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Analysing the Short Run Effects of China's Economic Reform Agenda

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Keywords

China, fiscal policy, industry policy reform, oligopoly, price caps, privatisation, internationalisation, capital account liberalization

JEL Classification

C54, C68, D58, E17, E62, L13, L43

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THE AUSTRALIAN NATIONAL UNIVERSITY

Analysing the Short Run Effects of China's Economic Reform Agenda*

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China's size limits its capacity to source further growth from exports and so the inevitable turn inward is in progress, as suggested by declining gross flows on its balance of payments relative to its GDP. Thus far, key home policy drivers have been fiscal expansion and public investment, though provincial indebtedness will constrain these in future and growth will be driven by the government's reform agenda, which includes further industrial reform and "internationalisation". The short run effects of these domestic policy and external shocks are examined using a model of the Chinese economy that takes explicit account of oligopoly behaviour. The results confirm that further fiscal expansions, even with large public investment components, will not contribute the major share of new growth, but industrial reform in heavy manufacturing and services would reduce costs and foster growth in output, private consumption and modern sector employment. At the same time, while China's private investment, and hence its overall performance, will be sensitive to the uncertain effects of internationalisation increased nominal exchange rate flexibility would offer a reliable cushion.

1. Introduction

The "East Asian" growth model has served both China and its trading partners well during the past three decades. It requires the transformation of lightly trained farmers into factory and service workers. The availability of these workers attracts capital from home and foreign saving to urban areas, raises the productivity of the transitioning workers and attracts further rural to urban migration. The snag is that the workers are not sufficiently well trained to support heavy manufacturing or sophisticated services and so production is highly specialised in light manufactures, relative to domestic demand. The transformation therefore requires considerable trade dependence. Moreover, in the East Asian experience, the resulting income growth has tended to outstrip perceived "permanent incomes" (Modigliani and Cao 2004) and so saving has been very high, causing current account surpluses. The domestic gains from the growth generated speak for themselves but trading partners have also gained, via both the product and financial terms of trade (Tyers 2014).

China's size and the slow growth of its trading partners now limit its capacity to source further growth from this model and so the inevitable turn inward is in progress. Thus far, the key elements in this transformation have been fiscal expansion and public investment, though provincial indebtedness will constrain these in future. China's government has therefore undertaken to identify reforms that will unleash further, necessarily inward, sources of growth. These include further reforms of industry policy, trade policy, land ownership laws, the one child policy, fiscal federalism and taxation, financial market regulation, urbanisation (*hukou*)

and capital account liberalisation under the general rubric of "internationalisation" (State Council 2014). For most of these, change will be gradual and the short run implications slight. For reforms to industrial policy, fiscal policy and the capital account, however, short run effects on overall economic performance are likely to be significant and accessible.

The approach adopted centres on an economy-wide model that takes explicit account of oligopoly behaviour in 17 industrial and service sectors.[1] This model makes it possible to examine the interactions between external shocks, fiscal policy, industrial reform and regulatory policy in response to the export slowdown. The results suggest that the combination of fiscal expansion with public investment, were its continuation possible, would offer comparatively little to growth in the short run. Industrial reform in heavy manufacturing and services has considerable potential, however, by reducing costs and fostering growth in output, private consumption and modern sector employment. The effects of capital and financial account liberalisation are less certain and could be negative depending on whether there is demand for foreign assets that has been constrained by outward capital controls.

The next section reviews China's on-going transition, its causes and effects. In Section 3, the special structure of the Chinese economy is detailed along with elemental reasoning behind the sensitivity of its employment performance to real exchange rate changes associated with government expenditure on the one hand and oligopoly rents in the largely non-traded sectors on the other. Section 4 then describes the model used and Section 5 presents the simulated effects of further fiscal expansions financing public investment. Section 6 then offers estimates of the effects of further inward growth-generating further industrial reforms. Section 7 then draws out the implications of the relaxation of capital controls and the associated changes in external flows. Conclusions are provided in Section 8.

2. China's Transition

Although China's rate of expansion during its three decades of reform has been spectacular, it is only in the last decade that its economic size has paralleled those of the US, the EU and Japan. China's exports have grown especially rapidly since the turn of the century and now dominate world trade in light manufactures.[2] As of 2011 its unadjusted share of global GDP

[1] The model is a distant descendant of that by Harris (1984).
[2] According to trade data from data.worldbank.org, Chinese manufactured exports now sum to more than a third of the collective manufactured imports of the US, the EU and Japan, to which level growth has been extraordinary since 2001, when China's share was only seven per cent.

was greater than Japan's and its shares of global exports, saving and investment were larger than those of the US and close to those of the EU (Table 2). Looking forward, notwithstanding China's comparative poverty on a per capita basis, there is not the scope for the rest of the world to absorb export growth from China at historical rates. Moreover, there has been an accelerated rise in Chinese labour costs, foreshadowing a Lewis "turning point"[3], which is associated with the depletion of mobile labour in rural areas and a nation-wide demographic contraction stemming from China's one child policy.

Superficially, it would seem that a switch from export-oriented to inward-focussed growth is simply a matter of sustaining high investment and substituting consumption for exports. But this has been problematic because the growth to date has emphasised light manufacturing while China's growing middle class demands quality products and services that are as yet poorly represented in its production basket. To diversify China's output toward these products requires major reform of its heavy manufacturing and services sectors and investment in associated human capital.[4] This requires the extension of industrial reforms into hitherto protected heavy manufacturing and services industries, where reductions in costs and prices could have major stimulatory effects on the economy as a whole.

A key element of the global imbalance to which China has contributed is associated with its high saving. It has tended to produce more than it has consumed as its rapid growth has run ahead of its citizens' permanent incomes. The effect of this has been to confer on the rest of the world gains via both the product and financial terms of trade but also losses due to wage rigidity and labour displacement as well as distributional stress and structural adjustment costs (Tyers 2014). A political backlash from the advanced economies has therefore also contributed to China's need for reforms that foster more inward-oriented growth. As a consequence, the new reforms are directed not only toward continuing growth in output but also to the restoration of balance. For this reason, and because capital growth is financed from saving, China's transition is clearest from the pattern and trends in its saving.

[3] The timing of China's Lewis turning point is a subject of controversy, as suggested by the contrasts between the views expressed by: Cai (2010), Garnaut (2010) and Golley and Meng (2011), which offer just a sampling of a substantial literature. There is, however, little doubt that the turning point is on its way, even if there is no agreement as to whether recent real wage rises suggest its presence.

[4] For a discussion of the institutional and industrial reform agenda and its difficulty, see for example Riedel (2011) and Deer and Song (2012).

2.1 Saving

National saving includes that by households, corporations and government. Savings that exceed the value of domestic private and public investment ("excess savings") result in the net acquisition of foreign assets and they are measured by the current account surplus:

$$(1) \qquad CA = S_{HH} + S_C + (T - G) - I = S_D - I = \Delta R - FI_{Inward} + FI_{Outward} = X - M + N$$

Here S_{HH} is household saving, S_C is corporate saving, $(T\text{-}G)$ is government saving or the fiscal surplus, S_D is total domestic saving, I is investment (including public investment), ΔR is official foreign reserve accumulation, CA is the current account balance and N is net foreign factor income.[5] FI signifies foreign investment, inflows or outflows. In China's case these terms have traditionally been dominated by FDI since cross-border portfolio investments have been restricted by its capital controls (Ma and McCauley 2007). Investment financing and the extent of imbalance therefore depends on household saving, corporate saving and government saving.

Household saving

China's households save between a quarter and a third of their disposable incomes, the pattern and time trend of which is analysed by Horioka and Wan (2007) and Horioka and Terada-Hagiwara (2012). They suggest that China's saving is in a declining phase; a point with which Yang (2012) agrees, citing a range of mainly social and trade policy reforms that will see reduced incentives for household saving many of which are stated priorities in the reform charter. Moreover, recent studies suggest that the household saving rate is falling faster than official statistics indicate (Ma and Yi 2010).[6] Thus, there is much to suggest a declining path for China's household saving rate.[7]

[5] This identity is readily obtained by combining the expenditure identity, $Y=C+I+G+X-M$ with the disposal identity for GNP, $Y+N=C+T+S$, where $S=S_{HH}+S_C$.

[6] If the weighted average of consumption-related retail and services sales growth is used to project the consumption share of GDP (Huang et al. 2012) the results suggest that the consumption share of GDP *climbed* from 49 to 54 per cent during 2008-2010, while China's NBS has it falling from 48 to 47 per cent. 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.

[7] Opposing voices include Wei and Zhang (2011) and Wen (2011). Wei and Zhang identify a link between saving and entrepreneurship effort on the one hand and China's increasingly inflated sex ratio on the other. The coincidence of son preference and sexual selection technology has seen a rise in the number of unmatched men and increasingly competitive behaviour by families with sons. Debate continues about the strength of this force for higher saving against those associated with policy reforms in the education, health and retirement insurance industries. Wen, on the other hand, employs a model of rapid growth with constant proportional idiosyncratic risk, following Modigliani and Cao (2004), to conclude that saving will continue to rise with income per capita.

Corporate saving

National accounts "flow of funds" data show corporate saving to have been fairly stable at about a fifth of GDP through 2009. In the period since, and looking forward, changes in total corporate saving might be anticipated for three reasons. First, to the extent that slower global growth since the GFC has affected profitability in the state sector, corporate savings might be expected to have also declined in recent years. Second, on-going industrial policy reforms, which have allowed substantial expansion in the share of private firms in the economy, are likely to have reduced oligopoly rents. Finally, financial development and the integration of formal and informal financial markets across the country have been proceeding apace. With more options and more security in the management of funds, it might be expected that the trend of corporate saving would be downward.

Government saving

Since the implementation of China's national tax law in 1994, an increasing share of economic activity taking place in the "formal sector". This has meant that central government tax revenue has grown at a rate that is notably faster than GDP.[8] Along with this, *central* government financial surpluses have expanded continuously. At the provincial level, however, borrowing from domestic commercial banks by SOEs and local governments has been extensive and deficits have expanded dramatically.[9] After 2007, the sum of the provincial deficits exceeded the central surplus, leading to a return to overall deficits with magnitudes expanding to unprecedented levels (Figure 1). Thus, government saving is also shifting in the negative direction in the post-GFC years and, as a consequence, there is little scope for the further use of government spending to balance the economy.

2.2 Saving Relative to Investment

The above discussions lead us to expect a declining trend in China's total domestic saving rate even where this is not yet fully represented in the official statistics, which thus far show only a modest decline since 2010. Since then, however, total (private and public) investment has risen to nearly half of GDP.[10] The investment change has therefore been the primary driver of

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The assumption of constant proportional risk is a strong one, however, in the face of social reforms to health and retirement systems.

[8] According to China's NBS *Statistical Yearbook* (2012), central government revenue has expanded its share of nominal GDP from 10% in 1994 to 23% in 2012.

[9] See Zhang and Barnett (2014). This is notwithstanding central government sharing of national revenue with the provinces at a 50-50 rate in 2011.

[10] In the medium term, at least, this has confirmed the prediction by Lee and McKibbin (2007) that investment would contribute substantially to China's "rebalancing".

the declining trend in China's *official* current account surplus since 2010. Looking ahead, it is difficult to imagine a higher rate of investment without the prospect of increasingly wasteful projects (Singh et al. 2013). Declines in household and corporate saving rates stemming from the combination of the proposed financial and industrial reforms are the least uncertain of the many likely consequences.

Internationalisation and new roles for private financial flows:

The internationalisation reforms will make private flows on the capital and financial accounts [the inward and outward private foreign investment terms in (1)] more influential. Eventually, it is expected that these will raise private holdings of foreign financial assets in both directions. This has not happened yet, however, as Figure 2 confirms. Since the GFC gross flows on China's balance of payments have fallen relative to its GDP and the most recent trends continue negative. On the one hand this is a sign that the turn inward is under way and that there is reduced reliance on exports to generate new growth. Moreover, official statistics suggest that at least three quarters of the inflows and 90 per cent of the outflows are not in the FDI or portfolio investment categories, which include property investment. Since no long term trends are yet evident in these shares, significant weakening of China's capital controls remains in prospect and the traditional dominance of these flows by debt instruments continues.

Yet expanded gross flows would seem inevitable. This raises the possibility that these flows could become unbalanced, favouring either inflows or outflows, due for example to pent-up demand for foreign assets that has heretofore been constrained by capital controls. The work of He and Luk (2013) does not foreshadow such unbalanced flows, nor does that of He et al. (2012), which envisions a trend toward trade balance, offset in the current account by higher yields on foreign (newly private) holdings. Further reasons why pent-up demand might not be a concern include that capital controls have been leaky enough for the wealthy to acquire the foreign assets they have wanted and that China's reserves are so large that they can be repatriated if private demand for foreign assets were to rise in a manner to maintain balance as desired by the government. Moreover, with widespread expectation that Balassa-Samuelson appreciations will continue as China grows relative to the advanced economies it is possible that there will be aversion to foreign assets along the lines seen in Japan, where private portfolio holders tolerate very low rates of return on home assets. A trend decline in China's saving rates and the absence of pent-up demand are therefore the reference circumstances under which capital account liberalisation might be expected to proceed.

It remains possible, however, that liberalisation could see a surge in outflows reflecting yet unobserved pent-up demand. Indeed, this prospect has come sharply into focus recently as private financial flows out of China have accelerated with the winding down of unconventional monetary policy in the US. The Yuan's appreciating trend has stalled and there is a temporary bolstering of Asian current accounts (Burns et al. 2014). The possibility of a substantial Yuan depreciation as a consequence is considered by Eichengreen (2014). The economic implications for China of these circumstances are therefore considered in Section 6.

3. Special Sensitivity to the Real Exchange Rate

The special sensitivity of China's economic performance to its real exchange rate stems from its economic structure, as summarised in Table 2. Note that 1) the great majority of non-agricultural employment is in the export-oriented light manufacturing sector – indeed, employment in this sector exceeds that in agriculture, 2) this sector is relatively competitive – price mark-ups are low and so pure or economic profits make up only a small share of total revenue, and 3) the SOE-dominated energy, metals and services sectors are less labour-intensive and at the same time they are oligopolistic, generating substantial rents that form a buffer against downturns. These facts clearly suggest that total labour demand in China is comparatively sensitive to the relativities between home wages and export prices, and hence to its real exchange rate.

