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A Macrotheoretic Model of the Chinese Economy[1]

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A stylized model of the Chinese economy is developed with three production sectors: agriculture, nontraded industrial goods, and industrial exports. The state purchases food from farmers by dual-track pricing; urban food sales are subsidized through ration coupons. Marginal prices clear markets except that currency controls constrain the availability of intermediates, the only imports. Devaluation is found to stimulate real variables, but deflates money variables; the reverse occurs with monetary expansion or raising the plan-track food procurement price. Lowering urban food subsidies or raising enterprise taxation reduces the budget deficit, reduces open and disguised unemployment, and deflates nominal prices. *J. Comp. Econom.,* June 1996, **22**(3), pp. 277–294. University of Wales Swansea, Swansea SA2 8PP, United Kingdom; University of York, Heslington, York YO1 5DD, United Kingdom. © 1996 Academic Press, Inc.

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1. INTRODUCTION

Because of the distinctive nature of its transition toward the market, China has recently become a major focus of attention among comparative economists.[2] Among the striking features of the organization of the Chinese econ-

[1] We are grateful to Josef Brada and a referee for helpful comments.

[2] For recent wide-ranging discussions see Joint Economic Committee (1991), Chen and Maruya (1992), and Perkins (1994). A clear introduction to the Chinese economic system is given by Wood (1991). For a formal analysis of general equilibrium in the context of the Chinese hybrid of plan and market economy, see Byrd (1989).

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omy are its diversity of ownership forms and the dual-track system of price formation. With respect to economic modeling, the existence of such complications makes the formulation of representative macroeconomic relationships inappropriate: a more disaggregated model is required to capture the different economic environments within which different agents operate.[3] In this paper we develop a three-sector model: agriculture is distinguished from industry, and industry is divided into two sectors. We use the model to analyze some of the macroeconomic policy tools employed by the Chinese government.

In China, restrictions on migration confine the majority of the labor force to the agricultural sector, which is organized on the basis of household production. Although free market prices have played an increasingly important role, grain, the most significant agricultural output, has remained in the dual-track pricing system.[4] With dual-track pricing, each producer agrees in advance to deliver a specified quantity of output to the state for a unit price fixed above the market-clearing level. Any excess output can be sold to the state at a lower price, sold on the free market, or consumed by the producer (Chai, 1992). In modeling the agricultural sector, we represent Chinese practice in a simple stylized way by assuming that the number of households is fixed and that all output is subject to the dual-track system.

Industrial production in China exhibits a variety of institutional forms, from state-owned enterprises (SOEs), through different types of collective to individual businesses (Byrd, 1992; Qian and Xu, 1993). SOEs produce nearly half of all industrial output (Gang, 1994), though on average they have operated with a rate of disguised unemployment reported to be 15–20% (Hussain, 1992). The primary source of the inability of many SOEs to keep their workers fully occupied seems to have been a shortage of complementary inputs (Joint Economic Committee, 1991, p. 79). In many cases, the critical constraint has been on imported inputs. For example, Chan (1992) reports on the dependence on imports of parts experienced by producers of consumer durables.[5] Nonetheless, the proportion of manufactures in China's total exports has grown in most years and by 1993 stood at 81.8% (SSB, 1994). This growth has come partly from more profit-orientated SOEs and partly from small profit-oriented firms with a high degree of independence from state control (World Bank, 1990; Yeh, 1992).

In our model, we distinguish nontraded and export sectors within industry. The nontraded good sector is meant to represent the bulk of SOEs and some other firms in which there is disguised unemployment. An enterprise in this sector is assumed to use two inputs, labor and an imported good, to produce a domestically consumed output. It has a predetermined number of workers

[3] See Hussain and Stern (1991) on the inapplicability of standard macroeconomic models to China.

[4] In 1989 the area sown in rice, wheat, maize, and coarse grain constituted over 78% of the total land area sown (Chai, 1992).

[5] About two-thirds of China's imports are inputs (including capital goods) (World Bank, 1990).

and a Leontief production function. When the availability of the imported input imposes a binding constraint on production, the enterprise cannot employ its workforce fully. In contrast, the export sector is assumed entirely geared to the pursuit of profit; it exports its entire output. Enterprises in this sector choose freely the number of workers they employ at the given money wage rate and money prices; they do not have disguised unemployment.[6]

Wage payments in Chinese SOEs are in theory made according to a national scale, but in practice SOEs have considerable discretion over workers' total income, including in-kind payments, bonuses, and payment by piece rates. Managers tend to collude with their labor force to increase such income (Hussain and Stern, 1991). We therefore assume that enterprises in our nontraded good sector pay their workers all of their sales revenue, net of nonlabor costs. However, this assumption seems inappropriate for the export sector in our model, where firms are profit maximizing. Instead, we assume that in this sector there is a competitive labor market, with an endogenously determined real wage rate. In practice, an important source of free market labor supply has been the floating population of 60–80 million, which comprises those people who have migrated to cities for work, but have not been formally classified as urban residents (World Bank, 1990).

