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The UNIVERSITY of WESTERN ONTARIO

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Political Economy Research Group,
Department of Economics,
Social Science Centre,
London, Ontario, Canada N6A 5C2
phone: (519) 661-3877
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Plan, Market and Inflation: Potential Problems

with China's Two-track System[*]

Terry Sicular
Department of Economics
Harvard University
Cambridge, MA, 02138

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Abstract

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Economic reform or transition in socialist economies is often
accompanied by inflation. This paper proposes that inflation can arise
in such economies due to inherent contradictions between plan and
market. Specifically, inflation can occur as the result of government
efforts to maintain planned allocation when market opportunities cause
plan evasion. A theoretical analysis shows that under these
circumstances the rate of inflation will depend on (1) the relative
sizes of planned and market allocation, and (2) the velocity of money.
Evidence for China suggests that such interactions have contributed to
recent price level instability.

Plan, Market and Inflation: Potential Problems

with China's Two-track System

Reform or transition of a socialist economy generally involves expanding the role of markets and reducing that of the plan. During this process the economy functions as a mixed system combining plan and market mechanisms. In the case of reform, the mixed system may be expected to persist; under transition, the mixed system is considered temporary.

During the reform or transition process, policy makers hope to maintain general price stability. Historical experience suggests that this goal is difficult to achieve. China, Poland, and Hungary have all experienced, to lesser or greater extents, rising price levels during the reform process. Their experiences raise the question of why inflation occurs during reform. This paper proposes that inflation can arise due to inherent contradictions between plan and market in mixed economies.

Explanations for why inflation occurs are numerous. One explanation is that prior to the reforms price and quantity controls had suppressed inflation and created monetary overhang. With the loosening of controls, prices rise. This type of inflation is not an inevitable byproduct of reform and will occur only if suppressed inflation characterizes the economy in question. Views differ regarding whether such overhang has characterized China, but studies suggest that suppressed inflation is less extreme in China than in the USSR and some countries in Eastern Europe (see Cheng, 1987; Feltenstein and Farhadian, 1987; and Portes and Santorum, 1987).

Some Chinese economists propose that inflation arises during reform for "frictional" reasons (Fan Gang, 1989). During the decades under planning, the structure of production had evolved to satisfy the planners' demand for producer and investment goods. Economic reform places emphasis on consumer demand, and a greater proportion of national income is now put in the hands of consumers. Time is needed to adjust the structure of physical and human capital to meet this new type of demand. The lag between the change in demand and that in supply results in "frictional inflation." Once the economy has adjusted, such inflation should disappear.

A third explanation attributes inflation to the absence of hard budget constraints for state enterprises. The budget constraints of state enterprises are "soft" because they are intimately linked to the government budget, and so enterprises do not bear full financial responsibility for their decisions. When price controls are loosened, soft budget constraints can contribute to wage drift and to a "hunger" for and excessive spending on inputs. These forces can lead to persistent inflation (Kornai, 1980). Elimination of this type of inflation requires a fundamental change in the financial relationship between enterprises and the state.

A fourth explanation for inflation is examined here. Inflation can arise due to interactions between planned allocation and market allocation in a mixed economy. This paper analyzes the potential for inflation in a mixed economy characterized by a "two-track" allocation system. Under the two-track system commodities are allocated both by the government according to plan and on the market. The government requires producers sell certain quantities of their products to the

state at below-market planned prices, and it then sells these products

to consumers at low, ration prices. Beyond-plan quantities can be

traded on the market at higher, market prices.[1] The two-track

allocation system exists in China, where products ranging from grain to

steel are traded both through the plan and on the market. It can also

be found in some Eastern European economies, and the Shatalin program

proposes its adoption in the USSR during economic transition.

The next three sections of the paper present a simple theoretical

model of how a two-track system can generate inflation. A theoretical

analysis shows that in this type of mixed economy the no-inflation

equilibrium may be unstable. Under certain conditions described below,

a small deviation from the initial no-inflation equilibrium can move the

economy towards a path characterized by persistent inflation, or

possibly even deflation. For this reason price stability may be

difficult to achieve and sustain.

The model implicitly assumes that the two-track system operates in

a setting where agents face hard budget constraints, as is the generally

the case for consumers and rural producers in China and other socialist

economies. Market opportunities encourage plan evasion. Evasion, in

turn, causes shortfalls in planned deliveries, and so forces the

government to take action to ensure adequate ration supplies.

The theoretical analysis examines the inflationary consequences of

several plausible government actions to maintain the ration program in

the event of such a shortfall. If the government attempts to overcome

the delivery shortfall by increasing the planned purchase price or by

purchasing needed ration supplies on the market, inflation will result.

The rate of inflation will depend on (1) the relative sizes of planned

and market allocation, and (2) the velocity of money. The process by which inflation occurs and the theoretical approach used in the analysis resemble those in seignorage models of inflation (see, for example, Dornbusch and de Pablo, 1990, or Anand and van Wijnbergen, 1988).

A fourth section of the paper presents empirical evidence for China on (1) inflation, (2) evasion and the government's response, (3) the relationship between price subsidies and the money supply, (4) the relative sizes of plan and market, and (5) money velocity. This evidence suggests that government efforts to maintain the ration program contributed to the inflation that China experienced in the late 1980s.

The model

Two key equations characterize the economy: the government's budget constraint, and the quantity of money identity. The sole activity of the government in this model is carrying out planned purchases and sales. The government budget is therefore determined by its net earnings or losses on planned trade. If S represents the quantity of output that the government purchases under plan, R the quantity it sells under plan, and $\bar{p}$ the planned price, then the nominal budget deficit is

$$D = \bar{p}(S-R) . \tag{1}$$

If the deficit is financed by issuing money, which I assume is the case, then the government's budget constraint is

$$D = \bar{p}(S-R) = \dot{M} , \tag{2}$$

where M is the money supply and $\dot{M} = \delta M/\delta t$ is the change in M with respect to time.

Deliveries S and sales R at the planned price are functions of the planned price, the market price, and quota levels. The government sets

a ration quota $\bar{R}$ which is the quantity of output that it promises to sell at the below-market planned price to consumers in the economy. It will sell up to, but no more than, this quantity of output at the planned price. In order to meet its ration commitment, the government also sets a delivery quota $\bar{S}$ for the quantity of output it requires producers to deliver at the planned price.[2]

Microeconomic agents in the economy thus face certain planned quotas and prices. Since the government permits beyond-plan market exchange, agents can also buy and sell at the market price. Actual levels of deliveries and sales at the planned price are determined by the optimizing behavior of agents given the levels of planned quotas, the planned price, and the market price.

Solutions of the microeconomic utility-maximization problems for the agents in this economy appear in the appendix. The marginal decisions of consumers and producers are determined by market prices and are not affected by the plan variables. Quotas and the planned price act as lump sum taxes/transfers, and so they affect consumer demand only indirectly, through income. The plan does not affect the level of profit-maximizing output;[3] however, the delivery quota and planned price will influence how much of total output is sold on the market versus to the state.

Under optimal microeconomic behavior, the values of S and R are given by the following functions:

$$R = \bar{R} \tag{3}$$

$$S = H(p-\bar{p}, \bar{S}) \ . \tag{4}$$

The intuition behind these functions is straightforward. If the planned price is less than the market price, which is the case of interest here,

agents who face ration quotas will buy the full amount of the ration. Therefore actual purchases at the ration price will exactly equal the ration quota.

Agents who face delivery quotas, however, will have an incentive to evade their delivery quotas and sell at the higher market price. The marginal benefit of quota evasion equals the difference between the market and state prices. If that difference increases (due, say, to a rise in the market price), the level of deliveries should decline, so that $H_1 = \delta H/\delta(p-\bar{p}) \leq 0$. The marginal cost of evasion is likely to depend on the size of the delivery shortfall, that is, on the difference between the delivery quota and actual deliveries. I therefore assume that an increase in the delivery quota tends to raise deliveries, i.e., $H_2 = \delta H/\delta \bar{S} \geq 0$.

For the moment I assume that the government does not require a cash or in-kind penalty payment from evasive agents--the possibility of a penalty payment is considered later. Rather, evasion entails costs because (1) agents must devote real resources to successfully achieve evasion, and (2) the government interferes with the affairs of evading agents in a way that reduces their utility or income-earning ability.