The key sensitivities explored in this paper are between China's real exchange rate and domestic expenditure by government and investors on the one hand and the oligopoly rents earned in its energy, metals and services sectors on the other. Consider first the effects of increased government spending. It is well understood that, in the realistic case where financial capital is imperfectly mobile internationally, other things equal increased government borrowing raises home yields and induces financial inflow.[11] The net effect is to raise demand for home relative to (more elastically supplied) foreign products and services and hence to appreciate the real exchange rate. Beyond this, however, De Gregorio et al. (1994), Froot and Rogoff (1995), and more recently Galstyan and Lane (2009), recognised what is sometimes referred to as the Froot-Rogoff effect: that boosting government expenditure further appreciates the real exchange rate by changing the composition of aggregate demand.[12] This is

[11] This is the fundamental point of Fleming (1962) and Mundell (1963).
[12] Galstyan and Lane (2009) distinguish between government spending and government investment, finding that the latter tends to cause real depreciation. In the short run, however, all investment is intensive in non-traded

because governments spend mainly on non-traded goods and services. This effect is illustrated in Figure 3, which is based on the abstraction that goods and services are starkly divided according to their tradability. If the share of government spending in aggregate demand rises, then the pattern of implied preferences shifts favouring non-traded goods, appreciating the real exchange rate.

In assessing fiscal expansions, these well-known negative effects are seen as being more than offset by the resulting expansion in aggregate demand. A key mechanism for this is that the increase in government dissaving reduces the *national* saving rate, at least temporarily, requiring the failure of Ricardian equivalence.[13] Because reduced national saving contracts the leakage of expenditure abroad, which in China has tended to take the form of foreign reserve accumulation, the current account surplus is reduced and more Chinese expenditure falls on the home relative to the foreign economy. This has the effect of either inducing a home inflation or arresting a deflation, thus preventing output prices from falling relative to wage costs in the short run and hence preserving employment. Other things equal, by lowering real wage costs, this effect tends to constrain any real appreciation due to the composition of government spending.

But there is a further real appreciating effect not commonly recognised. This is due to oligopoly rents, which are considerable in China's energy, metals and services sectors. In essence, since the excess profits are achieved by supplying less output than would occur in competitive markets they reduce productivity in the largely non-traded sectors of the economy. Again employing the abstraction that goods and services are either tradable or not, the effect of this productivity contraction on relative prices is illustrated in Figure 4. It raises the prices of non-traded goods relative to traded goods and hence China's real exchange rate. Fiscal expansions tend to exacerbate this effect by redirecting demand to toward the oligopoly sectors. By contrast, further reforms to competition policy and regulatory practice that reduce these oligopoly rents would have the opposite effect and spur Chinese employment by sustaining the expansion in the labour-intensive and real-exchange-rate-sensitive light manufacturing sector. To quantify the effects of these changes on the real exchange rate and hence on China's economic performance, we turn to a more complete model of the Chinese economy.

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services like construction and, within its gestation period, should cause appreciation. Of course, in the long run it adds to the capital stock and causes depreciation. For an application to China, see Tyers et al. (2008).

[13] Consistent with the empirical evidence, in what follows we assume Ricardian equivalence does fail in China.

4. An Oligopoly Model of the Chinese Economy

We use a comparative static macroeconomic model of the Chinese economy that embodies a multi-industry structure in which all industries are treated as oligopolies, with firms in each industry supplying differentiated products and interacting on prices.[14] Government expenditure creates demands for goods and services via nested constant elasticity of substitution (CES) preferences and government revenue stems from a tax system that includes both direct (income) taxes levied separately on labour and capital income and indirect taxes including those on consumption, imports and exports.[15] A capital goods sector is included which translates investment expenditure into product and service demands, again using a nested CES preference structure. The level of total investment expenditure has Q-like behaviour, being influenced positively by expected home rates of return on installed capital (which drive the market values of firms' assets) and negatively by a financing rate obtainable from an open "bond market" in which home and foreign bonds are differentiated to represent China's capital controls (the rates in which drive capital replacement costs).[16] Savings are sourced from the collective household at a constant rate and from corporations at industry-specific rates depending upon the magnitudes of pure (economic) profits earned. Foreign direct investment and official foreign reserve accumulation are both represented as per (1): $S_D - I = \Delta R - FI_{Inward} + FI_{Outward}$, to complete China's external financial accounts.

4.1 Model Structure

The scope of the model is detailed in Table 3. Firms in all industries are oligopolistic in their product pricing behaviour with the degree of price-setting collusion between them represented by conjectural variations parameters that are set to account for the level of regulatory surveillance. Each firm bears fixed capital and labour costs, enabling the representation of unrealised economies of scale. Home products in each industry are differentiated by variety and output is Cobb-Douglas in variable factors and intermediate inputs. While firms are oligopolists in their product markets they have no oligopsony power as purchasers of primary

[14] It is a distant descendant of that by Harris (1984), Gunasekera and Tyers (1990) and Tyers (2005), though it is considerably generalised to include interaction on prices and macroeconomic behaviour.
[15] Income taxes are approximated by flat rates deduced as the quotient of revenue and the tax base in each case.
[16] In the lengths of run considered there is no steady state that would equate expected net rates of return with current bond yields.

factors or intermediate inputs.[17] The economy modelled is "almost small", implying that it has no power to influence border prices of its imports but its exports are differentiated from competing products abroad and hence face finite-elastic demand.[18] The consumer price index is constructed as a composite Cobb-Douglas-CES index of post-consumption-tax home product and post-tariff import prices, derived from the aggregate household's expenditure function. This formulation of the CPI aids in the analysis of welfare impacts. Because collective utility is also defined as a Cobb-Douglas combination of the volumes of consumption by generic product, proportional changes in overall economic welfare correspond with those in real GNP.[19]

The quantity of domestically-owned physical capital is fixed in the short, so that changes in the total capital stock affect the foreign ownership share and hence the level of income repatriated abroad. Long and short run closures can be adopted but the analysis presented herein is focussed on the short run: physical capital is fixed in supply and immobile between industries. Production labour is mobile between industries but at a fixed real (CPI-deflated) wage, so that employment is endogenous, and the remaining factors, while also mobile between industries, are fixed in endowment and flexibly priced. There is no entry or exit of firms but the magnitudes of pure profits earned are endogenous. Fiscal policy closures vary according to application. In most applications, consistent with China's heretofore fiscal conservatism, the base fiscal position is held constant so that changes in endogenous revenue lead to corresponding changes in government expenditure.

Macroeconomic behaviour

[17] Imports in each industrial category are seen as homogeneous, differentiated from home products as a group, so that import varietal diversity never changes. Since all home varieties are exported there is no movement on the "extensive margin" of the type that is evident in the models of non-homogeneous export industries by Melitz(2003) and Balistreri et al. (2007).

[18] The effective numeraire is the import product bundle. Consumer and GDP price indices are constructed for real aggregations, following the practice in national modelling since Dixon et al. (1982) and Harris (1984).

[19] When the utility function is Cobb-Douglas in consumption volumes, the expenditure function is Cobb-Douglas in prices. If the consumer price level, P^C, is defined as a Cobb-Douglas index of prices, the equivalent variation in income can be expressed in terms of the proportional change in this index. Thus, following any shock, the income equivalent of the resulting changes to income and prices is:

$$\Delta W = Y_1 - Y_0 + EV\left(P_0^C, P_1^C, Y_1\right) = Y_1 - Y_0 - Y_1 \frac{\Delta P^C}{P_1^C} \ ,$$

which can be expressed in proportional change form as:

$$\frac{\Delta W}{W} = \frac{Y_1\left(1 - \frac{\Delta P^C}{P_1^C}\right) - Y_0}{Y_0} \cong \frac{\Delta Y}{Y_0} - \frac{\Delta P^C}{P_1^C} \ .$$

This is, approximately, the proportional change in real GNP.

As befits a comparative static analysis, the macroeconomics embodied is elemental. The short run closure fixes productive capital use in all industries but allows investment that would affect production in the future. Central is the open economy capital market which is built around the market clearing identity, a version of (1), above, in which inward and outward private financial flows are consolidated into "net foreign saving": $S_{NF} = FI_{Inward} - FI_{Outward}$. Thus:

$$(2) \qquad I(r^{ce}, r) = S_D\left(Y_{DH}, \pi, G\right) + S_{NF}\left(r, r^*\right) - \Delta R\left(r, r^*\right) ,$$

where r is the home real financing rate (bond yield), r^* is the real yield on bonds abroad (the two being differentiated and so offering different yields) and ΔR is the annual addition to official foreign reserves. Total domestic saving is the sum of saving by households, corporations and government: $S_D = S_H\left(Y_{DH}\right) + S_C\left(\pi\right) + \left(T - G\right)$, where Y_{DH} is home household disposable income. The household saving rate is assumed fixed, so that $S_H = s_H\, Y_{DH}$. China's extraordinarily high level of corporate saving, S_C, is assumed to stem only from pure profits, π, with a distinct but fixed saving rate calibrated separately for each industry:

$$(3) \qquad S_C = \sum_i S_{Ci} = \sum_i s_{Ci}\,\pi_i \ .$$

The rate r^{ce} is the expected average net rate of return on installed capital, which takes the following form at the industry level:

$$(4) \qquad r_i^{ce} = \frac{P_i^{Ye} MP_i^K}{P^K} - \delta_i \ ,$$

where P^K is the current price of capital goods, P^{Ye} is the product price level expected to prevail upon gestation and δ is the rate of depreciation. An average of the sector-specific rates, r_i^{ce}, is taken that is weighted by value added in each industry to obtain the economy-wide level r^{ce}. Investment expenditure, *I*, is then determined by:

$$(5) \qquad I = P^K I_0 \left(\frac{r^{ce}}{r}\right)^{\varepsilon_V} .$$

This relationship constrains the investment response to a change in either the rate of return or the financing rate, offering a reduced form representation of either gestation costs or expectations over short run consequences of installation for the rate of return.

In our comparative static analysis net foreign saving, S_{NF}, is motivated by changes in the level of an interest parity function that incorporates the difference between the home and foreign real bond yields and real exchange rate expectations. A linear relationship is used to allow for reversals of the direction of net flow in response to shocks.

(6) $$S_{NF} = a_{SF} + b_{SF}\left(r - r^* + \hat{e}_R^e\right), \quad b_{SF} > 0.$$

With tight capital controls there is a low level of responsiveness and so b_{SF} is small (the supply of net foreign private saving is inelastic). Correspondingly, the combination of China's high saving rate with outward capital controls necessitates that the surplus of saving over investment, which has ranged up to a tenth of GDP, be directed abroad by the PBC as official foreign reserves. This behaviour depends on a relationship that is linear, for the same reason as in (6):

(7) $$\Delta R = a_{DR} - b_{DR} r\,,$$

where, under capital controls, the movement of reserves is much more elastic to the home real interest rate than that of private financial capital, so that $b_{DR} >> b_{SF}$. The effect of this is to stabilise the home real rate in response to shocks, which cause, instead, elastic movements in the rate of reserve accumulation.[20] The liberalisation of China's capital and financial accounts is then readily represented as a lessening of the gap between the parameters b_{DR} and b_{SF}.

The capital market clearing identity (2) then determines the home real interest rate and the magnitude of the external financial deficit ($\Delta R - S_{NF} = S_D - I$). This is then equal in magnitude to the current account surplus [$X - M + N\left(r, r^*\right)$, where *N* is net factor income from abroad[21]]. The model is essentially Walrasian in that shocks originating in saving and investment, and hence in external flows, cause home (relative to foreign) product prices (and hence the *real* exchange rate) to adjust sufficiently to clear home markets and preserve the balance of payments.

S*hort run effects in a real model*

[20] It is argued elsewhere (Tyers and Zhang 2011), for example) that, under China's capital controls and given the high saving rate, the PBC had little residual discretion over annual increments to reserves. This is because there was no incentive for China's commercial banks to do other than relinquish unused foreign currency to the PBC. The scale of reserve accumulations were therefore not an instrument in the PBC's monetary policy. Equation (7) is intended merely as a reduced form description of this process.

[21] As modelled, *N* comprises a fixed net private inflow of income from assets abroad and fixed aid to the government, less endogenous repatriated earnings from foreign-owned physical capital in China.

In the short run nominal wage rigidity is important and this is not readily represented in real models such as this one. Indeed, nominal rigidity is essential to properly representing the effects of fiscal expansions, since their claimed beneficial effects depend on demand effects that alter the relationship between product prices and wage costs in the short run. China's nominal exchange rate targeting macroeconomic policy regime makes it possible to overcome this deficiency of our real model, however. In this case, any change in the real exchange rate takes the form of a corresponding change in the domestic price level. If the nominal exchange rate, *E*, is defined as the number of units of foreign exchange obtained for a unit of the domestic currency, then the real exchange rate, e^R, can be defined correspondingly as the rate of exchange between the home product bundle and corresponding bundles produced abroad. It follows that the bilateral real exchange rate with foreign trading partner *i* can be approximated as the common currency ratio of the GDP prices of the two countries, P^Y and P_F^Y / E,

$$(8) \qquad e^R = \frac{P^Y}{P_F^Y / E},$$

and so, when *E* is targeted and there is no indirect effect on the foreign currency price level in the rest of the world, a real appreciation must take the form of an inflation: $e^R \uparrow = \bar{E}\ P^Y \uparrow / \bar{P}_F^Y$.

If we then assume that our short run is sufficiently tight to render the nominal wage of production workers rigid, then the short run real wage movement mirrors the real appreciation: $\bar{W} / \left(P^Y \uparrow\right) = w \downarrow$, so that $\hat{w} = -\hat{e}^R$. By contrast, a flexible exchange rate regime with a price level target would see no change in the price level or real wage but a nominal appreciation of magnitude equal to the proportional change in the real exchange rate.

The liberalisation of capital controls will require increase nominal exchange rate flexibility, as the "impossible trinity" dictates. While we always retain the real exchange rate as endogenous, both closures linking it to the price level and real wage rate are used in our experiments.

Oligopoly in supply

Firms in each industry supply differentiated products. They carry product-variety-specific fixed costs and interact on prices. Cobb-Douglas production drives variable costs so that average variable costs are constant if factor and intermediate product prices do not change but average total cost declines with output. Firms charge a mark-up over average variable cost which they choose strategically. Their capacity to push their price beyond their average

variable costs without being undercut by existing competitors then determines the level of any pure profits and, in the long run, the potential for entry by new firms.

Thus, each firm in industry *i* is regarded as producing a unique variety of its product and it faces a downward-sloping demand curve with elasticity ε_i (< 0). The optimal mark-up is then:

$$(9) \qquad m_i = \frac{p_i}{v_i} = \frac{1}{1+\frac{1}{\varepsilon_i}} \qquad \forall i \ ,$$

where p_i is the firm's product price, v_i is its average variable cost and ε_i is the elasticity of demand it faces. Firms choose their optimal price by taking account of the price-setting behaviour of other firms. A conjectural variations parameter in industry *i* is then defined as the influence of any individual firm *k*, on the price of firm *j*: $\mu_i = \partial p_{ij} / \partial p_{ik}$.