Official urban residents in China also receive a subsidy in the form of ration coupons that enable them to buy grain cheaply from the state, although these coupons have been abolished in some parts of China at the time of writing. If the recipients of these coupons wish to make further grain purchases, they can use the free market, with its higher price. Unofficially, they may also sell coupons, in particular to the floating population (Wood, 1991). We model this by assuming that the coupon resale market operates without transaction costs, so that the equilibrium coupon price equals the differential between the free market price and the ration price.

The purchase by the state of agricultural output at one price and sale at a lower price has been a severe budgetary burden in China: the implicit subsidy constituted as much as 9% of GNP in the early 1980s (World Bank, 1990). In our model this subsidy is the only government expenditure. The main source of government revenue in China is the taxation of enterprises, and this leads us to make the simplifying assumption that the only tax is a lump-sum tax on enterprises.[7]

[6] The export sector may be regarded as containing enterprises beyond state control plus some of the more profit-orientated SOEs. Chai (1992) notes that SOEs under pressure to make profits have informally shed many of their former employees.

[7] The proportion of central government revenue coming from taxes on enterprises declined steeply in the 1980s, but nonetheless stood at roughly two-thirds by the end of the decade. There has also been significant government expenditure on subsidies to loss-making SOEs, as well as disguised subsidies through soft lending by banks. This is related to the problems of the soft budget constraint and investment hunger and is beyond the scope of the present paper. See Hussain and Stern (1992) and Yusuf (1994).

Our model bears some similarity to the two-gap models of development theory, which also assume a lack of substitution possibilities in production, the import of intermediates, and limited foreign exchange earnings (Gunning, 1983; Standaert, 1989).[8] However, two-gap models are generally used to consider foreign assistance and investment projects, rather than the budgetary and other macroeconomic issues that concern us. Our formulation is closer to the model of Brada (1982), who analyzes a centrally planned economy with fixed money prices. If net imports of an intermediate good are reduced in his model, there is an immediate negative impact on consumption goods output and this has further negative repercussions on real variables via a supply multiplier effect. In contrast, in our model the further negative repercussions on real variables occur through the endogenous variation of price variables.

In Section 2 we set out the various components of the model and in Section 3 we draw the strands together to formulate the macroeconomic equilibrium. Section 4 deals with the comparative statics including the effects of devaluation, changes in the parameters relating to dual-track pricing, and variation in the taxes on industrial enterprises. Section 5 summarizes the main implications for macroeconomic policy in China.

2. THE MODEL

The Utility Function

We consider a single period. A household derives utility from goods consumption during the period and from holding real balances when the period ends; it derives disutility from working during the period. All households possess the same utility function, which is similar to that used, e.g., by Blanchard and Kiyotaki (1987) and Ball and Romer (1990):

$$u = \phi(F_h^{\alpha} Q_h^{1-\alpha})^c (M_h/P)^{1-c} - N_h^{\delta}/\delta \qquad (0 < \alpha < 1;\ 0 < c < 1;\ 1 < \delta), \quad (1)$$

where $\phi^{-1} = \alpha^{\alpha}(1-\alpha)^{1-\alpha} c^c (1-c)^{1-c}$; ϕ is a convenient constant for normalizing the function. The household is indexed by the subscript h. Its consumption of food and the nontraded industrial good are F_h and Q_h, respectively. Its terminal money holding is M_h and the amount of time it spends working is N_h. $F_h^{\alpha} Q_h^{1-\alpha}$ is a Cobb–Douglas subutility function in goods consumption and P is the corresponding cost-of-living index, i.e., P is the money cost of obtaining a unit of utility from goods consumption. M_h is deflated by P because, for simplicity, we suppose that the cost of living will be the same in the future.[9] Since $(F_h^{\alpha} Q_h^{1-\alpha})^c (M_h/P)^{1-c}$ is also Cobb–Douglas, c is h's marginal (and average) propensity to consume. The restriction $1 < \delta$ implies increas-

[8] See also the development models of Islam (1984) and Arida and Bacha (1987) and the model of Chinese long-term growth formulated by Hsu (1990).