The government's budget constraint can now be rewritten as follows:

$$D = \bar{p} \ [H(p-\bar{p},\bar{S})-\bar{R}] = \dot{M} \ . \qquad (5)$$

The second key equation in this model is the quantity of money identity. The right-hand side of this identity is modified to reflect that exchange occurs on the market at market price p and under plan at planned price $\bar{p}$. If total output is Q and all output not sold to the

state is sold on the market,[4] then the quantity of money identity can be written as

$$MV = p(Q-S) + \overline{pR} \quad . \tag{6}$$

In the analysis below the velocity of money V is held constant.[5] I also assume (1) that the classical dichotomy holds (the level of output is insensitive to the money supply and price level), and (2) that any redistribution of income caused by inflation has relatively little effect on aggregate demand.

No-inflation equilibrium occurs when the market clears and the government budget is balanced.[6] Market clearing requires that the market price equate demand and supply on the market. A balanced budget requires that government purchases S equal government sales R. I assume there exists a set of plans G consistent with no-inflation equilibrium, and that initially the government chooses a plan $(\overline{p}^*,\overline{S}^*,\overline{R}^*) \in$ G. The market price level p^* depends on the size of the money supply, which is initially set at M^*. In the initial equilibrium, then,

$$S^* = H(p^*-\overline{p}^*,\overline{S}^*) = \overline{R}^* \quad , \tag{7}$$

$$D = \overline{p}^* [H(p^*-\overline{p}^*,\overline{S}^*)-\overline{R}^*] = \dot{M} = 0 \quad , \tag{8}$$

and

$$M^*V = p^*(Q-\overline{R}^*) + \overline{p}^*\overline{R}^* \quad . \tag{9}$$

The potential for inflation

In the equilibrium just described, the government's budget is balanced, the money supply is fixed at some level M^*, and the price level remains constant. Under certain conditions a small deviation from this equilibrium will take the economy onto an inflationary path. Whether or not inflation occurs depends on how the government responds

to the shock that caused the deviation. If inflation occurs, the rate of inflation will depend on the relative sizes of plan and market allocation and the velocity of money.

Suppose that the money supply increases slightly from M^* to $M_0 = M^* + k$.[7] This increase could occur because the government faces an unexpected expenditure which it finances by printing money--say, an unanticipated military outlay. Alternatively, the government might decide to raise the planned delivery price in order to reduce the tax on producers, but keep the level of actual deliveries, the ration quantity, and the ration price unchanged. (The level of deliveries would remain unchanged if the government reduced the delivery quota by enough to offset the rise in deliveries due to the higher planned delivery price.) The delivery price increase would be financed by printing money.

Regardless of the reason for the increase in M, expansion of the money supply would cause market prices to rise. The shock, then, would cause the market price level to rise to $p_0 > p^*$. The higher market price would in turn raise the level of evasion, and so deliveries would fall below the level required to meet the ration quota $\bar{R}^*$. If the government is firmly committed to supplying the ration $\bar{R}^*$ at the low, planned price $\bar{p}^*$, then it must take some action to guarantee it has supplies sufficient to meet its ration commitment.

Several actions are possible. The discussion below focuses on two likely actions, actions that have in fact been taken in the past: raising the planned price paid to producers, and buying on the market to make up for the shortfall in deliveries. In the case of the first action, the government raises the planned delivery price until deliveries return to their original level. This action entails a

budgetary deficit, as the output purchased at the new, higher planned
delivery price would continue to be sold at the original ration price.
In the second case, the government makes up for the delivery shortfall
by buying on the market. This action also entails a budgetary deficit,
as the state must sell products purchased on the market at the lower
ration price. Both of these actions have inflationary consequences.

I examine two other actions more briefly: raising the delivery
quota, and imposing a cash penalty payment for evasion. On the surface,
raising the delivery quota seems like an attractive option as it does
not require higher budgetary outlays. The government has not, however,
chosen this approach, and reasons why are discussed below. A cash
penalty discourages evasion and at the same time provides revenues with
which the government could pay for market purchases to cover any
delivery shortfall. This approach therefore need not generate
inflation. In fact, the Chinese government experimented with
"monetization" of the quota in some localities during the early and mid-
1980s.

Elimination or reduction of the ration program is not considered a
likely response to the delivery shortfall, and so it is not analyzed
below. In the analysis I assume that the government is firmly committed
to the prevailing levels of the ration quota and ration price. This
assumption overstates reality slightly, as the Chinese government has on
occasion reduced quantities or raised prices on consumer rations of some
foodstuffs (not for grain, however). Nevertheless, such measures have
occurred infrequently, and the huge urban subsidy program remains
largely intact. Assuming that the government does not alter the ration
program thus approximates reality.

Raising the state price

Suppose the government raises the price it pays producers. The government must raise its price by enough to maintain deliveries at their original level $S = \bar{R}^*$. In the event of inflation, deliveries will remain at their original level so long as the real value of $(p-\bar{p})$ remains constant. Let π represent the real value of $(p-\bar{p})$:

$$\pi = \frac{p-\bar{p}}{p} \quad . \tag{10}$$

Also, let H be redefined in terms of π, so that

$$S = H(\pi, \bar{S}) \quad . \tag{11}$$

If π^* is the initial equilibrium value of π, then at any time t the government can maintain deliveries at their original level by setting the planned price equal to

$$\bar{p}_t = (1-\pi^*) \, p_t \quad . \tag{12}$$

In this case the budget deficit is given by

$$D_t = (\bar{p}_t - \bar{p}^*)\bar{R}^* = [(1-\pi^*)p_t - \bar{p}^*]\bar{R}^* \quad , \tag{13}$$

and the government budget constraint becomes

$$D_t = [(1-\pi^*)p_t - \bar{p}^*]\bar{R}^* = \dot{M}_t \quad . \tag{14}$$

Substitution from (12) and some rearrangement of the terms in the quantity of money identity (6) yield the following version of the quantity of money identity at time t:

$$M_t = \frac{1}{V} \, [(Q-\bar{R}^*) + (1-\pi^*)\bar{R}^*] \, p_t \quad . \tag{15}$$

Taking the time derivative gives the relationship between change in the money supply and change in the price level:

$$\dot{M}_t = \frac{1}{V} \, [(Q-\bar{R}^*) + (1-\pi^*)\bar{R}^*] \, \dot{p}_t \quad . \tag{16}$$

From (14) and (16) one can derive the differential equation describing the time path of p:

$$\dot{p_t} = \frac{(1-\pi^*)\bar{R}^*V}{[(Q-\bar{R}^*)+(1-\pi^*)\bar{R}^*]}\, p_t - \frac{\overline{p}^*\bar{R}^*V}{[(Q-\bar{R}^*)+(1-\pi^*)\bar{R}^*]} \qquad (17)$$

Define Φ as the initial share of planned trade in the total value of plan and market exchange, or

$$\Phi = \frac{\overline{p}^*\bar{R}^*}{p^*(Q-R^*)+\overline{p}^*\bar{R}^*} \qquad (18)$$

Recalling that $(1-\pi^*)$ equals $\overline{p}^*/p^*$ and carrying out a few simple manipulations, one can now rewrite the differential equation as

$$\dot{p_t} = \Phi V(p_t - p^*) . \qquad (19)$$

Φ, V, and p^* are constant and positive. Consequently the solution of (19) is straightforward. Let $t = 0$ immediately after the shock, so that $M(t=0) = M_o = M^* + k$ and $p(t=0) = p_o$. Then the solution to equation (19) is

$$p_t = p^* + [p_o - p^*]e^{\Phi Vt} . \qquad (20)$$

This solution reveals that if the money supply experiences a positive shock and the government responds by raising the planned price so as to maintain deliveries, then the economy will experience inflation. The resulting rate of inflation will be constant and equal to ΦV, the velocity of money times the initial (pre-shock) share of planned trade in total exchange (total exchange is calculated valuing planned trade at planned prices and market trade at market prices.)

Since under this policy the planned price is a linear function of the market price, the planned price will increase at the rate of inflation ΦV. The nominal money supply and government deficit will also

increase at the rate of inflation, although their real values remain unchanged at the initial post-shock levels.

These findings imply that attempts to bring deliveries back up to their original level by raising the state price will be futile: the government will never be able to raise its price enough to close the gap between state and market prices. Indeed, efforts to do so will only lead to persistent inflation in market prices.

Purchasing on the market

Suppose that instead of raising the delivery price, the government decides to make up for the shortfall in deliveries by purchasing grain on the market. The planned price and quotas remain unchanged. In order to maintain ration sales, the government must purchase B_t, the difference between the ration commitment and grain deliveries, on the market:

$$B_t = \bar{R}^* - S_t = \bar{R}^* - H(\pi_t, \bar{S}^*) . \qquad (21)$$

Since the state procurement price remains constant,

$$\pi_t = \frac{p_t - \bar{p}^*}{p_t} . \qquad (22)$$

The planned quota $\bar{S}^*$ also remains constant, and so below I rewrite the delivery function $H(.)$ as a function solely of p_t: $S_t = H(.) = G(p_t)$.