These parameters are exogenous, reflecting industry-specific free-rider behaviour and the power of price surveillance by regulatory agencies. The Nash equilibrium case is a non-collusive differentiated Bertrand oligopoly in which each firm chooses its price, taking the prices of all other firms as given. In this case the conjectural variations parameter μ is zero. When firms behave as a perfect cartel, it has the value unity. This parameter enters the analysis through the varietal demand elasticity.

Critical to the implications of imperfect competition in the model is that the product of each industry has exposure to five different sources of demand. The elasticity of demand faced by firms in industry *i*, ε_i, is therefore dependent on the elasticities of demand in these five markets, as well as the shares of the home product in each. They are final demand (*F*), investment demand (*V*), intermediate demand (*I*), export demand (*X*) and government demand (*G*). For industry *i*, the elasticity that applies to (19), above, is a composite of the elasticities of all five sources of demand.[22]

$$(10) \qquad \varepsilon_i = s_i^F \varepsilon_i^F + s_i^V \varepsilon_i^V + s_i^I \varepsilon_i^I + s_i^X \varepsilon_i^X + s_i^G \varepsilon_,^G \qquad \forall i$$

where s_i^j denotes the volume share of the home product in market *i* for each source of demand *j*. These share parameters are fully endogenous in the model.

Thus, the strategic behaviour of firms, and hence the economic cost of oligopolies, is affected by collusive behaviour on the one hand and the composition of the demands faced by firms on

[22] The expressions for these elasticities are messy and voluminous. They are derived in the technical appendix.

the other, both of which act through the average elasticity of varietal demand. The collusive behaviour enters through conjectural variations parameters and composition through the demand shares s_i^j. Of course, the capacity firms have to reduce their prices also depends on their factor productivity performance and on the fixed cost burden carried by each industry and hence on firm numbers.

To study the effects of price-cap regulation a Ramsey mark-up, m_i^R is formulated as:

$$(11) \quad m_i^R = \frac{afc_i + v_i}{v_i} \ ,$$

where afc_i is average fixed cost and v_i is average variable cost in industry *i*. Compromise mark-ups can be simulated by altering the parameter φ_i in an equation for the "chosen" mark-up: $m_i^C = (\varphi_i - 1) m_i^R + (2 - \varphi_i) m_i \quad \forall i$. Thus, when $\varphi_i = 1$, $m_i^C = m_i$, thus maximising oligopoly profits, and when $\varphi_i = 2$, $m_i^C = m_i^R$, eliminating pure economic profits altogether.

4.2 The database and its representation of broad economic structure

The flow data for the current model originates from the GTAP Version 6 global database for 2001.[23] It combines detailed bilateral trade, transport and protection data characterizing economic linkages among regions, together with individual country national accounts, government accounts, balance of payments data and input-output tables which enable the quantification of inter-sectoral flows within and between regions. Factor shares and input output coefficients from these 2001 data are combined with Chinese national accounts and balance of payments data for 2005, inflating the database to that year and readjusting it for balance. Key structural elements are evident from Table 2, which shows that China's measured GDP is dominated by light manufacturing and services. The major contributors to exports are also those that export the largest shares of their output. Table 4 confirms that the traded industries in general and the exporting light manufacturing industries in particular are intensive in production labour. This is most notably true of processed agricultural products and textiles.

Calibration of pure profits and oligopoly parameters

[23] Documentation on the GTAP 6 Data Package may be viewed at: <http://www.gtap.agecon.purdue.edu/databases/>.

The flows represented in the database do not reveal details of intra-sectoral industrial structure. To represent oligopolistic behaviour, additional information is required on effective firm numbers, pure profits, fixed costs and minimum efficient scale for each industry. With the support of China's official statistics these variables are calibrated in the following manner. First, pure profits are required as a share of total revenue in each industry. This is needed to finalise the flow database by splitting capital payments between market and over-market returns.[24] It is also a starting point for calibrating industry competitive structure. Second, rough estimates are required of strategically interacting firm numbers in each industry and their corresponding conjectural variations parameters. Again, official statistics provide firm numbers and sizes and the proportion that are private and state-owned.[25]

Third, to complete the formulation of industry demand elasticities, values of elasticities of substitution between home product varieties on the one hand, and between generic home and foreign products on the other, are required for each industry. These are initially drawn from the estimation literature.[26] Preliminary industry demand elasticities are then calculated for each source of demand (final, intermediate, investment, government and export). Initial shares of the demand facing each industry are then drawn from the database to enable the calculation of weighted average demand elasticities for each industry. Preliminary mark-up ratios are deduced from these, via (19). The initial equilibrium industry shares, elasticities and mark-up ratios for each industry are given in Table 5.[27] This completes the initial demand side calibration. Work on the supply side begins with the application of mark-up ratios to deduce the initial level of average variable cost in each industry. Then the proportion of pure profits in total revenue is deducted from the mark-up to arrive at fixed cost revenue shares.[28] Total recurrent fixed cost in each industry then follows. At this point these results are reviewed and,

[24] Pure profit shares of total revenue in 2005were high in "metals and minerals", "petroleum and energy", "telecommunications", "insurance and finance" and "transport". Data on accounting profits in the latter three sectors is comparatively weak and the estimates are partly judgemental, accounting for such determinants as low borrowing rates for these SOE dominated sectors and hence low capital service costs. See the appendices to Tyers and Lu (2008).

[25] *Effective* firm numbers are smaller than totals since pricing is frequently dominated by a few large firms in each sector. For oligopolistic sectors in China, these tend to be state owned enterprises..

[26] Summaries of this literature are offered by Dimaranan and McDougall (2002) and at http://www.gtap.purdue.edu/databases/.

[27] Note that the reason the elasticities appear large in magnitude at first glance is that they do not represent the slopes of industry demand curves for generic goods. Rather, they are the elasticities faced by suppliers of individual varieties and are made larger by inter-varietal substitution.

[28] Fixed costs take the form of both physical and human capital costs using the rule of thumb (based on estimates by Harris and Cox, 1983) that physical capital has a fixed cost share of 5/6.

where conflicting information is available on fixed cost shares of total turnover, the calibration is recommenced with new initial elasticities.[29]

Importantly for the interpretation of later results, Table 5 also makes clear that the five sources of demand facing firms in each industry are not equally elastic. Export and final demand are the most elastic and intermediate demand the least.[30] Also from Table 5 it is evident that, where exports dominate demand firms face larger elasticities and charge smaller mark-ups. Consistent with these observations, pure profit shares of total revenue tend to be small or even negative for export-oriented industries and very large for the SOE dominated industries: petroleum, metals and minerals, telecommunications, finance and transport. In model simulations, because the elasticities are tied to database flows via mark-ups and hence pure profits, it is difficult to alter them without rebuilding the entire database. In short run applications, where smaller elasticities are sensible, the export elasticities are shocked down within simulations. The short run applications presented here have export elasticities (in particular, the foreign elasticity of substitution between home and foreign products) shocked down by 70%.[31] Oligopoly pricing is assumed to focus on a longer run than simulated and so these reductions in the external elasticities do not drive home pricing decisions. They only represent external adjustment at a length of run that is shorter than firms' planning horizons.

5. Fiscal Expansion and Short Term Growth

The shift toward external balance observed since the GFC is primarily due to fiscal expansions that have reduced the overall saving rate, combined with substantial public investment. Though further public investment is inevitable, it is likely to be constrained by the fiscal issues raised in Section 2. It is examined here to address the controversies arising over the effects of fiscal expansions in the presence of oligopoly behaviour, discussed in Section 3. It is approached in several ways. First, a simple fiscal expansion is introduced, amounting to 3.2 per cent of GDP, without public investment while retaining parameters in (6) and (7) to represent the retention of capital controls and introducing adjustments to the real wage of

[29] The actual calibration process is yet more complex than this because the elasticities of intermediate demand depend on intermediate cost shares, which depend on the variable cost share. It is therefore necessary to calibrate iteratively for consistency of elasticities and shares.

[30] Export demand is found to be more elastic because of the larger number of substitutable product varieties available abroad while intermediate demand is relatively inelastic because of firms' reluctance to alter arrangements for intermediate input supply which may depend on location or "just in time" relationships. These issues are addressed empirically by Harris and Cox (1983).

[31] For a discussion of elasticities and the length of run in comparative static analysis, see Cooper et al. (1985). The analytics of short run changes to the responsiveness of export demand, see the accompanying appendix.

production workers consistent with a fixed nominal exchange rate. Second, to identify the effects of oligopoly behaviour, this same shock is applied in the absence of oligopoly rents by forcing firms to apply mark-ups that result in pricing at average cost before the fiscal experiment is undertaken. Third, to observe the effects of public investment the optimistic assumption is made that all the additional government spending is committed to capital expansions in network services and that these are achieved in the current period. Finally, the expenditure expansion and public investment simulations are repeated in the presence of an open capital account and floating exchange rate.

Fiscal expansion with capital controls and a fixed exchange rate

As the results in the first column of Table 6 show, this reduces excess saving, which manifests as reduced reserve accumulation. It therefore redirects expenditure to the home economy that would previously have gone abroad. This and the Froot-Rogoff effect on expenditure composition contribute to an appreciation of the real exchange rate that impairs demand in the critical light manufacturing sector. Investment is crowded out and the net result is a contraction in output and production employment. As discussed in Section 2, part of the reason for the contraction is the change in oligopoly pricing due to the redirection of demand inward, which, as Table 5 attests, reduces average demand elasticities facing firms and raises mark-ups and oligopoly rents, thus further appreciating the real exchange rate.

The sectoral effects of the fiscal expansion are indicated in the first three columns of Table 9. Most notable is the pattern showing service industries expanding while tradable industries contract. This is a consequence of the Froot-Rogoff expenditure composition effect of a fiscal expansion and the real appreciation that accompanies it, which raises service prices relative to those of tradable inputs. Mark-ups and pure profits tend also to be larger in the more profitable network services industries as exported shares of home output fall and hence so do elasticities of demand.

Fiscal expansion without oligopoly rents

When the same fiscal expansion shock is re-introduced under conditions that constrain oligopolies to price at average cost, it proves to be net expansionary of output and employment, as the results in the second column of Table 6 show. The oligopoly pricing effect works primarily through intermediate products, raising the prices of metals, energy products, transport and "other services" and squeezing comparatively low-margin light manufactures. All fiscal expansions contract the construction industry because it is so prominent in investment, which is

crowded out. Thus, oligopoly behaviour is clearly significant. The inward redirection of demand that occurs following this modest fiscal expansion reduces demand elasticities and raises mark-ups yielding a negative turn-around of two per cent of GDP and four per cent of modern sector jobs.

Thus, even when oligopoly behaviour is restrained, the short run growth effects are weak. Yet the underlying assumptions thus far (a perfectly rigid nominal production wage, a rigid nominal exchange rate target and no Ricardian equivalence) represent extreme conditions that favour the largest possible output effects from a fiscal expansion. If anything, therefore, the power of a fiscal expansion is overstated. But the effects of high public investment content have not yet been accounted for.

Fiscal expansion with public investment

Under the very optimistic assumption that all the new government expenditure is translated into new physical capital in the network services sectors (raising industry-specific capital stocks equiproportionally in electricity, gas, telecommunications, transport and other services) within the length of run considered, the effects are net expansionary. This is indicated in the third column of Table 6. The net gains are small, however, and more private investment is crowded out due to the effect of the public investment on capital returns.

Fiscal expansion with a liberalised capital account and floating exchange rate

Finally, the same fiscal expansion is introduced under a liberalised external regime, with relaxed capital controls and a floating exchange rate. The pattern of these results is similar and the net effects similarly small. A key difference is that the fiscal expansion alone is net expansionary in this case, even with oligopoly behaviour and no public investment. This is because the open financial account allows the associated rise in home yields to attract substantial foreign investment, boosting domestic demand. Adding the public investment contributes further, though minor, expansion, again because the crowding out of private investment suppresses the scale of private financial inflows.

6. Further Industrial Reform and Short Term Growth

China's industrial reforms have contributed substantially to its overall economic growth in the past two decades, and this includes its spectacular growth in non-agricultural employment. The extension of these reforms into industries that have tended to be dominated by state-owned

enterprises and less accessible to FDI is certainly part of the government's official agenda (State Council 2014). Here two key elements of the industrial reform program are introduced: privatisation and competition policy. State-dominated sectors in the Chinese economy, including steel and other metals, motor vehicles, coal and petroleum, transport and finance enjoyed extremely large economic profits during the boom period (Lu et al. 2008). Since these profits were not distributed to owners (tax-payers), about a fifth of China's GDP was not available to households to allocate between consumption and saving (Kuijs 2006). The result was a declining consumption share of GDP and "excess" national saving.[32]

In this section the short run implications further industrial reforms that will reduce oligopoly rents and corporate saving are examined. Privatisation, by itself, redirects income to households that might previously have gone directly to investment by a state-owned corporation. It is therefore modelled as a reduction in the corporate saving rate.[33] The other industrial reforms include oligopoly pricing surveillance and output price regulation, or price caps, both of which are now common in advanced economies, particularly in the network services. Collectively, these reduce oligopoly prices, particularly of intermediate inputs, and therefore reduce costs throughout the economy while at the same time raising consumption expenditure as a proportion of GDP. In the experiments presented here these are packaged, modestly, to reflect the potential for reform in an individual year.

The package introduced here would reduce the corporate saving rate by 10 per cent. This compares with a 70 per cent reduction that would reduce the corporate saving level down to that prevailing in Taiwan and in many other advanced economies. The *level* of corporate saving is further reduced by additional reforms affecting the size of economic profits. The first of these is pricing surveillance, which is represented by a reduction in the conjectural variations parameters in all industries by 10 per cent (bearing in mind that, as per Section 4, values of zero indicate non-collusive oligopoly).[34] By making firms perceive more elastic demand, this reduces their profit-maximising mark-ups via (9) in Section 4. Excess profits are further limited, directly, by imposing regulatory price caps that remove 10 per cent of the gap between the profit-maximising output price and average total cost in all industries (the parameter φ_i is raised by 10 per cent, as per the discussion of (11) in Section 4).

[32] By reducing oligopoly rents and hence corporate saving, privatisation and competition policy have been shown to have the potential to accelerate China's long run growth, in both modern sector employment and output (Tyers 2013).
[33] Direct productivity implications associated with take-over risk and access to FDI are ignored here, though they are considered in the long run analysis by Tyers (2013).
[34] For the analytics of this, see the mathematical appendix.

The effects of this packaged shock are summarised in the first column of Table 7, which shows them to be very substantial, indeed sufficient by themselves to sustain China's historically high growth for several years. The cost reductions that follow from reduced oligopoly rents, particularly in key sectors supplying widely used intermediate goods and services, foster expansions in output and employment throughout the economy. Moreover, they depreciate the real exchange rate, thus fostering long run growth in exports.[35] Production is, on average, closer to minimum efficient scale and, even though oligopoly rents (pure profits) are reduced, average capital returns rise due to increased market rents on existing capital. The rise in these returns leads to increased investment expenditure that is financed by reduced net financial outflows in the form of reduced foreign reserve accumulation.

