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*Monetary Policy and Credit in China: A Theoretical Analysis**

A three-sector model of the Chinese economy is developed in which the activity of state-owned enterprises (SOEs) is constrained by the state-imposed credit plan for working capital. Our analysis indicates the weaknesses of credit control and nominal interest rate variation as tools for influencing the price level; but the hardening of SOEs' budget constraints is found to be an effective device. The existence of credit and currency controls tends to make devaluation contractionary. Furthermore, because of general equilibrium repercussions, policies that boost industrial exports tend to reduce welfare in the agricultural sector, where poverty is concentrated.

1. Introduction

The development of substantial elements of a market system in the real sector in China over the past two decades has been accompanied both by bouts of high inflation and, recently, by deflation. To combat these problems, the authorities have relied primarily on monetary policy.[1] However, commercial banking in China, which is dominated by four large state-owned banks, has remained subject to the type of controls associated with central planning. The main instrument of monetary control is quantitative regulation by the "credit plan," which is set by the People's Bank of China (PBC).[2] In formulating the credit plan the PBC collaborates closely with the State Planning Commission. As a result, the credit plan is used not just to control the money supply; it is also used to pursue more microeconomic objectives, with detailed priorities set for "policy lending," which, in some cases, is even specified at the level of the individual borrower. Policy lending is employed

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[1]See, e.g., Allsopp (1995) or World Bank (1995).

[2]For general discussions of the credit plan see Montes-Negret (1995) and World Bank (1995, 1996).

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both to support chosen growth sectors and to underpin loss-making state-owned enterprises (SOEs), and this leads to a large proportion of bank loans being non-performing.[3] Many loans are effectively subsidies extended under government direction (blurring the distinction between monetary and fiscal policy), while often the banks themselves concede parts of loans to ensure SOEs' survival (World Bank 1996; Zou and Sun 1996).

In this paper we develop a theoretical model of monetary policy and credit in China, focusing on the role of working capital.[4] This is a particularly important component of the credit plan, being a priority item (Montes-Negret 1995) and constituting about 60% of planned loans (World Bank 1996). We develop a three-sector model in which agriculture is modeled as a separate sector, but industry is split into two sectors, which produce a non-traded and an export good, respectively.[5] For simplicity, the sector producing the non-traded industrial good is assumed to be composed entirely of SOEs, for whom output is constrained by the availability of credit for working capital.[6] Also, by assuming that a portion of the loans in this sector is not repaid to the banks, we allow for SOEs having soft budget constraints. In contrast, the export sector is treated as facing no limits on the availability of credit for working capital. This is intended as a stylized representation of the priority that is given to exports in the credit plan (Montes-Negret 1995). However, during periods of severe credit tightening, the difficulties encountered by SOEs have led the authorities to override other priorities and give the SOEs a larger proportion of the credit available. This happened, for example, in early 1996 (see Sachs and Woo 1997). We therefore also modify the model to allow for credit rationing to the export sector. Throughout, the simplifying assumption is made that agriculture has no working capital needs.

Because of the complex mix of plan and market in China and the variety of institutional forms under which production takes place, any stylized model of the Chinese economy should be treated with caution. Nonetheless, we believe our analysis indicates the importance of attempting to model the specific features of the Chinese economy, for we obtain results about the effects of monetary policy that are quite different from those

[3]An official (i.e., conservative) estimate puts the proportion at 22% (*Economist* 1997).

[4]It appears that the Chinese monetary system has not been analyzed from the macrotheoretic viewpoint, though numerous econometric analyses have been undertaken (e.g., Chen 1997; Yu 1997; and Hassan 1999).

[5]This three-sector framework is also used in Bennett and Dixon (1996). There, however, we model dual-track pricing and urban goods rationing. Here, we suppress such considerations and elaborate on the monetary side.

[6]This is the key constraint that drives the determination of macro equilibrium. In contrast, in Bennett and Dixon (1996) the critical factor is the availability of imported intermediates, which is limited by the balance of trade constraint.

obtaining in a free-market economy. We find that the impact of credit controls on the aggregate price level can be of either sign. This is consistent with the belief of some Chinese economists that monetary expansion has not caused inflation (see Qin 1994). Furthermore, in our formulation, an increase in the nominal interest rate leads to a higher aggregate price level, while monetary expansion, in the sense of greater initial money balances for households, has an overall contractionary effect on output. This latter relationship has also been found empirically for the short term (up to seven quarters) by Phylaktis and Girardin (1999). Another of our findings is that devaluation may affect output negatively, which accords with the contradictory empirical evidence on the effect of Chinese devaluations (Brada, Kutan and Zhou 1993; Turay 1995). These "unorthodox" results of our paper are due to the general equilibrium repercussions of the credit plan and the control of foreign currency.