[9] Our results would still hold if future prices were proportional to current prices.

ing marginal disutility from work. Writing p_F and p_Q for the respective money prices of food and the nontraded manufacture, the cost-of-living index is

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

We use the subscript $h = F$ for a household in the agricultural sector, $h = Q$ for a household employed in the nontraded good industrial good sector, and $h = X$ for a household employed in the export sector. The number of households working in each sector is denoted by $L_h (h = F, Q, X)$. Below, we shall define the imputed income y_h for each type of household. From Eq. (1), each household has a unit-elastic demand for each consumption good:

$$\begin{aligned} F_h &= \alpha c y_h / p_F \\ Q_h &= (1 - \alpha) c y_h / p_Q \end{aligned} \qquad (h = F, Q, X) \tag{3}$$

The Agricultural Sector

The representative agricultural household $h = F$ agrees a contract with the state before production takes place, specifying that, out of its total production of food, A_F, it will deliver a fixed quantity, $\bar{A}_F$, to the state at a fixed unit price $\bar{p}_F$. The state will also be willing to buy units in excess of $\bar{A}_F$, at the free-market price p_F; alternatively, the household may consume any such units or sell them directly on the free market. We assume that the household always produces not only $\bar{A}_F$, but also enough to satisfy its own food consumption demand F_F. The household produces A_F according to the diminishing returns production function

$$A_F = N_F^a \qquad (0 < a < 1). \tag{4}$$

The household faces the budget constraint

$$M_F^0 + \bar{p}_F \bar{A}_F + p_F (A_F - \bar{A}_F - F_F) = p_Q Q_F + M_F, \tag{5}$$

where M_F^0 is the money holding with which it enters the period. Initial money holdings plus plan-track income plus income from market-track sales equal expenditure on the nontraded industrial good plus terminal money holdings. Rearranging Eq. (5) yields

$$M_F^0 + p_F A_F + (\bar{p}_F - p_F) \bar{A}_F = p_F F_F + p_Q Q_F + M_F. \tag{5'}$$

This is a conventional budget constraint in which $(\bar{p}_F - p_F)\bar{A}_F$ is the subsidy implicit in plan-track procurement. We shall call the left-hand side of Eq. (5′) the household's imputed income y_F.

Maximizing u, subject to Eqs. (2), (4), and (5′), we obtain

$$N_F = \left[a \left(\frac{p_F}{p_Q} \right)^{1-\alpha} \right]^{1/(\delta - a)}. \tag{6}$$

The hours worked by household F are increasing in the free market terms of trade p_F/p_Q: p_F and p_Q are the relevant prices for transactions at the margin. The household's supply of food net of own consumption is found from Eqs. (3), (4), and (6). We assume that this net supply always exceeds the amount contracted with the state for supply on the plan track.

The Nontraded Goods Sector

The representative enterprise in the nontraded goods sector has a fixed number of employees, L_Q, produces an output Q and uses an amount I of an imported input. Its production function is Leontief, with diminishing returns in the labor contribution:

$$Q = \min(L_Q^{\beta}, I) \qquad (0 < \beta < 1). \tag{7}$$

We assume that there is always a binding constraint on the availability of I, and so

$$Q = I. \tag{7'}$$

The amount of disguised unemployment U^D is therefore

$$U^D = L_Q - I^{1/\beta}.$$

The enterprise pays the unit price p_I, in domestic currency, for the imported input. China has operated several different types of exchange rate at the same time, but the spread between them has, apart from brief intervals, become relatively small (Lardy, 1992a; Perkins, 1994) and there is close to internal convertibility of the renmimbi for trade transactions (Lardy, 1992b). We therefore make the simplifying assumption that all international trade takes place at world prices, mediated by the official exchange rate:

$$p_I = ep_I^*, \tag{8}$$

where p_I^* is the foreign currency price at which intermediates are imported and e is the exchange rate; both p_I^* and e are assumed parametrically fixed.

A lump-sum profits tax $T_Q > 0$ is levied on the enterprise.[10] All after-tax profit is distributed among employees, each one receiving

$$W_Q \equiv (p_Q Q - p_I I - T_Q)/L_Q. \tag{9}$$

We assume that p_Q always exceeds p_I by an amount sufficient for W_Q to be positive.

