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Pre-Reform Industry and State monopsony in China

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Abstract. This paper concerns employment and wage determination in the state industrial sector in China, focusing on the pre-reform era as a baseline. We argue that in that period, the sector faced an upward sloping supply curve of labor, and we provide statistical evidence for this proposition. We then present a two-sector model in which the Chinese state acts as a monopsonist maximizing industrial profits (investment) subject to an agricultural production constraint. Finally, we analyze two sets of data providing evidence of monopsonistic behavior, and discuss corroborating evidence in the extant literature and suggest implications for future research.

1. Introduction

In the course of modern economic growth, one universal regularity is that industrialization, urbanization, and increases in per capita output tend to go hand in hand. In their models of the development process, W. A. Lewis (1954) and J.C.H. Fei and Gustav Ranis (1961, 1964) viewed agriculture as a relatively stagnant sector in which productivity was ever-threatened by population growth. They argued that in the dualistic economy composed of that sector and of a more dynamic industry, "the ... criterion of "success" in the development effort is thus a rate of industrial labour absorption sufficiently rapid to permit the economy to escape from the ever-threatening Malthusian trap" (Fei and Ranis, 1964, p. 3).

As one of us has argued elsewhere (Putterman, 1992), China fits well into the overall framework of economic dualism, although it displays some special features.[1] Productivity has been much higher in industry than in agriculture, and economic growth has seen a rapid expansion of the former sector's share of output and investment. Nonagricultural employment growth has been unusually slow, however, even by the standards of developing countries. The pre-1978 era, in particular, saw industry's share of output rose from 43.1% in 1952 to 71.9% in 1977, but its share of employment grew only from 6.7% to 14.1%. While post-1978 labour reallocation has been more in line with international trends, the job-creation record of the urban

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[1] This is not to assert the marginal product of agricultural labour in China's (or other developing economies') agriculture was zero--in fact, we believe the abundant evidence to the contrary, some of which is mentioned below. By dualism, we simply refer to the sharp gap in productivity and capital-labour ratios as between the rural and urban sectors, and to certain processes blocking or slowing the elimination of that gap by market forces (for references on dualism between China's urban and rural economic sectors, see Lardy, 1984, Zweig, 1987, Zhang, 1992).

industrial sector has nonetheless been disappointing. Even rural industry's growth, while spectacular by many standards of comparison, may have still fallen short of its potential.[2]

The commonly observed slowness of industrial employment growth in LDCs has often been attributed to too rapid a rise in urban real wages, ascribed, for instance, to the influence of strong labour unions, to urban-biased populism, to colonial legacies in civil service wage structures, and to other similar factors (for example, see Reynolds, 1965). While the wages of Chinese industrial workers may have exceeded labour earnings in agriculture for a variety of reasons, the wage argument does not offer a convincing explanation as to why China's industrial sector failed to play a major role in absorbing agricultural surplus labour during the Mao era. Evidence that will be reviewed in sections 4 and 5 of this paper suggests that the wages of workers in China's state industrial enterprises were substantially lower than their marginal product of labour (MPL) and nearly stagnant during 1952-77 (see Table 1 and Figure 1). We believe that an explanation of the peculiar pattern of structural change that characterized China during that period may be a key to understanding the more recent evolution of what is now one of the world's largest industrial economies. Not only does industrial job creation remain a problem for China today, but so too does the fate of the old state owned enterprise (SOE) sector, so critical to its economic and political prospects. A proper analysis of contemporary conditions in that sector, we suggest, requires an understanding of initial conditions that retained most pre-

[2] The rapid growth of China's rural industry may be intimately related to the constraints on urban employment growth on which this paper focuses, as we remark again in the conclusion. While rural industry created 55.25 million new jobs between 1978 and 1993, Chinese policy analysts still fret about rural labour surplus, and estimates based on data for the late 1980s suggest that employment by township and village enterprises was below socially optimal levels. See Dong and Putterman (1996) and Pitt and Putterman (forthcoming).

reform characteristics well into the 1980s.

In this paper, we propose an explanation of China's slow industrial employment growth during the pre-reform era based on the proposition that the state acted as a monopsonist facing an upward-sloping supply curve of labour. In Section 2, we develop our argument for modelling the pre-reform Chinese economy as a dual one with a state industrial monopsony, and provide statistical evidence that the state faced an upward sloping supply curve of labor. In Section 3, we present and analyze a formal two-sector model with state monopsony. In Section 4, we provide evidence of state industrial monopsony based on aggregate data for the years 1952-84, and on enterprise-level panel data for the years 1980-85, when reform in the SOE sector was in its infancy. In Section 5, we comment on other studies in the literature which have corroborated our core empirical finding without recognition of its monopsony-related implications, and on the paradox of the co-existence of a positive MPL-wage gap with the widespread phenomenon of "overmanning." We conclude with suggestions regarding the relevance of the analysis to the evolution of employment and wages in China's state owned enterprise sector in the years since the intensification of industrial enterprise reforms.

2. Initial Considerations and Evidence of the Upward Sloping Supply Curve of Industrial Labor

Under conditions of rural labour surplus, it might seem reasonable to suppose that urban industry faces an infinitely elastic supply curve of labour at the going average rural income, or some small premium above it. Lewis and Ranis and Fei considered a possible crisis in the

development process, as urban employers would face an upward sloping aggregate labour supply curve when absolute labour surplus began to be exhausted. However, no theory of a dual economy of which we are aware has yet considered the juxtaposition of such an upward sloping labour supply curve with monopsony in the industrial sector.[3] Once one's focus shifts to the case of a planned socialist economy like Maoist China's, it becomes clear that a monopsony assumption would at least merit exploration.

Consider the problem facing the Chinese state in the 1950s. As in the Soviet Union before it, rapid industrialization, viewed both as a basis for eventual improvements in living standards and as a means for demonstrating the superiority of socialism and for building a defensive capability against hostile external powers, was the Communist leadership's priority goal. Their observed behavior makes it seem reasonable to suppose that rather than solving the problem of maximizing industrial growth using some complex dynamic planning algorithm, China's leaders equated the industrial growth maximization problem with that of maximizing the rate of growth of the country's industrial capital stock. In a simplified depiction of the problem in which farmers consumed their own produce and used the proceeds of crop sales for nonfood subsistence and required farm inputs, and in which urban workers are likewise paid a wage just sufficient to afford their basic necessities, investment would be financed from the profits of state-owned industry, so the state's problem--collapsed to static terms for analytical

[3] Hornby (1968) and Dixit (1971), do consider the fact of an effective upward sloping supply curve of labour to the industrial sector, but they focus on the issues of planning in a free market economy, and not the decision making of the state as an industrial monopsonist in a centrally-planned economy. We thank Pranab Bardhan for alerting us to this work, of which we were initially unaware.

simplicity--would have boiled down to that of maximizing industrial profits.

If the state sector had faced a perfectly elastic supply of labor at the average level of earnings in the rural sector, or at some increment above that level (as in the labor surplus economy models), then its profit-maximizing strategy in the absence of further constraints would have been to employ workers in each SOE until their marginal product of labor (MPL) was just equal to that wage. In this case, we would observe a situation in which MPL was roughly equal to the wage with differences from complete equality being more or less randomly distributed and presumably attributable to managerial errors. Evidence that will be reviewed in the next section of this paper suggests, however, that the MPL of China's SOEs was typically substantially higher than the full wage paid (including generous imputations for the shadow value of housing provided, and so forth). If the supply of labor to the sector was really infinitely elastic, then the sector was systematically foregoing the profits that could have been earned by employing additional workers.

However, if drawing additional qualified workers into the sector required raising real wages, it would have been profit-maximizing on the state's part to set employment where the MPL curve of the sector intersected the curve tracing the marginal cost of labor, not the supply curve of labor. Wages paid, indicated by the height of the latter curve, would accordingly be found to be below MPL at equilibrium. The question is: why would the labor supply curve facing the technologically advanced core of Chinese industry have been upwardly sloped despite the seeming abundance of underemployed labor in rural China?