In Section 2 we set up the basic model. In Section 3 we characterize the macroeconomic equilibrium, while in Section 4 we examine various policy changes. We pay particular attention to variation of the credit plan, and we go on to consider a change in the nominal interest rate and a hardening of the budget constraint for SOEs. We also look at various other policy changes, including devaluation. In Section 5 we consider briefly the effect of the imposition of credit rationing in the export sector. In Section 6 we summarize our main conclusions and discuss their implications.

2. The Model

The Utility Function

Our formulation of the utility function is similar to that of Blanchard and Kiyotaki (1987), among others.[7] We consider a single period, for which any household h has the utility function

$$u_h = \psi(F_h^{\alpha} Q_h^{1-\alpha})^c (M_h/P)^{1-c} - N_h^{\delta}/\delta , \quad 0 < \alpha < 1 , \quad 0 < c < 1 , \quad 1 < \delta , \quad (1)$$

where $\psi^{-1} \equiv \alpha^{\alpha}(1 - \alpha)^{1-\alpha} c^c (1 - c)^c$; F_h and Q_h are h's consumption of food and the non-industrial good, respectively; M_h is its terminal money holding and N_h is the amount of time it spends working. c is h's average (= marginal) propensity to consume. P is the cost-of-living index associated with the Cobb-Douglas sub-utility function in goods:

[7]Our formulation of the utility function is the same as in our earlier paper, so we keep the exposition brief.

$$P = p_F^{\alpha} p_Q^{1-\alpha} , \tag{2}$$

where p_F and p_Q are the respective money prices of food and the non-traded industrial good.

The subscript $h = F, Q, X$ will be used for a household working in the agricultural, non-traded industrial good or export sector, respectively. We define imputed income y_h as initial money holding M_h^0 plus the relevant measure of h's earnings. This measure will be defined separately below for each of $h = F, Q, X$. The budget constraint facing h is

$$p_F F_h + p_Q Q_h + M_h \leq y_h , \qquad h = F, Q, X . \tag{3}$$

Maximizing u_h w.r.t. (3) yields

$$F_h = \alpha c y_h / p_F , \qquad Q_h = (1 - \alpha) c y_h / P_Q , \quad h = F, Q, X . \tag{4}$$

The Agricultural Sector

The disadvantages associated with migration confine the number of households in the agricultural sector to L_F.[8] The representative household in this sector produces an amount of food A_F according to the production function

$$A_F = N_F^{\eta} , \qquad 0 < \eta < 1 . \tag{5}$$

The household retains the amount of food F_F for its own consumption (by assumption $F_F < A_F$), but its imputed income y_F includes the entire market value of its output:

$$y_F = M_F^0 + p_F \eta_F . \tag{6}$$

The agricultural household is a price-taker (both p_F and p_Q are market-clearing). Given (2), (3), (5) and (6), its utility-maximizing input of labor time is

$$N_F = \left[\eta \left(\frac{p_F}{p_Q} \right)^{1-\alpha} \right]^{1/(\delta - \alpha)} . \tag{7}$$

[8]According to the World Bank (1997) the main factor limiting migration to towns and cities may be the difficulty migrants have in qualifying for urban welfare facilities. Also, if a household is absent from its village it may lose its chance of being allocated agricultural land.

N_F is increasing in the terms of trade p_F/p_Q. A_F, F_F, Q_F and y_F then follow from (3)–(6).

