GRAIN PRICES, LAND RENT, AND FOOD SELF-SUFFICIENCY IN CHINA

by

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Abstract

Two approaches to reform of agricultural prices in China are compared, one involving a two-tier combination of plan and market pricing, the other relying on land rent to recoup the tax on agriculture implicit in the two-tier system. The principal finding is that given the Chinese government's commitment to maintaining the real incomes of urban workers, an immediate move to land rents and unified pricing would be unsustainable. A gradual transition to unified pricing from an interim two-tier base is therefore recommended.
increases for in-plan procurements of staple food crops were not entirely passed on to the state’s final buyers; transactions losses were instead absorbed on the government budget. Finally, for those non-staple foods (i.e., foods other than grain and oil in the Chinese lexicon) for which higher prices were passed on, urban residents received wage bonuses in compensation.

The subsidies implicit in these schemes to protect selected urban consumers appear to have been substantial. Market prices for grain and edible oil fluctuated at roughly double the level of state retail prices through the 1980s. The volume of trade that took place at these higher prices grew steadily to account for ¥10.81 billion in exchanges by 1988 (SSB 1989, 627), a notable portion of the year’s ¥68.50 billion in total retail sales for the two crops (SSB 1989, 610 & 626). Despite this absorption of new demand on free markets however, state trading volumes also continued to grow, especially during the earlier years of reform. By weight, the increase in state grain sales amounted to 73 percent between 1978 and 1984, that for oil 214 percent (Hu 1986, 802). Since expanded state purchases were made at higher above-quota prices while new sales took place at uniformly low retail prices, budgetary subsidies ballooned with this growth. The value of all price subsidies shot up from ¥5.56 billion in 1978 to a peak of ¥32.08 billion (or 21 percent of government spending) in 1984 (SSB 1989, 673), with grain and oil responsible for just short of two-thirds of these totals (Gu et al. 1986, 257).

In a successful effort to confine the budgetary hemorrhaging, major policy changes were instituted in 1983 for oil and 1985 for grain. A single procurement price was adopted for sales to the state made under contract, with the new price a weighted average of the former quota and above-quota prices. The state had the option of buying additional output at a higher "negotiated"
in Lardy 1983, 218–9; Puttermann 1990; Rural Development Center 1988). The purpose of this paper is to compare the land rent alternative with the multiple-tier pricing system. Key aspects of the two reform approaches to be analyzed are the effect on the terms of trade between agriculture and industry, the impact on the real wages of various groups of workers, and the consequences for the government budget and national savings.

The next section of the paper sets forth a theoretical model of planners' choice within which the alternative approaches to price reform are defined. The model is calibrated and applied in Section 3. Implications for reform policy are drawn in Section 4. Then in Section 5 an assumption maintained in the initial application of the model - that China remain self-sufficient in meeting the domestic demand for food grains - is relaxed. A final section offers conclusions.

2. A Model of Planners' Choice

The model of planners' choice will be laid out in three variations: the first describes the pre-reform scenario for use as a benchmark; the second captures a two-tier pricing system reflective of the 1980s approach to reform; and the third offers an alternative approach involving land rent and prices that are entirely market based.3

SCENARIO I: STATE SETS TERMS OF TRADE & IMPOSES AGRICULTURAL OUTPUT QUOTA

The essence of the pre-reform situation is captured by the planners' optimization problem described in (1). The state sets the terms of trade between agriculture and industry $P$ (where the industrial good is numeraire) and imposes a quota on agricultural production such that food requirements of

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3A summary of notation is provided in Appendix A.
By substituting constraint expressions for the elements of the optimand and by combining the agricultural output constraint with the rule for choosing $M_A$ then solving for $P$, the problem may be written in more consolidated form with only two unknowns, $P$ and $L_A$:

$$\max_{P, L_A} \{ (1+\theta(1-\gamma)) \left[ \frac{1}{\beta} \left( \frac{\phi}{c_A} \right)^{1-\beta} \right] \left[ \frac{1}{\beta} \left( \frac{\phi}{c_A} \right)^{1-\beta} \right] \}$$

$$\text{s.t. } P = \frac{1}{\beta} \left[ \frac{\phi}{c_A} \right]^{1-\beta}$$

(2)

where $L_n$ remains here and henceforward a function of $L_A$ as defined in (1).