The government's budget deficit now equals the quantity of its purchases on the market B_t times the difference between the market and planned prices, so that

$$D_t = (p_t - \bar{p}^*)[\bar{R}^* - G(p_t)] = \dot{M}_t . \qquad (23)$$

Furthermore, the time derivative of the money identity is now

$$\dot{M}_t = \frac{(Q - \bar{R}^*)}{V} \dot{p}_t . \qquad (24)$$

Combining (23) and (24) and solving for $\dot{p}_t$ gives the following equation for the change in the price level:

$$\dot{p}_t = \left(\frac{\overline{R}^* - G(p_t)}{Q - \overline{R}^*}\right) V \ (p_t - \overline{p}^*) \quad . \tag{25}$$

The solution of (25) depends on the form of the delivery function $G(p_t)$. Suppose, for example, that $G(.)$ takes the form

$$S_t = (1 - \pi_t)\overline{S}^* = (\overline{p}^*/p_t)\overline{S}^* \quad . \tag{26}$$

Deliveries equal the quota level (no evasion) when the market price equals the planned price. As the market price rises above the planned price, deliveries decline. As the market price approaches infinity, deliveries approach zero.

In this case the differential equation (25) has the solution

$$p_t = \overline{p}^* + [\alpha e^{2\Omega V t} - \beta]^{1/2} \quad , \tag{27}$$

where

$$\alpha = (p_o - \overline{p}^*)^2 + \overline{p}^{*2}\left(\frac{\overline{S}^*}{\overline{R}^*}\right) \tag{27a}$$

$$\beta = \overline{p}^{*2}\left(\frac{\overline{S}^*}{\overline{R}^*}\right) \quad . \tag{27b}$$

Figure 1 shows the time path of prices for reasonable values of α and β and for several different possible values of ΩV (see the empirical discussion below). In all cases the price level p_t is increasing. The time derivative $\dot{p}_t$ is initially small but rises over time. The pace at which inflation accelerates is sensitive to the value of ΩV.

More generally, in initial equilibrium $S = \overline{R}^*$, so that $G(p^*) = \overline{R}^*$. Since $H_1 \leq 0$ and $\delta\pi_t/\delta p_t \geq 0$, therefore $\delta G/\delta p_t \leq 0$. For any $p_j \geq p^*$, then, $G(p_j) \leq \overline{R}^*$ and thus $\dot{p}_t$ will be nonnegative. It is also

easy to show that $\delta \dot{p}_t / \delta p_t \geq 0$. Thus for any market price greater than the initial equilibrium price, the price level will tend to increase, and over time inflation will accelerate. In other words, a positive shock to the money supply tends to generate rising inflation.

As the market price level rises, eventually the level of deliveries may decline to (or approach) zero. Since deliveries cannot be negative, once they fall to zero they will remain constant at zero. In this event

$$\dot{p}_t = \left(\frac{\overline{R}^*}{Q-\overline{R}^*}\right) V \; (p_t - \overline{p}^*) \quad . \tag{28}$$

Let $\Omega = \overline{R}^*/(Q-\overline{R}^*)$. Then the solution to equation (28) is of the form

$$\dot{p}_t = k + ce^{\Omega Vt} \; . \tag{29}$$

This solution reveals that after S falls to zero, the rate of inflation equals a positive constant ΩV. In the long run, therefore, the rate of inflation may approach a constant upper bound, the value of which depends on the velocity of money and Ω, the initial ratio of planned sales to market sales. Furthermore, ΩV is an upper bound on the attainable rate of inflation: if deliveries remain greater than zero, then the rate of inflation should be less than ΩV.

These findings demonstrate that inflation generated by purchasing on the market follows a different path than inflation generated by raising the state quota delivery price. Raising the quota price leads to inflation at a constant rate ΦV. Purchasing on the market results in a variable rate of inflation, where the path of inflation is determined by how deliveries fall in response to higher market prices. It is likely that over time inflation will be positive and rising, and that eventually the rate of inflation will approach or equal the constant

value ΩV. If deliveries eventually fall to zero, then the long-run inflation rate when the government buys on the market will exceed the rate of inflation that results when the government raises the planned delivery price. This can be seen by comparing the values of Ω and Φ:

$$\Omega = \frac{\bar{R}^*}{Q-\bar{R}^*} - \frac{\bar{p}^*\bar{R}^*}{\bar{p}^*(Q-\bar{R}^*)} > \frac{\bar{p}^*\bar{R}^*}{p^*(Q-\bar{R}^*)+\bar{p}^*\bar{R}^*} = \Phi \quad . \quad (30)$$

Raising the quota

A third action the government could take in response to a delivery shortfall is raising the delivery quota. The delivery quota must be increased enough to maintain deliveries S at the level of the urban ration $\bar{R}^*$, and so

$$H(\pi_t,\bar{S}_t) = \bar{R}^* \qquad (31)$$

must hold. Solving for $\bar{S}_t$ gives the function

$$\bar{S}_t = F(\pi_t,\bar{R}^*) \ , \qquad (32)$$

where F_1, $F_2 \geq 0$. The quota level required to maintain deliveries is thus a function of state and market prices and of the urban ration quota. In the event of an incremental rise in the market price, the quota must rise by

$$\delta\bar{S}/\delta p_t = (\bar{p}_t/p_t^2)F_1(.) \qquad (33)$$

in order to maintain deliveries.

Raising the quota requires incurs no expenditure and so will not induce inflation. This action therefore seems preferable to both raising the delivery price and buying on the market. Historically, however, socialist governments have increased quota levels infrequently. In China, for example, the government has not raised the grain delivery quota for decades. Even during the 1980s when the delivery shortfall

for grain became fairly serious, the grain quota was not increased; on the contrary, it was reduced (Sicular, 1990).

The reluctance of socialist governments to raise delivery quotas suggests that there may exist an accepted or customary quota level. If the government attempts to raise the quota above its customary level, agents in the economy will resist. In other words, the marginal response to an increase in the quota level may be small and asymmetric with the marginal response to a decrease in the quota level. Under these circumstances the relationship between actual deliveries and the quota will look something like figure 2, where $\bar{S}_c$ represents the customary quota level. The relationship is kinked at $\bar{S}_c$: an increase in the quota above its customary level will elicit only a small response in deliveries. Reducing the quota below its customary level will cause a larger response. (The whole curve lies below the 45 degree line, along which deliveries would equal the quota level.)

A relationship between deliveries and the quota level of the sort shown in figure 2 could explain why governments rarely raise quota levels in response to declines in deliveries. The government could, of course, mobilize a campaign to press producers to meet the higher quotas. This would not necessarily cause inflation, but would require that the government use up some political capital. The government could also induce producers to meet the higher quotas by giving them subsidized inputs or by paying them a higher price. This approach, however, requires government expenditures and so would have inflationary consequences.

Cash penalty for evasion

A fourth alternative is for the government to require producers to pay a cash penalty for not meeting the delivery quota. The government could then use the revenues from penalties collected to pay for necessary market purchases of grain.

The implications of such a penalty would depend on its design. An obvious design is to set the cash penalty equal to the losses the government incurs in its market purchases. In this case, the penalty $d(.)$ would equal

$$d(p_t, \overline{p}^*, S_t, \overline{S}^*) = (p_t - \overline{p}^*)(\overline{S}^* - S_t) . \qquad (34)$$

This penalty requires producers to pay the difference between the market and planned price values of the delivery shortfall, and it eliminates the producers' incentive to evade the quota. Moreover, the penalty generates exactly enough revenues to pay for the market purchases needed to cover delivery shortfalls, so that evasion would no longer cause a budgetary deficit. Indeed, the penalty collected may exceed the cost of market purchases. This can be seen by referring to the formula for the government deficit D_t, which is now

$$D_t = \overline{p}^*(\overline{R}^* - S_t) - p_t(\overline{R}^* - S_t) + d(.)$$
$$= (p_t - \overline{p}^*)(\overline{S}^* - \overline{R}^*) . \qquad (35)$$

This expression reveals that the government will enjoy a budgetary surplus if the delivery quota is set higher than the ration quota (as it was originally in anticipation of evasion). Once the penalty system is in place, however, the government would have no reason to set the delivery quota higher than the ration quota, and so would adjust the delivery quota downward.