Each household employed in the nontraded goods sector is allocated ration

[10] Ostensibly, taxes on enterprises in China vary with profit, but, for most SOEs, fixed nominal tax commitments are actually agreed in advance (Hussain and Stern, 1991). If we introduced a variable profits tax in our model there would be little effect on the results.

coupons by the government with which an amount of food $\bar{F}_Q$ may be bought at the unit price $p_F^R < p_F$. We assume that there is a resale market for ration coupons that clears without transaction costs. The household's budget constraint can therefore be written

$$M_Q^0 + W_Q + (p_F - p_F^R)\bar{F}_Q = p_Q Q_Q + p_F F_Q + M_Q, \tag{10}$$

where the notation is parallel to that in Eq. (5′). The left-hand side of Eq. (10) is the household's imputed income y_Q. $(p_F - p_F^R)\bar{F}_Q$ is the subsidy implicit in the rationing scheme. The household maximizes utility subject to Eq. (10), treating W_Q as a parameter: it disregards the infinitesimal effect its own demand for nontraded goods Q_Q has on the amount the enterprise pays, W_Q.

The Export Sector

The representative enterprise in the export sector produces output X, employing L_X workers. Given that there is open unemployment in the economy, see below, the enterprise chooses L_X freely to maximize after-tax profit. There is no disguised unemployment in the export sector. For simplicity, we treat labor as the only input variable in the short run in this sector. This assumption is discussed in Section 5. Production is given by

$$X = L_X^b \qquad (0 < b < 1). \tag{11}$$

For simplicity, we assume that the export good is not consumed domestically. In fact, the Chinese government has promoted export processing and manufacturing facilities devoted exclusively to export (Lardy, 1992a). For these parts of the economy our simplifying assumption would be entirely realistic. We further assume that China faces a given foreign currency price p_X^* for exports and that the exporting enterprise receives the domestic currency equivalent, p_X, where[11]

$$p_X = ep_X^*. \tag{12}$$

Also, it pays the nominal wage W_X to each worker and a lump-sum profit tax T_X to the government. Maximizing after-tax profit yields the number of workers the firm employs:

$$L_X = \left(\frac{bp_X}{W_X}\right)^{1/(1-b)}. \tag{13}$$

To close the model we assume that the after-tax profit is shared among

[11] Chinese enterprises have exported mainly via intermediaries known as foreign trade corporations (FTCs). The portion of export revenue retained by FTCs has become relatively small as the number of FTCs competing for business has risen (Lardy, 1992a).

employees in the export sector. However, because of the Cobb–Douglas element in Eq. (1) it would make no difference to our analysis if the payment were made to any other household in the model or to a pure capitalist household. There would be distributional effects, but such effects are not the concern of this paper. A similar argument applies with respect to food ration coupons for employees in the export sector. For a given total of coupons in the economy, the distribution of coupons would have no bearing on our macroeconomic results. For simplicity, we suppose that export sector employees receive no coupons officially, though they have the option of buying coupons on the resale market. The budget constraint for the representative household is therefore

$$M_X^0 + W_X + \Pi_X/L_X = p_Q Q_X + p_F F_X + M_X, \tag{14}$$

where $\Pi_X = p_X X - W_X L_X - T_X$ is the export sector's after-tax profit. Each employee is assumed to treat Π_X as a parameter. The left-hand side of Eq. (14) is the imputed income y_X.

The Labor Market

The labor market in China is characterized by heavy regulation in the form of urban residency permits. In this paper, households may be employed in one of three sectors. The number of households in the agricultural sector, L_F, is fixed in the short run by the supply of land, though each worker in this sector chooses freely the number of hours worked. In the other two sectors the hours worked per worker are assumed fixed. In the nontraded industrial good sector, the number of workers employed, L_Q, is predetermined and includes substantial disguised unemployment. The free labor market is represented in the model by the export sector, where the demand for workers is given by Eq. (13). Given that there is an excess supply in the labor market, the real wage paid per worker is pushed down to the level at which it equals the disutility of employment. We normalize the number of hours in the working day for an export sector worker to unity. Thus, in Eq. (1), for $h = X$, the time spent working in the day is $N_X = 1$, and the disutility of working for the day is $1/\delta$. The real wage for the day is therefore

$$W_X/P = 1/\delta, \tag{15}$$

where P is defined in Eq. (2). Equation (15) takes this simple form because the first part of the utility function (1) is homogeneous of degree one and so the marginal utility of income is constant. The normalization by ϕ in Eq. (1) ensures that this marginal utility is unity.

The remaining households are openly unemployed. There is little state welfare provision in China, so we assume that the unemployed live off trans-

fers from relatives.[12] Denoting the total number of households by H, unemployment, U, is defined as

$$U = H - L_F - L_Q - L_X. \tag{16}$$

The equilibrium wage equation (15) is valid if, as we assume, $U > 0$.

