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Weathering the Asian Crisis: the role of China

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Asia Pacific Press at the
AUSTRALIAN NATIONAL UNIVERSITY

<http://ncdsnet.anu.edu.au>

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The contribution of the Australian Agency for International Development (AusAID) to this series is gratefully acknowledged. The opinions contained in the series are those of the authors, and not necessarily of the National Centre for Development Studies or of AusAID.

ISSN 1443-7511

ISBN 0 7315 3628 2

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Acknowledgments

Special thanks are due to George Fane, Meng Xin, Max Corden, Xinpeng Xu and E.C. Hwa for constructive discussions and to the Economics Program of the Asia Pacific School of Economics and Management for resources provided in association with a Visiting Fellowship, August–December 1999.

Abbreviations

CES	constant elasticity of substitution.
CDE	constant difference of elasticities
CPI	consumer price index
FDI	foreign direct investment
GDP	gross domestic product
GTAP	Global Trade Analysis Project
IMF	International Monetary Fund
NBER	National Bureau of Economic Research
RDA	recessed developing Asia

Abstract

During the Asian crisis, China's healthy reserves and low debt made possible the avoidance of a 'country run'. Nonetheless, it did experience an apparently autonomous rise in private savings and a rise in capital outflow. This paper employs global general equilibrium analysis to examine the relative contributions of external and internal shocks in China during the crisis. The savings rise appears to have been dominant domestically and, by coincidence of timing, it was a significant contributor to the international effects of the crisis. The successful defence of fixed parity with the US dollar, however, has made the combined shocks more contractionary in China than would have been the case had it been possible to retain a flexible exchange rate regime.

Introduction

The spectacular growth of the East and Southeast Asian economies stalled in 1997 following a combined financial and currency crisis.¹ Several economies that had earlier been major contributors to both Asian growth and commodity imports experienced very substantial contractions associated with a surge of insolvencies following capital flight and unexpectedly large currency depreciations (McLeod and Garnaut 1998, Goldstein 1998, and Wong 1998). The government of China, however, chose to hold fast to its US dollar parity. Its comparatively large official foreign reserves and its history of capital controls restricting short-term capital inflow meant less risk of a serious 'country run' than in the most affected crisis countries. Nonetheless, the external crisis appears to have combined with domestic reforms and changes in macroeconomic policy to retard overall economic growth and increase unemployment (Meng 1999).

The primary effects of the crisis in China were a real appreciation against most trading partners and a rise in the risk premium demanded by investors in China (Fernald and Babson 1999). Taken alone, given the fixed exchange rate regime, these had to be contractionary. But the crisis came at a time when the proportion of total employment in China's relatively secure state sector had begun to decline (Meng 1998). Perceiving increased risk from this source, and possibly also from the crisis elsewhere in Asia, Chinese households appear to have chosen an autonomous substitution of savings for consumption. Other things being equal, this shock would have tended to offset the real exchange rate effect of the crisis. Nonetheless, both it and the external crisis acted to reduce the price level and retard output growth. The magnitude of these contractionary effects depends on the proportion of the increased saving channelled abroad and on the response of the Chinese government and central bank. The available evidence suggests that the outflow has been considerable, offset only partially by a virtual cessation of the previously rapid accumulation of official foreign reserves. Over and above the continuing domestic structural reforms, the immediate macroeconomic policy responses have been the fixing of parity with the US dollar and a substantial fiscal expansion, described in combination as a 'hard currency, soft budget' policy.

In this paper we review what information is available about China's aggregate performance during and since the crisis, examine the implications of both the external and internal shocks using elemental macroeconomic analysis and quantify some of the real effects using a global general equilibrium model. The use of global general equilibrium is important because one of the reasons the Asian crisis led to so deep a regional recession was that East and Southeast Asia have a lot of intra-regional trade. The effects were therefore transmitted, at least in part, through trade flows.² In what may have been an accident of timing, the rise in private savings in China accelerated capital outflow at the same time as capital was fleeing the crisis countries. The changes in the Chinese economy tended, therefore, to enlarge the flow of capital to the north, and particularly to the United States. We also examine the implications of this.

In simulating the crisis, we make no attempt to reproduce its short run dynamics.³ Instead, our analysis is comparative static, taking as our starting point the real shocks that emerged in its wake. In the short run, these included a severe contraction of domestic investment in affected countries (as home savings fled abroad and foreign savings in Asia were withdrawn). The contractionary effects of this were exacerbated by the temporary unemployment of capital as many Asian firms foundered under the escalated cost of foreign borrowings and the credit crunch that followed. Recent evidence suggests that a considerable number of firms in the most affected countries were rendered insolvent, and a larger number illiquid (World Bank 1999), and that this explains the bulk of the initial contractions in output.

Events in the crisis countries

We focus here on the real shocks associated with the crisis, rather than its financial origins. For the most affected Asian economies, the primary real shocks were of two types. First, as savings fled domestic investment declined. In Japan, where the process was more gradual, investment fell by about a tenth in the two years from late 1997.⁴ In the most affected economies of developing Asia, however, the initial panic of 1997 was so great that domestic investment declined by as much as half. Domestic capital goods and construction demand collapsed and private consumption demand also fell, driven by the associated wealth effects of asset price declines. Imports therefore fell dramatically.

The second of the real shocks was a further short run decline in domestic production in the affected economies. Because the credit squeeze was greatly exacerbated by an associated currency crisis and hence a blowing out of dollar denominated debt service costs, there was a high incidence of illiquidity and insolvency. This was the more so in developing Asia because of the rapid expansion of private sector credit there during the early 1990s. It was therefore inevitable that the substantial rise in debt service costs would drive more than the usual proportion of firms in the most affected economies into insolvency.⁵ This was the principal cause of the contractions in output experienced in developing Asia in the first year following the onset of the crisis.

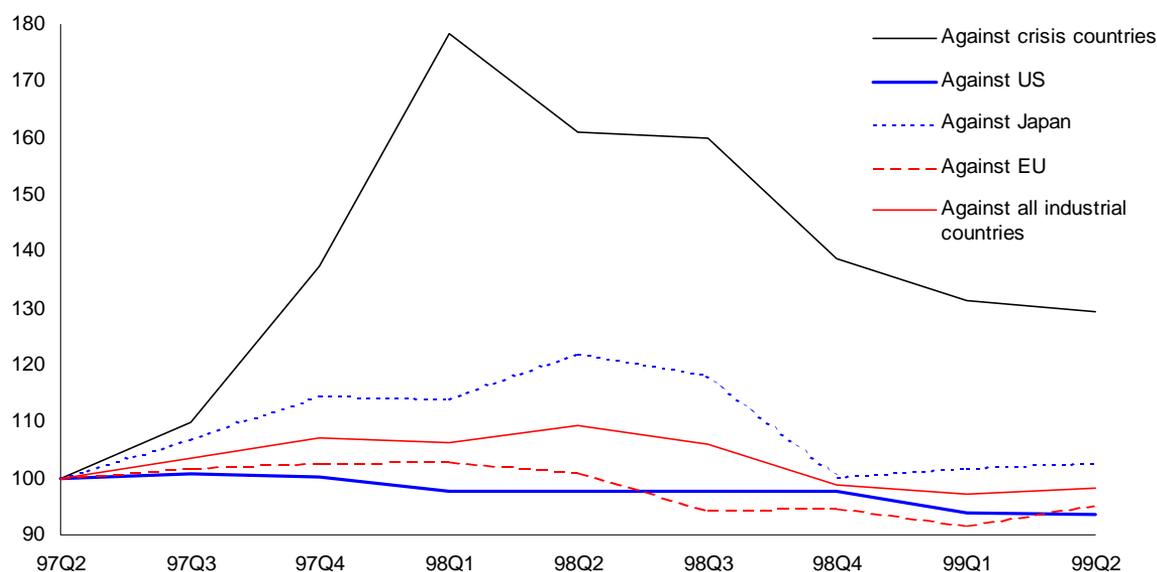
Events in China

Both economic and social change has been comparatively rapid in China during the last two decades. Underlying it has been the gradual but continuous transfer of economic activity from the public to the private sector and the expanded reliance on markets in the allocation process. In spite of this background of continuous change, there appears to have been an acceleration just prior to, and during, the crisis. From an external perspective, the most notable changes were an increase in outflows on the capital account, the government's adherence to fixed parity with the US dollar, and the resulting rise in China's real exchange rate relative to its Asian neighbours. We consider, below, evidence suggesting that these changes were not directly related to the surrounding crisis but rather that they stemmed from the evolution of China's economic policy regime and would have occurred even in its absence.