A significant transfer of labor from countryside to city could not be carried out without

raising the average real cost of industrial labor, for two main reasons. First, under the institutional conditions of Chinese agriculture in the collective period, it proved difficult to increase the marketing rate of the rural sector and to reduce the proportion of rural workers engaged in agricultural work. Indeed, even marketing rates well below those of the late 1950s proved to be unsustainable without raising procurement prices and, accordingly, the effective wage bill of the state as urban employer and provider. The increase in procurement prices went in large part to defraying the costs of inputs supplied by the state sector, such as electricity and diesel fuel, irrigation pumps, and chemical fertilizer. Second, providing housing, residential infrastructure, and services for the new residents was more costly to the state than providing the same amenities to existing residents, since for the most part the latter residents could rely on pre-existing housing and infrastructure, whereas supplying these to additional residents would entail costly new construction.

Our analysis of the evidence for the proposition that the effective supply curve of labor to Chinese industry was upward sloping focuses on the increasing cost of agricultural surplus. Numerous regression analyses of China's agricultural production prior to the 1978 reform have shown that a change of labour inputs significantly affected agricultural output, and the marginal productivity of labour in the Chinese agriculture was strictly positive (for references, see Tang 1980, Wiens 1982, Putterman 1990, Lin 1992, and Dong and Dow 1993; for review of other studies, see Putterman and Chiacu 1994). The difficulty that the state faced in its attempt to increase the marketing rate of the rural sector while reducing the proportion of rural workers engaged in agricultural work was well illustrated by the three major economic re-adjustments

that followed respectively the failure of the state's attempt at hyper-speed industrialization in 1958, 1971 and 1977 (Wu and Liu, 1985). In each of those events, a high rate of growth in industry had caused a decline in agricultural production and subsequently a severe shortage of food and industrial raw materials. To restore the balance between industry and agriculture, the state had to cut industrial investment and employment and raise the procurement prices for agricultural products.[4]

Tang (1985) compares agriculture-industry relations during the first decade of Communist rule in China (1949-58) to those during the first decade of collectivization and central planning in the Soviet Union (1928-37). He argues that while agriculture was a relatively weak sector in both countries, this did not become a major obstacle to industrial expansion in the early decades of the planned economy in the Soviet Union. By contrast, agriculture's problems directly affected industrial growth in China. Tang calculates the correlations between annual industrial and agricultural output growth for the respective decades, and finds them to be

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[4] In the most dramatic of these episodes, industrial output grew to 2.3 times its 1957 value in 1960, with SOE employment rising from 24.5 to 50.4 million workers, of whom perhaps 10 million were drawn from the countryside. According to official Chinese government statistics, however, agricultural output value declined by 23% over the same period. As a result of this shock and of the ensuing retrenchment, by 1962 industrial output value contracted to just 21% more than the 1957 figure, or fell by 48%, and SOE employment had fallen to just 33 million. Most rural workers transferred to the cities during 1958 to 1960 returned to the countryside, and agriculture took until 1965 to recover to its 1957 output value. In order to restart agricultural production growth and stabilize quota sales, the index of purchasing prices of farm and sideline products was raised by almost 24% in 1961 (China Statistical Yearbook, 1988; Lardy, 1983; Sicular, 1988; for discussions of the population movements associated with this episode, see Ashton et al., 1984, Bernstein, 1984, Walker, 1984, Riskin, 1987). A large increase in procurement prices also played a role in boosting China's farm output and contributing to a general acceleration of economic growth at the outset of the economic reform program in 1978.

significant and positive for the latter but not for the former country. Tang argues that the greater sensitivity of Chinese than of Soviet industrial growth to agricultural performance was due to the lower per capita crop output base with which China began: the Soviets could endure lower farm output and increased farm procurement, reducing rural incomes, yet leaving even the rural populace for the most part above the subsistence line. The Chinese, by contrast, could not raise procurement significantly without endangering rural subsistence.

As a result of the troublesome relationship between industry and agriculture, the purchasing prices of agricultural products relative to the prices of industrial goods sold to rural areas grew at a rate of 2.6 percent per year from 1952 to 1984 as a whole (see table 1) and at much higher rates during the post-Leap recovery and similar readjustment episodes. To examine whether changes in urban employment were a driving force behind the rise of the relative prices of agricultural versus industrial products, we conducted Granger causality tests based on vector autoregressions (VAR) for the price ratio, urban employment and labour productivity in grain production for the period 1952-1984.[5] The series on agricultural labour productivity was introduced to control for the output effect of injecting modern farm inputs into or adopting new technology in agriculture. The results are reported below:

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[5] The price data are published on p. 238 of the 1993 China Statistical Yearbook, the employment series are on P. 97 of the same publication, the grain output and agricultural labour force are on p. 109 and p. 141 of the 1984 China Statistical Yearbook and p. 328 and p. 345 of the 1993 China Statistical Yearbook. The VAR model was treated as a system of "seemingly unrelated regression equations" and estimated by the generalized least squares method. The lag length was chosen by the Akaike information criterion. The VAR model presented here is a stationary process because the roots of its polynomial equation all lie outside the unit circle. Hence, standard methods of statistical inference are valid for this model.

$$\ln P_t = -4.232 + 0.423\ln P_{t-1} + 0.215\ln L_{It-1} + 0.020 D_t \ln L_{It-1} - 0.167\ln\left(\frac{Q_A}{L_A}\right)_{t-1} \quad (1)$$

$$(-6.727) \quad (5.281) \quad (5.917) \quad (6.756) \quad (-3.053)$$

$$\bar{R}^2 = 0.98 \quad Durbin\ h = 0.48 \quad \chi^2_{(3)} = 61.61 \quad p\text{-}value = 0.0$$

$$\ln\left(\frac{Q_A}{L_A}\right)_t = 4.003 + 0.864\ln\left(\frac{Q_A}{L_A}\right)_{t-1} + 0.483\ln P_{t-1} - 0.235\ln L_{It-1} \quad (2)$$

$$(3.278) \quad (8.648) \quad (3.443) \quad (-3.023)$$

$$\bar{R}^2 = 0.75 \quad Durbin\ h = 0.41 \quad \chi^2_{(2)} = 12.02 \quad p\text{-}value = 0.002$$

and

$$\ln L_{It} = 3.085 + 0.810\ln L_{It-1} - 0.010 D_t \ln L_{It-1} + 0.329\ln P_{t-1} + 0.364\ln\left(\frac{Q_A}{L_A}\right)_{t-1} \quad (3)$$

$$(1.816) \quad (8.066) \quad (-1.463) \quad (1.551) \quad (2.498)$$

$$\bar{R}^2 = 0.95 \quad Durbin\ h = 1.17 \quad \chi^2_{(2)} = 6.86 \quad p\text{-}value = 0.03$$

where ln P is the log of the relative price of agricultural to industrial products, ln L_I is the log of urban employment, D is the dummy defined as equal to one for observations after 1977 and zero otherwise, ln (Q_A/L_A) is the log of grain output per agricultural labourer, the numbers in parentheses are t-statistics, χ^2 is the Wald statistics for testing the Granger causality in the respective equation, and p-value is the exact significance level of the Granger causality test.

All the coefficients of equations (1) and (2) are significant at the 1% level, and the coefficients of lagged urban employment and agricultural labour productivity of equation (3) are significant at the 5% level or better. The χ^2 and t statistics reported in these equations indicate

a unidirectional causality from urban employment to the ratio of agricultural to industrial goods prices, and a bilateral causality between the price ratio and agricultural labour productivity and between urban employment and the agricultural labour productivity. Specifically, equation (1) suggests that a one-percent increase in the urban employment would raise the relative price of agricultural to industrial goods by 0.22 percent in the next period and by 0.37 percent in the long-run. The price became more responsive to urban employment in the post-1977 period as the Chinese government permitted the decollectivization of crop production, reduced administrative control over peasant household activities, and increased its use of market-oriented incentives.[6] If these estimates are correct, industrial wage costs measured in terms of manufactured goods would have to have been adjusted by a similar magnitude in response to the rise of urban employment. Also as expected, agricultural labour productivity had a significant negative impact on the relative price, whereas the price ratio had a strong positive effect on agricultural labour productivity.[7] According to equations (1) and (2), a one-percent rise in agricultural labour productivity would reduce the price by 0.17 percent in the next period and by 0.29 in the long run; however, a one-percent increase in the relative price would raise agricultural labour productivity by 0.48 percent in the next period and by 3.54 percent in the long run. Clearly, the state had to pay a higher price premium for agricultural goods in order

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[6] The role of prices in the elicitation of farm sales could have been attenuated in China by the mandatory nature of most crop procurement and the enforcement capacities of the rural collective administration (see, for example, Butler, 1985). Because state control of agricultural pricing began after 1952 and was still in effect in 1984, the impact of the urban employment on the uncontrolled terms of trade between agriculture and industry would likely have been even stronger than what was indicated by the price regression equation presented here.