The Non-Traded Industrial Good Sector

This sector consists of SOEs.[9] In modeling the representative SOE we wish to highlight three particular factors. The first is that SOEs in practice carry a surplus labor force, which, for social and political reasons they are generally unable to reduce. The disguised rate of unemployment in SOEs is reported to be 15–20% (World Bank 1997). Second, we want to show the dependence of SOEs on the credit plan, in particular for working capital. Third, we wish to represent the failure of SOEs to honor their full debt obligations (this is associated with the soft budget constraint). We therefore model the representative SOE as having a parametrically fixed number of employees L_Q.[10] The SOE produces output Q using L_Q and an amount I_Q of an imported intermediate. Its production function is[11]

$$Q = L_Q^{\beta} I_Q^{\gamma}, \qquad \beta, \gamma > 0, \qquad \beta + \gamma < 1. \tag{8}$$

The credit plan specifies that working capital up to the amount M_Q may be advanced to the SOE at the nominal interest rate r. As will become clear from our formulation of SOE worker income, the SOE will always choose to borrow the full amount available. Also, we assume that M_Q is used entirely to buy intermediates. (Direct distribution to workers of part of M_Q is equivalent to a higher level of initial household money holding M_Q^0. This case is considered in Section 4.) Thus,

$$I_Q = M_Q/p_I. \tag{9}$$

Given L_Q, M_Q and p_I, output Q follows immediately from (8) and (9).

The managers of SOEs in practice tend to collude with their labor force to avoid centrally-imposed restrictions on wage scales (Qian 1995; Lee 1999). Given also that, with all households possessing utility function (1), changes in the distribution across households of a given total income have

[9]SOEs produce about 1/3 of industrial output and account for about 2/3 of urban employment (World Bank 1997).

[10]We use the terms "household" and "employee" interchangeably. In China family members tend to all work in the same enterprise, so our mixing of the terms may be of little consequence.

[11]It is immaterial whether we assume decreasing returns to scale in this sector. However, we assume decreasing returns for consistency with our specification of the export sector, where decreasing returns are necessary for there to be a unique employment equilibrium. This is because our formulation of the labor market entails an infinitely elastic labor supply in the relevant region.

no effects on goods demands, little is therefore lost if we model the representative SOE as distributing to its workforce all of its net revenue. In calculating this net revenue, however, we take into account that the SOE only honors the proportion ϕ of its debt, $(1 + r)M_Q$. Thus, each employee receives

$$W_Q = \frac{1}{L_Q}\left[p_Q Q - \phi(1 + r)M_Q - T_Q\right], \qquad 0 \leq \phi \leq 1, \tag{10}$$

where T_Q is the tax paid by the SOE. Substituting from (8) and (9) into (10),

$$W_Q = \frac{1}{L_Q}\left[p_Q L_Q^{\beta}\left(\frac{M_Q}{p_I}\right)^{\gamma} - \phi(1 + r)M_Q - T_Q\right].$$

We assume that the firm is a price-taker (p_Q is market-clearing).[12] For simplicity, we treat ϕ as constant, a larger ϕ implying a harder budget constraint.[13]

Imputed income for $h = Q$ is simply

$$y_Q = M_Q^0 + W_Q. \tag{11}$$

The Q-household maximizes u_Q subject to (11), treating W_Q as a parameter.

The Export Sector

China's exports come from enterprises of various institutional forms, including township and village enterprises (TVEs), joint ventures and more profit-oriented SOEs. In all these enterprises it is generally easier to fire workers than it is in traditional SOEs.[14] We therefore model the representative export sector firm as choosing freely its purchase of the services of L_X workers at the going wage. Also, since, in practice, priority is given to exporters in the credit plan, we assume that the amount of working capital M_X that the firm can borrow is unconstrained. This working capital is used to purchase I_X of imported intermediates:[15]

[12]In practice, more than 95% of industrial output is sold at market prices (World Bank 1997).

[13]The model might be reformulated with ϕ endogenous. If SOE employees find that their income W_Q is going to decline, they may be willing to risk greater conflict with the authorities by honoring less of their debt obligation (reducing ϕ). For example, suppose they choose ϕ so that W_Q always reaches a given target level. This affects the distribution of income distribution, but, given utility function (1), distributional changes have no effects on the macro equilibrium.

[14]In 1995 86% of China's merchandise exports were manufactures (World Bank 1997).