This form of cash penalty effectively transforms the in-kind quota tax to a cash tax, and so "monetizes" the quota. Since monetizing the quota eliminates budgetary deficits, an exogenous shock cannot lead to a inflation. This approach therefore appears to be superior to the three alternatives discussed above. The advantages of the cash penalty, however, hinge on the assumption that producers do not evade a cash tax. If tax evasion occurs regardless of whether the tax is in kind or in cash, then monetizing the quota does not eliminate the potential for inflation.

The potential for deflation

The analysis above demonstrates that government actions to raise the quota price or purchase grain on the market following a positive price shock will generate inflation. In theory, a negative price shock should have a symmetric, deflationary consequence. That is, if a shock causes the money supply and market prices to fall below their initial equilibrium levels, if the government then lowers the quota price or sells the excess deliveries on the market, and if the government uses the resulting budgetary surplus to reduce the money supply, then deflation will occur.

If the government responds to a negative shock by lowering the quota price, then the path of deflation should be symmetric to that which occurs following a positive shock. In this case, the deflation rate will be -$V. If the government responds by selling surplus grain on the market, the results will not be symmetric. Initially the path of deflation mirrors that for inflation described above. At some point, however, the market price will fall to the level of the quota price. The market price cannot be less than the quota price: if it were, then

agents would buy grain on the market and resell to the state. Such activity would drive the market price back up to the level of the quota price.

Regardless of whether the government lowers the quota price or sells surplus grain on the market, it will experience a budgetary surplus. It is unclear whether the government would use the budget surplus to reduce the money supply. An unanticipated deficit must be financed; the need to shrink the money supply in response to an unanticipated surplus is less compelling. Deflation would only occur if the money supply is reduced. Thus the potential for deflation following a negative shock is probably less than the potential for inflation following a positive shock.

Applicability of the model: a look at some evidence

The above analysis demonstrates how a shock can lead to inflation (or possibly deflation) in a two-track system. Official price indexes (table 1) and available monthly data (figure 3) show that China experienced inflation in the mid-1980s.[8] The rate of increase (over the same month, previous year) in the market prices of consumer goods reached about 20 percent in mid-1987, rising further to 35 percent in mid-1988. The national retail price index, which includes both market and state prices, followed a similar path, but with a six month lag. Inflation slowed in 1989 after the government strictly reduced credit availability, clamped down on free market price rises, and revived a variety of direct economic interventions.

Did shortfalls in plan deliveries and subsequent government efforts to maintain ration sales contribute to this inflationary episode? Available evidence suggests that such developments were a

factor explaining the inflation. Isolating their effect on inflation is difficult, however, because relevant evidence is fragmentary. Data on planned prices, quota and ration levels, and quota fulfillment are available only for a few products, and even for these products the data are incomplete.

Since a rigorous quantitative analysis is impossible, the discussion below is somewhat informal and qualitative. I begin by summarizing China's experience with delivery shortfalls for grain, an important planned product for which some relevant data are available. China's experience with grain has been consistent with the process of inflation described in the theoretical model. Then I present data on government price subsidies and change in the money supply, which suggest that price subsidies contributed to growth in the money supply. Finally, I examine evidence on variables that the theory predicts are key: (1) the relative sizes of planned and market trade, and (2) the velocity of money. Data for these variables can be used to calculate values for ΦV and ΩV. The estimates of ΦV and ΩV reveal that interactions between plan and market could have contributed significantly to China's inflation.

Delivery shortfalls and government response

Grain is only one of many commodities traded both under plan and on the market. Price subsidies on grain rations have constituted the government's largest single subsidy item, and the handling of the grain problem is indicative of the government's treatment of major commodities.[9] During the 1980s shortfalls in grain deliveries generated budgetary losses, and the government apparently financed those losses by printing money.

During the early 1980s the Chinese government began to lift restrictions on beyond-plan market trade and establish the two-track system. In the case of grain and most other agricultural products, prior to 1979 private trade was severely suppressed. By 1980 farm products could be traded on local free markets after delivery quotas had been fulfilled. By 1982 the central government had lifted restrictions on long-distance trade for most farm products, and private individuals were permitted to specialize in transport and trade. Grain surpluses in 1983 and 1984 led to low grain market prices (table 1) and overflowing government warehouses. These conditions prompted further market liberalization. On January 1, 1985, the central government announced that it would abolish mandatory quotas and instead sign voluntary procurement contracts at a government-set price with farmers for grain. All trade beyond these contracts would take place on the free market.

Within a year, however, the government retreated from this policy and stated that the contracts were a "responsibility," i.e., mandatory. This reversal was prompted by a drop in production, rising market prices for grain, and difficulties enforcing contracts. Since that time, market prices for grain have continued to rise (table 1), and deliveries at the planned "contract" price have continued to decline (table 2). By 1988 planned-price deliveries were at their lowest level in a decade. While deliveries at planned prices fell, the level of ration sales remained unchanged at about 80 million tons. Consequently, the shortfall between planned-price purchases and ration-price sales grew and by 1988 surpassed 40 million tons (table 2).

The government responded to these shortfalls both by purchasing grain on the market and by raising the planned price for grain

deliveries.[10] Government market purchases more than tripled between 1985 and 1988, rising from 25 to 88 million tons (table 2); in 1988 approximately half of these purchases were sold at low, ration prices. Planned delivery prices were raised several times after 1985: between 1985 and 1988 grain contract prices rose 8 to 16 percent. An additional 18 percent increase in grain contract prices was carried out in 1989. These price increases were intended to bolster deliveries, but had limited effect because market prices for grain rose by more than 80 percent during the same period.

Meanwhile, the ration sales price and quantity remained unchanged. Maintaining the grain ration program had clear implications for the budget. Losses per ton became quite large. In the case of rice, for example, by 1988 the contract price was 400 to 450 yuan, and the free market price exceeded 1000 yuan per ton. The ration price remained at about 300 yuan per ton, implying per ton losses (before transport and handling costs) of 100-150 yuan for rice purchased at the contract rice, and of more than 700 yuan for rice purchased on the market.

As mentioned above, in some localities the government has experimented with monetization of grain quotas. This experimental policy, called chajia digou ("using the price differential to maintain procurement"), allowed farmers to pay cash rather than grain to meet their delivery quotas. The cash payment per kilogram grain was set equal to the difference between the market and state prices. Experiments with chajia digou began in a handful of counties in the early 1980s. In 1985 Guangdong implemented the policy province-wide, and in that year nearly one-third of the provincial quota was met by cash payments.[11]

These experiments have had mixed success. In Guangdong the program initially proceeded smoothly. Guangdong farmers switched out of grain and into more profitable crops, and the provincial government used the cash receipts to import grain from neighboring provinces. Difficulties arose, however, when neighboring provinces complained that Guangdong's actions were driving up their market prices, hampering their ability to maintain planned deliveries, and so exacerbating their budgetary losses on planned grain commerce. The neighboring provinces responded by blockading trade and complaining to the central government. The central government prohibited Guangdong from importing grain from its neighbor provinces, and by 1988 Guangdong once again required its farmers to deliver grain in kind.[12]

Although some localities continue to accept cash in fulfillment of the quota contract, the central government has not sanctioned widespread implementation of the program. The experiments are associated with Zhao Ziyang and his supporters, and so they have undoubtedly been affected by recent political developments.[13] It is also possible that central policy makers doubt their ability to effectively implement and enforce the cash tax, especially if fluctuating market prices require frequent adjustments in the amount of the cash payment. Tax enforcement in rural areas is a notorious problem for developing countries, and the Chinese government may therefore have a legitimate concern.

Price subsidies and growth in the money supply

The Chinese government publishes data on total budgetary price subsidies broken down by broad commodity categories.[14] The data on total price subsidies and on the share of these subsidies spent on grain, cotton and edible oils appear in table 3. Price subsidies for

grain, cotton, and edible oils--of which the largest component was undoubtedly grain--accounted for more than two-thirds of total price subsidies.

Price subsidies rose in the early 1980s, leveled off in 1986, and then resumed growth in 1987. In 1985 and 1986 the government implemented measures aimed at controlling growth in price subsidies. The aborted shift to voluntary contracts for grain was partly motivated by this objective, as was the reduction (and, in some cases, elimination) of planned allocation for a variety of goods. At the same time the government issued special wage supplements to protect urban consumers from the resulting increases in the cost of living. Consequently, even though price subsidies declined, other categories of government spending rose. Regardless, price subsidies soon resumed their upward trend.

In order for the price subsidies on ration sales to have generated inflation, they must have been financed by issuing money. The money supply, whether measured in currency or currency plus deposits, grew rapidly during the 1980s (table 3). Regressions in table 4 indicate that this expansion in money supply was related to growth in price subsidies. These regressions estimate change in the money supply as a function of budgetary price subsidies and other budgetary expenditures. Due to the small number of observations (data are available for only 9 years) and multicollinearity between price subsidies and other expenditures, the results are merely suggestive. They indicate a positive relationship between change in the money supply and price subsidies.