The constraint shows an inverse relationship between $P$ and $L_A$ since as the price of the agricultural good rises relative to that of the industrial good, agricultural producers substitute manufactured inputs for labor and labor is released from the sector.

Differentiating the Lagrangian with respect to $P$ and $L_A$ yields the following first-order conditions:

$$\frac{\partial \phi}{\partial P} = -\beta \phi L - \theta \omega L_g - \lambda = 0$$

$$\frac{\partial \phi}{\partial L_A} = -(1+\theta(1-\gamma)) \gamma c_A \left[ \frac{1}{\beta} \left( \frac{\phi}{c_A} \right)^{1-\beta} \right] L_n^{1-\beta} - \frac{\alpha}{\beta^2} \left[ \frac{\phi}{c_A} \right]^{1-\beta} L_A^{1-\beta} = 0.$$  

(3)

The first of the conditions implies that the shadow cost of raising the price paid for agricultural output depends on the combined effects of i) increased diversion of industrial output to agriculture and ii) lost investment resulting from lower earnings in state enterprises due to the higher cost of employing workers at a constant food wage. The state has an interest in lowering $P$ in order to achieve higher state-sector profits for investment, but this interest must be weighed against the effects of choking off industrial activity outside the state domain as $L_n$ falls. Suitable choice of $\theta$ allows planner concern over the development of non-state industry versus accumulation
\[ M_A = \beta P' \bar{\psi} \bar{L}. \] (5)

Substituting this expression for \( M_A \) into the agricultural production function and solving for \( P' \) then yields a relationship between \( P' \) and \( L_A \) identical to that between \( P \) and \( L_A \) under Scenario I as represented in the constraint equation of (2).

The expression for \( P' \) may be substituted into (4) to eliminate this unknown and permit again a formulation of the optimization problem in unknowns \( P \) and \( L_A \):

\[
\max_{P, L_A} \left\{ \left[ 1 + \theta (1 - \gamma) \right] c_A \bar{P}_A^{-\gamma} \bar{L}_N - \left[ \frac{\phi \bar{L}}{c_A} \right]^{1/\beta} \bar{L}_A^{-\gamma/\beta} + \phi (\bar{L}_N - \omega P \bar{L}_g) \right\} \\
\text{s.t. } P = -\frac{1}{\beta} \left[ (\phi \bar{L})^{1-\beta} \right]^{1/\beta} \frac{(1 - \beta) \bar{L} - \bar{L}_g}{\bar{L}_A} \bar{L}_A^{-\gamma/\beta} + \frac{\gamma c_A \bar{P}_A^{-\gamma}}{\phi \bar{L}_g} \bar{L}_N^{-1} L_A.
\] (6)

The sign of the relationship between a change in \( P \) and a change in \( L_A \) is now theoretically ambiguous. On the one hand, an increase in the intramarginal \( P \) tends to raise the average product of labor in agriculture and hence to draw workers into the sector. This effect can be offset however if the marginal price \( P' \) rises along with \( P \) causing manufactured inputs to be substituted for labor. Examination of the derivative of \( P \) with respect to \( L_A \),

\[
\frac{\partial P}{\partial L_A} = \frac{\partial}{\partial L_A} \left[ \left( \phi \bar{L} \right)^{1-\beta} \left( 1 - \beta \right) \frac{\bar{L} - \bar{L}_g}{\bar{L}_A^{\beta/\gamma}} \bar{L}_A^{-\gamma/\beta} + \frac{\gamma c_A \bar{P}_A^{-\gamma}}{\phi \bar{L}_g} \bar{L}_N^{-1} \left[ 1 + (1 - \gamma) \frac{L_A}{L_N} \right] \right],
\] (7)

reveals that the negative impact of a rising \( P \) on \( L_A \) can potentially dominate only if \( L_N/L > 1 - \beta \). In China, where the proportion of the labor force employed by the state is about 20 percent and agricultural output increases are severely constrained by fixed cultivable land, such a condition cannot conceivably be met. An increase in the intramarginal price of agricultural output will therefore correspond to greater employment in agriculture, less
\[ I = Y_s - \omega P^R \bar{L}_A^* + (1-\gamma) Y_N + R. \] (9)