[7] A dummy variable was initially introduced to equation (2) to control for the effect of the post-1977 rural institutional reform but was dropped because it was not statistically significant.

to maintain an adequate food supply for its population with fewer agricultural labourers.

The relationship between urban employment and agricultural labour productivity was also fairly interesting. As shown by equations (2) and (3), a one-percent rise in urban employment would reduce agricultural labour productivity by 0.24 percent in the next period and by 1.73 percent in the long run; however, a one percent increase in agricultural labour productivity would lead to a 0.36-percent increase in urban employment in the next period and a 1.92-percent increase in the long run. The decline in agricultural labour productivity following an increase in industrial employment suggests that the removal of labour from agriculture might have created "dissavings" to agriculture by reducing the funds available for agricultural investment. All these results illustrate the severe constraint that China's agricultural sector had imposed on its industrialization program prior to the mid-1980s. Thus, the state could not expand industrial employment without offering collective agriculture higher prices and consequently paying higher industrial wages measured in terms of manufactured goods; the labour supply curve to Chinese state industry was upward sloping.

3. Theory

3.1 A Simple Model

Given the foregoing evidence that the state could shift additional labor into industry only by paying higher real wages and the historical reality of state monopoly over China's industry during the 1950s, '60s, and '70s, a simple textbook model of the Chinese state's behavior is straightforward to construct. The state would have maximized profits in each period by

employing the number of workers in industry at which the marginal cost of labor equalled its marginal revenue product. The equilibrium marginal product would be above the wage, with the gap being greater the more inelastic the labor supply.

In this section, we specify a more rigorous, general equilibrium model of the relationship between agriculture and state industry in such an economy. We consider the exercise to be instructive but not necessarily definitive, for it comes at some cost in terms of focusing on a few main links at the expense of others. Before presenting this model, we wish to emphasize that the evidence of a large MPL--wage gap in Chinese state industry, provided in Section 4, can be understood in terms of a more general model of monopsony, and is in no sense dependent upon acceptance of the specific structure introduced here.

Our model assumes that the Chinese economy prior to reform was divided into collective agricultural and state industrial sectors--thus leaving out details such as the existence of an urban collective sector and of rural private plots and nonfarm enterprises.[8] The model captures the

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[8] At the end of the 1950s when the Chinese government completed its collectivization program in agriculture and nationalization campaign in industry, the labour force employed by the private sector accounted for only 3.24 percent of urban employment. The share of private employment in the urban sector fell continuously until the late 1970s. The private sector was thus too small to pose any serious challenge to the state's monopoly position in the urban industrial sector. In the 1960s and '70s, about 20 percent of the urban labour force were employed by the so called collectively-owned enterprises (COEs). The COE sector was not really independent of the state's management, since most of the enterprises in this sector were either affiliated with state-owned enterprises or owned by the state at lower levels of administration. Within state industry, the state determined the wage rate and the employment level through the central and local labour bureau; individual SOEs had little autonomy in this regard.

While the existence of the roughly 5% of agricultural land reserved for private plots might be relevant to a model focusing on incentive issues, it is not important to our purposes, since peasants were prohibited from selling private outputs to urban residents prior to 1978. Rural collective industry was relatively unimportant before the mid-1970s. The fact that the centre made rural industrial investment conditional on meeting crop procurement targets, and

rising cost of industrial labour to the state as a need to pay a higher procurement price to peasants to allow them to cover increasing costs of manufactured inputs, thus leaving out such factors as the possible incentive effects of state procurement prices and the increasing cost of urban facilities, referred to earlier. Building on Dixit (1971), we abstract from population growth and consider only the question of reallocating labour from agriculture to industry. That process can be undertaken, in the model, only if the state provides the countryside with sufficient modern inputs and means to pay for them so that the same per capita food consumption can be supported by a smaller number of food producers.

Thus, assume that the agricultural sector produced only consumer goods which were foodstuffs, while the industrial sector produced only producer goods, which consisted of industrial investment goods, I_I and modern farm inputs, I_A. Let L_I and L_A denote respectively the industrial and agricultural labour force. By normalizing the total labour supply at unity, we set

$$L_I + L_A = 1. \tag{4}$$

The industrial output is defined as $Q_I = Q_I(L_I,K)$, where K is capital stock and fixed in the short-run, and agricultural output is defined as $Q_A = Q_A(L_A, I_A)$. Both production functions are non-decreasing and strictly concave in factor inputs.

The state is assumed to have been the sole employer of the industrial labour force

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emphasized a "grain first" approach in its interactions with the communes (see, for instance, Butler, 1985, Chan et al., 1984, Chen, 1982, Dong, 1991, Parish and Whyte, 1978, and Watson, 1983), is consistent with the overall thrust of our argument, and allows us to abstract from the reinvestment of farm earnings into industry, as an approximation.

whereas all members of the agricultural labour force are assumed to have worked in their collective production teams. Because the labour markets were tightly controlled by the state and agricultural collectives, the labour force was paid an institutionally given real wage rate (W^*), which is assumed to have been entirely spent on food consumption. Like Lewis 1954, Fei-Ranis 1961 and 1964, and Dixit 1971, we ignore the wage difference between the two sectors to simplify matters. We also abstract from income variation across industrial branches and rural regions.[9] In this abstract dual economy, state industry is modeled as having traded manufactured farm inputs with collective agriculture for the foodstuffs that its workers needed. Let P be the price of agricultural goods in terms of industrial output, i.e. the terms of trade between the two sectors when industrial output serves as numeraire. The industrial wage in terms of industrial output is

$$W = PW^*. \tag{5}$$

The supply price of labour to industry thus depended on the price of agricultural goods and the institutional real wage rate. In the equilibrium, we have

$$Q_I(L_I,K) = I_I + I_A \tag{6}$$

and

[9] In reality, a team could pay its members more if it were especially productive. Rural incomes also tended to vary between regions, reflecting historical patterns and resources. Nevertheless, caps on pay-out to peasants were frequently reported (Nolan, 1983), and procurement quotas were adjusted based on past surpluses. Thus, while inappropriate to modelling the elicitation of effort within the teams (on which, see Putterman (1993), Dong and Dow (1993)), the subsistence assumption is a reasonable approximation for present purposes.

$$Q_A(L_A,I_A) = W^*(L_I + L_A) = W^*. \quad (7)$$

The state imposed procurement quotas on agricultural collectives to ensure the equilibrium of the food market. It is assumed that under the government's intervention, agricultural collectives spent all their cash revenue on manufactured farm inputs in order to fulfill the sales quotas. Since agricultural teams were responsible for their own profits and losses, the state had to pay for its food procurement a price that enabled the teams to cover their production cost, i.e., a price at which the teams could afford to purchase modern farm input to fulfil their sales quotas. Thus, the demand for manufactured farm inputs is written as a simple identity

$$I_A = P(Q_A - W^*L_A) \quad (8)$$

which shows the quantity purchased, I_A, to be increasing in the price of agricultural goods, P, and in the agricultural surplus net of the food consumption in the sector. Assuming that the state invested all industrial profits in industry, we have in the equilibrium

$$I_I = Q_I - WL_I = Q_I - PW^*L_I. \quad (9)$$

Equations (4) to (9) constitue our basic model of the Chinese economy prior to the mid-1980. As in the conventional general equilibrium analysis of the dual economy, the terms of trade in this model play a pivotal role in integrating the industrial and agricultural sectors. But unlike those dualistic models in which the price of agricultural goods is introduced as an argument of the food demand function (for example, see Dixit, 1971), the terms of trade in our model are assumed to have affected the demand for manufactured farm inputs and hence the

aggregate food supply.[10] The neglect of the price effect on the demand side in our model is justified by the fact that the food consumption of China's population was more or less fixed through rural food procurements and urban food rationing during the 1960s and 70s. This system remained intact until the mid-1980s although the rural economic reform introduced in 1978 had considerably improved food availability to urban residents by allowing peasants both to retain more surplus and to sell their produce to urban residents in free markets.