National Income Accounts

We now turn to the definitions of aggregates. The balance of trade surplus B is, in foreign currency terms,

$$B \equiv p_X^* X - p_I^* I. \tag{17a}$$

We assume that B is a policy variable controlled by the government, which decides on the level of surplus/deficit it wants in order to accumulate/decumulate foreign exchange reserves. The government uses import licences to control the purchases of imported intermediates by firms in the nontraded industrial good sector, the quantity of intermediates purchased being a residual:

$$I = \frac{1}{p_I^*}(p_X^* X - B). \tag{17b}$$

Turning to the government's finances, we have assumed that it buys on the plan-track $\bar{A}_F$ units of food from each of L_F farmers at the price $\bar{p}_F$. It sells an amount $\bar{F}_Q$ to each of the L_Q employees in the nontraded industrial goods sector, or to those who have purchased ration coupons from these employees, at the price p_F^R. For simplicity, we assume that the government sells all of the food that it purchases, i.e., $\bar{F}_Q L_Q = \bar{A}_F L_F$. We shall now denote this quantity by $\bar{F}$. Also, we assume that any food that the government buys from farmers on the market track is all resold at the same price. Thus, the net cost to the government of its food policy is $(\bar{p}_F - p_F^R)\bar{F}$, yielding the budget deficit

$$D = (\bar{p}_F - p_F^R)\bar{F} - T, \tag{18}$$

where T is the total tax raised on profit: $T \equiv T_Q + T_X$.[13] We assume that D is financed entirely by money creation, which is the main form of financing in practice (Clutterbuck, 1992). Also, we suppose that D is a government policy variable. In our comparative statics we assume that when one of the budgetary parameters D, $\bar{p}_F$, p_F^R, $\bar{F}$, T is altered there is automatic

[12] Given that unemployed households all have the same utility function (Eq. (1)) as employed households, such transfers have no effect on goods demands.

[13] For expositional purposes, we treat the representative firms in the two industrial sectors as if they were the only firms in each sector.

adjustment of one or more of the other budgetary parameters such that Eq. (18) still holds.

We can now consider nominal national income Y:

$$Y \equiv p_F F + p_Q Q + eB + D, \tag{19}$$

where F is total food supply. With the utility function (1), every household h spends a proportion c of its imputed income on food and nontraded industrial goods. Summing imputed incomes over all h, we obtain $Y + M^0$, where $M^0 \equiv L_F M_F^0 + L_Q M_Q^0 + L_X M_X^0$. Thus, aggregate expenditure on goods consumption is $c(Y + M^0) = p_F F + p_Q Q$. Using Eq. (19) we then obtain

$$Y = \frac{1}{1 - c}(cM^0 + eB + D). \tag{20}$$

Nominal GNP is determined by a standard income–expenditure process. Note that, given M^0, B, and D, Y is fixed independently of what happens to prices and quantities.

Because the subutility function in goods is Cobb–Douglas (Eq. (1)), each household divides its goods expenditure into the proportions α on food and $(1 - \alpha)$ on nontraded industrial goods. As aggregate expenditure is $c(Y + M^0)$, we therefore have

$$p_F F = \alpha c(Y + M^0) \tag{21a}$$

$$p_Q Q = (1 - \alpha)c(Y + M^0). \tag{21b}$$

Since we have assumed that consumers cannot buy either foreign goods or the export good, there are no leakages via net imports. The level of imports is fixed by the government's imposition of a constraint on foreign exchange availability rather than varying with GNP.

3. MACROECONOMIC EQUILIBRIUM

Equilibrium in this system is characterized by five equations:

$$L_F\left[\alpha\left(\frac{p_F}{p_Q}\right)^{1-\alpha}\right]^{a/(\delta-a)} = \frac{\alpha c(Y + M^0)}{p_F} \tag{22}$$

$$p_Q = (1 - \alpha)c(Y + M^0)/I \tag{23a}$$

$$I = \frac{1}{p_I^*}(p_X^* X - B) \tag{23b}$$

$$W_X = p_F^{\alpha} p_Q^{1-\alpha}/\delta \tag{24}$$

$$X = \left(\frac{bep_X^*}{W_X}\right)^{b/(1-b)}. \tag{25}$$

Equation (22) is obtained from Eqs. (4), (6), and (21a); (23a) is obtained from (7′) and (21b); (23b) is the same as (17b); (24) is obtained from (2) and (15); and (25) follows from (11)–(13). These five equations define the equilibrium values of five endogenous variables: nominal variables p_F, p_Q and W_X and quantities X and I. With these, we can then derive the remaining quantities F and Q, using Eqs. (4), (6), and (7′). The exogenous variables are world prices, p_I^* and p_X^*; the exchange rate, e; the variables defining nominal GNP, D, B, and M^0; and the food policy parameters $\bar{p}_F$, p_F^R and $\bar{F}$. We have omitted the money market condition by Walras' law. Note that the money supply is only constant when the two deficits are zero ($D = B = 0$).