Average product of labor in agriculture must also be redefined to incorporate the effects of land rent and a single market price for output so that the labor market clearing condition previously defined as in (4) becomes:

\[ \frac{P' \phi \bar{L} - R - M_A}{L_A} = \gamma c_N^{-\gamma} L_N^{-1}. \] (10)

With these modifications to the basic model, the planners' problem of Scenario III is defined over choice variables \( R \) and \( L_A \) as follows:

\[
\max_{R, L_A} \left\{ (1 + \theta (1-\gamma)) \frac{c_N L_A^{-\gamma} L_N^{-1}}{\beta} \left[ \frac{\phi \bar{L}_A - \omega \bar{L}_N}{c_A} \right]^{1/\beta} L_A^{-\epsilon/\beta} \theta \gamma (1 + L_A \gamma) \right\} \\
\text{s.t. } R = \frac{1 - \beta}{\beta} \left[ \frac{\phi \bar{L}_A^{1/\beta}}{c_A} \right] L_A^{-\epsilon/\beta} - \gamma c_N^{-\gamma} L_N^{-1} L_A.
\] (11)

Differentiating \( R \) with respect to \( L_A \) in the constraint equation of (11) reveals a negative association:

\[
\frac{\partial R}{\partial L_A} = -\frac{\alpha (1-\beta)}{\beta^2} \left[ \frac{\phi \bar{L}_A^{1/\beta}}{c_A} \right] L_A^{-\epsilon/\beta} - \gamma c_N^{-\gamma} L_N^{-1} \left[ 1 + (1-\gamma) \frac{L_A}{L_N} \right].
\] (12)

Higher rents thus tend to result in less agricultural employment which must mean that more favorable terms of trade for agriculture are permitting greater reliance on manufactured inputs if the same output total is to be met.

The first order conditions for the Lagrangian are:

\[
\frac{\partial \mathcal{L}}{\partial R} = \theta - \lambda = 0
\]

\[
\frac{\partial \mathcal{L}}{\partial L_A} = -[1 + \theta (1-\gamma)] \gamma c_N^{-\gamma} L_N^{-1} + \frac{\alpha (\beta \phi \bar{L} - \omega \bar{L}_N)}{\beta^2} \left[ \frac{\phi \bar{L}_A}{c_A} \right]^{1/\beta} L_A^{-\epsilon/\beta} + \lambda \frac{\partial R}{\partial L_A} = 0.
\] (13)

The shadow benefit of raising \( R \) is simply the weight attached to the identical increase in investment generated. The state has an interest in raising \( R \) for the purpose of achieving these direct investment gains. The downside is that
both current inputs and capital consumption. If constant returns to scale prevail, the elasticity for the remaining input, land, would account for the residual 0.55 percent.

Physical units for both agricultural and industrial output may be arbitrarily defined such that one unit of each type of output is produced per worker in the economy, meaning that φ takes on a value of one and that the combined total of \( Y_a \) and \( Y_i \) is 100. Industrial output composition is set to reflect the minute contribution of non-state industry prior to the 1980s, here taken as 10 percent. The capital asset value for non-state industry is based on a capital/output ratio of five to one.

The terms of trade for the baseline scenario are set so that given equal physical magnitudes by sector, output composition in value terms accords with what is observed. Industry accounted for roughly three times the output value of agriculture during the late 1970s (SSB 1989, 44) implying a price of 0.333 for the agricultural good when the industrial good is numeraire.

The wage paid to state workers is set so as to yield a national investment rate of 30 percent. The wage implied is 7.95 units of the agricultural good, or equivalently 2.65 units of the industrial good when \( P \) is 0.333. Wages across sectors may be compared through reference to the final few entries in the first column of Table 2. The state wage is 7.6 times the average product of labor in agriculture. State Statistical Bureau figures (SSB, 719) show state wages higher than farming incomes by a factor of 4.6 in 1978 and a factor of 8.5 in 1957, the most recent previous year for which data are available. Given that income from sidelines bolsters the Statistical Bureau figure for farmers defined broadly and that greater in-kind income for urban dwellers is largely neglected in the official statistics, the model results appear reasonably well on track.
higher price. Non-state industry shows even greater growth potential than under Scenario II as more rural labor is made available.