Following unification in 1994, a key policy objective had been to 'get the exchange rate right', and a 'real targets' approach was adopted, whereby the nominal rate was set in relation to the cost of earning a unit of foreign exchange through exports.⁶ In effect this ensured the stabilisation of the real exchange rate.⁷ With the advent of the crisis in 1997 the government fixed nominal parity with the US dollar. Although this was initially in defence of Hong Kong and its currency board, the Chinese government held to its commitment beyond the Hong Kong financial crisis. That this meant a departure from the real targets approach is evident from the ensuing effects on China's real exchange rate, which are summarised in Figure 1. Nominal parity with an appreciating US dollar in a period of low inflation ensured real appreciations against almost all of China's trading partners. Deflation in China has, however, ensured that a real depreciation has been enjoyed relative to the US and, more recently, against Europe. In spite of the reduced competitiveness of Chinese exports relative to those from crisis affected countries, the value of Chinese exports continued to grow through early 1998, only beginning to fall off later that year. Exports to other Asian countries fell first and most dramatically while the growth of those to the US and Europe had virtually ceased by the end of the year (Fernald and Babson 1999; Hu 1999).

China's capital controls notwithstanding, capital outflows appear to have accelerated markedly in 1997 and 1998, as indicated in Table 1. Estimates of unsanctioned outflows include both private flows on the capital account and, on the current account, the effects of under-invoicing of exports on the one hand, and over-invoicing of imports on the other. Taken together, these appear to have more than doubled, to about six per cent of China's GDP. Between 1996 and 1998, for example, the change represents a reversal of private flows on the capital account, from a net inflow of about US\$30 billion to a net outflow of almost equal magnitude. These were offset by a decline in the rate of accumulation of reserves by about US\$30 billion. In magnitude, the corresponding change in the current account is about a fifth of that experienced collectively by the crisis affected countries (principally Indonesia, Malaysia, Thailand and Korea). It is smaller than the Korean change but larger than the contribution of any other affected country. As a proportion of GDP it is about half the collective change in those countries.

Figure 1 China's real exchange rate^a



Note: ^a The real exchange rate is expressed as $e_R = E.P/P^*$, where E is the nominal rate in foreign currency units per unit of home currency, P is the home price level and P^* is the foreign price level.

Source: Data are from IMF (1999).

Table 1 Estimated components of China's balance of payments, US\$ billion

	1994	1995	1996	1997	1998
<i>Capital account</i>					
+ Capital inflow, <i>KI</i>	40.9	41.0	46.2	53.4	50.4
- Sanctioned capital outflow, <i>KOS</i>	5.7	-7.8	6.2	19.0	14.8
- Unsanctioned capital outflow, <i>KOF</i>	8.4	18.3	11.1	31.6	62.9
- Change in reserves, <i>DR</i>	30.5	22.5	31.7	35.7	5.1
= Capital account surplus, <i>KA</i>	-3.7	8.0	-2.8	-32.9	-32.4
<i>Current account, CA^a</i>					
+ Observed CA surplus, <i>CAO</i>	1.6	-5.8	-0.3	20.6	20.1
+ Misinvoicing outflow, <i>CAM</i>	2.1	-2.2	3.1	12.3	12.3
= True CA surplus, <i>CA</i>	3.7	-8.0	2.8	32.9	32.4
<i>Unsanctioned outflows, KOF</i>	8.4	18.3	11.1	31.6	62.9
%GDP	1.5	2.6	1.3	3.4	6.3

Note: ^a This is an estimate of the true trade surplus, as distinct from the observed one.

Sources: Synthesis of capital flight calculations made originally by Song (1999). Data are from Song (1999) and State Statistics Bureau (1999). For 1998 capital inflows and foreign reserves are from *A Statistical Survey of China*, 1999. The 1998 current account balance and bank foreign asset data are from IMF (1999b). Capital flight via misinvoicing is assumed to be the same as for 1997 (Song 1999). Smuggling data are from Yu (1999) who assumes that import smuggling is 10–15 per cent of total imports. We assume that net smuggling ($M-X$) is 5 per cent of total imports. Outward FDI is derived from inward FDI from the Survey and the net FDI available from the Macro Team of CASS (1999:3–14).

This substantial increase in outflows appears to be fuelled by a rise in the rate of private saving, some evidence for which is presented in Table 2. There are many changes within China that could be contributing to this, but the most likely causes are twofold. First, liberalisation of the housing market began in the mid-1990s and private ownership sanctioned in urban areas. Since then, there has been a rapid increase in the proportion of accommodation that is privately owned and an obvious incentive to raise private savings to achieve private ownership. Second, the trend of transferring production activity from the state to the private sector has accelerated (Meng 1999). The proportion of workers enjoying 'cradle to grave' welfare services in the state sector has declined from about 60 per cent in the mid-1990s to less than half, with substantial and comparatively prominent lay-offs taking place in 1997. Thus, the perceived probability of obtaining or retaining state employment has declined and the need for savings to finance health, education and retirement has increased. All this suggests that the rise in savings and the associated increase in the true capital account deficit are largely autonomous and are related to the crises in other Asian countries mainly through an accident of timing.

While the evolution of China's domestic and macroeconomic policy regimes has continued, two policy changes standing out as having significance for macroeconomic circumstances in the crisis period. First, as indicated above, the retention of the fixed US dollar parity tends to tie up monetary policy, which has been tight. In spite of the increase in the supply of domestic savings, the real interest rate facing the relatively privileged customers of the state banking system is estimated to have risen from -4.8 per cent in 1995, to 1.8 per cent in 1996, 5.8 per cent in 1997 and 7.2 per cent in 1998.⁸ Second, a 'soft budget' policy has been maintained since the mid-1990s. Official estimates of fiscal deficits ranged in the vicinity of 0.8 per cent of GDP until 1998, when there was a rise to 1.1 per cent. Government spending had been below 12 per cent of GDP in the two years prior to the crisis but rose to 13 per cent in 1998 (IMF 1999b).⁹

The combination of the real appreciation, which reduced export growth, restrictive monetary policy and the autonomous switch to private savings appears to have contracted overall domestic demand, causing deflation. Growth in the CPI, which had exceeded 24 per cent in 1994, has since declined each year, reaching -0.8 per cent in 1998. Estimated GDP growth does appear to have slowed as a consequence, from the 10 per cent achieved in the mid 1990s to an official 7.8 per cent in 1998. The 1998 target of eight per cent

Table 2 The private savings rate in China^a

	1990	1995	1996	1997	1998
Rural households	15	17	18	23	26
Urban households	15	17	19	19	20
Total	15	17	19	21	24

Note: ^a Approximated from estimates of private income and consumption expenditure.

Sources: State Statistics Bureau, *A Statistical Survey of China*, 1999; and *China Statistical Yearbook*, 1997.

apparently influenced provincial estimates, leading to some controversy and a slight downward revision. The official rate for 1998 is widely believed to be an overestimate, however. Moreover, an unusually large part of expenditure on GDP in 1998 was investment by state owned enterprises and this included inventory investment (Fernald and Babson 1999:6). Nonetheless, total investment as a share of GDP has risen slightly and productive capacity continues to be transferred from the state sector to the presumably more productive private sector, all of which suggests the slowdown is not the result of slower productivity growth. We therefore look for nominal wages that are sticky downward, excessive real wage growth and rising unemployment.

Wage rigidities are not unexpected in China, where the labour market is more highly regulated than in other developing countries. The evidence presented in Table 3 suggests that the deflation in 1998 was indeed associated with a spurt in real wage levels. Again, however, the data on which this is based ignore non-wage and over-contract (bonus) payments.¹⁰ The former are large in state-owned enterprises while the latter are comparatively important in the private sector. The evidence on unemployment is also mixed. The principal source of lay-offs has been the state sector. Yet workers laid off by the state sector are not included in the unemployment statistics. The official unemployment rate is therefore an underestimate considering that more than a tenth of the nation's workers have moved out of the state sector in recent years.¹¹ In addition, there is anecdotal evidence that millions of rural migrants have returned to the countryside because of reduced opportunities in urban employment (Macro Team of CASS 1999). On balance, we conclude that there has been a slowdown in output growth associated with a rise in unemployment.

In sum, then, we think of macroeconomic events in China during the crisis period as comprising three important shocks and two key policy changes. The shocks are the crisis-driven external price decline, the rise in the interest premium on investments in China, and the spontaneous substitution of private saving for private consumption in the home economy. The policy changes are the adoption of a fixed nominal exchange rate and the fiscal expansion. Before turning to our global general equilibrium analysis of these events, we work through them in the context of an elemental macroeconomic model, employing a primarily graphical exposition.

Table 3 Real wage growth in China, per cent year on year^a

	1994	1995	1996	1997	1998
State owned enterprises	8.7	0.4	2.6	4.2	14.6
Collectives	0.2	3.7	0.6	1.7	19.1
Other employers	1.5	1.4	1.7	3.2	10.7
All workers	7.7	0.9	2.4	3.8	16.5

Note: ^a The real wage estimate for all workers is calculated (not copied directly) from the source.

