBER</b>	<b>AUTHORS</b>	<b>TITLE</b>
12.01	Clements, K.W., Gao, G., and Simpson, T.	DISPARITIES IN INCOMES AND PRICES INTERNATIONALLY
12.02	Tyers, R.	THE RISE AND ROBUSTNESS OF ECONOMIC FREEDOM IN CHINA
12.03	Golley, J. and Tyers, R.	DEMOGRAPHIC DIVIDENDS, DEPENDENCIES AND ECONOMIC GROWTH IN CHINA AND INDIA
12.04	Tyers, R.	LOOKING INWARD FOR GROWTH
12.05	Knight, K. and McLure, M.	THE ELUSIVE ARTHUR PIGOU
12.06	McLure, M.	ONE HUNDRED YEARS FROM TODAY: A. C. PIGOU'S WEALTH AND WELFARE
12.07	Khuu, A. and Weber, E.J.	HOW AUSTRALIAN FARMERS DEAL WITH RISK
12.08	Chen, M. and Clements, K.W.	PATTERNS IN WORLD METALS PRICES
12.09	Clements, K.W.	UWA ECONOMICS HONOURS
12.10	Golley, J. and Tyers, R.	CHINA'S GENDER IMBALANCE AND ITS ECONOMIC PERFORMANCE
12.11	Weber, E.J.	AUSTRALIAN FISCAL POLICY IN THE AFTERMATH OF THE GLOBAL FINANCIAL CRISIS
12.12	Hartley, P.R. and Medlock III, K.B.	CHANGES IN THE OPERATIONAL EFFICIENCY OF NATIONAL OIL COMPANIES
12.13	Li, L.	HOW MUCH ARE RESOURCE PROJECTS WORTH? A CAPITAL MARKET PERSPECTIVE
12.14	Chen, A. and Groenewold, N.	THE REGIONAL ECONOMIC EFFECTS OF A REDUCTION IN CARBON EMISSIONS AND AN EVALUATION OF OFFSETTING POLICIES IN CHINA
12.15	Collins, J., Baer, B. and Weber, E.J.	SEXUAL SELECTION, CONSPICUOUS CONSUMPTION AND ECONOMIC GROWTH
12.16	Wu, Y.	TRENDS AND PROSPECTS IN CHINA'S R&D SECTOR
12.17	Cheong, T.S. and Wu, Y.	INTRA-PROVINCIAL INEQUALITY IN CHINA: AN ANALYSIS OF COUNTY-LEVEL DATA
12.18	Cheong, T.S.	THE PATTERNS OF REGIONAL INEQUALITY IN CHINA
12.19	Wu, Y.	ELECTRICITY MARKET INTEGRATION: GLOBAL TRENDS AND IMPLICATIONS FOR THE EAS REGION
12.20	Knight, K.	EXEGESIS OF DIGITAL TEXT FROM THE HISTORY OF ECONOMIC THOUGHT: A COMPARATIVE EXPLORATORY TEST
12.21	Chatterjee, I.	COSTLY REPORTING, EX-POST MONITORING, AND COMMERCIAL PIRACY: A GAME THEORETIC ANALYSIS
12.22	Pen, S.E.	QUALITY-CONSTANT ILLICIT DRUG PRICES
12.23	Cheong, T.S. and Wu, Y.	REGIONAL DISPARITY, TRANSITIONAL DYNAMICS AND CONVERGENCE IN CHINA

12.24	Ezzati, P.	FINANCIAL MARKETS INTEGRATION OF IRAN WITHIN THE MIDDLE EAST AND WITH THE REST OF THE WORLD
12.25	Kwan, F., Wu, Y. and Zhuo, S.	RE-EXAMINATION OF THE SURPLUS AGRICULTURAL LABOUR IN CHINA
12.26	Wu, Y.	R&D BEHAVIOUR IN CHINESE FIRMS
12.27	Tang, S.H.K. and Yung, L.C.W.	MAIDS OR MENTORS? THE EFFECTS OF LIVE-IN FOREIGN DOMESTIC WORKERS ON SCHOOL CHILDREN'S EDUCATIONAL ACHIEVEMENT IN HONG KONG
12.28	Groenewold, N.	AUSTRALIA AND THE GFC: SAVED BY ASTUTE FISCAL POLICY?