The sectoral effects of the industrial reform package are summarised in the second block of three columns in Table 9. Mark-ups and pure profits decline in most industries, and particularly in those with high initial rents. There is also a redistribution of the production labour force out of agriculture, processed agricultural products and textiles and into industries that benefit most from cost reductions. These are the less labour-intensive industries (Table 4) and they include metals, motor vehicles, other manufactures, finance and transport. Real wages of production workers are modestly higher and those of skilled workers very substantially higher so the additional output is smaller in those industries with highest labour intensity. Even considering the higher unit factor rewards, most industries enjoy reductions in unit fixed costs as production runs expand. These include metals, petrochemicals, motor vehicles, other manufactures, transport and construction. Finally, the composition of exports changes with increased concentration in metals and motor vehicles and there is an expanded external role for the Chinese transport services industry.

In aggregate, then, even though this package of reforms allows the retention of some potentially distorting oligopolies, it is attractive in that it raises modern sector employment and productivity while restoring the prominence of consumption expenditure and further reducing the external imbalance. Moreover, it moves the structure of the economy away from its prior dependence on inexpensive raw labour toward a more mature phase in which China's services industries are larger and more competitive and the composition of its trade is more similar to that of most industrialised economies.

[35] In these short run simulations the export elasticities are smaller than those motivating firms' pricing behaviour (Table 5) and so export growth is curtailed. It is nonetheless substantial in key sectors: mining, electronics, motor vehicles and other manufacturing, all of which enjoy export volume expansions of between three and 10 per cent.

7. Capital Account Liberalisation

In Section 2 the case is made for a trend decline in China's overall saving rate and it is noted that the studies available thus far do not suggest any significant pent-up demand for rebalancing of private portfolios in favour of foreign assets. This suggests a smooth transition to balanced further growth irrespective of the extent of capital account liberalisation. Here such a scenario is compared with one in which there is pent-up demand for foreign assets that causes an outward rebalancing following capital account liberalisation. Thus, the experiments presented consider modest declines in saving rates on the one hand and a structural shift that reflects the release of pent-up demand for foreign assets on the other. In each case the effects are evaluated assuming either a monetary defence of the nominal exchange rate or a float. The results are summarised in Table 8.

Consider first the effects of a smooth continuation of China's savings decline. This is represented by shocking the household and corporate saving rates down by 10 per cent. This tightens the home financial market and, with liberalised capital and financial accounts, it draws in private foreign investment. The effects of this are partially offset by reduced reserve accumulation. Nonetheless, the private inflow is sufficient to cut the current account surplus by half. Combined with the boost to domestic consumption expenditure that accompanies reduced saving rates, this new inflow raises demand for home relative to foreign products and services and so appreciates the real exchange rate.

If monetary policy targets the nominal exchange rate, as in the first column of Table 8, this implies a domestic inflation and, with nominal wage rigidity, there is a substantial boost to production employment. Combined with new investment that is financed by the inflow and induced in part because greater employment raises capital returns, this leads to a substantial boost to real GDP growth. If the nominal exchange rate is allowed to appreciate the home inflation is avoided and much of the inducement to increase production employment disappears. Nonetheless, aggregate demand is still boosted by greater home consumption and the foreign private inflow and there is therefore a modest rise in real GDP. In both cases the increases in production runs boost industrial efficiency. But the increase in demand is internal and hence it reduces perceived elasticities and raises mark-ups in key industries, thereby raising oligopoly rents. This can be seen from the third block of columns in Table 9. Overall,

however, capital account liberalisation might be expected to have marginally positive effects under these circumstances.

Now consider the possibility that there is considerable home demand for foreign assets that is constrained by China's outward capital controls. To represent the effects of this following the liberalisation of the capital and financial accounts an arbitrary shift is introduced in the constant term of (6), a_{SF} (which is initially negative), that reduces net private inflow at all levels of the home bond yield. As the third column of Table 8 indicates, this shift is sufficient in the experiment to cause a private outflow amounting to about a fifth of GDP. Partially offset by a repatriation of foreign reserves, this shock also tightens the home financial market. This time, however, less investment is financed, it blows out the current account surplus and its effect on aggregate demand is therefore negative. The real exchange rate depreciates and, if monetary policy is directed to defend the nominal exchange rate, there is a deflation that exacerbates a significant shedding of production employment and a contraction in real GDP.

If the nominal exchange rate is allowed to float downward the results are less dire, as indicated in the final column of Table 8. The private outflow still impairs investment financing and the current account still blows out but there is no deflation, and hence no contraction in production employment; and the slide in GDP is much reduced. Clearly, this suggests that any commitment to capital and financial account liberalisation should accompany a preparedness to allow the nominal exchange rate to adjust, particularly downward, so as to avoid deflation. Interestingly, while the pent-up demand story is negative for China's growth, if the exchange rate is allowed to adjust to avoid deflation the costs are borne primarily by the wealthy. Oligopoly rents decline significantly as does the overall rate of return on capital, yet employment of production workers expands and real skilled wages rise, as do rents on land and natural resources. Thus, with flexible monetary policy, even a substantial out-pouring of private flows such as this need not impair China's short term growth very much.

The only caveat to this conclusion is that the simulations ignore the possibility of a banking or wider financial crisis. Home yields rise by about 17 per cent, suggesting a collapse in asset values that could threaten major financial institutions. This would cause the temporary sequestration of existing physical capital and a potentially substantial loss of employment.

8. Conclusion

China's recent rapid growth and its current size limits its capacity to source further expansion from exports and so the inevitable turn inward is in progress, as suggested by declines in gross flows on its balance of payments relative to its GDP that have been persistent since the GFC. The large current account surpluses of the boom period are closing, thus far primarily due to fiscal expansion and some associated public investment. Unfortunately, this option is being closed off in the short run by the need for reform of fiscal federalism in China, to resolve growing provincial indebtedness. The key reforms with positive short run implications focus on industrial policy and capital and financial account liberalisation under the general rubric of "internationalisation". The short run effects of these policy shocks are examined using a 17 sector model of the Chinese economy that takes explicit account of oligopoly behaviour and financial flows in the short run.

The results confirm that further fiscal expansions, even with large public investment components, will not contribute the major share of new growth, but industrial reform in heavy manufacturing and services would reduce costs and foster growth in output, private consumption and modern sector employment. Moreover, they would reduce external imbalance by curtailing corporate saving, cut distortionary oligopoly rents and increase production runs in previously inefficient industries, thus raising the productivity of existing physical capital and labour. At the same time, the anticipated trend toward reduced saving and increased private consumption would be rewarding under capital and financial account liberalisation since expanded home consumption demand would be supplemented by a greater inflow of private foreign investment, raising both employment and real GDP. Were pent-up demand for foreign assets to be revealed following further liberalisation, the resulting financial outflows would only be seriously damaging were monetary policy to attempt to defend the nominal exchange rate, or if declines in asset values were to precipitate a domestic financial crisis. Moreover, in the absence of financial disruption and with the cushioning effect of exchange rate flexibility, such temporary outflows are shown to be beneficial to Chinese employment and labour incomes, with temporary negative impacts falling on capita returns.

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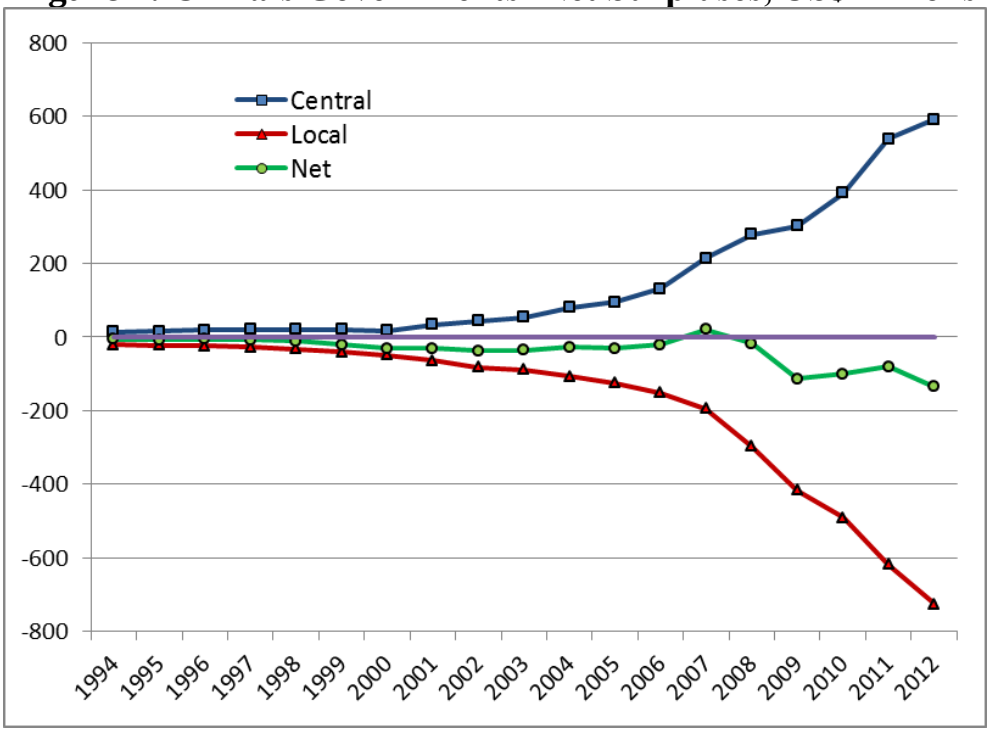
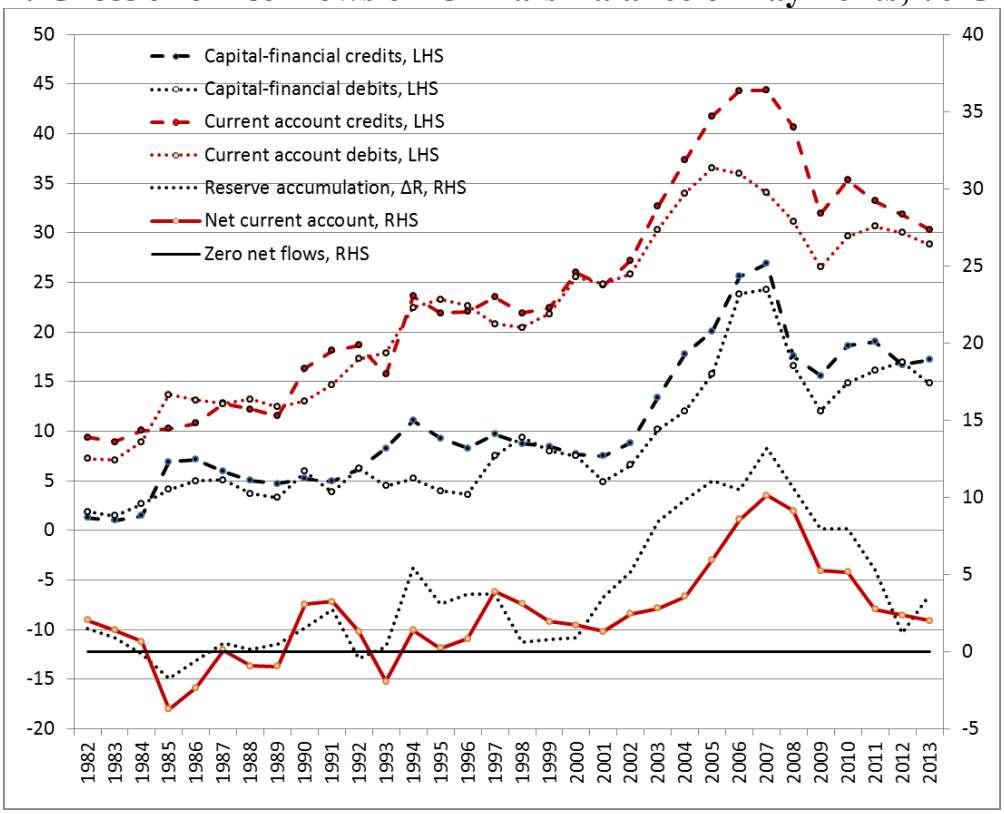
Figure 1: China's Governments' Net Surpluses, US$ Billions



Sources: Government debt and general government gross debt position, IMF Fiscal monitor; External debt outstanding, Chinese statistical yearbook 2012.