Equation (22) is the condition for clearance of the food market. Equations (23a) and (23b) determine the price of the nontraded industrial good: output is constrained by the level of net exports, and p_Q then clears the market. Equations (24) and (25) characterize equilibrium in the labor market and export sector, respectively. Note that the model operates in some ways like a standard Walrasian economy. Marginal prices are market clearing; dual-track pricing merely redistributes income. The only serious deviation from a Walrasian economy is that the supply of imported inputs is constrained.

Combining Eqs. (23)–(25), an explicit solution to the model is only obtainable if $B = 0$, although, even then, the solution is complicated by the appearance of various exponential terms. However, given the satisfaction of a stability condition, the comparative statics are quite intuitive.

4. COMPARATIVE STATICS

The Benchmark Case: $B = D = 0$

We begin with the benchmark case in which the trade surplus B and the budget deficit D are each zero. In the next subsection we drop these assumptions and in the final subsection we discuss the implications of potential changes to the model. Our reason for beginning with the benchmark case is purely expositional. When B and D are nonzero, the forces underlying the results for the benchmark case are still at work, but the imbalance in either trade or the government budget causes additional factors to operate. In fact, since 1979 there has continuously been a budget deficit in China (Yusuf, 1994). The balance of trade was negative in 8 years in the 1980s and was positive in 1990–1992, but has since been negative (EIU, 1993; OECD, 1995). The results for the benchmark case are summarized in Table 1, where the column shows the parameter changes and the row shows the endogenous effects.[14] It is assumed that when these parameter changes occur one or more of the budgetary parameters $\bar{p}_F$, p_F^R, $\bar{F}$ and T, is adjusted so that D, as defined by Eq. (18), remains at zero. Since $D = 0$, changes in budgetary parameters

[14] The stability condition is that $\delta(1 + \alpha b - 2b) - a\alpha(1 - b) > 0$.

TABLE 1

THE EFFECTS OF PARAMETER CHANGES WHEN $B = D = 0$

	dp_Q	dp_F	dQ	dF	dX	dP	dW_X	dU
dp_I^*	+	+	−	−	−	+	+	+
dp_X^*	−	−	+	+	+	−	−	−
de	−	−	+	+	+	−	−	−
dM^0	+	+	−	−	−	+	+	+

have no feedback on the endogenous variables listed in the table, having only distributional effects.

The first three rows of Table 1 are concerned with changes in parameters associated with international trade. To explain these rows intuitively, note what happens if a parameter change allows imports, I, to be greater. As a result, the output of the nontraded industrial good sector is greater ($dQ > 0$) and its price lower ($dp_Q < 0$). The lower level of p_Q yields a higher real wage in agriculture, which, from Eq. (6), causes both the food output to be greater ($dF > 0$) and the food price to be lower ($dp_F < 0$). With both p_Q and p_F lower, the price index P is lower ($dP < 0$) and so, to satisfy the real wage condition (15), the nominal wage must be lower ($dW_X < 0$). This stimulates exports ($dX > 0$) and restricts unemployment ($dU < 0$).

Given the constraint of balanced trade, a higher level of p_I^* requires that the quantity of imports be lower; but a higher level of p_X^* creates greater foreign exchange earnings, allowing the quantity of imports to be greater. The effects of dp_I^* can then be explained as in the previous paragraph, while the effects of dp_X^* are the reverse in sign. Thus dp_I^* is contractionary in terms of real variables, but inflationary with respect to price variables; dp_X^* has the reverse effects. However, it seems more interesting to examine the effects of variation of the exchange rate, e, for, unlike p_I^* and p_X^*, this is under the control of the Chinese authorities. Indeed, devaluation, i.e., an increase in e, has been a frequently used policy tool. From Eqs. (11)–(13), a higher level of e is associated with greater exports X and so, from Eq. (17), a larger quantity of imports can occur. Using our previous reasoning, it follows that devaluation is a highly successful policy in that it is expansionary with regard to real variables and deflationary in terms of price variables.[15]