3.2 The Labour Supply Curve to State Industry

As shown by equation (5), the supply price of labour to industry involves the price of agricultural goods. Thus, to see the effect of industrial employment on wages, we must examine its impact on the price of agricultural goods. Substituting equation (8) into (7) and differentiating equation (7) with respect to the price P and the industrial employment L_I yields

$$\frac{\partial P}{\partial L_I} = \frac{\frac{\partial Q_A}{\partial L_A} - P(W^* - \frac{\partial Q_A}{\partial L_A})\frac{\partial Q_A}{\partial I_A}}{\frac{\partial Q_A}{\partial L_A}(Q_A - W^* L_A)} \qquad (10)$$

where

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[10] Note, too, that the "demand for manufactured farm inputs" is assumed to be determined by the state, rather than by the rural collectives themselves. We imagine the state to be attempting to maximize industrial profits subject to constant food consumption by a fixed total population. To allocate more labor to industry, the state must produce the added manufactured inputs necessary to keep total crop output constant, compensating for the reduced labor force, and it must pay farmers enough so they can purchase those inputs. Rural collectives may be seen as being constrained to meet crop sales quotas and to cover their remaining members' subsistence needs, with the purchase of specified amounts of farm inputs being a requirement of doing so, taking production technology and effort per worker as given.

$$\frac{\partial P}{\partial L_I} \lesseqgtr 0 \quad if \quad \frac{\partial Q_A}{\partial L_A} \lesseqgtr P(W^* - \frac{\partial Q_A}{\partial L_A})\frac{\partial Q_A}{\partial I_A} \tag{11}$$

According to equation (11), the price of food (and thus industrial wage W = PW*) would have been increasing as labour was allocated from agriculture to industry if the marginal product of agricultural labour (MPL_A) was either greater than or equal to the wage, or below the wage by not too great an amount. If the MPL_A were small enough relative to the wage, P could, by contrast, have been unaffected, or even have been decreasing, as L_I rose and L_A fell.

Indeed, the two sides of the second inequality in (11) reflect two different effects which the removal of the marginal unit of labour from agriculture would have had on agricultural output. The left side of this inequality reflects the direct reduction in the aggregate food supply due to reducing the number of agricultural labourers, assuming that the MPL_A was greater than zero. The right side of the inequality shows the effect of reduced agricultural labour on the marketable surplus of agriculture and consequently the collectives' ability to acquire modern farm inputs at any given price P. Specifically, the withdrawal of labour from agriculture could generate savings (dis-savings) for the collectives (i.e. additional funds with which to purchase modern inputs, or a reduction in such funds) if the institutional real wage W^*, i.e. the amount of food consumed by the last unit of agricultural labour, was higher (lower) than its contribution to agricultural production, i.e. the MPL_A. The withdrawal of labour from agriculture would decrease, increase or have no effect on the price of agricultural goods and consequently the industrial wage depending upon whether the labour input effect was smaller than, larger than, or equal to the savings effect.

An interpretation of (11) is that at the very early stage of development where the MPL_A was much lower than the institutional wage W^*, a state-command economy could finance its industrial expansion by tapping the agricultural "savings" created by labour transfer itself without paying a price premium to the agricultural sector. However, as the reallocation of labour from agriculture to industry and the injection of modern inputs into agriculture continuously raised the MPL_A and closed the gap between W^* and MPL_A, a higher price had to be paid for agricultural goods because the "savings" to agriculture from being relieved of semi-surplus workers (workers whose income exceeded their marginal products) became insufficient to support the investment needed to sustain a given level of food production with fewer labourers. The "savings" effect would completely vanish when the $MPL_A = W^*$. Finally, still more removal of labour from agriculture could generate "dis-savings" to the agricultural sector if the collectives paid their members wages below the MPL_A, i.e., the last unit of agricultural labour produced more food than it consumed. In these situations, which were probably unusual,[11] the price would have had to rise even more rapidly as rural labour was shifted to industry. As the price of agricultural goods changed, the industrial wages had be adjusted accordingly. Thus, if examined over a wide enough range, the overall labour supply curve to industry could be a U-shaped curve in a centrally-planned economy; its slope was determined by the price effect of

[11] Using micro-level data on Chinese production teams from a moderately prosperous commune and unusually input-intensive commune during 1970-76, Dong and Dow (1993) find that the marginal value products of the sampled teams were consistently higher than the net average distributable income of the teams. Dong (1991) attributes this pattern of distribution to the excessive use of expensive modern inputs by the sampled teams. The unusual input-intensity in this particular case is also commented upon by Butler (1985), Wiens (1985), and Putterman (1993).

industrial employment, that is,

$$\frac{\partial W}{\partial L_I} = \frac{\partial P}{\partial L_I} W^* \begin{matrix} \leq \\ > \end{matrix} 0 \quad if \quad \frac{\partial P}{\partial L_I} \begin{matrix} \leq \\ > \end{matrix} 0. \tag{12}$$

However, the evidence reviewed in Section 2 suggests that during the period in question, Chinese industry faced a rising labour supply curve. Our empirical finding that $\delta P/\delta L_I > 0$ is consistent with equation (11), given findings (referred to earlier) of a positive marginal product of labour in Chinese agriculture.

3.3 The Monopsonist Solution and its Efficiency Implications

We now examine the state's optimal choice of industrial employment in a short-run equilibrium. The first order condition for the assumed maximization of profit or industrial investment as defined in equation (9) is

$$\frac{\partial Q_I}{\partial L_I} = PW^* + \frac{\partial P}{\partial L_I} W^* L_I \tag{13}$$

where the term on the left-hand side is the marginal product (MPL_I) of an extra worker and the sum of the right-hand terms is the marginal cost (MC) to the state of employing the extra worker. The MC equals the new wage plus the price premium that must be paid to ensure the food consumption W^* of the existing work force.[12]

In light of equation (13), the state's employment decision was affected by the shape of the labour supply curve facing the industrial sector. If the labour supply curve to industry was

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[12] In practice, the Chinese government often held constant the retail prices of food ration supplies and industrial wages but used industrial profits to subsidize the retail loss resultant from raising the procurement prices for agricultural products.

downward sloping, i.e., the second term on the right-hand side of equation (13) was less than zero, the state would choose an employment level at which the MPL_I of the last worker was below the industrial wage PW^*. In such an equilibrium, the state industry would absorb more labour than would the industry in a purely competitive labour market.[13] This was because, in the latter case, despite a downward-sloping labour supply curve to the whole industry, the employment decision of an individual firm would have no effect on the wages at which it hired labour in a competitive labour market, and hence the $MPL_I = PW^*$ condition would have prevailed.

If the labour supply to industry was perfectly elastic at PW^*, i.e. the second term on the right-hand side of equation (13) was equal to zero, the state would choose the employment level at which the MPL_I of an extra worker was equal to PW^*. In this case, the lack of competition among SOEs in the labour market would have had no effect on resource allocation; the state's choice of employment levels would have been just as efficient as the competitive outcome.

However, if the growth of industrial employment drove up the price of agricultural goods and consequently the wages at which the state hired workers, as suggested by the tests reported in Section 2, the state would have employed labour to the point where the MPL_I of an extra worker was below the industrial wage PW^*. Given sufficient sensitivity of P to L_I, the state monopsony equilibrium would then involve much less industrial employment than would the competitive equilibrium where each individual firm saw a flat supply curve and equated the

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[13] One might indeed speculate that the difference between this case and the monopsony case could explain the difference between the rapid labour reallocation that occurred in the Soviet Union and the much slower process that characterized China, although the required empirical analysis would take us beyond the scope of this paper.

MPL_1 to a given industrial wage.

From a static point of view, the resource allocation in the state monopsonist equilibrium was not efficient because given the same level of industrial capital stock and the same labour endowment, larger total output could have been obtained in a dualistic economy with a competitive industrial labour market. More precisely, while the same agricultural output would have been produced, meeting the food demand of the entire labour force in both types of equilibria, the industrial output would have been larger in the competitive equilibrium, because of the higher industrial employment. In addition, in the competitive equilibrium the terms of trade would have been more favorable to the agricultural sector, and the labour productivity of agriculture would have been much higher because fewer labourers would have been engaged in agricultural production and more modern inputs would have been injected into agricultural production.