[15]Almost half of all Chinese imports are processed to go to export (World Bank 1996).

$$I_X = M_X/p_I \ . \tag{12}$$

The firm produces output X according to the production function

$$X = L_X^{\lambda} I_X^{\mu} , \qquad \lambda, \mu > 0 , \quad \lambda + \mu < 1 . \tag{13}$$

Since the bad-debt problem in China is largely confined to traditional SOEs, we make the simplifying assumption that the export-sector firm always repays its debt fully. After-tax profit is hence $\Pi_X = p_X X - W_X L_X - p_I I_X - rM_X - T_X$, where p_X is the unit price of exports in domestic currency, W_X is the market wage rate (in nominal terms) and T_X is the amount of tax paid by the firm. Using (12) and (13), we therefore have

$$\Pi_X = p_X L_X^{\lambda} I_X^{\mu} - W_X L_X - (1 + r)p_I I_X - T_X . \tag{14}$$

Maximizing (14) w.r.t. L_X and I_X, yields

$$p_X X = W_X L_X/\lambda = (1 + r)p_I I_X/\mu ,$$

$$\text{where } X = \left\{ \left[\frac{\lambda}{W_X} \right]^{\lambda} \left[\frac{\mu}{p_I(1 + r)} \right]^{\mu} p_X^{\lambda+\mu} \right\}^{1/(1-\lambda-\mu)} . \tag{15}$$

Given the utility function (1), the identity of the recipients of Π_X is of no significance for the macro equilibrium, provided that all of Π_X goes to domestic residents. For simplicity, we assume that Π_X is shared equally between the L_X workers in the firm. Thus, imputed income is

$$y_X = M_X^0 + W_X + \Pi_X/L_X .$$

Each employee is assumed to treat Π_X/L_X as a parameter.

The Labor Market

Open unemployment is $U = H - L_F - L_Q - L_X$, where H denotes the total number of households. We treat both L_F and L_Q as given, whereas L_X is determined in a competitive labor market. The rationale for this assumption is the existence in China of a "floating population" of 100–150m. wandering in search of work (Sachs and Woo 1997). Normalizing the number of working hours in the work period in the X-sector to unity, $N_X = 1$ in (1), and so the disutility of working is $1/\delta$. Assuming that $U > 0$, the real wage is driven down to this disutility:

$$W_X/P = 1/\delta . \tag{16}$$

International Trade

Imports of the intermediate, $I_Q + I_X$, and exports, X, occur at world prices, p_I^* and p_X^* respectively, mediated by the official exchange rate e:

$$p_I = ep_I^* ; \qquad p_X = ep_X^* . \tag{17}$$

We must take into account, however, that China retains a complex import control system. For many years, imports of inputs were the main priority, but there has recently been a shift in import composition toward food, reflecting the government's desire to reduce the pressure on domestic food prices (World Bank 1996). The government pays the foreign currency price p_F^* for food and then releases it on to the domestic market. Since the government's control of domestic prices has declined substantially in the 1990s, we assume that the domestic food price p_F is market-clearing. The injection of imports of food by the government is a rightward shift in the supply curve.

National Income Accounts

We reflect China's import management system by assuming that the balance of trade in foreign currency, B^*, is determined by policy. We have already specified I_Q, I_X and X as endogenous, but we now further assume that the government allows in imports of food A^M insofar as the balance of trade constraint allows. We therefore have

$$B^* = p_X^* X - p_I^*(I_Q + I_X) - p_F^* A^M , \tag{18}$$

where A^M is determined as a residual, which we assume throughout is positive.[16]

We define the nominal budget deficit as

$$D = -T + (ep_F^* - p_F)A^M - \{rM_X + [1 - \phi(1 + r)]M_Q\} , \tag{19}$$

where $T \equiv T_Q + T_X$. The term $(ep_F^* - p_F)A^M$ is the subsidy to the domestic food market from the government buying at the foreign currency price p_F^* and selling domestically at p_F. The term $rM_X + [1 - \phi(1 + r)]$, the profit of the commercial banking sector (which may be negative), is included because commercial banking is not so much an industry as an arm of government in China.[17] Its inclusion makes our definition of D close to what is

[16]We economize on notation by writing aggregate variables for the two industrial sectors as if there were only one firm in each sector.

[17]It might appear that the losses of the SOE sector should be added into (19). However, allowing for the possible non-payment of some debt, the SOE sector breaks even by definition, because all surplus is distributed to workers.

known as the "consolidated government deficit." Since money creation has been the main form of financing of the consolidated government deficit in practice (World Bank 1995), we assume that D is financed entirely by money creation. Furthermore, we assume that T is adjusted automatically so that the target level of D is always attained.