Sources: State Statistics Bureau, *China Statistical Yearbook*, 1998, and *A Statistical Survey of China*, 1999.

An elemental macroeconomic analysis

The model

To foster intuition about Chinese policy, we begin with an elemental macroeconomic model of a small open economy. ‘Smallness’ keeps the foreign real interest rate, r^* , and price level, P^* , exogenous.¹² The model emphasises the short run, or at least a length of run within the average gestation period of investment. The productive capital stock is therefore constant and unaffected by the level of investment. And the model is comparative static, so that expectations and their implications are not endogenous and there is no continuous inflation to separate the real from the nominal rate of interest. Flows on the capital account are motivated by real interest rate divergences.

The demand side of the model has equilibrium in the markets for money and ‘loanable funds’. Money market equilibrium equates real money demand, m_D , with real money supply, yielding an LM curve. The nominal money supply, M_S , then depends on the monetary base and hence the assets of the central bank. GDP is Y , the domestic interest rate is r and the domestic price level is P .

$$LM: m_D = g_1 Y - g_2 r = \frac{M_S}{P}$$

The monetary base is $B = M_S / \theta$, where θ is a money multiplier. Official foreign reserves are R , and DC is the central bank’s holding of domestic credit, so that $B = R + DC$.

Turning to the components of domestic absorption, consumption, C , depends on the real interest rate and disposable income and the tax system is assumed linear, so that $C = a_1 - b_1 r + c(Y - T)$, where $T = t + \tau Y$. Investment is $I = a_2 - b_2 r$, and government spending, G , is exogenous.¹³ Private saving by domestic residents is $S_D = Y - T - C$, which is the same as $S_D = s^* Y - a_1 - st + b_1 r$. Where the marginal propensity to save out of domestic GDP is $s^* = (I - c)(I - \tau)$. Saving in the home economy by foreigners net of saving abroad by domestic residents is S_{NF} . This is the private component of net inflow on the capital account and it depends on the domestic and foreign real interest rates, so that $S_{NF} = S_{NF}^0 + \phi(r - r^*)$, or $S_{NF} = (S_{NF}^0 - \phi r^*) + \phi r$. We now have total private saving in the home economy, which, along with government saving, must equal domestic investment. Thus, the Hicksian IS identity is $I = (T - G - \Delta R) + (S_D + S_{NF})$. With this we have an IS curve that takes the form

$$IS: r = \frac{a_1 + a_2 - S_{NF}^0 - ct}{b_1 + b_2 + \phi} + \frac{1}{b_1 + b_2 + \phi} (G + \Delta R) + \frac{\phi}{b_1 + b_2 + \phi} r^* - \frac{\tau + s^*}{b_1 + b_2 + \phi} Y$$

By substituting the traditional money market equilibrium (LM) condition, above, we have the aggregate demand (AD) curve,

$$AD: P = \frac{M_S}{f_1 Y - f_2 (G + \Delta R) - f_3 r^* - f_4}$$

Here the f_s are positive constants that consolidate the above parameters. This relationship is useful when the exchange rate is floating and the nominal money supply is exogenous. When the exchange rate is fixed, however, the monetary instruments are dedicated to its fixity and therefore endogenous. It is then useful to construct a version of the AD curve along which the exchange rate is constant. To do this we need to represent the current account of the balance of payments. Recall that private net inflows on the capital account are $S_{NF} = S_{NF}^0 + \phi(r - r^*)$. Ignoring the net capital income component of the current account, inflows on the capital account must finance any surplus of imports over exports. Thus, $S_{NF} - \Delta R = M - X = NM$. Net imports then depend positively on both domestic disposable income and the real exchange rate, so that $NM = a_3 + b_3 e_R + m(Y - T)$. Here the real exchange rate is defined as the relative price of the home good, or $e_R = EP/P^*$, where the nominal exchange rate, E , is the value of the home currency in terms of the foreign (say US\$ per unit of the home currency).

Returning to the IS curve, the interest rate can this time be substituted out by the above balance of payments condition. This yields the alternative AD , or $IS-BOP$, curve

$$IS - BOP : P = \frac{P^*}{E} (h_1 + h_2 G - h_3 \Delta R - h_4 r^* - h_5 Y)$$

Here too, the h_s are positive constants that consolidate the parameters introduced earlier. The main exogenous shifters are the nominal exchange rate, E , the foreign price level, P^* , the change in official foreign reserves, ΔR , government spending, G , and the foreign interest rate, r^* . The change in reserves is made exogenous here so that the central bank's sterilisation behaviour can be reflected. Monetary policy, or at least its ultimate effect on the nominal money supply, is endogenous.

It remains to close the model with the supply side. Recall that the length of run considered here is one over which the stock of useful physical capital is unaffected by new investment. If the technology is Cobb-Douglas and the expenditure share of variable labour is β , output depends on variable labour input, because $Y = a L^\beta$. At this length of run, in a heavily regulated economy such as that of China, we would expect to see at least some nominal wage rigidity. Equating the marginal product of mobile labour with the real wage, W/P , and setting the nominal wage, W , exogenous, we have

$$SAS(W) : P = \frac{W}{\alpha \beta} \left(\frac{Y}{\alpha} \right)^{\frac{1-\beta}{\beta}}$$

In equilibrium these three curves in $P-Y$ space intersect at a common point, as illustrated in Figure 1.¹⁴ They must always do so since one of the downward sloping curves always has an endogenous shifter. If the exchange rate is fixed, the $IS-BOP$ curve applies and monetary policy must conform, thereby shifting the AD curve for consistency with the other two. If the exchange rate is floating, E is endogenous and the AD curve is active. Monetary policy is set exogenously and the exchange rate adjusts, shifting the $IS-BOP$ curve to conformity.

The directional effects of shifters are also indicated in Figure 2. When the exchange rate is floating, the *AD* curve is active and it shifts conventionally, with rises in either government spending or the nominal money supply shifting it upward or to the right.¹⁵ When the exchange rate is fixed, the *IS–BOP* curve is active. It has more exogenous shifters. A rise in the foreign price level, P^* , shifts the *IS–BOP* curve upward and to the right. Imagine that the level of output is fixed in a clearing labour market. We then seek the direction of any vertical shift by asking what the change in the domestic price level is. Since output is fixed and the only shock is that to P^* , savings supply is unaffected and so, therefore, are net inflows on the capital account. The real exchange rate and net imports must be constant. So the home price level rises by the same proportion as the foreign one. Hence, for constant output, a rise in P^* raises the demand side equilibrium price level and hence the *IS–BOP* curve shifts upward. A rise in the foreign interest rate, r^* , or in the interest premium required to attract savers to China, however, shifts the curve downward and to the left. This is because an increase in outflows on the capital account reduces net imports and depreciates the real exchange rate. For given output and for given E and P^* , the demand side equilibrium price level is therefore lower.