The surprise under Scenario III is the magnitude of the drop in national investment to less than half its pre-reform level. Investment is augmented, as under Scenario II, by the expansion of non-state industry profits. In addition, the state claims the rents garnered from agriculture for its investment budget. These new sources of investment revenue are insufficient, however, to offset the massive wage subsidies required in state industry to maintain workers' purchasing power parity in the face of deteriorating sectoral terms of trade. Higher land rents cannot solve the problem as long as agricultural workers are free to seek alternative employment since the agricultural output price must rise with land rents if domestic food self-sufficiency is to be assured.

The differential between state and agricultural wages under Scenario III is closer to that shown prior to reform than that yielded by reform with two-tier pricing. While agricultural wages rise dramatically in terms of the industrial good under Scenario III, so do the wages of state industrial workers. By contrast under two-tier pricing, state workers' constant wage in terms of the agricultural good is similarly a constant wage in units of the industrial good and only agricultural workers are made better off by reform. The latter's gains under both reform programs derive from competitive pressure in the labor market and the requirement that non-state industrial workers pay for food at its opportunity cost of production. Non-state industrial workers suffer a drop in income relative to the pre-reform period under either reform scenario both in terms of the industrial good as an influx of new labor from agriculture bids down the market wage and even more so in terms of the agricultural good as the terms of trade shift in favor of agriculture.
4. Implications for China's Reform Program

The devastating impact of the land rent version of reform on national savings derives from the model's requirement that state workers receive wage increases in proportion to the rate of food price inflation rather than according to the absolute magnitude of higher food expenditures. The two-tier pricing approach to reform essentially allows the real income standard, which is defined in terms of food, to be met through a subsidy specific to food. By contrast, the generalized wage subsidy of Scenario III provides a far less efficient vehicle for meeting the same standard.

If under a Scenario III approach to reform, state wage increases could be held to less than the rate of food price inflation, the negative effects on state enterprise profitability and national savings would be mitigated. While this might seem feasible in the abstract since food expenditures account for only a portion of household spending (and hence real wages in terms of a market basket of consumer goods could be stabilized even with the lower rate of nominal wage increase), the psychological import of food price increases should not be underestimated. Workers who witness food prices rising 100 percent and their own wages rising only 50 percent (or 60 percent or 80 percent) are all too prone to become restive. Judging by the actual Chinese experience with regard to non-staple foods, compensation is indeed not easily confined to the absolute rise in expenditures. Sales price increases for non-staple foods instituted in 1979 brought the government an additional ¥4 billion a year in revenue, but wage supplements intended to offset the higher food prices in turn cost ¥5 billion and, in addition, 40 percent of urban workers were promoted to higher wage grades at further cost to the state (Wan 1982, 41-2, cited in Sicular 1989, 273). Economists at the (now defunct) Chinese Rural Development Center have charged that urban workers managed
have become agents of the state as opposed to true collective decision-making bodies. In that capacity, they would be well-suited to administer land rental payments made by households to the government, just as they have administered crop procurement at controlled prices. The RDC advocates a system of competitive bidding to determine land rental rates. The system would apply only to land used for commercial cultivation, not that used for meeting household rations, and land parcels would carry with them a contract obligation for sale of a given amount of output at the state's price.

The RDC's concern rested primarily in fostering more efficient use of land in the immediate term with existing crop procurement institutions to remain in force. Nevertheless, the system the RDC has proposed would readily accommodate gradual elimination of controlled procurement prices. The government need only adopt in advance a schedule of yearly procurement price increases and sales obligations to be publicized at the time that bidding for land took place. In an inflationary environment such as China had during most of the reform period, future procurement prices would need to be linked to the general price level, or perhaps more specifically to market-determined prices for procured as well as unprocured crops and the cost of agricultural inputs. Failure to take adequate heed of inflation in the 1980s led to a rapidly widening gap between procurement and market prices which in turn brought growing contract enforcement problems and serious strains on the two-tier system (Siculer 1988). In order for the two-tier system to be successfully phased out, procurement prices would have to rise faster than market prices and moreover, farmers would have to have confidence that such would be the case when they submitted their bids for land. Faith in the increasing returns to be generated by farming is critical to inducing the higher rental payments necessary to offset price subsidy outlays borne by the government budget. A
negative in the static sense though, the dynamic gains associated with an expedited reform program might be adequate to justify imports provided that capital markets functioned well enough to finance a short-term trade deficit.