Figure 2: Gross and Net Flows on China's Balance of Payments, % GDP



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

Figure 3: Expenditure Composition – the Froot-Rogoff Effect

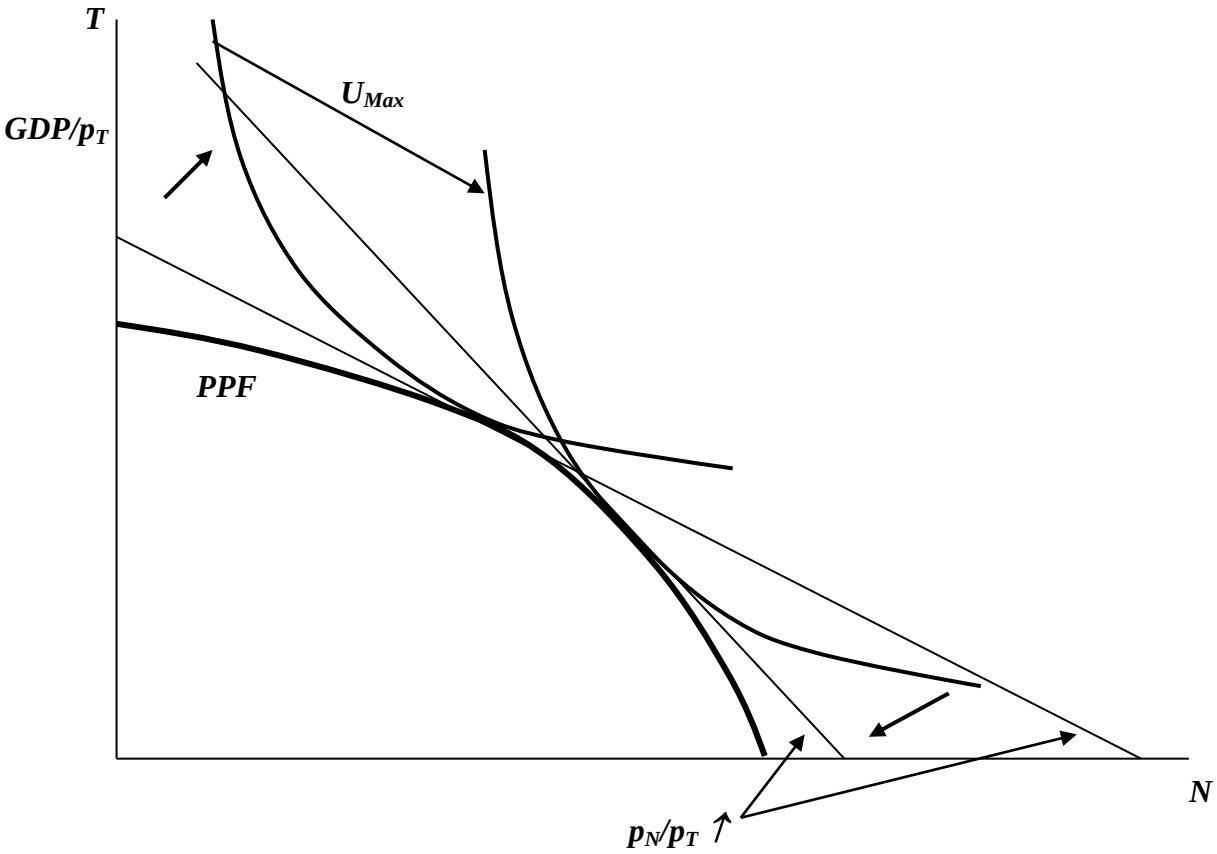


Figure 4: Service Oligopoly Rents and the Real Exchange Rate

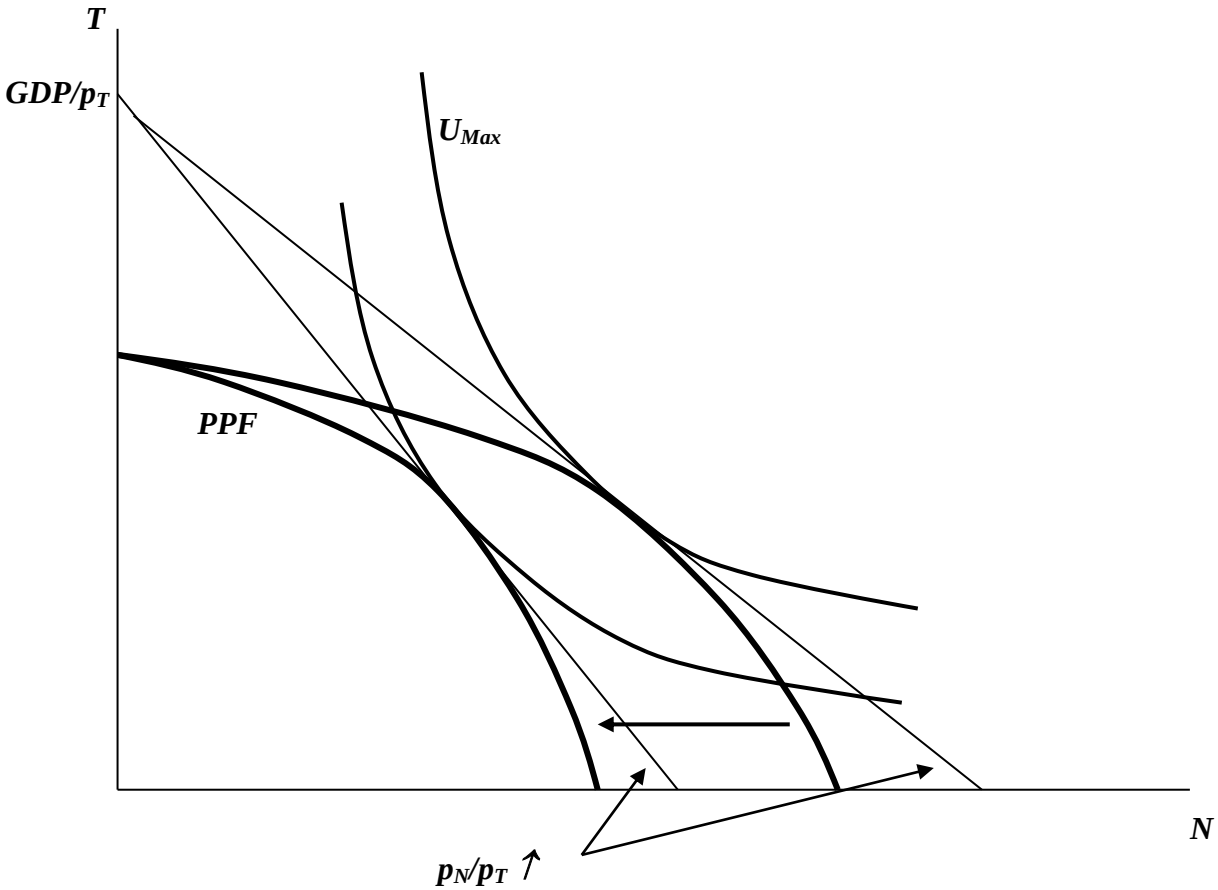


Table 1: Relative Economic Sizes of China and Other Large Regions, 2011:

% 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: Structure of the Chinese Economy[a]

Per cent	Value added share of GDP	Share of total production employment	Share of total exports	Pure profit share of gross revenue
Agriculture	13	24	2	0
Petroleum, coal, metals	16	11	10	20
Light manufacturing	29	33	82	5
Services	42	32	6	20
Total	100	100	100	12

a Pure profits are calculated from national statistics estimates of accounting profits, deducting required returns to service industry specific prime rates. Here they are presented gross of tax and corporate saving and as shares of total revenue.

Source: Model database (social accounting matrix), derived from Dimaranan and McDougall (2002), and an updating of the national data to 2005, as described in Tyers and Lu (2008).

Table 3: Model scope

Regions	China
	Rest of world
Primary factors	Land
	Natural resources (mineral, energy deposits)
	Skilled (professional) labour
	Unskilled (production) labour
	Physical capital
Industries	Agriculture
	Metals, including steel, minerals and (non-coal) mining
	Coal mining and production
	Petroleum production and refining
	Processed agricultural products
	Electronic equipment
	Motor vehicles
	Chemical, rubber, plastic products
	Textiles
	Other manufactures
	Electricity supply and distribution
	Gas supply and distribution
	Telecommunications
	Insurance and finance
	Transport
	Construction
	Other Services

Source: Aggregates of the 57 industry GTAP Version 6 database from Dimaranan and McDougall (2002).

Table 4: Factor Intensities by Industry[a]

	Capital	Production labour	Skilled labour	Land and nat resources
Agriculture	11	59	0	30
Metals & minerals	66	27	5	2
Coal	28	30	3	39
Petroleum	86	5	1	7
Processed agriculture	38	54	7	0
Electronic equipment	66	26	8	0
Motor vehicles	59	35	6	0
Chemical products	62	32	6	0
Textiles	40	52	7	0
Other manufactures	68	27	5	0
Electricity	69	21	11	0
Gas mfg & distribution	49	37	14	0
Communications	92	5	3	0
Insurance and finance	80	12	8	0
Transport	78	18	4	0
Construction	56	37	7	0
Other Services	54	27	19	0

a These are factor shares of total value added in each industry, calculated from the database. Capital shares include pure profits. Shares sum to 100 per cent horizontally.
Source: Model database (social accounting matrix), derived from Dimaranan and McDougall (2002).

Table 5: Initial Demand Shares, Elasticities and Mark-Ups[a]

	Demand shares, %					Demand elasticities					Average demand elasticity	Industry mark-up[b]
	Inter mediate	Final	Export	Invest ment	Govt	Inter mediate	Final	Export	Invest ment	Govt		
Agriculture	53	40	4	3	0	-10.2	-28.6	-40.1	-15.6	-16.0	-18.8	1.06
Metals, Minerals	84	3	10	2	1	-2.9	-4.4	-8.9	-2.8	-2.8	-3.5	1.39
Coal	61	4	33	0	2	-3.6	-6.1	-11.2	-2.4	-2.5	-6.2	1.19
Petroleum	58	12	5	14	12	-2.1	-2.8	-6.2	-2.3	-2.1	-2.4	1.69
Proc agriculture	50	34	15	0	1	-12.0	-30.8	-26.8	-16.4	-17.0	-20.7	1.05
Electronics	24	4	65	6	0	-2.7	-6.4	-9.8	-2.9	-2.9	-7.5	1.15
Motor vehicles	46	8	15	29	1	-4.8	-10.0	-16.9	-3.4	-3.7	-6.6	1.18
Chemicals	77	6	17	0	0	-3.6	-6.3	-10.4	-2.5	-2.5	-4.9	1.26
Textiles	45	11	44	0	0	-6.5	-16.9	-25.7	-10.4	-10.2	-16.1	1.07
Other mfg	43	5	35	16	0	-2.6	-7.1	-9.5	-4.0	-4.0	-5.5	1.22
Electricity	84	13	1	1	1	-6.4	-12.3	-21.0	-7.5	-7.7	-7.3	1.16
Gas mfg & distn	50	10	0	8	32	-4.9	-7.7	-13.4	-4.8	-4.9	-5.2	1.24
Telecommunications	42	24	1	5	27	-1.7	-1.4	-5.1	-1.5	-1.7	-1.7	2.45
Finance	57	29	2	3	8	-1.8	-2.6	-6.6	-2.2	-2.2	-2.2	1.86
Transport	53	18	8	7	14	-1.3	-1.6	-5.9	-1.6	-1.5	-1.8	2.26
Construction	4	2	0	86	8	-2.5	-5.1	-12.3	-4.4	-4.0	-4.3	1.30
Other Services	46	21	4	4	25	-3.4	-8.6	-11.7	-3.1	-2.8	-4.7	1.27

a All these variables are endogenous in the model. Initial (base) values are provided here. In model simulations, because the elasticities are tied to database flows via mark-ups and hence pure profits, it is difficult to alter them without rebuilding the entire database. In short run applications, where smaller elasticities are sensible, the export elasticities are shocked down within simulations. The short run applications presented here have export elasticities shocked down by 70%. For a discussion of elasticities and the length of run in comparative static analysis, see Cooper et al. (1985).

b Industry mark-ups are the ratio of producer prices and average variable costs.

Source: Model database, derived from Dimaranan and McDougall (2002) and 2005 national statistics.

Table 6: Short Run Economic Effects of a Fiscal Expansion that Raises the Deficit by 3.2% of GDP[a]

	Baseline regime with capital controls[b]			Liberalised capital account with currency float[c]	
	Expenditure only	Expenditure only without oligopoly response[d]	With 100% public investment[e]	Expenditure only	With 100% public investment[e]
			% changes		
Real GNP[f]	-0.8	1.0	0.1	0.3	0.1
Real GDP[g]	-0.8	1.1	0.7	0.5	0.7
Real investment[h]	-2.1	-0.5	-2.6	0.4	-1.9
Real exchange rate	2.2	-0.2	0.9	2.2	1.1
Production employment	-3.2	1.1	-0.8	-0.8	-1.0
Av gross rate of return[i]	-0.2	1.5	0.3	1.7	0.3
			Changes as % of initial GDP		
Investment expenditure, I/Y_0	-0.1	-0.3	-0.7	0.8	-0.4
Private financial flows, S_{NF}/Y_0	0.1	0.1	0.0	2.7	2.0
Reserve accumulation, $\Delta R/Y_0$	-2.4	-2.6	-1.8	-0.1	0.0
Current account, CA/Y_0	-2.4	-2.6	-1.8	-2.7	-2.0

a All these simulations use a short run closure in which numbers of firms are fixed and pure profits endogenous, physical capital is fixed at the sectoral level with rates of return endogenous and the real wage of production workers is adjusted opposite to the change in the real exchange rate (consistent with a fixed nominal exchange rate) with all labour mobile between sectors. The fiscal closure has government the government deficit exogenous, and shocked, while revenue and expenditure are endogenous. It is assumed that there is no change in expectations over the real exchange rate. There is no Ricardian equivalence, and so the household and corporate saving rates are constant.
b This is using the standard model with capital controls represented by elasticities of S_{NF} and ΔR to the interest parity value of 0.2 and -10, respectively. The change in the real wage of production workers is equal and opposite to that of the real exchange rate, as discussed in the text.
c Here the model is modified to represent a liberalised capital account and floating exchange rate with a GDP price target. The elasticities of S_{NF} and ΔR to the interest parity value are 20 and -0.2, respectively, and the real wage of production workers is constant. Note, however, that these substantial parameter differences apply to marginal changes due to the fiscal policy shock only. The starting level of private inflow remains small and the rate of reserve accumulation large.
d Here full price regulation is imposed at the outset, so that $P=AC$ in all sectors and hence there are no oligopoly rents. The fiscal expansion is then introduced while maintaining this regulatory regime. Mark-ups change only to retain zero economic profits.
e It is assumed that the entirety of the spending increase is devoted to equal proportional increases in the capital stocks of electricity, water and gas, telecommunications, transport and other services.
f To facilitate welfare interpretation GNP is expressed relative to the consumer price index.
g As a measure of collective output volume, GDP is expressed relative to the GDP price.
h Measured relative to the home GDP price.
i The rate of return on physical capital is here gross of depreciation and inclusive of pure economic profits. The percentage change in the rate is shown, rather than the difference in percentage or basis points.
Source: Simulations of the model described in the text.

Table 7: Short Run Economic Effects of Further Industrial Reform[a]

	Short run model simulations[b] with:	
	capital controls and a fixed exchange rate[c]	a liberal capital account and floating exchange rate[d]
% changes		
Real GNP[e]	5.5	6.7
Real GDP[f]	7.4	8.8
Real investment[g]	10.8	13.4
Real exchange rate	-2.2	-2.2
Production employment[h]	5.5	8.2
Av gross rate of return[i]	7.4	9.4
Production scale[j]	0.5	0.6
Pure profits/GDP[k]	-5.6	-4.4
Changes as % initial GDP		
Investment expenditure, I/Y_0	2.6	3.5
Private financial flows, S_{NF}/Y_0	0.1	2.6
Reserve accumulation, $\Delta R/Y_0$	-2.3	-0.1
Current account, CA/Y_0	-2.2	-2.6

a These simulations use a short run closure in which numbers of firms are fixed and pure profits endogenous, physical capital is fixed at the sectoral level with rates of return endogenous and the real wage of production workers is adjusted opposite to the change in the real exchange rate (consistent with a fixed nominal exchange rate) with all labour mobile between sectors. The fiscal closure has the government deficit exogenous while revenue and expenditure are endogenous. It is assumed that there is no change in expectations over the real exchange rate. There is no Ricardian equivalence, and so the household and corporate saving rates are constant.
b A combination of reforms is introduced simultaneously: 1) progress on further privatisation is indicated by a 10% reduction in the corporate saving rate, 2) oligopoly pricing is moderated via surveillance, which reduces the conjectural variations parameters in all industries by 10%, and 3) excess profits are limited directly by imposing price caps that remove 10% of the gap between output price and average total cost in all industries.
c This is using the standard model with capital controls represented by elasticities of S_{NF} and ΔR to the interest parity value of 0.2 and -10, respectively. The change in the real wage of production workers is equal and opposite to that of the real exchange rate, as discussed in the text.
d Here the model is modified to represent a liberalised capital account and floating exchange rate with a GDP price target. The elasticities of S_{NF} and ΔR to the interest parity value are 20 and -0.2, respectively, and the real wage of production workers is constant. Note, however, that these substantial parameter differences apply to marginal changes due to the fiscal policy shock only. The starting level of private inflow remains small and the rate of reserve accumulation is correspondingly large.
e To facilitate welfare interpretation GNP is expressed relative to the consumer price index.
f As a measure of collective output volume, GDP is expressed relative to the GDP price.
g Measured relative to the home GDP price.
h This is the proportional change in the level of total production, or low-skill, employment.
i The rate of return on physical capital is here gross of depreciation and inclusive of pure economic profits. The percentage change in the rate is shown, rather than the difference in percentage or basis points.
j This is the per cent change in the weighted average of the ratio of gross output to minimum efficient scale, measured across all industries.
k This is the per cent change in the sum of all pure or economic profits across industries as a proportion of current GDP.
Source: Simulations of the model described in the text.