Let Y denote nominal national income. Since, from (1), c is the average propensity to consume, standard manipulations yield

$$Y = \frac{c}{1 - c}(M^0 + D) + B ,$$

where $M^0 \equiv L_F M_F^0 + L_Q M_Q^0 + L_X M_X^0$ and $B = eB^*$. Hence, Y is determined by a standard income-expenditure process. Note that Y depends only on policy parameters, not on what happens to prices and quantities.

Using the Cobb-Douglas sub-utility function (see Equation 1), aggregate household expenditure $c(Y + M^0)$ divides between food and the non-traded industrial good in the proportions α and $1 - \alpha$, respectively:

$$\begin{aligned} p_F F^d &= \alpha c(Y + M^0) , \\ p_Q Q^d &= (1 - \alpha)c(Y + M^0) , \end{aligned} \tag{20}$$

where $F^d \equiv L_F F_F + L_Q F_Q + L_X F_X$ is total food demand and $Q^d \equiv L_F Q_F + L_Q Q_Q + L_X Q_X$ is the total demand for non-traded goods.

3. Macroeconomic Equilibrium

Given that the markets for food, non-traded industrial goods and export sector labor all clear, the equilibrium for this system can be expressed in three equations. First, we take the market-clearing condition for food, $F^d - L_F A_F - A^M = 0$, and, using (5), (7), (9), (15), (17), (18) and (20), we obtain

$$\frac{\alpha c(Y + M^0)}{p_F} - L_F \left[\eta \left(\frac{p_F}{p_Q}\right)^{1-\alpha}\right]^{\eta/(\delta-\eta)} - \frac{1}{p_F^*}\left[\left(1 - \frac{\mu}{1 + r}\right) p_X^* X - B^* - \frac{M_Q}{e}\right] = 0 . \tag{21}$$

Similarly, for the non-traded industrial good we substitute into $Q^d - Q = 0$ from (8), (9), (17) and (20), yielding

TABLE 1. *Comparative Statics*

	Endogenous Variables									
Parameters	p_F	p_Q	W_X	P	L_X	X	Q	A^M	A_F	F^d
M_Q	(+)	−	?	?	?	?	+	(−)	(+)	(−)
r	+	0	+	+	+	−	0	−	+	−
M^0, D	+	+	+	+	−	−	0	−	+	−
ϕ	−	−	−	−	+	+	0	+	−	+
e	(−)	+	?	?	?	?	−	(+)	(−)	(+)
p_X^*	−	0	−	−	+	+	0	+	−	+
p_I^*	+	+	+	+	+	−	−	−	?	−
p_F^*, B^*	+	0	+	+	−	−	0	−	+	−

$$\frac{(1 - \alpha)c(Y + M^0)}{p_Q} - L_Q^{\beta}\left(\frac{M_Q}{ep_I^*}\right)^{\gamma} = 0 . \tag{22}$$

Finally, for the labor market in the export sector, we substitute into (16) from (2), (13) and (17) to obtain

$$\lambda\left[\frac{\mu}{(1 + r)ep_I^*}\right]^{\mu/\lambda}(ep_X^*)^{(\lambda+\mu)/\lambda}\, X^{(\lambda+\mu-1)/\lambda} - \frac{p_F^{\alpha}p_Q^{1-\alpha}}{\delta} = 0 . \tag{23}$$

There are three endogenous variables in (21)–(23): p_F, p_Q and X. Once the solution to (21)–(23) is obtained, the equilibrium values of other variables are easily found from the rest of the model.

In the next section we consider the comparative statics of this system. We assume that a standard stability condition, (A1) in the appendix, is satisfied. In the case of some of the results that are found to be ambiguous in sign, we introduce a further assumption, (A2) in the appendix, which is essentially a condition that direct impacts of certain parameter changes dominate the indirect repercussions.

4. Policy Changes

The comparative statics of the model are set out in Table 1. The left-hand column shows the parameters that are varied, while the top row shows the main endogenous variables that may be affected. The signs in parentheses are those for which we assume that condition (A2) is satisfied in order to get a determinate sign.

The first parameter change shown is variation of the amount of working capital M_Q in the credit plan for the non-traded industrial good sector. According to the OECD (1996) tight credit controls from the end of 1993 provoked a sharp real contraction. Our model tends to support this view, though some signs are indeterminate. A higher level of M_Q enables the non-traded industrial good sector to buy more intermediates I_Q, thereby raising output Q. The higher level of Q has a negative impact on price p_Q, while the higher level of intermediates imports I_Q is associated with a reduction in imports of food A^M, which has a positive impact on the domestic food price p_F. The terms of trade p_F/p_Q facing domestic producers thus improves, causing domestic food output to rise.