Figure 2

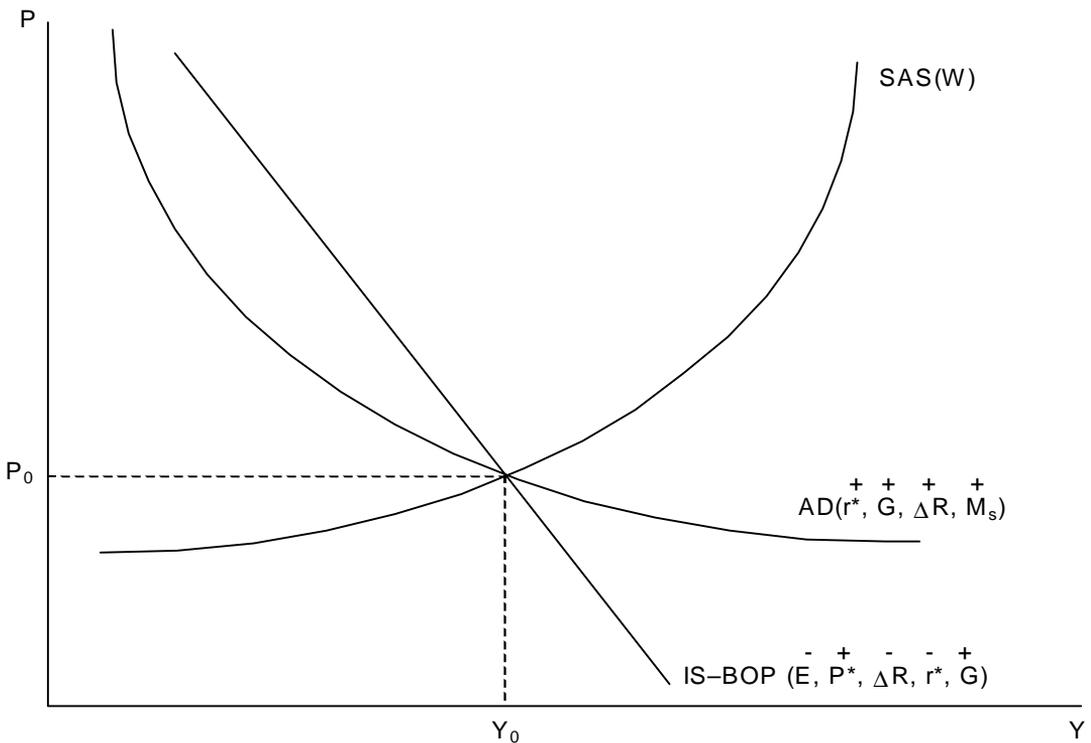
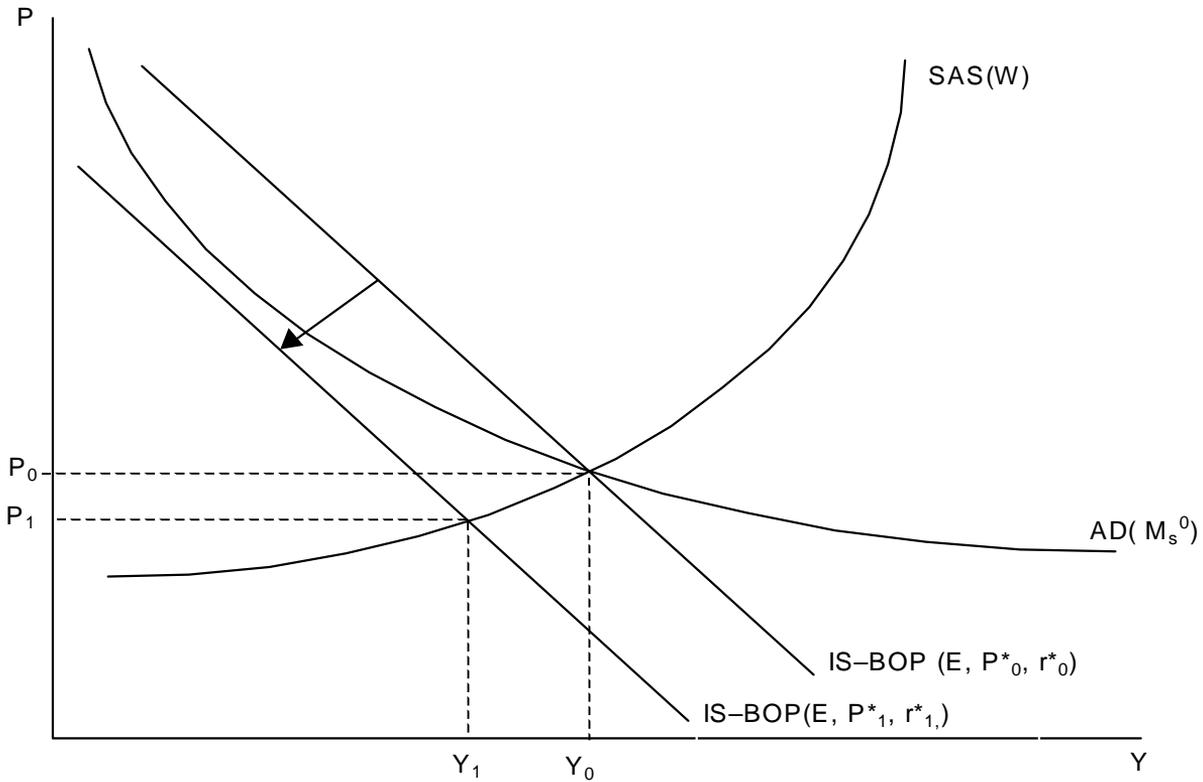


Figure 3



Finally, an increase in official foreign exchange reserves also shifts the *IS-BOP* curve downward and to the left. This is because, other things equal, the increase adds to outflows on the capital account. Net imports contract and the relative price of foreign goods in the home economy rises, implying a real depreciation. For constant output and a fixed nominal exchange rate this implies a lower price level and hence the curve shifts downward. For a given equilibrium Y, P combination, however, the *IS-BOP* curve represents a relationship between the nominal exchange rate and the change in official foreign reserves. A rise in one is consistent with a fall in the other. Throughout our analysis, we consider the change in reserves to be exogenous. In the world of the floating rate we will consider it to be constant, so that it is always the more sustainable change in E , rather than in ΔR , that restores equilibrium. When the exchange rate is fixed, changes in ΔR become important in the short run. Because the nominal money supply is then endogenous, however, the change in it, combined with the change in reserves will imply a pattern of sterilisation via $\Delta R + \Delta DC = \Delta B$.

The crisis and the Chinese domestic savings shock

The three key shocks to be considered are

- a decline in the foreign price level, P^* , representing the increased competitiveness of exports from China's crisis-affected neighbours
- a rise in the interest premium required on Chinese investments
- an autonomous increase in the private saving rate.

We can represent the second as a rise in the external interest rate, r^* . Consider the first two shocks, both of which are crisis related. China's fixed exchange rate regime requires that the active downward sloping curve be the $IS-BOP$ curve.¹⁶ The curve shifts downward as explained in the previous section and as shown in Figure 3. Although the two shocks have opposing effects on the real exchange rate, both contract domestic demand and the price level falls. The real wage therefore rises and output declines. Because the nominal money supply is endogenous, it must contract sufficiently for the AD curve to make a compatible downward shift. Monetary policy is therefore restrictive in defence of the fixed nominal exchange rate.

Evidence presented earlier suggests that the Chinese central bank slowed the growth of official foreign reserves between 1997 and 1998. Such a contraction in DR causes an offsetting upward shift in the $IS-BOP$ curve because it tends to appreciate the real exchange rate and, with a fixed E , the nominal exchange rate, this raises the price level and hence restores some lost output. Of course the contraction in the nominal money supply, M_s , implies a contraction in the monetary base, B . Any difference between the change in B and the new DR implies a complementary change in the level of domestic credit.¹⁷ That the price level in China did fall nonetheless confirms that the response was only partially offsetting.

By comparison with the fixed exchange rate regime, the appeal of a floating rate in this circumstance is also clear from Figure 3. In a floating rate regime, the active downward sloping curve is the AD curve. For a given money supply target, M_s^0 , and assuming no change in government spending or the foreign interest rate, the real economy is unaffected by the change in foreign competitiveness. There is no change in the real exchange rate or in the real money supply. Since the nominal money supply is fixed, there can be no change in the price level. And, from the definition of the real exchange rate, there can therefore be no change in the ratio E/P^* . The nominal exchange rate simply carries all the adjustment, by falling equiproportionally with the foreign price level. As Dornbusch (1999) points out, however, the downside is that this is a 'beggar thy neighbour' policy in any but a truly small country and it could elicit competitive devaluations in neighbouring countries. A float would also remove the exchange rate as the 'nominal anchor' (Edwards 1996). The risk that this could facilitate instability would seem low in the Chinese case, however (Zhang 1999).

The effect of an autonomous rise in private savings (say a fall in the marginal propensity to consume, c , in the consumption equation, is also to shift the *IS–BOP* curve downward and to the left. The increased supply of saving reduces the home interest rate and raises domestic investment even while it raises the net outflow of savings from China. The rise in net outflow on the capital account reduces net imports and raises the relative price of foreign goods in the domestic market. The real exchange rate therefore depreciates. The fixed nominal exchange rate requires that this change come about entirely through a decline in the home price level. If the nominal wage is sticky downward, output must decline. Although the source of the shock is different, the resulting deflation and output contraction has the same effect on the diagram as shown in Figure 3.

A global general equilibrium framework

To examine the global effects of the crisis shock and the rise in savings in China, we turn to a multi-region model. Our analysis remains comparative static and, as before, we focus on a short run in which the stock of physical capital is fixed and sectorally immobile. Given that the crisis countries have flexible labour markets and that China's labour market is highly regulated, however, we need to accommodate a mix of labour market specifications. The model used must also offer an open capital account in each region and therefore an explicit treatment of savings and investment. We meet these requirements by adapting the GTAP global general equilibrium model to our purpose.¹⁸ Its analytics are summarised in Table 4. As a starting point, it offers the following useful generalisations

- a capital goods sector in each region to service investment
- explicit savings in each region, combined with open regional capital accounts that permit savings in one region to finance investment in others
- multiple trading regions, goods and primary factors
- non-traded goods and services
- product differentiation by country of origin
- empirically based differences in tastes and technology across regions
- non-homothetic preferences
- explicit allowance for transportation costs and policy distortions.