Although price subsidies and changes in the money supply are positively correlated, the data do not rule out the possibility that other factors contributed to inflation. Moreover, the regressions do not correct for simultaneity and so do not reveal the extent to which subsidies contributed to growth in currency, or vice versa. Both directions of causality are consistent with the theoretical analysis above.

Key variables determining inflation in the two-track system

The theoretical model predicts that the rate of inflation will depend on the the velocity of money V and on the relative sizes of the plan and market sectors as measured by either Φ or Ω. The greater the velocity of money, and the larger the relative size of planned trade, the higher the rate of inflation that will result.

Estimates of money velocity usually calculate velocity as the ratio of nominal GNP to money supply. The theory above suggests a slightly different definition: the ratio of <u>traded</u> final goods and services (hereafter called TNP) to money supply, where traded goods include those traded both on the market and through state channels (at their respective, nominal prices). GNP is larger in absolute size than TNP because it includes products that are not traded (farm products retained for consumption on the farm and industrial products manufactured and used internally by enterprises). Thus estimates of money velocity calculated using TNP will be lower than those calculated using GNP. Furthermore, since the degree of commercialization has risen during the reform period, velocity calculated using TNP has declined less during the 1980s than that calculated using GNP.[15]

The estimates of money velocity shown in table 5 are calculated using retail sales of consumer goods as a measure of TNP. Retail sales data for China exclude services and probably undercount market trade, and so would bias downward the velocity estimates. Velocity calculated using these data is constant or falling during the late 1980s. The theoretical analysis assumes constant velocity; falling velocity would dampen the inflationary impact of government actions to offset delivery shortfalls.

Data on the relative sizes of trade at planned and market prices in China are available for the late 1980s. Table 6 shows the shares of retail sales at state-fixed, state-guided, and market prices. State-fixed prices are the low, subsidized prices that the government charges consumers for rationed commodities. These prices are adjusted infrequently. State-guided prices are also planned prices, but they are adjusted more frequently in light of supply and demand conditions. Usually guidance prices are set between market prices and state-fixed prices. Market prices are unplanned prices. In principle they are determined by market forces, but at times the government has set price ceilings or otherwise intervened in markets.

These data reveal that trade at planned prices remained large: in 1985 sales at fixed prices alone accounted for half and in 1986-88 for about a third of total retail sales. The sum of the shares for fixed and guided prices, a rough upper bound on the size of the planned sector, exceeded 50 percent for all four years.

Using the data in tables 5 and 6, I have calculated rough estimates of the rates of inflation predicted theoretically. In the scenario where the government raises its quota procurement price, the

rate of inflation would equal ΦV, velocity times the share of planned

sales in total trade (with planned and market trade valued at their

respective prices). A lower estimate for Φ would be the share of retail

sales at fixed prices given in table 6, and an upper bound would be the

sum of the shares of retail sales at fixed and guidance prices.

Multiplying by the two estimates of V gives values for ΦV of between

0.05 and 0.28. Thus government efforts to maintain deliveries by

raising the planned delivery price could have generated inflation at a

rate as low as 5 percent, or as high as 28 percent.

If the government makes up the delivery shortfall by purchasing on

the market, in the long run as deliveries fall to zero the rate of

inflation would eventually approach ΩV, where Ω is the ratio of ration

sales to market sales (quantities, or both valued at the same prices).

For lack of better data, the numbers in table 6 are used to calculate Ω,

but the resulting estimates of Ω are low because ration sales are valued

at planned prices and market trade at higher, market prices. The data

for 1985 yield estimates of ΩV ranging from 0.09 to 0.62; the data for

1988 give estimates ranging from 0.04 to 0.33.

In the short run the rate of inflation would be lower than ΩV.

Rearrangement of the terms in (25) above gives the following expression

for rate of inflation at any point in time:

$$\dot{P}_t / P_t = \frac{\vec{p}^*(\vec{R}^* - G_t)}{P_t(Q - R^*)} \, V \, (P_t / \vec{p}^* - 1) \, . \qquad (36)$$

Since P_t exceeds $\vec{p}^*$, this expression shows that at any point in time

the rate of inflation will exceed the ratio of the delivery shortfall to

market trade times the velocity of money. (Note that the delivery

shortfall is valued at planned prices and market trade at market prices.)

Unfortunately, data on the total value of delivery shortfalls for all commodities do not exist. My educated guess is that the shortfall accounted for at least 10 percent, and possibly as much as 30 percent, of total planned sales of consumer goods.[16] If in 1988 the shortfall had been only 10 percent of planned sales, then government purchases on the market to make up the shortfall would have caused inflation in market prices at a rate of less than 3 percent. If the shortfall had been 30 percent, the resulting inflation would have been between 1 and 10 percent.

The calculations above give a broad range of estimates for the rate of inflation. Identifying the inflationary effect of government actions is further complicated by the fact that the government used a combination of the two methods to maintain the ration program--it both raised the delivery price and purchased on the market. The calculations do reveal, however, that in the short term buying on the market is likely to generate less inflation than raising the procurement price. The calculations also show that government efforts to maintain planned sales could potentially have explained a substantial portion of the inflation that occurred.

Conclusion

A theoretical analysis of the two-track system reveals that such a mixture of plan and market may be susceptible to inflation. Evidence suggests that China in fact experienced the problems of plan evasion, budgetary losses, and growth in currency supply discussed analytically.

Contradictions between plan and market could therefore have contributed to the inflation that China experienced in 1985-88.

The analysis above is based on several strong assumptions. First, it implicitly assumes that agents in the economy face hard budget constraints and maximize utility or profits. These assumptions apply reasonably well to consumers, farm producers, and private enterprise; they might also apply for some rural industries. They may not, however, hold for the state enterprise sector.

The presence of state enterprises would not necessarily invalidate the results presented above. The potential for budgetary losses on planned trade of farm products would remain. The response of state enterprises to a price shock and the budgetary consequences of their response, however, could differ from that for farm products. For example, suppose an exogenous shock caused the market price of coal to rise. A state-run coal mine faces delivery quotas, but at the same time it is dependent on the government for supplies of labor and low-priced inputs, and its management is appointed by the government. This dependency would reduce the mine's eagerness to evade the delivery quota. Even if it did evade, the inflationary consequences of government efforts to maintain planned sales might be lower than for farm products. Since a large fraction of the profits of state enterprise go to the government, the government would recoup some of its losses from raising the quota price or purchasing coal on the market.

The model also assumes that real output and money velocity are constant. Growth in real output would allow money supply to rise at the rate of output growth without causing inflation. Endogenous money velocity would raise or lower the predicted rate of inflation, depending

on whether velocity rises or falls with inflation. The model could be extended to treat these issues.

Despite these limitations, the analysis yields some useful insights about appropriate policy in China and other mixed economies. Both the theory and also the evidence for grain suggest that raising delivery quota prices may not attain their goal of improving quota fulfillment. The inflation generated by such a policy will only prompt more quota evasion. The Chinese government's reluctance to raise quota prices for grain and other products may therefore be justified.

The government has shown a greater willingness to purchase on the market to make up for delivery shortfalls. This approach also has inflationary consequences, but in the short term may cause lower rates of inflation than raising the quota price. In the long term, however, declining deliveries could cause the rate of inflation to rise above the rate that would arise if the government raised the quota price.

What non-inflationary options exist? In theory, raising the quota avoids problems of inflation, but for reasons discussed earlier this alternative may not be viable. Monetizing the quota is the most promising of the four policy responses analyzed above, although its success is not sure. In-depth analysis of the experience of China's experimental localities would be useful for evaluating the potential of this approach.

The government could also avoid inflation by backing out of its commitment to the ration program. Reducing or eliminating the ration quota would avert inflation. Alternatively, the government could suppress inflation by administratively restricting free markets, for example, by enforcing ceilings on market prices. In other words,

inflation could be avoided by either shifting the economic system
further toward a market economy or by moving back toward a planned
economy.

Inflation-averse governments may therefore opt for an economic
system where either planned or market allocation dominates by a large
margin. In the case where planned allocation dominates, inflation can
be contained by administrative intervention. In the case where market
allocation dominates, budgetary losses are small relative to the economy
as a whole, and so the potential for inflation of the sort discussed
here is low.

APPENDIX

In this appendix I lay out the microeconomic foundations of the model described in the body of the paper. Consider an economy consisting of two groups of agents, say, farm households and urban consumers. Both types of agents maximize utility. Urban consumers are assumed to be identical, as are rural households. Urban preferences and endowments may, however, differ from those of rural households. Moreover, rural households engage in production (farming), while urban consumers do not.