Some indeterminacy arises in the first row of Table 1, however, because of general equilibrium repercussions through exports X. Since the variations of p_F and p_Q described above are in opposite directions, the net effect on the price index P may be of either sign, and so the money wage rate W_X may vary in either direction. As L_X and X are decreasing functions of W_X, they too may vary in either direction. Intuitively, there are two main factors determining the sign of dX/dM_Q. First, if the price ratio p_Q/p_F is relatively small, then, in the price index P, the weight of the price p_Q is relatively small compared to the weight of the price p_F; that is, the significance of the price that falls is small, compared to the price that rises. Consequently, P tends to rise, in which case X falls. Second, if the marginal productivity of intermediates in the production of the non-traded good is relatively small, then the marginal relaxation of the credit constraint has little effect on Q, and so p_Q falls by a relatively small amount. Given the rise in p_F, the price index P therefore tends to rise, again affecting X negatively.

Nonetheless, provided (A2) is satisfied, a greater M_Q is associated with higher levels of the food price p_F and production A_F, and with lower levels of food imports A^M and consumption F^d. And, regardless of whether (A2) is satisfied, output of the non-traded industrial good Q is greater and its price p_Q is lower. However, since the effects on W_X, P and X are unclear in sign, we conclude that a policy of credit *restriction* of SOEs does not necessarily lead to a lower price level and *may* have indirect effects that limit exports. Similarly, under recent deflationary conditions, credit expansion may not lead to a higher price level.

The second row of Table 1 shows the effects of a variation of the nominal interest rate r, a policy that has frequently been used in China in recent years (World Bank 1996). In our model the higher level of r has no effect on the output of non-traded industrial goods Q (the binding constraint on Q is the credit plan M_Q, which is unchanged). However, the higher cost of working capital causes exports X to be reduced (though employment L_X rises because exporters substitute away from intermediates). The fall in ex-

ports results in fewer food imports A^M being allowed in (because of the balance of trade constraint B^*). This causes p_F, and therefore also P to rise. Hence, the nominal wage rate W_X increases, with repercussions reinforcing those already described. Since p_F/p_Q increases, so too does domestic food output. However, since $dP/dr > 0$, it appears that anti-inflationary policy in China might have been more successful without interest rate increases. This macroeconomic argument may be combined with the microeconomic rationale given by Zou and Sun (1996) for keeping the nominal interest rate low in China.

Third, consider the effects of a monetary expansion in the form of higher initial household money holdings M^0. The initial impact is that the demands for the two domestically-consumed goods rise in equal proportions, as therefore, do the prices p_F and p_Q. Hence, P and W_X also rise, and, because of the latter, L_X and X are reduced, though there is some increase in intermediates usage I_X. Because these changes have a negative impact on the balance of trade, fewer food imports A^M are allowed in. This gives a further stimulus to p_F, so that the terms of trade p_F/p_Q rises, causing some increase in domestic food output A_F, though, given (A1), this output increase is less than the amount that food imports fall. Thus, as Q is unaffected (since M_Q is constant), the greater money supply is associated with *lower* domestic consumption. A rise in the budget deficit D, through a reduction in lump-sum taxes T, has the same qualitative effects.

Part of the interest in examining the effects of a higher level of M^0 is that this also reveals the effects of a higher level of the "financial discipline" (or "budget hardness") parameter ϕ. When ϕ is greater, firms in the non-traded industrial good sector pay the banks a larger proportion of what they owe them. Also, however, when ϕ is greater, workers in this sector are paid a smaller amount, W_Q per head, *ceteris paribus*. The macroeconomic effects are qualitatively the same as those of a *reduction* in M^0.[18] Hence, the effects described in the previous paragraph again apply, but in reverse. Among the benefits of making budget constraints harder are that exports and food consumption rise and that the aggregate price level is reduced.[19] However, food output A_F and employment L_X fall.