To assess the potential for a relaxation of the food self-sufficiency constraint to alleviate the redistributional pressures associated with reform, Scenarios II and III of the model have been re-estimated with a 10 percent lower constraint value for agricultural output. The results are presented as Scenarios II' and III' in Table 2. Under two-tier pricing the plan-market price divergence is only 40 percent with the introduction of imports versus 70 percent given self-sufficiency. Under the system of unified pricing with land rents the price rise drops to 47 percent as opposed to 94 percent without imports. The land rent payment is only about a third of that prescribed when self-sufficiency is imposed. Yet because the wage burden on state enterprises is greatly reduced, national investment rebounds to about three-quarters of its pre-reform level from less than a half.

The figures presented in Table 2 treat the agricultural imports as a windfall, at least in the static sense, thus if any exports are in fact required to achieve a trade balance these must be deducted from the wage and investment magnitudes shown. Without reference to world terms of trade the exact cost of the imports cannot be known, and at the level of aggregation embodied in the model any attempt to produce an estimate would be dubious. The domestic relative price ratio may under- or over-state world terms of trade. Domestic agricultural prices will tend to be pushed above their world levels if China is producing such goods against its comparative advantage. On the other hand, they will tend to be depressed as long as labor's value marginal product in agriculture can remain below a competitive wage. If the former effect dominates, the roughly 5 units of the industrial good required
embodied in II, agricultural workers become accustomed to higher standards of living. The move from II to III', prior to the withdrawal of any exports, already involves a modest drop in rural wages measured in units of the industrial good as imports release agricultural labor to industry and marginal productivity there declines while land rents undercut the average product wage of farmers. In terms of the agricultural good, rural workers nevertheless become somewhat better off due to industry's terms of trade improvement. The more ambiguous impact on agricultural labor for the II to III' transition would severely hinder the state's ability to mobilize industrial exports. Although the transition brings an increase in industrial output totaling 10.3 units if the release of intermediate inputs from agriculture is included, this and more is swallowed up by the 25 unit increase in the state's wage bill. In order for imports to make the critical difference in allowing the land-rent reform package to be adopted from a Scenario II base, capacity to pay for the imports would need to be generated via growth over time. In the short run, capital inflows would be required to support the transition.

6. Conclusions

The findings from such an abstract modeling exercise as the one contained in this paper can only be suggestive as to the nature of viable reform options and possible approaches to solving problems. In that spirit, the following conclusions are offered on the prospects for using land rents to replace the implicit tax on agriculture embodied in the two-tier pricing system.

The two-tier system draws its appeal from its capacity to allow subsidies to be administratively focused on a select group of recipients, for a select group of commodities. If the objective of Chinese planners is to
APPENDIX A: Notation

Sectors
A  agriculture
S  state industry
N  non-state industry

unsubscripted variables refer to economy-wide aggregates

Variables
Y  output
L  labor
K  capital
M  intermediate inputs
I  investment
P  plan price of the agricultural relative to the industrial good
P'  market price of the agricultural relative to the industrial good
R  land rent paid by the agricultural sector
X  variable x held fixed at initial magnitude

Parameters
γ  output elasticity wrt labor in non-state industry
α  output elasticity wrt labor in agriculture
β  output elasticity wrt intermediate inputs in agriculture
Cλ  agricultural production function shift coefficient
Cn  non-state industry production function shift coefficient
φ  agricultural output per capita
θ  planners' weight on investment
ω  wage to urban workers in agricultural equivalents
λ  Lagrangian multiplier
**TABLE 1: Scenario I Model Calibration**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<td>$L_A$</td>
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<tr>
<td>$L_M$</td>
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<tr>
<td>$K_M$</td>
<td>50</td>
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</table>

\[
\frac{Y_S + Y_M}{P + Y_A} = 3 \Rightarrow P = 0.333
\]

\[
\frac{I}{Y} = 0.3 \Rightarrow \omega = 7.95
\]

Scenario I

Lagrangian Conditions

$\theta = 2.78$
TABLE 2: Reform Scenario Results

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