The dynamic implication of the state monopsonist outcomes is, however, less straightforward. The industrial investment would have been maximized in the state-command equilibrium, and this might have led to the fastest rate of economic, or at least industrial, growth consistent with an institutionally given real wage rate (abstracting from more complex dynamics of a sort not addressed here). Lewis (1954) considers an upwardly sloped labour supply curve to industry at an early stage of development as a major threat to industrial investment and consequently the absorption of agricultural surplus labour because he believed the labour's marginal propensity to save (MPS) to be much lower than the MPS of private or state capitalists. Hornby (1968) and Dixit (1971) argue that in the situation where private saving is socially

suboptimal, paying industrial workers wages lower than the MPL_I, an outcome resembling the one in the state monopsony equilibrium, would be a necessary condition for the optimal growth. This raises the issue of whether the long-run development consequences of the state monopsonist solution may have been favourable, from a certain standpoint. To answer this question may need us to develop an optimal growth model, which is beyond the scope of the present study.[14]

One result that is easy to show is that to change the dualistic employment structure between the agricultural and industrial sectors in an economy where the state managed industry as a monopsony may need much more capital investment than in a competitive economy. To compare the industrial employment response to an increase in the size of capital stock K between the two types of equilibria, in the situation where the labour supply curve was upward sloping, we derive the comparative statics respectively for the state and competitive equilibria:

$$\frac{\partial L_I}{\partial K} = \frac{-\dfrac{\partial^2 Q_I}{\partial L_I \partial K}}{\dfrac{\partial^2 Q_I}{\partial L_I^2} - 2\dfrac{\partial P}{\partial L_I}W^* - \dfrac{\partial^2 P}{\partial L_I^2}L_I} > 0 \qquad (14)$$

and

In both cases, an increase in industrial capital stock would increase industrial employment. However, a rise of capital stock would create fewer jobs under state monopsony than it would in a competitive labour market under fairly general conditions. Thus, our state monopsony

[14] A policy-relevant answer would also have to take into account such issues as the quality of the capital goods accumulated and the allocative efficiency of the investment decisions taken under central planning.

$$\frac{\partial L_I}{\partial K} = \frac{-\dfrac{\partial^2 Q_I}{\partial L_I \partial K}}{\dfrac{\partial^2 Q_I}{\partial L_I^2} - \dfrac{\partial P}{\partial L_I} W^*} > 0 \qquad (15)$$

thesis offers an explanation for the puzzle in the Chinese economic development with which we began our discussion: that despite more than three decades of rapid industrial growth and unprecedented sacrifice of current consumption on the part of Chinese urban and rural residents, China's employment structure remained overwhelmingly agrarian.

By now we have established our conjecture that the state acted as a monopsonist in China's urban labour market prior to the mid-1980s, employing fewer workers than would a sector composed of competitive firms and paying a wage below those workers' marginal product of labour, as described by equation (13). We will validate this conjecture using two sets of industrial enterprise data in the next section.

4. The MPL-Wage Gaps under State Monopsony: Empirical Evidence

4.1 Empirical Framework

In Section 3, for the sake of simplicity we ignored the income gap between Chinese industrial workers and peasants, and assumed that all industrial wages were spent on food consumption. In reality, the wages of Chinese industrial workers, W, were higher than average labour earnings in agriculture (Yang and Zhou, 1996). There were two major components in industrial wages: (1) direct wage payments, and (2) welfare benefits. While maintaining

adequate food consumption was the main determinant of direct wage payments, as assumed in Section 3, the welfare benefits, including housing subsidies and the benefits for health, retirement, death, maternity, disability, etc, were determined by the state's commitment to maintaining at a minimum the pre-existing living standard of urban workers, and perhaps also to gradual improvements in the welfare benefits for that population. Also left out of our formal model, although noted earlier, is the fact that the average welfare benefit expenses would have tended to rise as industrial employment grew, because providing housing, residential infrastructure, and services for new residents would have been more costly than providing the same amenities to existing residents. A rising welfare benefit expense per worker would make the wage cost even more sensitive to the level of industrial employment. To examine the employment and wage behaviour of China's state industry more realistically, we replace PW^* by W and rewrite the first order condition in (13) as

$$\frac{\partial Q_I/\partial L_I - W}{W} = \frac{\partial W}{\partial L_I}\frac{L_I}{W}. \qquad (16)$$

The term on the left-hand side of this equation is the percentage gap between the marginal product of industrial labour MPL[15] and wages, whereas the term on the right-hand side is the inverse elasticity of labour supply. The percentage gap between the MPL and wages is a measure of the monopsony power held by the state, i.e., the state's ability to hold the wages below the marginal product of labour. In view of Dixit (1971), the MPL-wage gap can also be interpreted as a measure of the implicit tax imposed on China's population for China's

[15] In the rest of the paper, the subscript "I" is dropped to simplify the notation.

industrialization program prior to the mid-1980s.

In the next two sections, we will verify our proposition by examining empirically the relationship between the MPL and industrial real wages, and estimating the MPL-wage gaps in China's state industry[16]. To obtain estimates of the marginal product of industrial labour, we assume that China's state industry was characterized by the technology represented by a translog production function:

$$lnQ = \alpha_0 + \alpha_1 lnK + \alpha_2 lnL + 0.5\alpha_3(\ln\frac{L}{K})^2 \qquad (17)$$

where Q is real value-added, K is the real net value of capital assets, and L is the total number of employees (measured, in the data, at year's end). Equation (17) allows us to test the specification of the production technology, since the translog function reduces to a Cobb-Douglas function if $\alpha_3 = 0$. For the translog production function, the MPL is defined as

$$MPL = (\alpha_2 + \alpha_3(lnL_I - lnK))\frac{Q_I}{L_I}, \qquad (18)$$

and for the Cobb-Douglas production function, the MPL is defined as

$$MPL = \alpha_2\frac{Q_I}{L_I}. \qquad (19)$$

[16] Strictly speaking, the state industry that will be examined in the next two sections is only one of many branches in the urban state sector which we sometimes call interchangeably the state industrial sector in the dual economy model of this section. The decision to focus on state industry instead of the entire urban state sector in the empirical analysis was made based on data availability.

4.2 Data and Variables

The empirical study of this Section is based on two sets of data. The first one involves the national aggregate time series data on China's state industry (*quanminshuoyouzhi gongyie*) from 1952 to 1984. The second one is a panel of data on stated-owned industrial enterprises for the period 1980 to 1985. This data set was collected by the Chinese Economic System Reform Commission (CESRC) in cooperation with the World Bank. It contains data on 967 SOEs located in 26 of what were then 29 Chinese provinces and province-level entities and distributed among 10 broadly defined industrial branches.[17]

For the time series data, the marginal products of labour were computed using the estimates of output elasticities by Chen *et al.* (1988). Chen *et al.* fit Cobb-Douglas production functions with two sets of data: (1) the official data that were directly obtained from various issues of China Statistical Yearbook, and (2) data that were revised to subtract from capital and labour inputs components devoted to nonproduction activities. Their estimate of the output elasticity of labour was 0.434 for the original data and 0.458 for the revised data. We use these estimates in the first of our own calculations.

In our own analysis of the time series data, output is measured as the net industrial output at 1952 prices of independent accounting units within state industry. Labour is measured by total year-end employees in the state industry. The time series of industrial output and labour were obtained from table 1 of Chen et al. The wage variable is constructed beginning with the series of total wage bill for state industrial employees obtained from the 1984 and 1993 China's

[17] The CESRC panel data set was provided to us by Gary Jefferson. For a description of this data set, see Xu et al (1993).

Statistical Yearbook. The "total wage bill" is the direct wage compensation for state industrial employees, which includes piece-rate and hour-rate wages, over-time compensation, bonuses, direct subsidies for food and fuels, and allowances. In 1978 subsidies and allowances accounted for 6.5 percent of the total wage bill and their share rose to 14.5 percent in 1984.