For the corresponding database, we use the GTAP Version 4 database for 1995, aggregated into the regions listed in Table 5.¹⁹ Note that we use the aggregate, 'recessed developing Asia' to represent the most seriously affected Asian region. Within this region there is considerable variance in the degree to which countries were affected by the crisis. The shocks we impose are therefore averages across the region and do not reflect the severity of the effects in individual economies such as Indonesia.

Households and firms in the model consume a composite of goods and services that is a blend of home products and imports, the composition of which depends on relative prices and an elasticity of substitution. In turn, imports are a blend of the products of all

Table 4 Model analytics

Single household in each region.

Utility Cobb-Douglas in

private household expenditure

government expenditure

savings (shares and marginal propensities can be modified exogenously)

Government consumption: Cobb-Douglas composite of all goods.

Private household consumption: CDE^a expenditure function.

CES decomposition between home goods and imports

CES decomposition of imports by region of origin.

Firms are perfectly competitive with constant returns to scale.

Technology is a CES combination of intermediate inputs with a separate CES composite of primary factors.

Intermediate demand is decomposed to home goods and imports as for household final consumption.

Primary factor demand : nested CES system^c.

Factor specificity: Land specific to agriculture

Natural resources specific to mining

Physical capital is sector specific

Labour and skill intersectorally mobile.

Primary factor supply: all factors are inelastic in supply at the regional level.^b

Capital returns are intra-regional.

Investment:

worldwide sum across regions' savings.

Does not affect the current productive capital stock.

Does consume 'capital goods' and enter the capital account of each region's balance of payments.

Capital goods are a Cobb-Douglas composite of domestic goods and services.

The endogenous allocation of investment across 'non-Asia' equalises 'expected returns' in each region. These are a decreasing function of regional investment.^d

Notes: ^a Constant Difference of Elasticities. See Hertel (1997).

^b Households can transform labour between skilled and unskilled. However, this capability is reduced to negligibility in the applications discussed in this paper.

^c For the primary factor demand structure, see Figure 1 in Yang and Tyers (1999).

^d The formulation of expected returns, along with some alternative investment allocation rules, is discussed in Hertel and Tsigas (1997:4–60).

regions and their composition depends on regional trading prices and a further elasticity of substitution. This structure facilitates the departures from the law of one price that tend to occur even in tradeable goods sectors in the short and medium run.²⁰ For this reason, we do not adopt the practice common amongst GTAP users of choosing larger than the standard elasticities of substitution in all industries when doing long run comparative static analysis.²¹

Our adaptation of the model involves changes to its intermediate input and labour demand structure. In particular, to accurately represent substitution between inputs and primary factors, we have made output a CES composite of intermediate products and primary factors. To reflect factor market impacts of external shocks better, we have also introduced a further composite of skilled and unskilled labour. This allows the two types of labour to be substitutable differently for each other than each is for the other mobile factor, capital. Finally, the short run nature of the Asian crisis necessitates that we use throughout a version of the model that restricts intersectoral capital mobility in all regions. Returns to physical capital therefore vary across industries and regions.

Table 5 Model structure

Regions	Share of world GDP ^f
1. Recessed developing Asia ^a	5.1
2. Japan	18.0
3. China ^b	2.5
4. European Union ^c	29.0
5. United States	25.2
6. Australasia	1.4
7. Rest of world	18.8
Primary factors	
1. Agricultural land	
2. Natural resources	
3. Skill ^d	
4. Labour ^d	
5. Physical capital	
Sectors ^e	
1. All agriculture	
2. Mining and energy (coal, oil, gas and other minerals)	
3. Skill-intensive manufacturing (petroleum, paper, chemicals, processed minerals, metals, motor vehicles and other transport equipment, electronic equipment and other machinery and equipment)	
4. Labour-intensive manufacturing (textiles, apparel, leather and wood products, metal products, other manufactures)	
5. Skill-intensive services (electricity, gas, water, financial services and public administration)	
6. Labour-intensive services (construction, retail and wholesale trade, dwellings)	
Notes: ^a Korea (Rep.), Indonesia, Philippines, Malaysia, Singapore, Thailand, Vietnam.	
^b China excludes Hong Kong and Taiwan.	
^c The European Union of 15.	
^d The labour disaggregation is based on the International Labour Organisation Classification of Occupations. Professional workers are defined as including managers and administrators, professionals and para-professionals. Production workers are plant and machine operators and drivers, tradespersons, clerks, labourers and related workers, salespersons and personal service workers.	
^e These are aggregates of the 50 sector GTAP Version 4 database. See McDougall <i>et al.</i> (1998).	
^f Share of 1995 GDP in US\$ measured at market prices and exchange rates.	

Constructing three scenarios

We begin with a reference scenario that includes all the real shocks associated with the crisis as well as the simultaneous changes in China. Two counterfactuals are then considered. First, we imagine that the Chinese economy was passive during the crisis, being subjected to no domestic shocks. Comparing this with the reference scenario then yields the contribution of changes in China to the crisis in Asia and the capital flows to the north. The second counterfactual is designed to shed some light on the effects of the fixed parity decision. We introduce all the shocks of the reference scenario but assume that a floating exchange rate regime allowed control over the price level via monetary policy and that this would have prevented any excessive rise in the Chinese real wage.

The full set of reference shocks and closures is detailed in Table 6. Consider first the crisis affected regions, ‘recessed developing Asia’ and Japan. Because our comparative static model does not have intertemporal optimisation by households or firms, we capture the capital account effects of the crisis by observing levels of investment and current account imbalances in the immediate aftermath, making these exogenous and then endogenising average rates of private saving.²² By themselves, however, the capital account shocks had only small short run effects on output. As indicated earlier, the more serious problem was exposure to foreign denominated debt by domestic firms and financial institutions in recessed developing Asia. ‘Country runs’ therefore precipitated numerous insolvencies and the sluggish resolution of the associated property rights issues led to the closure of some plants and considerable lay-offs at others. To capture this, we make output exogenous in affected sectors, based on the survey by the World Bank (1999a), and allow some sectoral physical capital to be idle.²³

Turning to the representation of China, the reference scenario also incorporates the rise in Chinese private saving, the fiscal expansion and the effects of both on China’s overall savings rate and hence on the balance of payments. It assumes that there is downward rigidity of the nominal wage over the length of run considered and that the nominal exchange rate is fixed against the US dollar.²⁴ To incorporate these nominal rigidities in our real model, we take advantage of the definitions of the real wage and the real exchange rate and the fact that data are now available on changes in price levels during and since the crisis. Eliminating the home price level from the definitions of the real wage, $w = W/P$, and the real exchange rate, $e_R = (E/P^*)P$, we have

$$w = \left(\frac{WE}{P^*} \right) \frac{1}{e_R}$$

In proportional change form, when the nominal wage is fixed, this implies

$$\hat{w} = \hat{E} - \hat{P}^* - \hat{e}_R$$

This equation is incorporated in the model, in which e_R is already an endogenous variable, and hence it renders the real wage w , endogenous also. Whenever nominal wage rigidity is assumed, the observed proportional change in E/P^* is introduced as an exogenous shock. For this purpose, we use the trade weighted average of the ratio E/P^* for the five regions trading with China. Over the first four quarters following the crisis, this rose 3.5 per cent.

A key element of the crisis and its consequences for the world economy is the flight of savings from Asia and the resulting global redistribution of investment. This is captured in our comparative static model by constructing a closure that identifies an ‘expected rate of return’ on investment in each region that is different from the average rate of return on global investment. Investment demand functions then make the expected rates of return diminishing functions of regional investment. The accumulated total of global savings

Table 6 Reference shocks and closures^a

Recessed developing Asia

Regional investment is exogenous and reduced from 1995 to 1998 levels.

Regional expected rate of return on current investment is endogenous.^c

The average regional saving *rate*, S/Y , is made endogenous.^b

The trade balance, $X-M$, is exogenous and changes as observed.

Sectoral production volumes are exogenous and shocked as observed.^f

Sectoral capital use is endogenous, so that capital is idled in contracting sectors.^f

Labour in agriculture is reduced by 5 per cent while land productivity is raised by 2 per cent.

Labour (skilled and unskilled) remains sectorally mobile and is fully employed.

Japan

Regional investment is exogenous and reduced from 1995 to 1998 levels.

Regional expected rate of return on current investment is endogenous.^c

The average regional saving *rate*, S/Y , is made endogenous.^b

The trade balance, $X-M$, is exogenous and changes as observed.

Sectoral production volumes are exogenous and shocked as observed.^f

Sectoral capital use is endogenous, so that capital is idled in contracting sectors.^f

Labour (skilled and unskilled) remains sectorally mobile and is fully employed.

China

Regional investment as a percentage of GDP is exogenous and is increased by three per cent.

Regional expected rate of return on current investment is endogenous.^c

Government spending as a percentage of GDP is exogenous and increases as observed.