The economy has two goods. The first good, say grain, is produced and consumed. The second good is not consumed directly but is used as an input in production of the first good. Agents in the economy hold endowments of the second good, which I will call fertilizer.

The government sets delivery and ration quotas for grain. Rural households face delivery quotas $\bar{s}$ that specify a fixed quantity of their output that they should sell to the state at the low state price $\bar{p}$. Urban consumers can buy up to their ration allotments $\bar{r}$ at the same, low price. I assume that transfer costs are zero and that initially state purchase and sales prices for grain are equal. I also assume that the government deliberately sets its price for grain lower than the market price so as to provide a subsidy to urban consumers.

The government permits market exchange of both grain and fertilizer. In the case of grain, any exchange among agents beyond deliveries to and ration purchases from the government occurs on the market at the market price p. The government does not plan the

distribution of fertilizer, and so all exchange of fertilizer takes place on the market at the market price w.

Agent behavior[17]

The rural household maximizes utility $U_r(x_r)$, where x_r is its consumption of grain. All output is sold, some within the rural sector and some to the urban sector.[18] Grain production is given by a household production function with the usual properties

$$q = f(z) , \qquad (a.1)$$

where q is the level of output and z the level of fertilizer input. Total output is divided between sales on the market m at market price p and sales to the state s at the planned price $\bar{p}$, so that

$$s + m = q = f(z) . \qquad (a.2)$$

If the planned price is less than the market price, the farmers have an incentive to evade the quota. Evasion is not costless, and the costs rise with the degree of evasion. Measured in units of output, the cost of evasion is a function of the delivery shortfall, which is the difference between the quota $\bar{s}$ and actual deliveries s:

$$c = c(\bar{s}-s) , \qquad (a.3)$$

where

$$c(0) = 0, \text{ and} \qquad (a.3a)$$

$$\delta c/\delta(\bar{s}-s) \geq 0 . \qquad (a.3b)$$

Farm-household income equals earnings from sales of output, minus costs of inputs and costs of evasion:

$$Y_r = pm + \bar{p}s - wz - pc(\bar{s}-s) . \qquad (a.4)$$

The farm household's maximization problem can be written as

$$\max_{x_r,z,s} L = U_r(x_r) - \alpha\{pf(z) - (p-\bar{p})s - wz - pc(\bar{s}-s) - px_r\} . \qquad (a.5)$$

Solution of this problem yields the usual marginal conditions for profit-maximizing production. Production depends solely upon relative market prices and is not influenced by plan variables. Consumption is a function of relative market prices and household income.[19] Optimal household behavior can be described by the following demand, supply, and grain marketing functions:

$$z = z(p,w) \tag{a.6}$$

$$q = q(p,w) \tag{a.7}$$

$$s = h(p-\bar{p},\bar{s}) \tag{a.8}$$

$$x_r = x_r(p,Y_r) \tag{a.9}$$

$$m_r = q(p,w) - h(p-\bar{p},\bar{s}), \tag{a.10}$$

where

$$Y_r = pq(p,w) - wz(p,w) - (p-\bar{p})h(p-\bar{p},\bar{s}) - pc(\bar{s}-s) . \tag{a.11}$$

Note that planned prices and quotas affect household consumption indirectly through income. Deliveries to the state are a function $h(.)$ of the quota level and the difference between market and state prices for grain. Market sales are the difference between total output and deliveries to the state.

First order conditions imply that households equate the marginal cost of evasion with the marginal benefits thereof, or

$$p \, \delta c/\delta(\bar{s}-s) = p - \bar{p} . \tag{a.12}$$

Consequently, if the market price rises (increasing the gap between the state and market prices), the level of deliveries will fall. This implies that $h_1 \leq 0$. A higher quota level will tend to increase deliveries, so that $h_2 \geq 0$.

The urban consumer maximizes utility $U_u(x_u)$ subject to income from its endowment $\bar{z}$ of the input. Consumed grain x_u is purchased either

from the state at price $\bar{p}$ or on the market at price p. Consumers are allowed to buy up to a fixed ration $\bar{r}$ at the low state price. The urban consumer's maximization problem is

$$\max_{x_u, r} L = U(x_u) - \theta_1 [w\bar{z} - p(x_u - r) - \bar{p}r] - \theta_2 (\bar{r} - r) . \quad (a.13)$$

Solution of this problem yields optimal grain demand and marketing functions:

$$x_u = x_u(p, Y_u) \quad (a.14)$$

$$r = \bar{r} \quad (a.15)$$

$$m_u = \bar{r} - x_u(p, Y_u) . \quad (a.16)$$

Demand is a function of the market price p and consumer income Y_u, which equals the market value of the endowment plus the subsidy associated with the ration quota

$$Y_u = w\bar{z} + (p - \bar{p})\bar{r} . \quad (a.17)$$

Planned prices and the ration quota do not affect marginal decisions, but affect consumption indirectly through their effect on income.

Initial equilibrium

No-inflation equilibrium occurs when markets clear and the government budget is balanced. As discussed in the text, a balanced budget requires that government purchases of grain equal government sales of grain. Equilibrium conditions are therefore

$$S = H(p - \bar{p}, \bar{S}) = \bar{R} \quad (a.18)$$

$$Q(p, w) - S - X_r(p, Y_r) - X_u(p, Y_u) - \bar{R} ,$$

$$\text{or} \quad Q(p, w) = X_r(p, Y_r) + X_u(p, Y_u) \quad (a.19)$$

$$Z(p, w) = \bar{Z} , \quad (a.20)$$

where capital letters represent aggregate quantities (e.g., $S = \Sigma s$). Furthermore, the quantity of money identity shown in the text must hold.

Note that since inputs can only be used in production and their supply is fixed, the aggregate level of input use will always equal $\bar{Z}$ and of output $Q = f(\bar{Z})$. This effectively ensures that changes in the money supply and price level do not affect the level of output, i.e., the classical dichotomy holds.

The government sets the planned price, delivery quota, and ration. I assume that there exists a set of plans G consistent with equilibrium. Choice of a plan from this set will allow solution of relative market prices. The price level will then depend on the level of the money supply. Thus if the government chooses a plan from G and fixes M, one can solve for equilibrium market prices and levels of income and consumption.

I assume that initially the government chooses a plan $(\vec{p}^{*}, \vec{S}^{*}, \vec{R}^{*})$ in G and sets the money supply equal to M^{*}. Equilibrium market prices, given this plan and money supply, are (p^{*}, w^{*}), output is Q^{*} (or simply Q in the text), and deliveries are $S^{*} - \vec{R}^{*}$.[20] Note that the government will anticipate evasion and so the delivery quota level will be higher than the ration quota level.

References

Anand, Ritu, and Sweder van Wijnbergen. Inflation, external debt and financial sector reform: A quantitative approach to consistent fiscal policy with an application to Turkey. National Bureau of Economic Research Working Paper No. 2731. 1988.

Cheng Hang-seng. Monetary policy and inflation in China. Manuscript, Federal Reserve Bank of San Francisco, September 8, 1987.

China Price Almanac Editorial Group. Zhongguo wujia nianjian (China price almanac). Beijing: Zhongguo Wujia Chubanshe, 1989.

China Statistics Monthly, various issues.

Dornbusch, Rudiger, and Juan Carlos de Pablo. Debt and macroeconomic instability in Argentina. In Jeffrey D. Sachs, ed. Developing Country Debt and Economic Performance. Volume 2. Chicago: University of Chicago Press, 1990, pp. 40-155.

Fan Gang. Gaige, tiaozheng, zengzhang yu mochaxing tonghuo pengzhang (Reform, adjustment, growth, and frictional inflation). Jingji yanjiu (Economic research) 1 1989: 13-25.

Feltenstein, Andrew, and Zibn Farhadian. Fiscal policy, monetary targets, and the price level: An application to the case of China. Journal of Money, Credit and Banking 19(2) 1987: 137-56.

Gao Xiaomeng and Song Guoqing. Zhongguo liangshi wenti yanjiu (Research on China's grain question). Beijing: Jingji Guanli Chubanshe, 1987.

Kornai, János. Economics of Shortage. Volume B. New York: North Holland, 1980.

Naughton, Barry. The current macroeconomic disturbances in China: Policy and institutional factors. Manuscript, UCSD Graduate School of International Relations and Pacific Studies, 1989.

Portes, Richard and Anita Santorum. Money and the consumption goods market in China. _Journal of Comparative Economics_ 11(3) 1987: 354-371.