To obtain a complete measure of employee compensation in Chinese state industry, it is important to consider also elements additional to wages, bonuses and subsidies. Apart from the elements of the wage bill, discussed above, state employees also received the benefits of health care, retirement, disability and maternity, and death and emergency aid. The benefits are estimated based on a series of welfare and benefit payments as a percentage of the total wage bill published on p. 189 of China's Labour and Wage Statistics: 1949-1985; together, they added an additional 14 percent to the "total wage bill" in 1962 and an additional 24 percent in 1984 (CSYB, 1985, p.560). Housing subsidies are another major component of the state employees' compensation. In the 1986-90 panel data on SOEs compiled by the CESRC and the World Bank, the enterprises' expenses on depreciation, maintenance, repairs, and interest payments for nonproductive capital assets added, on average, an additional 20.4 percent to the "total wage bill". We use this figure to estimate housing subsidies. The full workers' compensation is thus calculated as the sum of the "total wage bill", welfare and benefit payment, and housing subsidies.[18] The wage variable used to calculate the MPL-wage gaps is derived as this grand

[18] Lardy (1984) estimates that in 1978 the value of subsidies and benefits accruing to state employees was 82 percent of the basic wage payment. By our own calculation, the value of subsidies and benefits was 44 percent of the wage bill in 1978 and 68.8 percent in 1984. Our estimates are likely to understate the total subsidies and benefits received by state industrial employees, because we do not attempt to calulate the implicit subsidies for rationed cereal and edible vegetable oil supplies bestowed by the state by selling cereals and oils at prices below its

sum divided by the total number of year-end employees in the state industrial sector. It is deflated by the Chinese retail price index with 1952 as base year.

For the panel data, value-added is obtained by subtracting the real value of purchased materials, fuel, and power from GVIO at 1980 prices. Data on GVIO at 1980 prices are directly available. The value of intermediate inputs was deflated by the industry-level industrial product price indices published in the 1994 China Statistical Yearbook. Capital input is measured by real net value of fixed assets used in production; the panel data contain the information that permits us to exclude the assets associated with nonindustrial services, in the manner of Chen et al. With the data on investment and depreciation, a recursive deflation procedure developed by Jefferson *et al.* (1992) was applied to derive real net value of fixed assets. This procedure corrects the potential distortion of investment good prices arising from the Chinese convention for calculating the current year's fixed assets. The Chinese capital stock deflators at 1980 prices, which include a separate series for each industry, were used. As with the time series data, labour input is taken to be the total number of year-end employees. Also as with the time series, the wage variable is calculated as a sum of direct wage payment, welfare and benefits, and housing subsidies. The direct wage payment is obtained directly from the data set.[19] The welfare and benefits are estimated using the time series information provided by China's Labour

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purchasing, transport, and distribution costs. However, the state's losses on the purchase and resale of rationed cereals and edible vegetable oils were not very large before the 1978 rural reform, and our overall findings are in any case robust to a revision in the direction of (or even beyond) the figure suggested by Lardy.

[19] Like the time series data, the direct wage payment includes piece-rate and hour-rate wages, bonus, and food and fuel subsidies and allowances.

and Wage Statistics: 1949-1985.[20] The expenses on depreciation, maintenance, repairs and interest payment for nonproductive assets are used as a proxy for housing subsidies.[21] Overall, for a typical SOE in the panel, direct subsidies and allowances added 19.6 percent to the wage and bonus payment, welfare and benefits added 26.8 percent, and housing subsidies added 24.4 percent. The total subsidies and benefits thus added 70.8 percent to the wage and bonus payments. The wage variable was deflated by the Chinese urban consumer price index with 1980 as base year. The descriptive statistics for the variables defined above are presented in table 2.

4.3 Empirical Results

The summary statistics for internal wages, MPLs, and the MPL-wage gaps for the time series data studied by Chen *et al.* are presented in Table 3. Both the original and revised data were applied in the calculation. As shown by this table, the SOEs' real wages were substantially lower than the estimated marginal products of SOE workers. The sample mean of the gap between the MPL and the wage was 175.52% of the full wage with a standard deviation of 74.68% for the original data and 190.76% of the full wage with a standard deviation of 78.81%

[20] The welfare and benefits paid by SOEs were 18.4 percent of the direct wage payment in 1980, 20 percent in 1981, 21.7 percent in 1982, 24 percent in 1983 and 1984, and 26.1 percent in 1985 (China's Labour and Wage Statistics: 1949-1985, p. 189).

[21] In this data set, the information on maintenance and repair expenses and interest payment are not available for the 1980-85 period, but they are available for the 1986-90 period. For the latter period, depreciation, on average, accounted for 41.9 percent of total capital expenses. This figure is used to estimate the total capital expenses on nonproductive assets for the 1980-85 period.

for the revised data.[22] Figure 1 plots the time series of the MPLs and the real wages for the 1952-84 period based on the original data. The gaps between the two series, when calculated based on the methodology described above, are found to have been getting wider over time in the post-1950s periods. A t-statistic for the difference in the population means between the estimated MPL and the wage using paired samples[23] is reported at the last column of table 3. In both cases, the t-test rejects the null hypothesis that China's state industry in a typical year employed workers to the point where the MPL equalled the wage rate with a p-value approaching zero. In other words, the gap between the MPL and the wage was significantly greater than zero for the 1952-84 time series data. Moreover, the magnitude of the gap is such that it would remain substantial even if our procedures understated the implicit subsidy elements in employees' full compensation levels or overestimated labour's marginal product.

Table 4 displays the estimates of the production function based on the CESRC panel data for the 1980-85 period. The production function was estimated either as a fixed-effects model using the least squares dummy variable (LSDV) method or as a random-effects model using the generalized least squares (GLS) technique.[24] The choice between the two models was made based on the Hausman tests reported near the bottom of table 4. We first fit the production

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[22] It seems noteworthy that these figures are generally compatible with the tax rates suggested by Dixit (1971) for socially optimal savings in a dual economy where decision making is at least partially decentralized.

[23] For the detail of the t-test using paired sample, see Kvanli, Guynes and Pavur (1995).,

[24] As is often the case for a large panel data set, the data analyzed here are fairly noisy. To examine the sensitivity of our estimates to data errors and outliers, we used the diagonal elements of the "hat" matrix and studentized residuals derived from the OLS estimates to detect influential observations. The dropping of these identified influential observations did not lead to any appreciable change in the estimates.

function with the entire sample, assuming that the technological differences between industries shift the intercept of the production function but do not alter factor elasticities. Then, relaxing the assumption of constant slope coefficients across industries, we estimated the production function for each of ten industries separately. To choose an appropriate representation of technology, we test the hypothesis that $\alpha_3 = 0$. The test results indicate that the translog function is adequate for the whole sample, and for textiles and machine building industries, whereas the Cobb-Douglas form is appropriate for coal mining, metallurgy, building materials, food, beverage and tobacco, garment, paper and printing, chemicals and pharmaceutical industries.

Judging by the adjusted R^2s reported at the bottom of table 4, the data fit the selected models quite well. The estimates of the time dummy variables show that the TFP of the SOEs in the combined sample grew steadily at a rate of 5.42 percent per year from 1980 to 1985, although the growth was uneven across industries. The factor coefficients are all significant at the 5% level or better for the full sample, and for food, beverage and tobacco, textiles, chemicals and machine building industries. However, the capital coefficients cannot be precisely estimated at conventional level of significance for coal mining, metallurgy, building materials, garments, paper and printing, and pharmaceutical industries. The estimates of labour coefficients are more satisfactory: except for the garment industry, all of the labour coefficients are significant at the 5% level or better. The estimated output elasticities of labour range from 0.487 to 1.407. These estimates are used to calculate the marginal products of labour and the MPL-wage gaps, and the results are reported in table 5.

As shown in table 5, the MPL-wage gaps based on the panel data are considerably wider than are those from the time series data reported in table 3. For the full sample of the 1980-85 panel data, the mean gap between the MPL and the wage was 571.4% of the wage with a standard deviation of 890.1%. This large standard deviation suggests that the data are quite noisy. When the sample contains outliers, the median may be a more reliable estimate of the average tendency than the sample mean. The median gap is 320.8% for all industries combined. The median gaps vary across industries with a range from 15.8% in the coal mining industry to 594.1% in the chemicals industry. The table also presents the quartile distribution of the MPL-wage gaps. For the coal mining and building materials industries, the workers in less than 50% but more than 25% of the enterprises received wages higher than their marginal products. For the rest of the industries, more than three quarters of the enterprises paid their workers wages substantially lower than their estimated MPLs.

Differences among industries could in part be due to the administered pricing structure peculiar to China's pre-reform economy, e.g., the well-known fact that the products of extractive industries like coal were priced low, raising profit rates in investment goods industries. Individual industry estimates may also be somewhat unreliable due to smaller sample sizes. The main finding remains that a positive gap between the MPL and the wage appears to be as characteristic of the employment and wage behaviour of China's state-owned industry in the early part of the reform period, as reflected in enterprise level panel data for 1980 to 1985, as it was over the long period from 1952 to 1984, as reflected in time series data. The last column of table 5 displays the t-statistics for testing the difference between the MPL and full

wages. The t-test rejects the null hypothesis that a typical SOE chose the employment level where the MPL equals the wage rate with a p-value approaching zero for the full sample and for each individual industry. Again, these qualitative results would be robust to considerable undercounting of nonwage benefits or overestimation of labor marginal products.