Table 8: Short Run Effects of Capital Account Liberalisation[a]

	Capital account liberalisation in the presence of saving rate decline[b], with:		Capital account liberalisation in the presence of pent-up demand for foreign assets[c], with:	
	defence of a fixed exchange rate[d]	a liberal capital account and floating exchange rate[e]	defence of a fixed nominal exchange rate[d]	a liberal capital account and floating exchange rate[e]
% changes				
Real GNP[f]	2.1	1.2	-1.7	-0.7
Real GDP[g]	2.4	1.4	-1.9	-0.7
Real investment[h]	2.1	1.0	-12.7	-11.5
Real exchange rate	1.7	2.0	-2.1	-2.4
Production employment[i]	2.7	0.6	-1.8	0.8
Av gross rate of return[j]	2.9	1.5	-3.5	-1.8
Production scale[k]	0.1	0.04	-0.1	-0.01
Pure profits/GDP[l]	1.1	0.3	-5.0	-3.9
Changes as % initial GDP				
Investment expenditure, I/Y_0	1.2	0.9	-5.3	-5.0
Private financial flows, S_{NF}/Y_0	2.5	2.5	-19.5	-19.6
Reserve accumulation, $\Delta R/Y_0$	-0.9	-1.0	-16.2	-16.1
Current account, CA/Y_0	-3.3	-3.3	3.4	3.4

a These simulations use a short run closure in which numbers of firms are fixed and pure profits endogenous, physical capital is fixed at the sectoral level with rates of return endogenous and the real wage of production workers is adjusted opposite to the change in the real exchange rate (consistent with a fixed nominal exchange rate) with all labour mobile between sectors. The fiscal closure has the government deficit exogenous while revenue and expenditure are endogenous. It is assumed that there is no change in expectations over the real exchange rate. There is no Ricardian equivalence, and so the household and corporate saving rates are constant.

b The shock is a reduction by 10% in both the household and corporate saving rates.

c Here the shock is an arbitrary shift in the private net foreign inflow equation, to the parameter a_{SF} (6) that creates a large net private financial outflow, in the presence of an enlarged elasticity of private flows to the interest parity term in (6). There is no change to household or corporate saving rates.

d This assumes a liberalised capital account but a short run monetary defence of the nominal exchange rate. The elasticities of S_{NF} and ΔR to the interest parity value are 50 and -10, respectively. The defence of the exchange rate requires a change in the real wage equal that is opposite to the change in the real exchange rate, as discussed in the text.

e Here the model is modified to represent a liberalised capital account and floating exchange rate with a GDP price target. The elasticities of S_{NF} and ΔR to the interest parity value are 50 and -10, respectively. The price level target and sticky nominal wage ensure that the real wage of production workers is constant in this case.

f To facilitate welfare interpretation GNP is expressed relative to the consumer price index.

g As a measure of collective output volume, GDP is expressed relative to the GDP price.

h Measured relative to the home GDP price.
i This is the proportional change in the level of total production, or low-skill, employment.
j The rate of return on physical capital is here gross of depreciation and inclusive of pure economic profits. The percentage change in the rate is shown, rather than the difference in percentage or basis points.
k This is the per cent change in the weighted average of the ratio of gross output to minimum efficient scale, measured across all industries.
l This is the per cent change in the sum of all pure or economic profits across industries as a proportion of current GDP.
Source: Simulations of the model described in the text.

Table 9: Short Run Sectoral Effects of Reforms[a]

% changes	Fiscal expansion[b]			Further industrial reform[c]			Capital account liberalisation in the presence of saving rate decline[d], with:			Capital account liberalisation in the presence of pent-up foreign asset demand[e], with:		
	Mark-up ratio	Pure profit	Gross output	Mark-up ratio	Pure profit	Gross output	Mark-up ratio	Pure profit	Gross output	Mark-up ratio	Pure profit	Gross output
Agriculture	-0.01	-45.6	-3.9	-0.01	21.0	4.7	-0.07	-4.77	1.74	-0.03	-11.6	0.2
Metals & minerals	0.15	-0.1	-1.7	-0.89	-0.9	15.3	0.20	2.83	-0.03	-0.95	-14.6	-4.1
Coal	0.27	0.7	-2.0	-0.23	-2.1	6.4	0.38	5.87	-1.34	-0.41	-6.5	2.4
Petroleum	0.00	3.9	2.5	-1.84	1.2	19.1	0.01	4.23	2.35	-1.85	-8.9	-0.2
Proc agriculture[f]	0.01	5.0	-4.1	-0.01	-9.5	4.9	-0.05	3.65	0.58	-0.02	-0.1	1.9
Electronics	0.03	-1.5	-1.7	-0.28	-7.7	5.5	0.08	0.59	-0.66	-0.25	-3.2	0.9
Motor vehicles	0.18	-3.7	-2.9	-0.44	0.9	13.4	0.20	4.59	-0.47	-1.42	-37.3	0.3
Chemical products	0.04	-7.3	-2.5	-0.55	-1.8	10.9	0.12	2.23	-0.27	-0.20	-3.9	1.8
Textiles	0.02	-18.8	-5.2	0.04	-0.1	2.8	0.05	-3.70	-2.36	-0.04	3.5	3.0
Other manufactures	0.05	-1.4	-1.9	0.28	1.0	7.9	0.15	2.45	-0.23	-0.94	-13.6	-1.2
Electricity[f]	0.00	8.9	-1.0	-0.29	-10.9	8.5	-0.10	3.45	1.22	-0.07	4.9	0.1
Gas mfg & distn[f]	-0.05	-32.6	5.6	-0.98	29.4	10.2	-0.02	3.02	1.38	-0.34	80.4	-1.1
Telecommunications	-0.46	6.8	3.5	-5.25	-1.9	12.5	-0.11	-9.53	2.38	-1.31	-7.4	-1.2
Finance	0.07	2.9	0.3	-4.09	-3.2	15.2	0.41	6.15	2.14	-0.78	-5.3	-0.6
Transport	0.65	4.4	0.7	-2.35	0.1	15.8	-0.32	5.28	3.16	-2.99	-9.8	0.7
Construction	-0.46	-1.6	-0.2	-0.12	-0.5	12.4	0.92	5.90	1.39	-0.70	-26.8	-15.8
Other Services	0.65	9.4	2.1	-0.45	-2.8	8.2	-0.09	2.77	1.25	-0.49	-7.4	-1.2

a All these simulations use a short run closure in which numbers of firms are fixed and pure profits endogenous, physical capital is fixed at the sectoral level with rates of return endogenous and the real wage of production workers is fixed in nominal terms with all labour mobile between sectors.

b This assumes a fiscal expansion that raises the deficit by 3.2% of GDP. Capital controls and a fixed nominal exchange rate are retained, which requires that the real wage of production workers rise equiproportionally with any real depreciation.

c A combination of reforms is introduced simultaneously: 1) progress on further privatisation is indicated by a 10% reduction in the corporate saving rate, 2) oligopoly pricing is moderated via surveillance, which reduces the conjectural variations parameters in all industries by 10%, and 3) excess profits are limited directly by imposing price caps that remove 10% of the gap between output price and average total cost in all industries. Capital controls and a fixed nominal exchange rate are retained, which requires that the real wage of production workers rise equiproportionally with any real depreciation.

d The shock is a reduction by 10% in both the household and corporate saving rates. The case shown here is with no defence of the nominal exchange rate and hence a nominal appreciation and fixed real wage of production workers.

e The shock is an arbitrary shift in the private net foreign inflow equation, to the parameter a_{SF} (6) that creates a large net private financial outflow, in the presence of an enlarged elasticity of private flows to the interest parity term in (6). This assumes a liberalised capital account but a short run monetary defence of the nominal exchange rate,

implying that the outflow causes a deflation that is tolerated but moderated by a run-down in reserves. The elasticities of S_{NF} and ΔR to the interest parity value are 50 and -10, respectively. The defence of the exchange rate requires a rise in the real wage equal and opposite to the change in the real exchange rate, as discussed in the text.
f In these industries note that pure profits (oligopoly rents) are initially negative, so positive changes in profits indicate reductions in profitability.
Source: Simulations of the model discussed in the text.

Appendix to:

Analysing the Short Run Effects of China's Economic Reform Agenda

A.1: The Model in Detail

This appendix complements the presentation of the model offered in the main text and so the analytics offered there are not repeated. It emphasises the representation of demand and production technology in the model and it details the tax system that is built into it. Although the model simulates only the real economy, an exchange rate is defined in the equations as a solution device. In one available closure its value adjusts to satisfy a balance of payments condition, thereby bringing about changes in domestic relative to international prices. Most often, however, an alternative closure is adopted in which the balance of payments condition is eliminated from the model and the artificial exchange rate fixed, so that all the adjustments to shocks are made by the home prices relative to those of imported products, which constitute the numeraire. The balance of payments condition is still met because it is implied by the household's and the government's budget constraints.

Mark-ups:

Oligopolistic firms operate in differentiated product markets and so each chooses its price, and hence mark-up, to take advantage of its monopoly over the supply of its own product variety. Thus, within each industry, each firm faces an elasticity of demand that depends on the number of other firms and the degree of pricing collusion between firms. Symmetry within each sector implies a common optimal unregulated mark-up for each firm, as in equation (16) of the main text.

Demand elasticities

These depend on the structure of the model, to be detailed below. They are essential to the capture of oligopoly behaviour since they determine the size of mark-up ratios, via equations (16) through (18) in the main text. For final demand the elasticity expression is:

$$\text{(A1.1)}\quad \varepsilon_i^F = -\eta_i^F + \frac{1}{n_i}\left\{\left(\sigma_i^F - 1\right)\delta_i^F\left(\frac{P_{iH}}{P_i^F}\right)^{(1-\sigma_i^F)} + \left(\eta_i^F - \sigma_i^F\right)\left(1+\left(n_i - 1\right)\mu_i\right)\right\},$$

where η_i^F is the elasticity of substitution of final demand across home varieties in sector *i*, δ_i^F is the home share in final demand for product *i*, σ_i^F is the elasticity of substitution of final demand for good *i* between domestic and foreign countries, n_i is the number of domestic firms in industry *i*, $\hat{P}_{iH}$ is the CES composite price of all home varieties of product *i*, and $\hat{P}_i^F$ is the

CES composite of home and foreign final product prices in the domestic market, weighted by domestic consumption shares. Equation (A1.1) is derived in A.2, below.

The behaviour of government consumption and the expenditure of the capital goods sector on home and foreign products are similar, except that the government pays no import duties or consumption tax and the capital goods sector pays no import duties. Their composite prices are therefore formulated differently. Their structure is nonetheless the same:

$$\text{(A1.2)}\quad \varepsilon_i^G = -\eta_i^G + \frac{1}{n_i}\left\{\left(\sigma_i^G - 1\right)\delta_i^G\left(\frac{P_{iH}}{\hat{P}_i^G}\right)^{(1-\sigma_i^G)} + \left(\eta_i^G - \sigma_i^G\right)\left(1+\left(n_i - 1\right)\mu_i\right)\right\},$$

$$\text{(A1.3)}\quad \varepsilon_i^V = -\eta_i^V + \frac{1}{n_i}\left\{\left(\sigma_i^V - 1\right)\delta_i^V\left(\frac{P_{iH}}{\hat{P}_i^V}\right)^{(1-\sigma_i^V)} + \left(\eta_i^V - \sigma_i^V\right)\left(1+\left(n_i - 1\right)\mu_i\right)\right\}.$$

For the intermediate demand elasticity a similar expression is obtained:

$$\text{(A1.4)}\quad \varepsilon_i^I = \sum_{j=1}^{N} s_{ij}^I\left[-\eta_i^I + \frac{1}{n_i}(\gamma_{ij} + \sigma_i^I - 1)\phi_{ij}\left(\frac{P_{iH}}{\hat{P}_i^I}\right)^{1-\sigma_i^I} + \left(\eta_i^I - \sigma_i^I\right)\left(1+\left(n_i - 1\right)\mu_i\right)\right],$$

where s_{ij}^I is the share of industry *j* in the total intermediate demand for input *i* and $\hat{P}_i^I$ is the CES composite of home and foreign intermediate product prices in the domestic market, weighted by domestic intermediate consumption shares.

For exports it is assumed that home firms face such competition in foreign markets that non-collusive pricing behaviour is necessitated. The foreign demand elasticity takes the same form as (A1.1), except that the foreign conjectural variation parameter, μ_i^X, is zero:

$$\text{(A1.5)}\quad \varepsilon_i^X = -\eta_i^X + \frac{1}{n_i}\left\{\left(\sigma_i^X - 1\right)\theta_i\left(\frac{P_i^e}{\hat{P}_i^X}\right)^{(1-\sigma_i^X)} + \left(\eta_i^X - \sigma_i^X\right)\left(1+\left(n_i - 1\right)\mu_i^X\right)\right\}$$

$$= -\eta_i^X + \frac{1}{n_i}\left\{\left(\sigma_i^X - 1\right)\theta_i\left(\frac{P_i^e}{\hat{P}_i^X}\right)^{(1-\sigma_i^X)} + \left(\eta_i^X - \sigma_i^X\right)\right\},$$

where $\hat{P}_i^e$ is the CES composite foreign currency price of all exported varieties of product *I* and $\hat{P}_i^X$ is the CES composite of exported and competing foreign final product prices in the foreign market, weighted by foreign consumption shares. Foreigners differentiate home exports from corresponding foreign products with elasticity of substitution σ_i^X and home varieties from one another with elasticity of substitution η_i^X.