Sicular, Terry. Plan and market in China's agricultural commerce. _Journal of Political Economy_ 96(2) 1988: 283-307.

Sicular, Terry. Ten years of reform: Progress and setbacks in agricultural planning and pricing. Harvard Institute of Economic Research Discussion Paper No. 1474, March 1990.

State Statistical Bureau. _Zhongguo tongji nianjian_ (China statistical yearbook). Beijing: Zhongguo Tongji Chubanshe, various years.

Tuan, Chyau and Anthony M. Tang. Income Velocity in China, 1953-1986. _Journal of Asian Economics_ 1(2) 1990: 291-308.

Wang, Bingqian. Report on the implementation of the state budget for 1988 and on the draft state budget for 1989. _Beijing Review_ 32(18), May 1-7, 1989, pp. XI-XVIII.

Webb, Shwu-Eng. Estimating China's grain procurement and market prices, 1979-88. In USDA Economic Research Service, _CPE Agriculture Report_ 3(2), March/April, 1990, pp. 11-13.

Zhang Fengbo. An analysis of Chinese macroeconomy. Manuscript, Cambridge, Mass., 1989.

Notes

1. An alternative way of mixing plan and market is to divide goods into two distinct groups, where one group of goods is allocated solely through the plan, and the other group solely on the market. The extent to which the sort of inflation discussed here arises for this second form of mixed system depends on the degree of substitutability between the two categories of goods. The higher the degree of substitutability between planned and unplanned goods, the greater the tendency for inflation to occur.

2. For notational simplicity, I begin with the assumption that the planned delivery and ration prices are equal. In fact, quota delivery prices of rationed consumer goods in China have often been lower than their ration sales prices.

3. I assume that the government sets the quota so that it is less than the level of profit-maximizing output. Even if the delivery quota is set higher than the level of profit-maximizing output, if output can be traded freely on the market then producers will still produce at the profit-maximizing level given market prices. In this case producers will make up the difference between their output and quota levels by buying on the market (from consumers who have purchased output at the

ration price). Thus the same output may pass through the state commercial system more than once.

4. For simplicity, I assume that all output is marketed, either through the state or on the market. This assumption does not affect the basic conclusions of the model so long as inflation-induced changes in the quantity sold on the market are small.

5. If the velocity of money increases with inflation, then the inflationary tendencies of the two-track system would be strengthened. If it declines with inflation, then the inflationary tendencies would be dampened.

6. See the appendix for a fuller discussion of the initial equilibrium.

7. The consequences of a negative shock are discussed below.

8. Although these data probably understate actual inflation, they provide a reasonable indicator of general price trends. The index of retail prices includes both planned and market prices. Since planned prices change more slowly than market prices, the retail price index is lower than the index of free market prices. Product coverage may differ for the two series.

9. A more detailed discussion of the developments described below can be found in Sicular (1990).

10. The government also increased imports of grain, which, since world prices exceeded the domestic ration price, also contributed to budgetary losses.

11. This policy and local experiments are discussed in Gao and Song (1987). See especially pages 17, 164-72, 224-255.

12. Author interviews.

13. Monetizing the grain quota was initially proposed by researchers in the Rural Development Research Center (RCRD) under the State Council. Experiments with the policy were apparently carried out under RCRD's auspices. The RCRD was set up and closely allied with Zhao Ziyang, and its fortunes declined with Zhao's. RCRD was officially closed after the Tiananmen incident.

14. Unfortunately, information on the definition and coverage of these data is scanty. The data probably include subsidies on imported as well as domestically produced goods.

15. Estimates of velocity calculated using GNP can be found in Naughton (1989), Zhang (1989), and Tuan and Tang (1990).

16. Note that in 1988 the delivery shortfall for grain accounted for more than half of ration grain sales. Pork, another important item sold at ration prices, was not even subject to delivery quotas: all pork sold under the ration program was purchased at higher market or guidance prices.

17. The optimal behavior of agents outlined here is similar to that discussed in more detail by Sicular (1988); that article, however, assumes no evasion.

18. As stated in an earlier footnote, this assumption does not alter the basic conclusions of the model. The conclusions will hold when only part of grain output is sold, so long as inflation-induced changes in the quantity sold are relatively small.

19. These conclusions hold so long as the market price is greater than or equal to the state planned price, which I assume is the case. One can show theoretically that for this kind of mixed economy state prices must be less than or equal to market prices, because if they were higher

agents would buy on the market to sell to the state. Such reselling would continue until the market price was driven up to the level of the planned price.

20. For a more extensive discussion of consumer behavior and equilibrium in this sort of model, see Sicular (1988).

Table 1

National Average Price Indexes
(previous year = 100)

	Retail Prices	Free Market Consumer Goods Prices	Free Market Grain Prices
1980	106.0	102.0	94.6
1981	102.4	105.8	100.4
1982	101.9	103.3	100.4
1983	101.5	104.2	97.5
1984	102.8	99.6	89.5
1985	108.8	117.2	101.7
1986	106.0	108.1	120.6
1987	107.3	116.3	118.1
1988	118.5	130.3	124.2
1989	117.8	110.8	136.6

Sources: State Statistical Bureau (1990), pp. 249, 268; Sicular (1990), table 6.

Table 2

Government Grain Purchases by
Price Category and the Delivery Shortfall
(1,000 tons husked grain)

Year	Total government purchases	of which: Purchases at planned prices[a]	Purchases at negotiated prices[b]	Approximate delivery shortfall (ration sales minus planned-price purchases)[c]
1979	60,095	55,499	5,395	25,000
1980	61,290	55,694	9,016	24,000
1981	68,455	52,243	11,252	28,000
1982	78,055	59,324	18,444	21,000
1983	102,485	94,885	7,784	-15,000
1984	117,245	111,267	9,991	-31,000
1985	107,828	75,141	25,185	5,000
1986	115,162	76,464	38,656	4,000
1987	126,865	52,005	74,860	28,000
1988	124,085	35,860	88,225	44,000

a. Prior to 1985 includes purchases at quota and above-quota prices; from 1985 onward includes purchases at the contract price.

b. Negotiated price purchases take place at near-market prices.

c. Ration sales are assumed to be roughly 80 million tons (Gao and Song, p. 15). These numbers are rounded to the nearest million.

Sources: Shwu-Eng Webb (1990), pp. 11-13.
Sicular (1990), table 6.

Table 3

Government Price Subsidies and Growth in Money Supply

| | Budgetary Price Subsidies | | Annual Change in Money Supply[*] (billion yuan) | |
	Total (bill. yuan)	Percent on grain, cotton, and oils	Currency	Currency plus deposits
1980	11.77	87.3	na	na
1981	15.94	89.2	64.32	347.68
1982	17.22	90.7	46.46	352.58
1983	19.74	92.2	66.72	363.10
1984	21.83	92.4	176.50	509.96
1985	26.18	75.9	229.03	755.72
1986	25.75	65.8	213.13	997.87
1987	29.46	66.3	233.33	1149.51
1988	31.68	64.4	457.84	1021.88
1989	37.03	70.1	444.77	1220.90

* Change from mid-year to mid-year, estimated by averaging year-end figures. Deposits include both short- and long-term deposits of enterprises, financial and administrative organizations, and urban and rural residents.

Sources: State Statistical Bureau 1987, p. 639.
State Statistical Bureau 1988, p. 769.
State Statistical Bureau 1989, p. 679.
State Statistical Bureau 1990, pp. 244, 666.

Table 4

Regressions of Change in Money Supply on Government Price Subsidies, 1981-89

	Dependent variable = annual change in:			
	Currency		Currency + Deposits	
	I	II	III	IV
constant	-299.7***	-284.9**	-464.8**	-275.9
	(-4.20)	(-3.21)	(-2.69)	(-1.77)
price subsidies	2.06***	1.40	4.85***	-3.54
	(7.46)	(0.69)	(7.24)	(-0.99)
other expenditures		0.08		1.08*
		(0.33)		(2.37)
R^2	0.89	0.89	0.88	0.94
adj R^2	0.87	0.85	0.87	0.92
F-stat	55.68***	24.34***	52.42***	46.38***

Notes: a. Data for price subsidies and change in the money supply are taken from table 3. "Other expenditures" equal total government budgetary expenditures excluding price subsidies. Official data for government budgetary expenditures are given by State Statistical Bureau 1990, p. 229. Note that price subsidies were not counted as part of government expenditures before 1986. Starting in 1986 they are included, and so must be subtracted out to arrive at "other expenditures."

b. * indicates significance at 10% level, ** at 5%, *** at 1%.