The average *rate* of saving is endogenous, while the current account surplus ($X-M$) is made exogenous and shocked as per the observed 1998 change.

Sectoral production volumes are endogenous, while sectoral capital use is exogenous.

Labour (skilled and unskilled) remains sectorally mobile.

Nominal wage is fixed so that real wage depends on the endogenous real exchange rate and external nominal price shock. Full employment is therefore not ensured.

US, EU, Australasia and Canada, and the rest of world

Regional investment is endogenous.

Regional current account, $X-M$, is exogenous and changes as observed.

Regional expected return on current investment is endogenous.^c

Sectoral production volumes are endogenous, while sectoral capital use is exogenous.

Labour (skilled and unskilled) remains sectorally mobile and the real wage of raw labour is flexible upward only.^{de}

Notes: ^a In all scenarios, capital is completely sector specific in all regions, so that the rate of return differs across sectors.

^b Since the capital account and current account must be equal in magnitude and opposite in sign, $I-S=M-X$. For both recessed developing Asia and Japan, these shocks impose explicit contractions in investment and in imports relative to exports relative. The volume of saving then follows endogenously.

^c In the subsequent scenarios, regional investment is endogenous to equalise regional average 'expected returns', adjusted for risk premia. The trade balance is endogenous, while the average savings rate is retained exogenous and the observed reference scenario shock to it imposed. Expected rates of return on current investment are then exogenous and also shocked as indicated in the reference scenario.

^d In the end, this constraint does not bind since the real wages of raw and skilled labour both rise.

^e Since home products are differentiated from imports, the ratio of home goods prices and import prices does vary. That between home goods prices and export prices remains fixed, however.

^f The approach taken to this, and its numerical consequences, are detailed by Yang and Tyers (1999).

Source: IMF (1998, 1999a); Statistics from web sites for countries concerned, as summarised in Duncan and Yang (2000). The sources for China are indicated in Section 3.

yields a quantity of worldwide investment, which in the standard GTAP formulation, is distributed between regions so as to equalise these expected rates (Hertel and Tsigas 1997:54–60). In our reference scenario, the changes in current account balances in all regions except the ‘rest of the world’ are set as exogenous and fixed at known values in proportion to regional GDP. We then allow the expected rates of return in all regions except the ‘rest of the world’ to depart from the global average.²⁵ The resulting expected rates all differ between regions and we think of the differences as risk premia. Relative to the US, the implied risk premia range up to 78 per cent of the reference rate of return for ‘recessed developing Asia’, with a premium for China of 14 per cent of the reference rate of return.²⁶ In the subsequent counterfactual scenarios, these risk premia are imposed as shocks and the current accounts are made endogenous. Investment is then allocated across regions so as to equalise expected rates of return adjusted for the fixed risk premia.

In our first counterfactual scenario, the crisis experiment is run against a ‘passive China’. Recall that the crisis as perceived by China comprises three elements. First, there was a trade shock due principally to the collapse of imports by the affected countries. Second, there was a rise in the risk premium on investment, not only in the affected countries but also in China, and, third, there was an outflow of savings and hence a rise in investment in the north. To construct the passive China scenario, then, we replace the shocks to investment and the current accounts of the affected countries with equivalent shocks to risk premia and savings rates. For China, the change in the risk premium is exogenous in place of the current account but the savings rate is held at its pre-crisis level.

We had intended to simulate the continuation of the ‘real targets’ approach to exchange rate policy by holding China’s real effective exchange rate constant. When subjected to the decline in the foreign price level and the rise in the investment premium, however, a constant real exchange rate could only have been maintained with an unrealistically extreme contraction of the domestic economy.²⁷ Moreover, we have no observations on nominal variables with which to complement our real model in this case. We therefore retain the fixed parity with the US dollar and assume that the changes in bilateral nominal exchange rates and foreign price levels would have been the same as in the reference case. The same shock as before is therefore administered to the real wage equation. Of course, relative to the reference scenario, the change in the Chinese real wage will differ in this passive China scenario because the Chinese real exchange rate differs.

The second counterfactual scenario differs from the reference one only in that China is assumed to adopt a flexible exchange rate and a monetary policy designed to keep employment constant. As in the passive China scenario, we first replace the shocks to investment and the current accounts of the affected countries and China with equivalent shocks to risk premia and savings rates. This time, however, the Chinese foreign exchange policy response is to adopt sufficient nominal exchange rate flexibility to give monetary policy power over the domestic price level. The assumed policy might then be thought of as targeting the real wage.

Simulation results

The three scenarios were run as three different sets of shocks against the GTAP Version 4 database. For each of the six regions represented, the effects on the balance of payments, real exchange rate and the terms of trade are summarised in Table 7. The corresponding changes in output and in total employment are given in Table 8, while Table 9 lists the effects on real unit factor rewards. All the results are comparative static and should therefore be seen as changes relative to some growth trend.

The reference scenario

The substantial redistribution of global investment away from Asia and into the north is clear from Table 7. In China, this is fuelled by a rise in total domestic savings and a fall in investment. The Chinese average net domestic savings rate (private plus government), S/Y , rises from 25 to 30 per cent. Since the Chinese ratio I/Y is held constant in this shock, the decline in investment stems from a contraction in GDP, as indicated in Table 8.²⁸ Chinese imports fall while exports rise. The real appreciation against other Asian currencies, and the loss of export markets there, is more than offset by the real depreciation against the north. In the short run, therefore, Chinese exports expand, since they compete against exporters elsewhere in Asia constrained by insolvencies and idled capital.²⁹ Output of Chinese agricultural and mineral products, directed largely to other Asia, falls, as does output of 'elaborately transformed' products and services. China's main export sector, labour intensive manufacturing, expands in spite of this economy wide contraction.

The reference shocks generally raise real unit factor rewards in the north and shrink them in Asia, as indicated in Table 9. There are three clear exceptions to this pattern, however. First, the real return to installed physical capital rises in the affected Asian countries. This is because so much of it is idled by insolvencies (Yang and Tyers 1999). Second, Chinese workers gain while those in the rest of Asia are worse off. This is because of the substantial deflation in China and our assumption that nominal wages are rigid downward there in the short run. The model predicts a decline in China's real effective exchange rate of 1.9 per cent, while the exogenous nominal ratio E/P^* rises 3.5 per cent. The result is an average real wage rise of 5.4 per cent. Third, owners of land, natural resources and manufacturing capital in the north are losers. This is because of the loss of exports of agricultural and natural resource based goods to Asia and of competitive pressure from cheaper imports following the northern real appreciations.

The 'passive China' scenario

This scenario differs from the first in that there is no departure from the pre-crisis savings rate in China, implying no change in the private savings rate and no change in fiscal policy or in the rate of accumulating foreign reserves. Recall that investment and the current account is now endogenous in all regions, while the shocks come from the investment premia and any changes in average savings rates in the crisis countries. This time, the overall economic contraction in China is comparatively small. The decline in Chinese

Table 7 Short run changes in the balance of payments and the real exchange rate, 1995
US\$ billion^a

Sector	Developing Asia ^b	Japan	China	USA	EU	Canada, Aust, NZ
Reference crisis scenario						
Capital account surplus (I-S)=(M-X)	-134	-33	-28	126	75	14
Investment, I	-186	-187	-13	162	85	17
Saving, S	-52	-154	15	36	10	3
Imports, M	-166	-48	-19	70	38	8
Exports, X	-32	-15	9	-56	-37	-7
Change in real effective rate ^c (per cent)	-14.2	-5.5	-1.9	12.9	4.2	0.6
Real appreciation against USA ^d (per cent)	-21.5	-15.6	-13.5	0.0	-6.4	-5.5
Terms of trade ^e (per cent)	-5.6	-6.7	-1.2	10.3	1.3	0.2
Counterfactual: passive China^f						
Capital account surplus (I-S)=(M-X)	-135	-37	-3	119	66	13
Investment, I	-186	-191	-7	154	76	16
Saving, S	-50	-154	-5	35	9	3
Imports, M	-163	-49	-5	66	34	7
Exports, X	-28	-12	-2	-53	-32	-6
Change in real effective rate ^c (per cent)	-13.8	-5.8	2.6	12.2	3.9	0.6
Real appreciation against USA ^d (per cent)	-20.7	-15.3	-9.4	0.0	-6.3	-5.2
Terms of trade ^d (per cent)	-5.2	-7.1	1.9	9.7	1.2	0.2
Counterfactual: flexible exchange rate^g						
Capital account surplus (I-S)=(M-X)	-135	-32	-35	128	78	15
Investment, I	-189	-185	-17	164	89	18
Saving, S	-53	-153	18	37	11	3
Imports, M	-167	-47	-17	72	41	8
Exports, X	-32	-15	18	-56	-37	-7
Change in real effective rate ^c (per cent)	-15.0	-4.8	-4.5	13.3	4.6	0.9
Real appreciation against USA ^d (per cent)	-22.5	-15.6	-16.2	0.0	-6.4	-5.5
Terms of trade ^d (per cent)	-5.9	-6.3	-3.2	10.5	1.4	0.3

Notes: ^a Reference closure and shock details are indicated in Table 6.