Domestic prices of imported goods:

These are:

(A1.6) $p_i^* = \dfrac{p_i^w(1+\tau_i^M)(1+\tau_i^C)}{e}$

where p_i^w is the exogenous foreign currency price of goods produced in the rest of the world, τ_i^M is the ad valorem tariff rate and τ_i^C is the consumption tax rate on final demand for the products of industry *i*.

Domestic prices of home products:

As in equation (16) of the main text, these are marked up over average variable cost. To obtain average variable cost, note that production is Cobb-Douglas in variable factors and inputs, with output elasticities α_i for capital, β_{ki} for factors k and γ_{ji} for inputs *j* and that the subaggregation of imported and domestic inputs is CES. Unit variable costs are therefore calculated as:

(A1.7) $v_i = b_i r^{\alpha_i} \prod_{k=1}^{K} w_k^{\beta_{ki}} \prod_{j=1}^{N} \left[\hat{P}_{ji}^{\ I} \right]^{\gamma_{ji}} \qquad \forall i$.

where the scale coefficient b_i is calibrated from the SAM, as are all the exponents in the equation, and $\hat{P}_{ji}^{\ I}$ is a CES composite of home and imported input prices weighted by the domestic and imported shares specific to consuming industry *i*:

(A1.8) $\hat{P}_{ji}^{\ I} = \left[\phi_{ji} \left(p_j \right)^{(1-\sigma_j^I)} + (1-\phi_{ji}) \left(p_j^* \right)^{(1-\sigma_j^I)} \right]^{\frac{1}{1-\sigma_j^I}}$,

where ϕ_{ji} is the domestic share of inputs from industry *j* in use by industry *i*. Then, domestic producer prices are simply higher by the mark-up, m_i: $p_i = m_i v_i$, $\forall i$.

Unit factor and input demands:

A full set of inter-industry flows is characterised in the model. The volumes of each intermediate demand are derived by solving the firm's cost minimisation problem with Cobb-Douglas production in variable factors and inputs. It is assumed that firms have no monopsony power in either factor or input markets. Therefore, the unit factor demands for capital and other factors are:

(A1.9) $u_i^K = \dfrac{\alpha_i v_i}{r} \qquad \forall i, \quad \text{and} \quad u_{ki}^L = \dfrac{\beta_{ki} v_i}{w_k} \qquad \forall k, i$,

where *k* denotes non-capital factors which are natural resources and skilled and unskilled labour.

The corresponding unit input demands are Leontief input-output coefficients, except that their values depend on product and input prices. For home-produced and imported inputs from industry *i* used in the product of industry *j*, respectively they are:

(A1.10) $A_{ij} = \gamma_{ij} \dfrac{\phi_{ij} v_j}{\hat{P}_{ij}^{\ I}} \left(\dfrac{p_i}{\hat{P}_{ij}^{\ I}} \right)^{-\sigma_i^I}$, $A_{ij}^{\ *} = \gamma_{ij} \dfrac{(1-\phi_{ij}) v_j}{\hat{P}_{ij}^{\ I}} \left(\dfrac{p_i^*}{\hat{P}_{ij}^{\ I}} \right)^{-\sigma_i^I} \qquad \forall i, j$.

Prices of home product exports in foreign markets:

These are in foreign currency so they depend on the home producer price, the exchange rate, the export subsidy rate s_i^X and the foreign import tariff rate, τ_i^{*M}:

$$p_i^e = \frac{p_i\, e(1+\tau_i^{*M})}{(1+s_i^X)} \qquad \forall i \ . \tag{A1.11}$$

Export demand:

Foreigners differentiate home exports from corresponding foreign products with elasticity of substitution σ_i^X (>0) and home varieties from one another with elasticity of substitution η_i^X. This gives the following expression for foreign demand for variety *j* of home product *i*:

$$X_{ij} = \frac{\theta_i}{n_i}\left(\frac{E_i}{\hat{P}_i^X}\right)\left(\frac{p_i^{e0}}{\hat{P}_i^{X0}}\right)^{\Delta\sigma_i^X}\left(\frac{p_i^e}{\hat{P}_i^X}\right)^{-\left(\sigma_i^X+\Delta\sigma_i^X\right)}\left(\frac{p_{iHj}}{P_i^e}\right)^{-\eta_i^X}, \tag{A1.12}$$

where θ_i is the calibrated reference share of the home export in total consumption, E_i is a calibrated constant representing foreign expenditure on exports from industry *i*, and $\hat{P}_i^X$ is a CES composite of the home export price, p_i^e, and the foreign product price, p_i^w, in the foreign market, weighted by foreign consumption shares. $\Delta\sigma_i^X$ is a shock that can be applied under short run conditions to reduce trade elasticities without affecting the database calibration. It requires the inclusion in the equation of the initial values for the home export price, p_i^{e0}, and the composite price of products abroad, $\hat{P}_i^{X0}$, so that the constant term is re-calibrated by the shock.

Final demand:

Home consumers differentiate home products from corresponding foreign products with elasticity of substitution σ_i^F (>0) and home varieties from one another with elasticity of substitution η_i^F. They have Cobb-Douglas utility in broad product groups, with the result that expenditure shares are constant across these groups. Final demand for variety *j* of home product group *i* is therefore:

$$D_{iHj} = \frac{\delta_i^F a_i^F}{n_i}\left(\frac{Y-T_Y}{\hat{P}_i^F}\right)\left(\frac{P_{iH}}{\hat{P}_i^F}\right)^{-\sigma_i^F}\left(\frac{p_{iHj}}{P_{iH}}\right)^{-\eta_i^F} . \tag{A1.13}$$

where a_i^F is the calibrated reference expenditure share of product group *i*, δ_i^F is the corresponding share of home goods in final demand for product *i*, *Y* is GNP, T_Y is total direct (income) tax, and the composite price is:

$$\hat{P}_i^F = \left[\delta_i^F (p_{iH})^{(1-\sigma_i^F)} + \left(1-\delta_i^F\right)(p_i^*)^{(1-\sigma_i^F)}\right]^{\frac{1}{1-\sigma_i^F}}, \tag{A1.14}$$

where the home share is δ_i^F. The expression for imports is correspondingly given by:

(A1.15) $$M_i^F = (1-\delta_i^F)a_i^F\left(\frac{Y-T_Y}{\hat{P}_i^F}\right)\left(\frac{p_i^*}{\hat{P}_i^F}\right)^{-\sigma_i^F}$$

Government demand:

The formulation adopted is similar to that for final demand by households. Total government expenditure, *G*, is endogenous in the simulations presented in the main text, where it is assumed that the government maintains a fixed fiscal deficit. This can be generalised in other applications to allow for fiscal policy shocks with exogenous government spending.

Tax revenue, and therefore the fiscal surplus or deficit, is endogenous, determined by the level of economic activity. Government expenditure is turned into demand for home produced products and imports, respectively, is given by:

(A1.16) $$G_{iHj} = \frac{\delta_i^G a_i^G}{n_i}\left(\frac{G}{\hat{P}_i^G}\right)\left(\frac{P_{iH}}{\hat{P}_i^G}\right)^{-\sigma_i^G}\left(\frac{p_{iHj}}{P_{iH}}\right)^{-\eta_i^G},$$

$$G_i^* = \left(1-\delta_i^G\right)a_i^G\left(\frac{G}{\hat{P}_i^G}\right)\left(\frac{p_i^*}{\hat{P}_i^G}\right)^{-\sigma_i^G},$$

where the composite price of government purchases is:

(A1.17) $$\hat{P}_i^G = \left[\delta_i^G\left(p_i\right)^{(1-\sigma_i^G)} + (1-\delta_i^G)\left(p_i^*\right)^{(1-\sigma_i^G)}\right]^{\frac{1}{1-\sigma_i^G}}$$

Investment demand:

Investment behaviour is modelled as in the main text. The effect of changes in investment is to change the demand on the part of a capital goods industry for products used as intermediate inputs. The capital goods sector employs no primary factors. It translates investment expenditure, *V*, into demands for goods and services:

(A1.18) $$V_{iHj} = \frac{\delta_i^V a_i^V}{n_i}\left(\frac{V}{\hat{P}_i^V}\right)\left(\frac{P_{iH}}{\hat{P}_i^V}\right)^{-\sigma_i^V}\left(\frac{p_{iHj}}{P_{iH}}\right)^{-\eta_i^V},$$

$$V_i^* = \left(1-\delta_i^V\right)a_i^V\left(\frac{V}{\hat{P}_i^V}\right)\left(\frac{p_i^*}{\hat{P}_i^V}\right)^{-\sigma_i^V},$$

where the composite price of capital goods sector purchases is:

(A1.19) $$\hat{P}_i^K = \left[\delta_i^V\left(p_i\right)^{(1-\sigma_i^V)} + (1-\delta_i^V)\left(p_i^*\right)^{(1-\sigma_i^V)}\right]^{\frac{1}{1-\sigma_i^V}}.$$

This price is used as the average for all capital goods in the formulation of the rate of return on installed capital, which determines overall investment expenditure as in (12) and (13) in the main text.

Demand for inputs:

This is derived from the input-output coefficients and gross industry output, Q ,to be specified below. Demands for home-produced and imported varieties of the intermediate good *i* are:

$$\text{(A1.20)} \qquad I_i = \sum_{j=1}^{N} A_{ij} Q_j , \qquad I_i^* = \sum_{j=1}^{N} A_{ij}^* Q_j \qquad \forall i$$

Tax revenue:

The government raises tax revenue from both direct and indirect taxation, the rates applied to each being exogenous and constant but the revenues earned then depend on levels of economic activity. The revenue raised from each source is expressed below.

Direct income tax revenue

$$\text{(A1.21)} \qquad T_Y = \sum_{i=1}^{N} \tau_{K_i} \left(rK_i + \pi_i \right) + \tau_U w_U L_U + \tau_S w_S L_S \ ,$$

where K_i denotes total capital stock in industry *i*, π_i denotes total pure profit in industry *i* and the subscripts "*U*" and "*S*" denote unskilled and skilled labour (production workers and the combination of professionals and para-professionals as per the ILO classification of occupations). Note that the tax rate on capital income is not generic. This enables the capture of tax policies that discriminate between sectors.

Consumption tax revenue

$$\text{(A1.22)} \qquad T_C = \sum_{i=1}^{N} \tau_i^C p_i D_i + \sum_{i=1}^{N} \tau_i^C p_i^* M_i$$

Import tariff revenue

$$\text{(A1.23)} \qquad T_M = \sum_{i=1}^{N} \tau_i^M (M_i + I_i^*) \frac{p_i^w}{e}$$

Export tax revenue

$$\text{(A1.24)} \qquad T_X = \sum_{i=1}^{N} (-s_i^X) p_i X_i \ ,$$

where s_i^X denotes the net power of the export subsidy rate.

Total tax revenue is then simply a sum of the individual components above.

Economic profits or losses:

These are calculated as revenue derived from mark-ups over unit variable costs, less total fixed costs. For sector *i*:

(A1.25) $$\pi_i = (p_i - v_i)Q_i - n_i(r\, f_i^K + w_S\, f_i^L) \qquad \forall i \ ,$$

where n_i is the number of firms, f_i^K is the fixed capital requirement per firm and f_i^L is the fixed skilled labour requirement per firm in sector i. Net profit in industry i is therefore:

(A1.26) $$\pi_i^N = \left[(p_i - v_i)Q_i - n_i(r\, f_i^K + w_S\, f_i^L)\right]\left(1 - \tau_i^K\right) \qquad \forall i$$

National income (GNP):

This is the sum of payments to domestically owned factors of production with the home share of any net profits or losses made, the net income from indirect taxation and the net inflow from abroad, B, which represents the net income component of the current account and unrequited transfers.

(A1.27) $$Y = rK_D + \sum_{k=1}^{K} w_k L_k + \left(\frac{K_D}{K_T}\right)\sum_{i=1}^{N}\pi_i + \left(T - T_Y\right) + \frac{B}{e} + \left(1 - \frac{K_D}{K_T}\right)\tau_K^*\left(r\left(K_T - K_D\right) + \sum_{i=1}^{N}\pi_i\right),$$

where T_Y is revenue from direct (income) tax. GDP, on the other hand, is a measure of the income from production in the domestic economy, so it excludes factor payments and other flows to and from abroad:

(A1.28) $$GDP = rK_T + \sum_{k=1}^{K} w_k L_k + \sum_{i=1}^{N}\pi_i + \left(T - T_Y\right)$$

Total factor demands:

The model has two capital market closures. In one (the "long run closure") physical capital is perfectly mobile abroad at the exogenous world interest rate r. In the other (the "short run closure"), physical capital stocks are fixed in each industry and industry rates of return are endogenous. Either way, physical capital is fully employed, with total demand having variable and fixed components:

(A1.29) $$K_T = \sum_{i=1}^{N}\left(u_i^K Q_i + n_i^D f_i^K\right),$$

where f_i^K is the total fixed cost outlaid by industry i. Similarly, the demand for skilled labour also includes a variable and fixed component. It is:

(A1.30) $$L_S = \sum_{i=1}^{N}\left(u_{Si}^L Q_i + n_i^D f_i^L\right)$$

Finally, demand for all other variable factors (unskilled labour and mineral-energy resources) is:

(A1.31) $$L_j = \sum_{i=1}^{N}\left(u_{ji}^L Q_i\right) \qquad j = 2,...,F$$

In the short run closure, employment of unskilled labour is endogenous, while either the real consumption or production wage is exogenous, so that unskilled labour can be unemployed.