The next parameter change shown in Table 1 is an increase in the exchange rate e, that is, devaluation, a policy that the Chinese government used in 1994, but has been reluctant to use again, given the financial fragility

[18]If part of M_Q is distributed directly to workers W_Q is thereby increased. The macroeconomic effects are qualitatively the same as those of an increase in M^0.

[19]The greater ϕ also reduces the budget deficit D; but, by assumption, the authorities respond by setting higher taxes T to maintain D.

of the region and the concerns about the implications for the Hong Kong dollar (Economist 1998). The higher level of e has two immediate effects. One is that exports X rise. The other is that, since M_Q is constant, but p_I increases, SOEs can buy fewer intermediates I_Q, and therefore their output Q falls and the price p_Q rises. These effects improve the balance of trade in foreign currency and so more food imports are allowed in, with a negative effect on the food price p_F. However, with p_Q and p_F affected in opposite directions, the consequences for the aggregate price level P, and therefore for the nominal wage rate W_X, are unclear. The further repercussions on exports X are therefore unclear in sign. Nonetheless, if (A2) is satisfied the overall effects on food imports and food consumption remain positive, while domestic food output falls.

To summarize, there are two reasons why devaluation may be contractionary in our model, each of which is associated with government constraints on market behavior. The first is because of the control of food imports. It is well-known that if, as part of a policy package, import controls are relaxed when devaluation occurs, the resulting inflow of imports can be harmful to domestic producers of the good concerned (see Cooper 1971). The second is because of the role of the credit plan and is specific to China. With credit for SOEs fixed in domestic currency terms, devaluation raises the domestic currency price of inputs and so forces SOEs to reduce their output.[20] We conclude that it may not be to China's disadvantage that regional considerations constrain its policy.[21]

The effects of exogenous increases in each of the foreign currency prices p_I^*, p_X^* and p_F^* are shown in the last three rows of Table 1. Briefly, when p_X^* is higher or p_I^* lower, exports rise, so that more food imports are allowed in. It is straightforward to trace through the various repercussions. Whereas, for example, a higher p_X^* has no effect on Q, a lower p_I^* allows the non-traded industrial good sector to buy more intermediates with its given credit plan M_Q, so that Q rises. The effects of a higher foreign currency price of food, p_F^*, as shown in the last row of the table, are the same in sign as those of higher balance of trade requirement B^*. In each case food imports A^M decline, so that the food price p_F rises. Although this stimulates food production, it also raises the price index P. The money wage rate W_X therefore rises, causing exports X to decline. Thus, a higher balance of trade requirement leads to a decline in exports.

[20]A corresponding effect in a market economy is that devaluation may force up the interest rate because it reduces the real volume of credit. The interest rate rise then has contractionary effects (see van Wijnbergen 1986).

[21]In our earlier model (Bennett and Dixon 1996) we did not allow for credit controls or food imports, and so we found that devaluation was expansionary.

5. Credit Rationing in the Export Sector

During some more severe inflationary episodes the authorities have subordinated all other objectives to containing inflation, with credit rationing extended to the more dynamic sectors of the economy. In terms of our model, the representative exporting firm is assumed to face a binding credit plan. All equations in Section 2 still hold, except that M_X is now interpreted as exogenous, so that I_X follows from (12) and, instead of (15), profit-maximization now yields $L_X = (\lambda p_X I_X^{\mu}/W_X)^{1/(1-\lambda)}$. Equation (23) is replaced by

$$\lambda_X p_X I_X^{\mu/\lambda} X^{(\lambda-1)/\lambda} - \frac{p_F^{\alpha} p_Q^{1-\alpha}}{\delta} = 0 . \tag{24}$$

In the comparative statics of the reformulated model there are no signs that are the reverse of those shown in Table 1. However, the rate of interest r becomes an entirely impotent policy tool. Since X and Q are both constrained by the amount of credit available, the terms on which credit is provided have no effect.[22]

The additional policy tool, M_X, can now be considered. A higher level of M_X causes X and L_X to be greater.[23] With more net foreign exchange earnings, food imports A^M are allowed to rise. The consequent negative impact on the food price p_F causes food production A^F to fall. Since p_Q (and Q) are unaffected, the price index P and the money wage rate W_X also fall. Consequently, exports X increase. Hence, a policy of *tightening* credit to exporters in order to hold back the aggregate price level is mistaken. Not only does it cause exports to fall, it also has a *positive* effect on the aggregate price level.