5. Discussion

Our finding that the marginal product of labour in Chinese SOEs was generally substantially higher than the full cost of employing a labourer both during the pre-reform period and the early part of the reform period (before the reforms had radically affected the SOE sector), is consistent with our hypothesis that the sector as a whole acted like a monopsonist facing an upward sloping supply curve of labour. Two further sets of corroborative evidence can be found in the recent econometric literature on the performance of Chinese state enterprises. First, in responding to arguments by Woo *et al.* (especially 1993) that unwarranted wage growth in the SOE sector was responsible for SOEs' mounting losses and for consequent macroeconomic problems in the course of China's economic reforms, Gary Jefferson and others have repeatedly pointed to the inequality between labour's earnings share and its output elasticity that is apparent in their own studies and those of other scholars. For instance, Jefferson and Rawski (1994) argue that for any reasonable estimate of the full wage, "labour's effective income share is unlikely to exceed 0.15, the figure around which estimates of labour's (gross) output elasticity appear to cluster" (*op. cit.*, pp. 54-5). When returns to scale are roughly constant, the finding that labour's income share is less than its output elasticity is

equivalent to our finding that the MPL of labour is greater than its wage, as in the equilibrium condition of a monopsonistic employer.

Second, in their intensive study of a panel of enterprise level data from the mid-1980s, Hay *et al.* found a large disparity between the MPL and the wage. For instance, on p. 381 of their book, they report finding that "[a]n additional worker ... raises output by 5,620 yuan" whereas "[t]he direct cost to the firm of an additional worker is 1,017 yuan per worker in wages and bonus" and that even after accounting for housing and welfare costs "it is likely that the returns to additional workers exceed the employment costs by a large margin".

Since Jefferson *et al.* focus exclusively on the idea that wage growth was not the cause of SOE losses, they do not mention or attempt to explain the apparent employment inefficiency implied by their findings. Hay *et al.* express some puzzlement at their own finding, in view of persistent reports of overmanning, but they suggest that given the administrative assignment of labour to SOEs, an excess of low-skilled workers in SOEs need not be inconsistent with a situation in which "the firms would indeed like to take on more workers with production skills, the system parameters suggesting that the value of marginal product greatly exceeds the additional wage costs" (p. 398).[25] This remark, made in passing by Hay *et al.*, appears quite similar in spirit to the position we take in the following paragraphs.

In particular, an argument that we anticipate from those resisting the unorthodox

[25] Jefferson *et al.* (forthcoming), find that, for enterprise panel data for the years 1988-92, the share of wages, welfare, and bonuses in SOE value added was .538, while labour's output elasticity was .648. (Corresponding estimates for the COE sector are .460 and .728.) In this case, however, they argue that since "labour also captures in-kind services, in the form of housing, health care, and pensions, ... [w]e expect ... that for the state sector ... cash and indirect payments to labour at least exhaust labour's technical contribution to production."

interpretation that China's pre-reform SOEs behaved as a collective monopsonist is that numerous estimates suggest that the SOEs are overmanned.[26] Not only might adherents of the overmanning idea expect marginal products of labour in SOEs to be low; on a literal reading, they might expect them to be approximately zero. They would thus be skeptical of our argument that the SOEs employed fewer, not more workers than the socially efficient benchmark.

We think that the best way of responding to the apparent paradox of observed labour redundancy combined with high marginal products is to bear in mind that the data and estimation procedures used by this and other studies cannot distinguish between workers who are highly productive and ones who are redundant. If all SOE workers were equally skilled and motivated, and if all were assigned to equally productive jobs, then production function estimates should indeed lead to estimates of marginal products of labour that approach zero, were there to be absolute overmanning. If workers vary in their qualifications, or if some are assigned to productive jobs while others are given mere "busy work," however, then as both more productive and more unproductive workers are added on the margin, estimates will only reveal the average marginal product of this mix, not that of the less productive workers. In this case, the fact that the average marginal product estimates are usually much higher than the wage implies that the marginal product of another productive worker, as opposed to a mix of productive and unproductive workers, was even further above the wage than our estimates indicate. Put differently, we would be underestimating the degree to which employing additional productive workers could have increased profits, but for monopsonistic concerns. Finally, the

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[26] See, e.g., Jefferson and Rawski, 1992, and sources cited therein.

existence of redundant workers, which we do not doubt, supports our assumption that the SOE sector would generally have been forced, in the past, to go to the rural sector for a supply of trainable industrial workers, since it suggests that the attempt to find SOE jobs for the existing urban population was pushed to the point at which workers who were not qualified for the core productive activities of a SOE often found themselves on its payroll despite that.

6. Conclusions

In this paper, we suggest that China's state industrial enterprises in the pre-reform and early reform era employed fewer workers than would have been socially efficient because the state faced an upward-sloping supply curve of industrial labour, and acted in the fashion of a profit-maximizing monopsonist who equates the marginal product of labour not with the wage, but with labour's marginal cost. The supply price of labour to state industry was increasing in the number employed because drawing additional labour from agriculture while maintaining the per capita food supply of the urban population required that a higher price be paid for agricultural goods. This hypothesis provides a potentially powerful explanation of the contrasts between China's rapid structural change, when measured by output, and its peculialy modest pre-reform structural change, with respect to employment.

It is remarkable that decades of research on the Chinese economy have noted this disparity in rates of structural change, and that a number of recent econometric studies have stumbled upon the type of marginal product-wage gap for which we have provided further evidence, yet the literature of which we are aware contains no suggestion that the state behaved monopsonistically. We believe that the failure to consider our hypothesis is mainly explained

by an assumption that there was a large labour surplus in China, an assumption that is inconsistent with the pricing and other historical evidence cited above. The dual economy literature, for its part, took note of the possibility of an upward sloping supply curve to a developing country's modern sector, but it did not model the case in which the industrial sector consists of a monopsonistic employer.

While potentially opening an important wedge for future studies of China's early decades of economic transformation after 1949, the analysis begun here may be equally valuable to our future understanding of the changing employment behaviour of China's SOEs since the intensification of economic reforms in the late 1980s and early 1990s. If the SOEs were beginning to exercise more control over their employment choices, if they were responding to pressures and opportunities to earn profits, and if the state's monopsony position was being eroded by competition from other firms and between state enterprises under different jurisdictions, during that period, then we should expect to see SOEs expanding employment from monopsonistic towards competitive levels, although at the same time attempting to shed unneeded workers earlier assigned to them by state labour bureaus. Instantaneous adjustment to a competitive equilibrium is implausible, however. Past patterns would be likely to leave their traces for some time. During the early reform period, moreover, employees may initially have benefited from the combination of increased enterprise autonomy and of only gradually declining state monopoly profits by increasing their compensation levels above their opportunity costs, and

this may also leave traces that will be eliminated, if at all, only gradually.[27] The more rapid expansion of industrial employment in rural than in urban enterprises in post-reform China might also be integrally related to the legacy of state monopsony and to the related reluctance of the Chinese government to expand urban social infrastructures. A full understanding of the evolution of wages and employment levels in Chinese industry in the reform era is therefore likely to prove to be impossible without giving adequate consideration either to the monopsony starting point posited by this paper, or to some alternative explanation of the evidence presented by us.

[27] On enterprise autonomy and employee compensation, see Walder, 1989; on the gradual decline in monopoly profits, see Naughton, 1992. Some analysts have suggested that China's SOEs may behave, in the reform era, more like labour-managed firms (LMFs) than like profit-maximizing ones, in view of the sorts of worker influence on management discussed by Walder. Although the employment-restricting tendency of theoretical profit-making LMFs could produce outcomes resembling those of monopsony, LMFs would not engage in the same monopsonistic exploitation of their workers. A full treatment of this contrast lies beyond the scope of this paper.