^b Recessed developing Asia (RDA), excluding China.

^c The ratio of the home GDP deflator to a trade-weighted average of the GDP deflators of other regions.

^d The ratio of the home GDP deflator to that of the US.

^e Change in the value of exports at endogenous prices, weighted by fixed 1995 (base period) export volumes, divided by the value of imports, weighted by fixed 1995 import volumes.

^f Here the shocks to other regions are as for the reference case, except that investment risk premia are exogenous in place of current accounts. In China, the savings rate remains at its pre-crisis level and the reference changes to the ratio E/P^* are introduced, implying the retention of fixed nominal parity with the US\$.

^g Here the shocks to other regions are as for the reference case, except that investment risk premia are exogenous in place of current accounts. In China, the savings rate rises to its reference (post crisis) level and the nominal exchange rate is assumed flexible enough to permit price level changes that avoid excessive real wage increases. Employment therefore remains constant.

Source: Model simulations described in the text.

investment is smaller than before, though it does represent a decline in the ratio I/Y , due to the rise in the risk premium. There is no rise in Chinese home savings to fuel the capital outflow of the reference scenario— S/Y remains constant. There is a real appreciation relative to China's trading partners and a smaller real depreciation against the US. Greater domestic demand ensures smaller contractions in skill intensive manufacturing and services and therefore a very much smaller reduction in employment. This is due to smaller real wage rises, stemming from the real appreciation and hence a smaller decline in the home price level. Accordingly, real losses sustained by other primary factors are also smaller.

Overall, the savings shock, comprising as it did a rise in the private savings rate and a slowdown in the rate of accumulation of foreign reserves larger than the increase in government spending, had a greater contractionary effect on the Chinese economy than the external crisis. Of course, we have retained the fixed exchange rate here and that does represent a change of policy regime associated with the crisis. Had the government attempted to retain its previous 'real targeting' regime through the crisis, the extent of crisis-driven contraction would have been larger.³⁰

The flexible exchange rate scenario

Here, monetary policy is assumed free enough to effect a sufficient change in the price level to prevent excessive real wage growth and hence to retain the pre-crisis level of employment relative to trend. There is, therefore, no contraction in Chinese GDP. Output and income are greater and hence China's savings are greater, fuelling an increased capital outflow and yielding a very much larger real depreciation relative to its trading partners than in either of the other scenarios. Exports expand by more and so the production of labour intensive manufactures expands by more. In the north, the corresponding contraction in labour intensive manufacturing is therefore larger than in the other scenarios.

In Chinese factor markets, this time there is no real wage rigidity and employed unskilled workers lose slightly. Skilled workers, on the other hand, gain substantially due to an expansion in China's skill-intensive services sector. The capital goods sector, which produces for investment, tends to be intensive in labour-intensive services. Investment falls, so the demand for these services contracts. Labour intensive manufacturing, on the other hand, is intensive in inputs from the skill-intensive services sector. The demand for these therefore expands. Overall, however, employed Chinese workers are worse off under the flexible exchange rate response to the crisis than in the reference scenario. There is no increase in unemployment, however. The relatively painless return of GDP to trend is the attractive feature for the Chinese government, particularly given the continuing structural unemployment that must accompany necessary domestic reforms. In the end of course, though it is beyond the scope of this paper, the flexible exchange rate option might prove unattractive because of the risk of competing devaluations elsewhere in Asia.

Table 8 Short run changes in gross sectoral output and GDP (per cent)^a

Sector	Developing Asia ^b	Japan	China	USA	EU	Canada, Aust, NZ
Reference crisis scenario						
Agriculture	0.2	-0.1	-6.7	-1.6	-0.8	-1.6
Mining	-3.9	-2.7	-1.0	-0.4	-0.2	-0.3
Manufacturing: labour intensive	-11.4	-3.8	2.2	-3.0	-0.9	-2.1
skill intensive	-12.1	-3.0	-4.9	-0.5	-0.4	-0.3
Services: labour intensive	-11.0	-5.4	-5.2	1.2	0.6	0.9
skill intensive	-10.1	-6.2	-3.7	-0.2	0.0	-0.3
GDP	-10.3	-5.1	-4.2	0.1	0.1	0.2
Employment (% labour force)	0.0	0.0	-9.8	0.0	0.0	0.0
Counterfactual: passive China^c						
Agriculture	0.2	0.0	-0.5	-1.4	-0.6	-1.4
Mining	-3.9	-2.7	-0.3	-0.4	-0.2	-0.3
Manufacturing: labour intensive	-11.4	-3.8	1.5	-2.7	-0.7	-1.7
skill intensive	-12.1	-3.0	-1.1	-0.5	-0.4	-0.3
Services: labour intensive	-11.0	-5.4	-1.3	1.1	0.5	0.8
skill intensive	-10.1	-6.2	-0.5	-0.2	0.0	-0.3
GDP	-10.3	-5.1	-0.4	0.1	0.1	0.2
Employment (% labour force)	0.0	0.0	-1.5	0.0	0.0	0.0
Counterfactual: flexible exchange rate^d						
Agriculture	0.4	-0.1	-2.6	-1.6	-0.8	-1.7
Mining	-3.9	-2.7	0.1	-0.4	-0.2	-0.3
Manufacturing: labour intensive	-11.4	-3.8	10.0	-3.2	-1.1	-2.6
skill intensive	-12.1	-3.0	-0.8	-0.5	-0.4	-0.3
Services: labour intensive	-9.4	-5.4	-1.2	1.2	0.7	0.9
skill intensive	-10.1	-6.2	1.5	-0.2	0.0	-0.3
GDP	-9.9	-5.1	0.0	0.1	0.1	0.2
Employment (% labour force)	0.0	0.0	0.0	0.0	0.0	0.0

Notes: ^a Reference closure and shock details are indicated in Table 6.

^b Recessed developing Asia (RDA), excluding China.

^c Here the shocks to other regions are as for the reference case, except that investment risk premia are exogenous in place of current accounts. In China, the savings rate remains at its pre-crisis level and the reference changes to the ratio E/P^* are introduced, implying the retention of fixed nominal parity with the US\$.

^d Here the shocks to other regions are as for the reference case, except that investment risk premia are exogenous in place of current accounts. In China, the savings rate rises to its reference (post crisis) level and the nominal exchange rate is assumed flexible enough to permit price level changes that avoid excessive real wage increases. Employment therefore remains constant.

Source: Model simulations described in the text.

Table 9 Short run changes in real unit factor rewards (per cent)^a

Primary factor	Developing Asia ^b	Japan	China	USA	EU	Canada, Aust,NZ
Reference crisis scenario						
Labour	-8.0	-4.1	5.3	0.5	0.1	0.5
Skill	-10.4	-4.3	6.9	0.2	0.1	0.4
Natural resources	-10.7	-5.5	-13.0	-8.8	-4.5	-8.7
Land	-14.3	-4.5	-23.4	-16.3	-5.1	-13.0
Capital (regional average return)	8.5	6.1	-1.7	-0.1	0.0	-0.1
Capital specific to:						
Agriculture	-8.4	-4.5	-23.4	-16.3	-5.1	-13.0
Mining	30.3	13.9	-9.8	-8.0	-4.3	-8.0
Manufacturing: labour intensive	108.5	30.7	8.6	-3.7	-0.9	-2.1
skill intensive	45.5	-3.8	-2.9	-0.3	-0.4	0.1
Services: labour intensive	-23.1	2.9	-0.6	1.7	0.7	1.6
skill intensive	4.6	9.6	1.8	0.1	0.0	0.1
Counterfactual: passive China^c						
Labour	-8.0	-4.1	1.1	0.5	0.1	0.5
Skill	-10.4	-4.4	0.9	0.2	0.1	0.3
Natural resources	-10.8	-5.3	-3.1	-8.4	-4.0	-8.2
Land	-14.3	-4.3	-1.1	-15.0	-4.2	-11.1
Capital (regional average return)	8.5	6.1	-0.2	-0.1	0.0	-0.1
Capital specific to:						
Agriculture	-8.5	-4.3	-1.1	-15.0	-4.2	-11.1
Mining	29.8	14.6	-3.7	-7.7	-3.9	-7.7
Manufacturing: labour intensive	109.1	33.0	3.0	-3.3	-0.7	-1.6
skill intensive	45.6	-3.6	-0.8	-0.3	-0.4	0.1
Services: labour intensive	-23.1	2.1	-0.4	1.6	0.6	1.4
skill intensive	4.6	9.6	0.4	0.1	0.0	0.1
Counterfactual: flexible exchange rate^d						
Labour	-7.9	-4.0	-0.5	0.5	0.1	0.5
Skill	-9.9	-4.3	2.7	0.2	0.1	0.4
Natural resources	-9.4	-5.7	-1.7	-8.9	-4.6	-8.7
Land	-13.1	-4.7	-12.3	-16.6	-5.5	-13.5
Capital (regional average return)	7.8	6.0	0.3	-0.1	0.0	-0.1
Capital specific to:						
Agriculture	-7.2	-4.7	-12.3	-16.6	-5.5	-13.5
Mining	33.2	13.7	1.5	-8.1	-4.2	-8.0
Manufacturing: labour intensive	114.2	29.3	12.7	-3.9	-1.1	-2.6
skill intensive	49.4	-3.8	-1.3	-0.3	-0.3	0.1
Services: labour intensive	-27.6	3.4	-1.3	1.7	0.8	1.6
skill intensive	7.1	9.5	2.8	0.2	0.0	0.1

Notes: ^a Short run closure details are indicated in Table 6. All entries are unit rewards *relative to the region's GDP deflator*.