The final row of Table 1 shows the comparative statics of variation in the money supply M^0. In contrast to many of the transition economies of Eastern Europe and the former Soviet Union, it appears that China has not had a

[15] This is consistent with the empirical evidence found for China in the 1980s by Brada *et al.* (1993).

monetary overhang. Therefore, the effects of varying M^0 are perhaps of less significance than in models representing the other transitional economies.[16] Nonetheless, the results of dM^0 in Table 1 are important in the context of the discussion of the changes in budgetary parameters considered in the next subsection. A higher M^0 is associated with greater domestic demands for consumption goods, whose prices, p_F and p_Q, rise by equal proportions. The price index P and the money wage rate W_X consequently attain higher levels. Because of the higher W_X, the quantity of exports is made smaller and unemployment greater. Via the balance of trade constraint, the quantity of inputs imported is reduced, as, therefore, is the supply of nontraded industrial goods. Hence, there is a further positive effect on p_Q, causing the terms of trade p_F/p_Q to be smaller in the new equilibrium than in the old one. Food production is therefore smaller in the new equilibrium.

Unbalanced Budget and Unbalanced Trade

We now move away from the benchmark case and allow for imbalances in the budget and trade. As an imbalance is unsustainable in the long run, we regard our analysis as short run.[17]

With an unbalanced budget ($D \neq 0$) but balanced trade ($B = 0$), all the results in Table 1 still hold, but, additionally, we can consider changes entailing variation of D. We assume that when D is altered as a policy choice, there is automatic adjustment, as in the benchmark case, of one of $\bar{p}_F$, p_F^R, $\bar{F}$, T such that Eq. (18) remains satisfied. With this interpretation of the model, we are able to examine the comparative statics of changes in $\bar{p}_F$, p_F^R, $\bar{F}$, T with associated changes in D. The presence of a budget deficit causes changes in the money supply, since the deficit is monetized. The deficit D is greater if the price paid to farmers on the plan track, $\bar{p}_F$, is greater. The deficit is smaller if the price paid for food by holders of ration coupons, p_F^R, or the tax on manufacturing enterprises, T, is greater. Also, assuming that $\bar{p}^F - p_F^R > 0$, the deficit is greater if the quantity of food purchased by the government on the plan track, $\bar{F}$ is greater. The results of such variations are summarized in Table 2. These results are straightforward to explain. Any budgetary parameter change that increases the deficit D is seen from Eq. (20) to be equivalent to an increase in the money supply M^0. The comparative statics results in Table 2 therefore follow from the results shown in the dM^0 row of Table 1. We note here some of the more interesting implications.

Consider first what happens when the government sets $\bar{p}_F\bar{F}$ at a higher level, i.e., it either pays farmers a higher price, $\bar{p}_F$, or buys from them a

[16] See, e.g., Bennett and Dixon (1995), for analysis of a former Soviet-type economy.

[17] Alternatively, in the case of a trade deficit, we could interpret our results as a steady state where the deficit is financed by interest payments from overseas assets or through a flow of foreign aid.

TABLE 2

THE EFFECTS OF CHANGES IN BUDGETARY PARAMETERS WHEN $D \neq 0$

	dp_Q	dp_F	dQ	dF	dX	dP	dW_X	dU
$d\bar{p}_F$	+	+	−	−	−	+	+	+
$d\bar{F}$	+	+	−	−	−	+	+	+
dp_F^R	−	−	+	+	+	−	−	−
dT	−	−	+	+	+	−	−	−

greater quantity, $\bar{F}$. This policy change increases the budget deficit, but does not improve farmers' incentive to produce. It constitutes an increase in their lump-sum income, but does not directly affect their marginal real wage. However, as it is equivalent to a monetary expansion, it has indirect general equilibrium effects which, as we have seen, include a fall in farmers' marginal real wage, causing them to reduce their output. The outputs of the industrial sectors also fall, whereas price variables rise.

A policy of raising the ration price of food, p_F^R, hurts official urban residents. However this policy is perhaps better regarded as a reduction in subsidy than as a rise in price. It is equivalent to fall in the money supply and so, as well as reducing the budget deficit, it stimulates real variables while deflating price variables. Similar results are obtained by a policy of higher enterprise taxation, T. As can be seen from the table, this raises output in all sectors, including the sector that is taxed more.