The effects of diverting credit from exporters to the producers of the non-traded good can be seen from combining a rise in M_Q with an equal-size *fall* in M_X. Without further assumptions, the results are all the same as in the first row of Table 1. Thus, non-traded industrial output Q rises, and, if (26) is satisfied, food output A_F rises too. The effect on exports X can go either way for the reasons discussed concerning a change in M_Q. However, since $dX/dM_Q > 0$, X is more likely to fall when credit is diverted than when M_Q is increased, but M_X is constant.

[22]When r is raised the price of intermediates increases relative to that of labor. Provided, however, that credit remains a binding constraint, the effective demand for labor is unaffected.

[23]Although I_X and L_X are substitutable in the production function (13), when I_X is rationed, the "effective demand" for labor L_X (in the sense of Barro and Grossman 1971) is increasing in I_X.

6. Concluding Comments

We have attempted to formulate a macro model of the Chinese economy, taking into account some of the differences between production sectors in China, with particular attention to monetary policy. We find that a tightening of the credit plan for SOEs has an effect on the aggregate price index that is unclear in sign. Of course, this does not indicate that the policy is necessarily ineffective; but it does suggest that in the Chinese institutional framework such a policy should be used with care. And we find that the extension of binding credit controls to the export sector should be avoided because there is then a clear-cut positive effect on the aggregate price index.

We also find that another commonly used tool of monetary policy in China, interest rate variation, has the opposite of the desired effect. Given the institutional framework of the credit plan, a higher nominal interest rate is associated with a higher aggregate price index (though if credit controls are extended to the export sector, interest rate variation has no significant effects).

Money is not neutral in the model. Consider an increase in the money supply in the form of higher initial money holdings for households or as an increased allocation of working capital to SOEs that is then distributed to workers, rather than used for buying intermediates. The price index therefore rises, but the effects on output are mixed. The output of SOEs is unaffected, whereas exporters produce less and food production rises. We also examine an increase in financial discipline in the form of SOEs honoring a larger proportion of their debt obligations. The effects are opposite in sign to those of an increase in initial money holdings by households. Since the aggregate price index therefore falls, this indicates that the hardening of budget constraints is an effective anti-inflationary device. An added bonus, through general equilibrium repercussions, is that exports increase. Devaluation, however, is of rather doubtful benefit in the model. It has an unclear effect on exports and the price index, while causing SOEs to reduce output; and the effect on food production is likely to be negative.

Finally, notice that a characteristic feature of the model is that policy changes that lower the price index and raise exports tend to reduce welfare in the agricultural sector. (Agricultural welfare is positively related to the terms of trade p_F/p_Q and so also to output A_F.) Since poverty in China is largely concentrated in the agricultural sector (World Bank 1997) this indicates a significant conflict facing policy makers.

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Appendix

Differentiating (21)–(23) totally, we obtain a system of the form

$$\begin{bmatrix} -k_{11} & k_{12} & -k_{13} \\ 0 & -k_{22} & 0 \\ -k_{13} & -k_{32} & -k_{33} \end{bmatrix} \begin{bmatrix} dp_F \\ dp_Q \\ dX \end{bmatrix} = K_z[dz] \ ,$$

where the k_{ij}s are the numerical values of the partial derivatives attached to the endogenous variables dp_F, dp_Q and dX (i.e., $k_{ij} > 0 \forall i,j$). The rows of the matrix of partial derivatives correspond, respectively, to (21)–(23). dz is the column vector of differentials of parameters listed in Table 1, while K_z is the corresponding matrix of partial derivatives.

The determinant of the k_{ij}-matrix is

$$\Delta \equiv -k_{11}k_{22}k_{33} + k_{13}k_{31}k_{22} \ . \qquad \text{(A1)}$$

For stability it is sufficient to assume that $\Delta < 0$. The signs in Table 1 that are not in parentheses then follow immediately. For the signs in parentheses we further assume that

$$\frac{k_{22}k_{33}}{ep_F^*} - (k_{12}k_{33} + k_{13}k_{32})\left[L_Q^{\beta}\gamma\left(\frac{M_Q}{ep_I^*}\right)^{\gamma-1}\right] > 0 \,. \qquad \text{(A2)}$$

This is essentially an assumption that direct partial derivatives dominate indirect partial derivatives.

If there is credit rationing in the export sector the only effect is that the value of k_{33} changes.