A.2: Final Demand Elasticity with Price Interaction

Here the final demand elasticity is derived to illustrate the method by which all the elasticity expressions of Appendix I (A1.1 – A1.4) are arrived at. From (A1.12) the demand equation for domestic variety *j* of commodity *i* is:

$$\text{(A2.1)}\quad d_{iHj} = \frac{\delta_i^F a_i^F}{n_i}\left(\frac{Y-T_Y}{\hat{P}_i^F}\right)\left(\frac{P_{iH}}{\hat{P}_i^F}\right)^{-\sigma_i^F}\left(\frac{p_{iHj}}{P_{iH}}\right)^{-\eta_i^F},$$

where the composite prices are the average price of generic product *i* available on the home market from both home production and imports:

$$\text{(A2.2)}\quad \hat{P}_i^F = \left[\delta_i^F (p_{iH})^{(1-\sigma_i^F)} + \left(1-\delta_i^F\right)(p_i^*)^{(1-\sigma_i^F)}\right]^{\frac{1}{1-\sigma_i^F}},$$

and the average price of home varieties of product *i*:[36]

$$\text{(A2.3)}\ \hat{P}_{iH} = \left[\frac{1}{n_i}\sum_{j=1}^{n_i}(p_{iHj})^{(1-\eta_i^F)}\right]^{\frac{1}{1-\eta_i^F}}.$$

Substitute (A2.2) and (A2.3) into (A2.1) and the full demand equation can be re-written as:

$$\begin{aligned} d_{iHj} &= \frac{\delta_i^F a_i^F}{n_i}\left(\frac{Y-T_Y}{\hat{P}_i^F}\right)\left(\frac{P_{iH}}{\hat{P}_i^F}\right)^{-\sigma_i^F}\left(\frac{p_{iHj}}{P_{iH}}\right)^{-\eta_i^F} \\ &= \frac{\delta_i^F a_i^F}{n_i}\left(Y-T_Y\right)\left(\hat{P}_i^F\right)^{\sigma_i^F-1}\left(P_{iH}\right)^{(\eta_i^F-\sigma_i^F)}\left(p_{iHj}\right)^{-\eta_i^F} \\ &= \frac{\delta_i^F a_i^F}{n_i}\left(Y-T_Y\right)\left[\delta_i^F (p_{iH})^{(1-\sigma_i^F)} + \left(1-\delta_i^F\right)(p_i^*)^{(1-\sigma_i^F)}\right]^{-1}\left[\sum_{j=1}^{n_i}\frac{1}{n_i}(p_{iHj})^{(1-\eta_i^F)}\right]^{\frac{\eta_i^F-\sigma_i^F}{1-\eta_i^F}}\left(p_{iHj}\right)^{-\eta_i^F} \end{aligned}$$

Differentiating with respect to p_{iHj} gives:

$$\begin{aligned} \frac{\partial d_{iHj}}{\partial p_{iHj}} &= \frac{\delta_i^F a_i^F}{n_i}(Y-T_Y)\left\{(-1)\left[\delta_i^F (p_{iH})^{(1-\sigma_i^F)} + \left(1-\delta_i^F\right)(p_i^*)^{(1-\sigma_i^F)}\right]^{-2}\cdot(1-\sigma_i^F)\delta_i^F (p_{iH})^{-\sigma_i^F}\cdot\left(\frac{1}{1-\eta_i^F}\right)\left[\sum_{j=1}^{n_i}\frac{1}{n_i}(p_{iHj})^{1-\eta_i^F}\right]^{\frac{\eta_i^F}{1-\eta_i^F}}(1-\eta_i^F)\frac{1}{n_i}(p_{iHj})^{-\eta_i^F}\right\}(P_{iH})^{(\eta_i^F-\sigma_i^F)}(P_{iHj})^{-\eta_i^F} \\ &+ \frac{\delta_i^F a_i^F}{n_i}(Y-T_Y)\left\{\left(\frac{\eta_i^F-\sigma_i^F}{1-\eta_i^F}\right)\left[\sum_{j=1}^{n_i}\frac{1}{n_i}(p_{iHj})^{(1-\eta_i^F)}\right]^{\frac{\eta_i^F-\sigma_i^F}{1-\eta_i^F}-1}\cdot\frac{(1-\eta_i^F)}{n_i}\left[(p_{iH1})^{-\eta_i^F}\left(\frac{\partial p_{iH1}}{\partial p_{iHj}}\right)+(p_{iH2})^{-\eta_i^F}\left(\frac{\partial p_{iH2}}{\partial p_{iHj}}\right)+\cdots+(p_{iHj})^{-\eta_i^F}\left(\frac{\partial p_{iHj}}{\partial p_{iHj}}\right)\right]\right\}(P_i^F)^{(\sigma_i^F-1)}(p_{iHj})^{-\eta_i^F} \\ &+ \frac{\delta_i^F a_i^F}{n_i}(Y-T_Y)\left\{(-\eta_i^F)(p_{iHj})^{(-\eta_i^F-1)}\right\}(P_i^F)^{(\sigma_i^F-1)}(P_{iH})^{\eta_i^F-\sigma_i^F} \end{aligned}$$

Noting that: $\dfrac{\partial p_{iHj}}{\partial p_{iHh}} = \begin{cases}\mu_i & j \neq h \\ 1 & j = h\end{cases}$,

[36] In equilibrium, because firms have identical technologies, these prices are equal, though this is not perceived by firms in setting their prices.

and noting further that $p_{iHj} = p_{iHh} \quad \forall\, j \neq h$, because firms within an industry behave symmetrically, the expression can be written as:

$$\frac{\partial d_{iHj}}{\partial p_{iHj}} = \frac{\delta_i^F a_i^F}{n_i}\left(Y - T_Y\right)\left(\sigma_i^F - 1\right)\left(P_i^F\right)^{2(\sigma_i^F - 1)} \delta_i^F \cdot \frac{1}{n_i}\left(P_{iH}\right)^{2(\eta_i^F - \sigma_i^F)} \left(p_{iHj}\right)^{-2\eta_i^F}$$
$$+ \frac{\delta_i^F a_i^F}{n_i}\left(Y - T_Y\right)\left(\eta_i^F - \sigma_i^F\right)\left(P_{iH}\right)^{\left(2\eta_i^F - \sigma_i^F - 1\right)} \frac{1}{n_i}\left(p_{iHj}\right)^{-2\eta_i^F} \left(1 + \left(n_i - 1\right)\mu_i\right)\left(P_i^F\right)^{\left(\sigma_i^F - 1\right)}$$
$$+ \frac{\delta_i^F a_i^F}{n_i}\left(Y - T_Y\right)\left(-\eta_i^F\right)\left(p_{iHj}\right)^{\left(-\eta_i^F - 1\right)}\left(P_i^F\right)^{\left(\sigma_i^F - 1\right)}\left(P_{iH}\right)^{\eta_i^F - \sigma_i^F}$$

This further simplifies to:

(A2.4)
$$\frac{\partial d_{iHj}}{\partial p_{iHj}} = \frac{\delta_i^F a_i^F}{n_i}\left(Y - T_Y\right)\left(P_i^F\right)^{\left(\sigma_i^F - 1\right)}\left(P_{iH}\right)^{\eta_i^F - \sigma_i^F}\left(p_{iHj}\right)^{-\eta_i^F} \left\{ \begin{array}{l} \left(\sigma_i^F - 1\right)\left(P_i^F\right)^{\left(\sigma_i^F - 1\right)} \delta_i^F \cdot \frac{1}{n_i}\left(P_{iH}\right)^{\left(\eta_i^F - \sigma_i^F\right)}\left(p_{iHj}\right)^{-\eta_i^F} + \\ \left(\eta_i^F - \sigma_i^F\right)\left(P_{iH}\right)^{\left(\eta_i^F - 1\right)} \frac{1}{n_i}\left(p_{iHj}\right)^{-\eta_i^F}\left(1 + \left(n_i - 1\right)\mu_i\right) + \left(-\eta_i^F\right)\left(p_{iHj}\right)^{-1} \end{array} \right\}$$

So that the elasticity of final demand is:

$$\frac{\partial d_{iHj}}{\partial p_{iHj}} \cdot \frac{p_{iHj}}{d_{iHj}}$$
$$= \frac{\delta_i^F a_i^F}{n_i}\left(Y - T_Y\right)\left(P_i^F\right)^{\left(\sigma_i^F - 1\right)}\left(P_{iH}\right)^{\eta_i^F - \sigma_i^F}\left(p_{iHj}\right)^{-\eta_i^F}$$
$$\cdot \left\{\left(\sigma_i^F - 1\right)\left(P_i^F\right)^{\left(\sigma_i^F - 1\right)} \delta_i^F \cdot \frac{1}{n_i}\left(P_{iH}\right)^{\left(\eta_i^F - \sigma_i^F\right)}\left(p_{iHj}\right)^{-\eta_i^F} + \left(\eta_i^F - \sigma_i^F\right)\left(P_{iH}\right)^{\left(\eta_i^F - 1\right)} \frac{1}{n_i}\left(p_{iHj}\right)^{-\eta_i^F}\left(1 + \left(n_i - 1\right)\mu_i\right) + \left(-\eta_i^F\right)\left(p_{iHj}\right)^{-1}\right\}$$
$$\cdot \frac{p_{iHj}}{\frac{\delta_i^F a_i^F}{n_i}\left(Y - T_Y\right)\left(P_i^F\right)^{\left(\sigma_i^F - 1\right)}\left(P_{iH}\right)^{\eta_i^F - \sigma_i^F}\left(p_{iHj}\right)^{-\eta_i^F}}$$

On the symmetry assumption this simplifies to:

(A2.5)
$$\varepsilon_i^F = -\eta_i^F + \frac{1}{n_i}\left(\frac{p_{iHj}}{P_{iH}}\right)^{1-\eta_i^F}\left\{\left(\sigma_i^F - 1\right)\delta_i^F\left(\frac{P_{iH}}{P_i^F}\right)^{(1-\sigma_i^F)} + \left(\eta_i^F - \sigma_i^F\right)\left(1 + \left(n_i - 1\right)\mu_i\right)\right\}$$

A.3: Calibrating Pure Profit Rates

No complete publicly available set of data on the structure and conduct of China's oligopolistic industries. Some relevant data is available piecemeal, for individual sectors or industries, though this is occasionally at too fine a level of aggregation for an illustrative economy-wide study such as this. It has therefore been necessary to extrapolate patterns to some sectors and to make crude assumptions about others. To clarify the assumptions made, this appendix offers an expansion of the summary given in Section 4 of the text.

For the flow database, or social accounting matrix (SAM), the original sources are GTAP 6, as indicated in the main text.[37] These flows include only market capital returns. Estimates of

[37] GTAP Version 6 global database for 2001 (Dimaranan and McDougall 2002), http://www.gtap.agecon.purdue.edu/databases/.

pure profits are required to complete the record of capital payments but also to calibrate industry competitive structure. Before this can be done, however, the social accounting matrix based on the 2001 GTAP flows must first be inflated to 2005. For this, the national accounts[38] and balance of payments statistics[39] for China are compared as between 2001 and 2005. Domestic flows are inflated according to changes in GDP while external flows are inflated according to balance of payments data.

For the derivation of over-market capital returns the principal sources are from the *China Statistical Yearbook 2006*. They are Tables 14-4: "Main Indicators of State-Owned and Non-State-Owned Industrial Enterprises above Designated Size by Industrial Sector, 2005" and 14-8: "Main Indicators of State-Owned and State Holding Industrial Enterprises by Industrial Sector, 2005". These sources offer annual data from which is drawn, for each industry,[40] numbers of private firms and SOEs, gross revenue, fixed assets, accounting profits and business taxes paid.

Accounting profits net of depreciation are expressed as rates over fixed assets and these are compared with estimates of prime borrowing rates available to corporate borrowers in the private and state-owned sectors. The main problem with this step is that the prime lending rate available to firms varies according to whether they are small, large, private or state-owned, and according to their industrial classification. Even though government bond rates in China are low by international standards, prime rates only a per cent or so above these tend only to be available to the larger SOEs. The rates some private firms are forced to accept to finance investment can still be as high as 20% per year.[41] The crude assumption made here is that, in 2005, SOEs had access to funds at 5% per year and private firms at an average 10% per year. The prime rate for each sector is then assigned as an average of these two rates, weighted by private and SOE shares of gross output value.

The next step is to subtract industry-specific prime rates from net rates of profit on fixed assets, to obtain rates of pure profit on fixed assets. Crude estimates of the value of total capital use in each industry are then obtained by dividing inflated SAM market capital returns by industry prime rates. The sums paid in the form of pure profits are then the products of the pure profit rates with the values of capital use. To obtain pure profit shares of total revenue in each industry, these are divided by total revenue numbers from the inflated SAM. Once the pure profits row is included in the inflated (2005) SAM it is rebalanced (to equate the sums of earnings by industries, government and households with expenditures by each).[42] Finally, since the SAM incorporates a special row to capture corporate tax payments, entries must be net of corporate tax.

A further complication of these steps is that the available data offers no information on the profitability of agricultural businesses or firms in telecommunications, finance, transport and construction. To complete the calculation, rates of accounting profit over fixed assets are assigned to these industries as: agricultural businesses 16%, telecommunications 18%, finance 20%, transport 20% and construction 25% and the assigned prime rates for these industries are,

[38] National Bureau of Statistics of China, Table 3-1 Gross Domestic Product and United Nations Statistics Division (2008.01.25) China GDP by Expenditures.xls.
[39] International Monetary Fund, International Financial Statistics (series:78AFDZF); Balance on Goods & Services.
[40] The industry classification used differs from the ISIC-based GTAP classification in Table 1 of the text, so it is necessary to construct an approximate concordance.
[41] Peoples Bank of China, personal communication.
[42] This is done industry by industry, since standard RAS (row and column sum) procedures do not apply where the social accounting matrix combines negative flows and zero elements, as this one does.

respectively, 16%, 5%, 5%, 5% and 6%. A numerical summary of these steps is offered in Table A3.1.

Table A3.1: Calibration of Pure Profits by Industry[a]

	State-owned share of gross output value, %	Industry specific borrowing rate, % per year	Accounting profit rate on fixed assets, %	Pure profit rate, gross of corporate tax , on fixed assets, %	Pure profit rate, net of corporate tax, on fixed assets, %
Agriculture		15.0	16.0	1.0	1.0
Metals & minerals	28.4	8.6	32.7	24.1	21.0
Coal	67.8	6.6	17.0	10.4	7.3
Petroleum	81.0	6.0	40.7	34.7	28.4
Proc agriculture	24.4	8.8	20.1	11.3	-7.2
Electronics	13.2	9.3	23.2	13.9	12.9
Motor vehicles	51.8	7.4	17.1	9.7	3.6
Chemical products	23.9	8.8	15.2	6.4	4.6
Textiles	5.0	9.7	15.5	5.7	4.0
Other manufactures	24.5	8.8	17.6	8.8	7.1
Electricity	89.3	5.5	5.3	-0.2	-0.7
Water	75.7	6.2	-0.1	-6.3	-6.6
Gas mfg & distn	56.4	7.2	3.1	-4.1	-4.5
Telecommunications		5.0	18.0	13.0	13.0
Finance		5.0	20.0	15.0	15.0
Transport		5.0	20.0	15.0	15.0
Construction		6.0	25.0	19.0	19.0
Other Services	17.1	6.0	14.2	8.2	7.1

Sources: GTAP Version 6 global database for 2001 (Dimaranan and McDougall 2002), *China Statistical Yearbook 2006*; Tables 14-4: "Main Indicators of State-Owned and Non-State-Owned Industrial Enterprises above Designated Size by Industrial Sector, 2005" and 14-8: "Main Indicators of State-Owned and State Holding Industrial Enterprises by Industrial Sector, 2005".

The seemingly representative rates of accounting profit assumed for the undocumented services translate into very high rates of pure profit over total revenue, as indicated in Table 6 of the main text. This is because these sectors are assumed to have access to finance at quite low rates and so their implied levels of capital use (the quotient of SAM capital income at market rates and the industry specific prime rate) are high compared with their revenue. It is possible that these results overestimate the extent of pure profits in these services during 2005. Without better data on their accounting profitability and their comparative access to finance, however, this cannot be established.