## ECONOMICS DISCUSSION PAPERS

**2013**

<b>DP NUMBER</b>	<b>AUTHORS</b>	<b>TITLE</b>
13.01	Chen, M., Clements, K.W. and Gao, G.	THREE FACTS ABOUT WORLD METAL PRICES
13.02	Collins, J. and Richards, O.	EVOLUTION, FERTILITY AND THE AGEING POPULATION
13.03	Clements, K., Genberg, H., Harberger, A., Lothian, J., Mundell, R., Sonnenschein, H. and Tolley, G.	LARRY SJAASTAD, 1934-2012
13.04	Robitaille, M.C. and Chatterjee, I.	MOTHERS-IN-LAW AND SON PREFERENCE IN INDIA
13.05	Clements, K.W. and Izan, I.H.Y.	REPORT ON THE 25 <sup>TH</sup> PHD CONFERENCE IN ECONOMICS AND BUSINESS
13.06	Walker, A. and Tyers, R.	QUANTIFYING AUSTRALIA'S "THREE SPEED" BOOM
13.07	Yu, F. and Wu, Y.	PATENT EXAMINATION AND DISGUISED PROTECTION
13.08	Yu, F. and Wu, Y.	PATENT CITATIONS AND KNOWLEDGE SPILLOVERS: AN ANALYSIS OF CHINESE PATENTS REGISTER IN THE US
13.09	Chatterjee, I. and Saha, B.	BARGAINING DELEGATION IN MONOPOLY
13.10	Cheong, T.S. and Wu, Y.	GLOBALIZATION AND REGIONAL INEQUALITY IN CHINA
13.11	Cheong, T.S. and Wu, Y.	INEQUALITY AND CRIME RATES IN CHINA
13.12	Robertson, P.E. and Ye, L.	ON THE EXISTENCE OF A MIDDLE INCOME TRAP
13.13	Robertson, P.E.	THE GLOBAL IMPACT OF CHINA'S GROWTH
13.14	Hanaki, N., Jacquemet, N., Luchini, S., and Zylbersztejn, A.	BOUNDED RATIONALITY AND STRATEGIC UNCERTAINTY IN A SIMPLE DOMINANCE SOLVABLE GAME
13.15	Okatch, Z., Siddique, A. and Rammohan, A.	DETERMINANTS OF INCOME INEQUALITY IN BOTSWANA
13.16	Clements, K.W. and Gao, G.	A MULTI-MARKET APPROACH TO MEASURING THE CYCLE



13.17	Chatterjee, I. and Ray, R.	THE ROLE OF INSTITUTIONS IN THE INCIDENCE OF CRIME AND CORRUPTION
13.18	Fu, D. and Wu, Y.	EXPORT SURVIVAL PATTERN AND DETERMINANTS OF CHINESE MANUFACTURING FIRMS
13.19	Shi, X., Wu, Y. and Zhao, D.	KNOWLEDGE INTENSIVE BUSINESS SERVICES AND THEIR IMPACT ON INNOVATION IN CHINA
13.20	Tyers, R., Zhang, Y. and Cheong, T.S.	CHINA'S SAVING AND GLOBAL ECONOMIC PERFORMANCE
13.21	Collins, J., Baer, B. and Weber, E.J.	POPULATION, TECHNOLOGICAL PROGRESS AND THE EVOLUTION OF INNOVATIVE POTENTIAL
13.22	Hartley, P.R.	THE FUTURE OF LONG-TERM LNG CONTRACTS
13.23	Tyers, R.	A SIMPLE MODEL TO STUDY GLOBAL MACROECONOMIC INTERDEPENDENCE
13.24	McLure, M.	REFLECTIONS ON THE QUANTITY THEORY: PIGOU IN 1917 AND PARETO IN 1920-21