With a nonzero trade balance B, the results in Tables 1 and 2 still apply, provided that a modified stability condition is satisfied.[18] Additionally, we can consider the effects of changes in the parameter B itself. A higher level of B is associated with higher values of all money variables, but real variables are smaller. The explanation is that if B is higher then, ceteris paribus, fewer inputs can be imported, and this has general equilibrium repercussions similar to those we have described for other parameter changes.

Further Discussion

We now consider briefly some changes of assumption.[19] First, the assumption that the money wage is endogenous (Eq. (15)) may be dropped and instead we may suppose that W_X is fixed by government regulation. Under the assumption of a flexible W_X, changes in the parameters p_I^* and M^0 affected the endogenous price variables p_F and p_Q, and these in turn affected W_X.

[18] The stability condition for this more general case is complicated, but it essentially involves the further requirement that the balance of trade B be not too positive.

[19] In each case we assume that an appropriately modified stability condition holds.

When W_X is exogenously given, however, this general equilibrium linkage is severed. Export sector output therefore becomes independent of the import price p_I^* and the money supply M^0. A further amendment is that in our tables of comparative statics dW_X is moved from the columns to the rows. An exogenous rise in the level of W_X has general equilibrium effects opposite in sign to those of a rise in p_X^*.

Second, we may introduce imported inputs as a further argument in the export sector production function. The working of the model then depends on how the inputs are allocated between the two industrial sectors. But if the export sector is always given priority, e.g. by import licensing, our qualitative results would still apply.[20]

Third, suppose we allow for the fact that part of the supply of input is produced domestically. If the domestic output is produced by a labor force whose size is exogenously given, then our comparative statics signs still hold. The one extra result is that if this labor force is expanded, so that the domestically produced supply of the input rises, this is equivalent to a reduction in the balance of trade surplus B, for, ceteris paribus, it enables greater production of the nontraded industrial good.

Finally, suppose that we alter the constraint on production activity in the nontraded industrial good sector. For some enterprises disguised unemployment may be the consequence, not of inability to find a supply of inputs, but of lack of financial resources with which to purchase inputs (Wu and Zhao, 1987). To address this issue, our model might be developed by including commercial banks and the credit quotas that have been set in periods of tight monetary policy (Perkins, 1994).

5. CONCLUDING COMMENTS

The dual-track pricing system was developed in China with the aim of having marginal decisions made according to market pressures, while leaving the state with a means of direct intervention (Gelb *et al.*, 1993). In our formulation, we allow for dual-track pricing and the use of food ration coupons, but the model is Walrasian, with marginal prices clearing markets, except that there are currency controls that constrain the availability of imported inputs. The most important property of the model is that reduction of the budget deficit, expansion of output, and the lowering of endogenous price variables are complementary, rather than conflicting, objectives. This leads to clear-cut conclusions concerning some of the policies that have been used in China.

During attempts at macroeconomic stabilization, particularly to try to control inflation, the Chinese government has restricted food prices (Yusuf, 1994;

[20] Lardy (1992a) reports that in 1989, 46% of imports required licensing.

OECD, 1995). In the context of our model, this policy is incorrect: it gives coupon holders a subsidy that raises their nominal demand for goods, leading to an increase in market prices. As this causes upward adjustment of the money wage in the export sector, the quantity of exports falls, with general equilibrium repercussions that bring about a contraction of output across the economy. However, another policy that has frequently been adopted, devaluation, is deflationary in price variables, as well as expansionary in real terms, because the stimulus to exports causes some relaxation of the foreign exchange constraint, thereby allowing more imports of inputs.

In our model, the plan-track element of the dual-track system can be seen as harmful; i.e., greater direct intervention by the state, in the sense of buying and selling a larger quantity of food, damages economic performance. Given that the state pays a higher price for food than it receives, the policy involves greater budgetary expenditure on subsidizing consumption, and the resulting increase in nominal aggregate demand causes market prices and wages to rise. This discourages exports, and, with less foreign currency being earned, fewer inputs can be imported.

By the reverse reasoning, taxes on firms' profits have beneficial macroeconomic effects. Yet, in practice, the Chinese government has received steadily less net revenue from firms (Yusuf, 1994). This has been partly because of falling profit, but also because of massive increases in subsidies to loss makers. Many commentators now regard such subsidies as a crucial macroeconomic problem in China (e.g., Yusuf, 1994; OECD, 1995). Our analysis suggests that these subsidies not only have adverse budgetary and inflationary implications, but also, through their macroeconomic effects, hold back aggregate output.[21]

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[21] This effect on output is distinct from microeconomic sources of inefficiency resulting from the availability of subsidies.

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