Table 5

Estimates of Money Velocity

Year	Value of retail sales of consumer goods (billion yuan)	Velocity calculated using currency	Velocity calculated using currency + deposits
1980	179.40	0.58	0.12
1981	200.25	0.54	0.11
1982	218.15	0.52	0.10
1983	242.61	0.50	0.10
1984	289.92	0.44	0.09
1985	380.14	0.43	0.10
1986	437.40	0.40	0.09
1987	511.50	0.38	0.09
1988	653.46	0.36	0.09
1989	707.12	0.32	0.09

Sources: 1) Retail sales are from State Statistical Bureau (1990), p. 622.

2) Year-end money supply data are taken from State Statistical Bureau 1987, p. 639; 1988, p. 769; 1989, p. 679; and 1990, p. 666. Velocity is calculated using mid-year estimates of money supply (annual averages of the year-end figures).

Table 6

Proportions of Retail Sales Traded at
State-Fixed, State-Guidance, and Market Prices

	1985	1986	1987	1988
At state-fixed prices	47.0	35.0	33.7	28.9
At state-guidance prices	19.0	25.0	28.0	21.8
At market prices	34.0	40.0	38.3	49.3

Source: China Price Almanac Editorial Group (1989), p. 351.

Figure 1

Time Path of the Market Price when the Government Purchases on the Market to Make Up the Delivery Shortfall

Equation for the time path:

$$p(t) = \bar{p}* + [\{(p_o - \bar{p}*)^2 + \bar{p}*^2 (\frac{\bar{S}*}{\bar{R}*})\} e^{2\Omega Vt} - \bar{p}*^2 (\frac{\bar{S}*}{\bar{R}*})]^{\frac{1}{2}}$$

Parameter values:

$\Omega V = r$ (values given below)
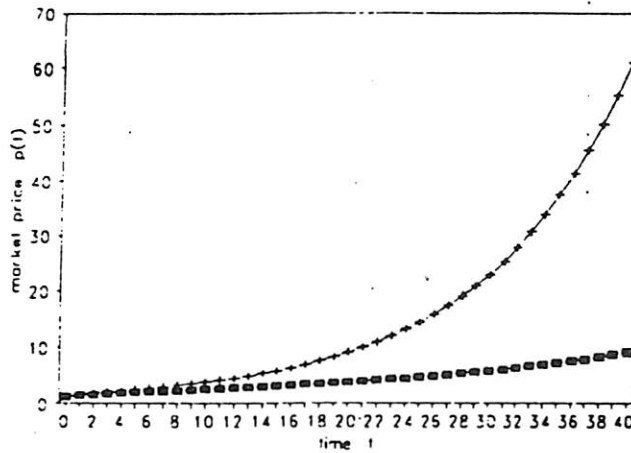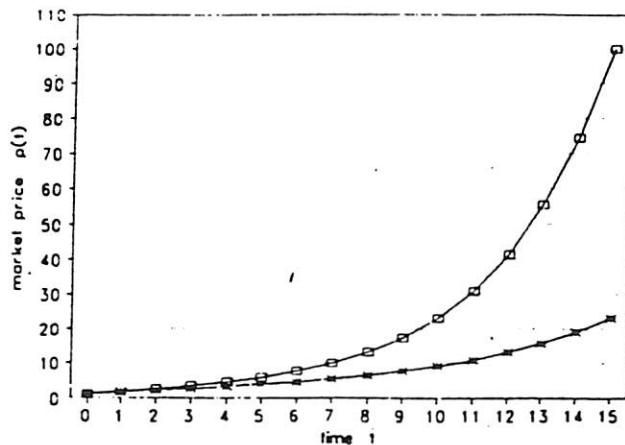
$p_o = 1.10$
$\bar{p}* = 1.00$
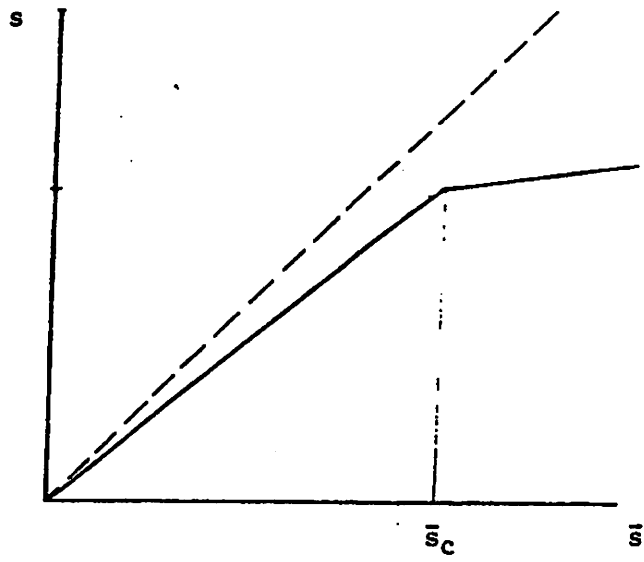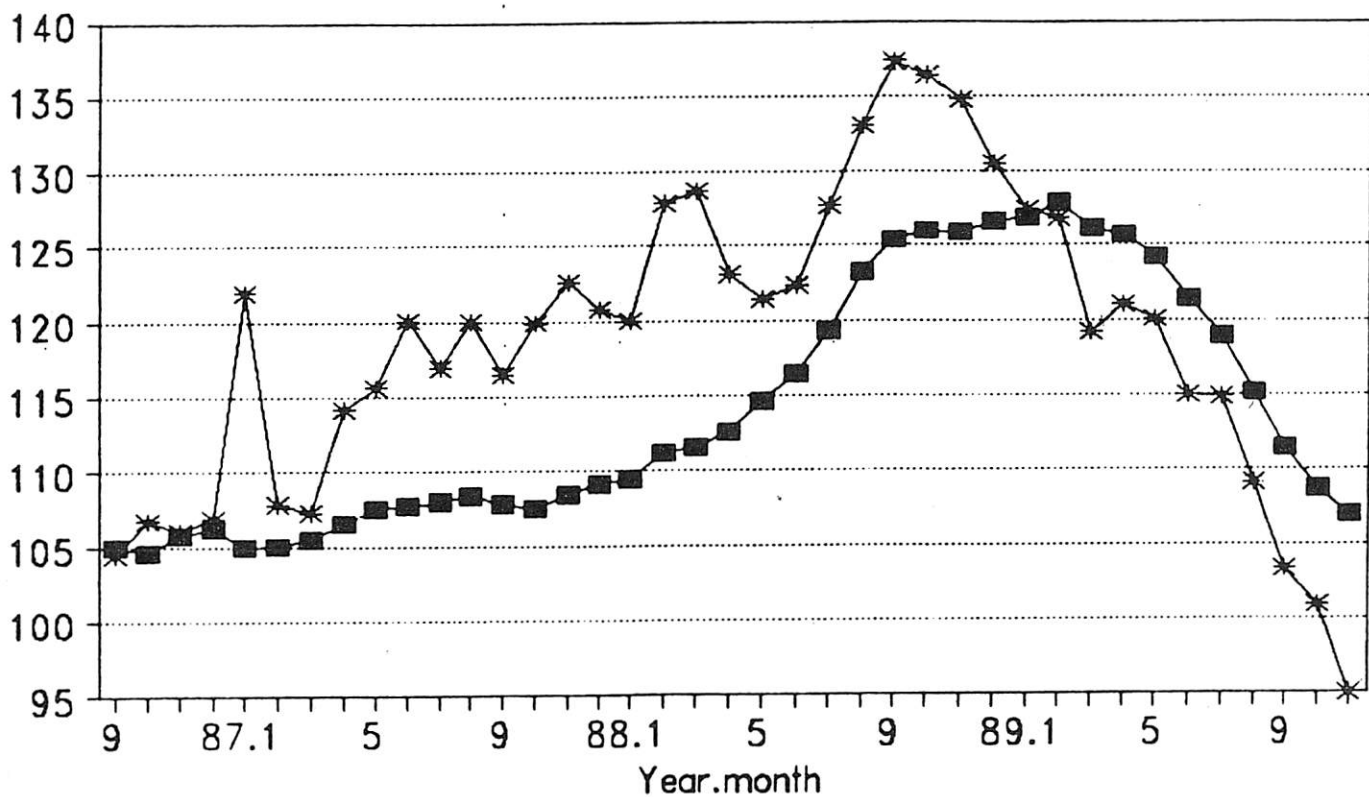$\bar{S}*/\bar{R}* = 1.20$

Figure 2

Figure 3

Retail and Market Price Indexes
(over same month previous year)

Legend: National retail — Market (cons goods)

X-axis: Year.month