^b Recessed developing Asia (RDA), excluding China.

^c See footnote c to Table 8.

^d See footnote d to Table 8.

Source: Model simulations described in the text.

Conclusion

From the Chinese perspective, the principal external shocks during and since the Asian crisis are a real appreciation against its Asian neighbours and a loss of exports to them, increased export competition in the north and a rise in the interest premium demanded from investments in China. Within China, however, there has been a significant increase in the private saving rate. This, in combination with the rise in China's investment premium, caused a large increase in outflows on the capital account. Both the trade shock and the changes in China's capital market tend to depress the domestic price level and hence are contractionary in the short run. Our analysis suggests that the capital market changes, and the private savings rate increase in particular, have been the more contractionary. At the same time, these changes have contributed at least an extra ten per cent to capital flowing into the north. Northern output has risen, particularly in the services sector, and northern workers have gained at the expense of the owners of capital and other resources specific to tradeable goods sectors.

The deflation in China has also benefited Chinese workers, yet the analysis suggests many more are probably unemployed due to excessive real wage increases. Although the increased unemployment and reduced output may be ameliorated as the crisis shocks fade, the more contractionary change in domestic savings is likely to be permanent. To the extent that wage rigidities may be long lasting in China, it is tempting to consider the transition to a flexible exchange rate regime. From a domestic standpoint, this would free monetary policy to adjust the price level, ensuring that real wage rises do not reduce employment and offering the least politically painful approach to the restoration of output to its potential level. Two risks arise, however. First, this dispenses with the 'nominal anchor' and, depending on how China's wage determination process evolves, it could initiate an inflationary spiral. Recent history, however, does not suggest this risk is particularly serious in China. Second, since China is a large economy, at least in its own region, there is the risk of competing devaluations and another round of capital flight. This risk is the more serious and warrants consideration in the choice of China's eventual exchange rate regime.

Notes

¹ Subsequent but associated 'crises' in Latin America, Eastern Europe and in Russia followed. We focus on the effects of the Asian shocks only.

² Earlier applications of this basic approach to the crisis include those by Adams (1998), Noland *et al.* (1998), Liu *et al.* (1998) and Yang and Tyers (1999).

³ Although the events that precipitated the crisis are now fairly well understood (Chang and Velasco 1998, Krugman 1999), the best dynamic global macroeconomic models to date still do not fully endogenise the capital flight of 1997 (McKibbin 1998a, 1998b).

⁴ According to IMF(1998), gross fixed capital formation in Japan declined by 3.5 per cent in 1997 and was forecast to decline by 7.2 per cent in 1998.

⁵ This is borne out in a recent World Bank survey of 3,700 companies in the worst affected economies (World Bank 1999) as reported in *Asiaweek*, 16 April 1999.

⁶ This view is put by Zhang (1999) and borne out in the form of a policy reaction function estimated by L.L. Song (1999).

⁷ This accorded with the strategy advocated by Corden (1993).

⁸ The real interest rate is here estimated as the concurrent difference between the state bank lending rate and the rise in the CPI. The source for both is IMF (1999b).

⁹ These government spending statistics apparently ignore subsidies to state-owned enterprises. Such subsidies are large, though they probably take the form of transfers rather than spending on goods or services or public investment.

¹⁰ Although the data in Table 3 for 1998 are drawn from the indicated sources without adjustment, they do look out of line by more than we would expect, and we regard them as questionable at best.

¹¹ The extent of underestimation is moderated, however, by the disguised employment amongst these workers. Because they retain generous allowances and payments in kind, which are denied to workers who take new jobs, when new employment is attained these workers rarely concede it to officialdom (Meng 1999).

¹² That China is not 'small' has been emphasised by others, including Dornbusch (1999). Our subsequent global general equilibrium analysis corrects for this. Even there, however, the 1995 database has China contributing only 2.5 per cent of global output.

¹³ More realistically, consumption might distinguish between the demand for home produced goods, C_H , and imported goods, M , so that $C = C_H + M$. These two components both depend on the real exchange rate (the ratio of the prices of home to imported goods) but with opposing signs. For the sake of this elemental analysis, we assume that these two effects just cancel out, leaving total consumption, C , independent of the real exchange rate.

¹⁴ The shape of the $SAS(W)$ curve depends on the value of β . The labour share embodied in the GTAP general equilibrium database for China is $\beta = 0.45$ (McDougall *et al.* 1998) and this value does yield the shape shown.

¹⁵ Both ΔR and r^* also shift the AD curve positively. A rise in ΔR raises outflows on the capital account, reduces the quantity of saving directed to the domestic economy and raises r . Imagine that output is fixed in a clearing labour market. At a higher r , money market equilibrium is only attained at a lower real money supply. Since the nominal money supply is exogenous, the result must be a higher price level and hence an upward shift of the curve. Similarly, if r^* rises, or if the interest premium demanded of investments in China rises, once again, saving directed to the home economy falls and r rises. Again, at constant output, a higher r will only find equilibrium in the money market at a lower real money supply and hence a higher equilibrium price level.

¹⁶ Because of realignments amongst the major currencies, nominal parity with the US\$ has not prevented changes in the effective exchange rate. We allow for these later but ignore them here.

¹⁷ Expectations play an important role here. Such behaviour by a central bank well endowed with foreign reserves would have helped resist speculation against the nominal exchange rate at the time.

¹⁸ For a detailed description of the standard version of this model, see Hertel (1997). Our modifications to the structure of the model are detailed in Yang and Tyers (1999). They are principally changes to the factor demand structure. For the present purpose, though, they include the sector specificity of capital in all regions.

¹⁹ For a detailed description of the database, see McDougall *et al.* (1998).

²⁰ The early literature on real exchange rate changes tended to focus on associated relative price changes where tradeable goods prices retained parity with international trading prices. More recently it has become certain that short run departures from the law of one price occur across all tradeable goods sectors (Engel 1999).

²¹ See the discussion of long run shocks in Hertel *et al.* (1996, Appendix C:212). Indeed, to reflect the unusually short run nature of the shocks, we use smaller than the standard elasticities. The elasticities associated with

trade in the relatively standardised natural resource based goods and labour intensive manufactures are reduced by two thirds, while those associated with skill intensive manufactures and services are reduced by three quarters.

²² As discussed later in the text we also endogenise the difference between the regional expected rate of return on current investment and the global average regional rate of return. These rates differ, in turn, from rates of return on installed capital, which vary by region and sector.

²³ This approach and what it implies about the behaviour of firms is detailed in Yang and Tyers (1999).

²⁴ As indicated in Table 5, both skill and raw labour are included as primary factors. Since both markets are regulated in China, the resulting real wage rigidity applies to a weighted average of the two real wages.

²⁵ In GTAP parlance, this means endogenising variable *cgdslack* while maintaining *RORDELTA*=1.

²⁶ Relative to the US rate of return, the premia for the other regions were: Japan: 25 per cent, the EU three per cent, Canada and Australasia two per cent, and the collective 'rest of the world' six per cent.

²⁷ See a more complete discussion of the macroeconomics of this point in Tyers (2000).

²⁸ Investment as a proportion of GDP has not fallen in China, but the GDP growth rate has. A decline of three per cent relative to trend is a fall of US\$30 billion, at least a third of which would be investment.

²⁹ The more recent slowdown in China's exports (Fernald and Babson 1999, Hu 1999) may reflect the resolution of property rights in the affected countries and a subsequent surge in competing exports. The truth for China remains unclear, however, because of inaccuracies in the measurement of the current account, as indicated in Table 1.

³⁰ For a numerical analysis of this using the model of Section 4, see Tyers (2000).

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