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Table 1: Trends in China's Dual Economy and Industrial SOEs[1]

	Annual Rate of Growth						
	Dual Economy			Industrial State-Owned Enterprises			
Periods	Terms of Trade[2]	Urban Employment[3]	Industrial Output[4]	Industrial Capital Assets[5]	Industrial SOE Employment[6]	Labour Productivity[7]	Real Wages[8]
1952-77	2.14% (18.08)	4.62% (11.92)	9.59% (13.31)	11.08% (18.12)	5.98% (7.38)	3.61% (7.80)	0.1% (0.28)
1978-84	5.06% (4.14)	4.13% (20.59)	5.84% (8.76)	7.06% (51.57)	3.01% (10.53)	2.83% (3.11)	4.44% (4.55)
1952-84	2.60% (20.97)	4.60% (19.24)	8.92% (19.35)	10.05% (23.97)	5.54% (10.93)	3.39% (11.71)	0.72% (2.86)

Notes: 1. The figures in this table are obtained from the time trend regressions using the aggregate data published in various issues of China's Statistical Yearbook. Numbers in parentheses are the t statistics of the coefficients on time trends.

2. Terms of trade is measured by the ratio of the overall agricultural procurement price index to the industrial rural retail price index with industrial price index in 1950 as 100.

3. Urban employment is a sum of staff and workers in state-owned units and in collective-owned units in the urban sector and self-employed registered urban residents.

4. Industrial output is measured by the net industrial output at 1952 prices of independent accounting units within state industry. The data are obtained from Chen et al (1988).

5. Industrial capital assets are measured by the net value of fixed assets at 1952 price of independent accounting units within state industry. The data are again from Chen et al.

6. Industrial SOE employment is the total staff and workers in the industrial SOEs.

7. Labour productivity is measured as industrial output per SOE worker in industry.

8. Real Wages is the average "full" wage of industrial SOEs deflated by the overall retail price index with 1952 as base year. The "full" wage is defined in Section 4.

Table 2: Summary Statistics of the Variables[1]
Panel Data, 1980-1985

	Real Value-added	Real Assets	Employment	Real Wages
	10,000 yuan	10,000 yuan	workers	yuan
All Industries Combined:				
Mean	2,726.49	2,531.16	3,257	1,233.6
Std. Dev.	9,693.83	16,207.63	10,683	344.3
Coal Mining:				
Mean	4,852.27	10,460.04	15,215	1,551.4
Std. Dev.	12,385.43	25,715.46	28,913	403.6
Metallurgy:				
Mean	7,794.38	8,901.15	7,865	1,265.3
Std. Dev.	25,637.34	45,784.11	24,431	310.3
Building Materials:				
Mean	950.60	1,379.65	1,975	1,286.6
Std. Dev.	1,189.68	2,026.65	2,301	267.7
Food, Beverage, and Tobacco:				
Mean	2,775.69	546.31	1,204	1,183.3
Std.Dev.	4,760.88	511.54	934	401.7
Textiles:				
Mean	3,422.36	1,420.98	3,682	1,128.8
Std. Dev.	3,489.86	1,986.95	2,686	211.9
Garments:				
Mean	905.01	252.82	1,253	999.7
Std. Dev.	1,109.66	316.72	1,121	243.8

Table 2: Summary Statistics of the Variables (cont'd)
Panel Data, 1980-1985

	Real Value-added	Real Assets	Employment	Real Wages
	10,000 yuan	10,000 yuan	workers	yuan
Paper and Printing:				
Mean	760.96	782.84	1,323	1,162.4
Std. Dev.	869.89	1,336.30	1,076	280.1
Chemicals:				
Mean	1,598.86	996.31	1,504	1,234.2
Std. Dev.	2,055.08	2,020.58	1,424	305.6
Pharmaceutical Products:				
Mean	1,805.66	647.17	1,254	1,186.1
Std. Dev.	3,752.82	1,486.79	1,061	525.5
Machine Building:				
Mean	1,501.45	1,659.65	2,506	1,241.1
Std. Dev.	2,198.29	6,712.88	2,610	284.3

Notes: 1. The data are collected by the CESRC in cooperation with the World Bank.

Table 3: Summary Statistics of MPL, Wage and the MPL-Wage Gaps
Time Series Data, 1952-1984[1]

	Mean	Std. Dev.	Median	Quartiles		t-test
				1st Qrt	3rd Qrt	p-value
Original data:						
MPLs (yuan)	2081.51	688.35	2183.48	1453.08	2593.01	12.20
Wages (yuan)	748.87	107.25	739.05	690.96	787.60	0.00
Gaps (%)	175.52	74.68	196.18	100.26	244.42	
Revised data:						
MPLs (yuan)	2343.92	794.04	2466.01	1621.19	2922.29	12.34
Wages (yaun)	797.14	119.23	788.98	735.75	834.91	0.00
Gaps (%)	190.76	78.81	212.56	111.33	263.47	

Notes: 1. Author' computations use data from China's Statistical Yearbook, various issues and the output elasticities estimated by Chen et al (1988).

Table 4: Production Functions: 1980-1985 Panel Data[1]
Dependent Variable: Log Value-Added

	All Industries	Coal Mining	Metallurgy	Building Materials	Food, Bev. & Tobacco	Textiles
Models	GLS[2]	LSDV	LSDV	LSDV	LSDV	GLS
Log K	0.167 (6.338)	0.019 (0.376)	-0.010 (-0.275)	0.135 (1.321)	0.287 (3.981)	0.513 (7.472)
Log L	0.897 (24.309)	0.688 (3.823)	0.572 (2.815)	0.487 (1.634)	0.538 (2.719)	0.728 (6.782)
0.5(Log L - Log K)^2	0.011 (4.737)	------	-------	-------	-------	0.031 (3.914)
Labour Elasticity	0.908	0.688	0.572	0.487	0.538	0.767
Capital Elasticity	0.155	0.019	-0.010	0.135	0.287	0.475
Year Dummies						
1981	-0.053 (-2.495)	-0.003 (-0.043)	-0.078 (-1.248)	0.087 (0.985)	0.048 (0.635)	0.036 (0.680)
1982	-0.014 (-0.713)	0.047 (0.644)	0.024 (0.383)	0.173 (2.001)	-0.043 (-0.556)	-0.099 (-1.856)
1983	0.055 (2.643)	0.061 (0.823)	0.079 (1.250)	0.165 (1.848)	-0.128 (-1.576)	-0.079 (-1.494)
1984	0.149 (7.237)	0.070 (0.893)	0.186 (2.933)	0.263 (2.875)	-0.106 (-1.201)	0.012 (0.228)
1985	0.271 (12.877)	0.097 (1.212)	0.232 (3.455)	0.249 (2.614)	-0.075 (-0.744)	0.161 (2.895)
Industry Dummies[3]	yes	no	no	no	no	no
Regional Dummies[4]	yes	no	no	no	no	yes
Constant	-1.581 (-6.053)	no	no	no	no	-1.836 (-2.501)
Hausman Test[5]	12.744	17.783	23.396	20.522	28.394	10.497
p-value	(0.121)	(0.013)	(0.003)	(0.005)	(0.000)	(0.232)
Adjusted R^2	0.916	0.971	0.964	0.927	0.942	0.927
No.Obs.	4,565	205	455	333	404	427

Table 4: Production Functions: 1980-1985 Panel Data (cont'd)

	Garments	Paper & Printing	Chemicals	Pharmaceutical Products	Machine Building
Models	LSDV	LSDV	GLS	LSDV	LSDV
ln K	0.129 (1.397)	0.016 (0.335)	0.056 (1.816)	-0.002 (-0.033)	0.374 (3.583)
ln L	0.688 (1.045)	0.628 (3.528)	1.086 (15.265)	0.408 (3.367)	1.369 (6.802)
$0.5(\ln L - \ln K)^2$	------	------	--------	-------	0.033 (4.195)
Labour Elasticity	0.688	0.628	1.086	0.408	1.407
Capital Elasticity	0.129	0.016	0.056	-0.002	0.335
Year Dummies					
1981	-0.137 (-0.608)	0.089 (1.439)	-0.091 (-1.694)	-0.024 (-0.368)	-0.207 (-4.048)
1982	0.013 (0.061)	0.169 (2.702)	0.064 (1.206)	0.007 (0.109)	-0.174 (-3.410)
1983	0.300 (1.329)	0.144 (2.354)	0.135 (2.604)	0.133 (1.979)	0.055 (1.069)
1984	0.343 (1.533)	0.263 (4.237)	0.203 (3.892)	0.289 (4.183)	0.201 (3.807)
1985	0.402 (1.746)	0.357 (5.329)	0.393 (7.472)	0.526 (7.108)	0.366 (6.522)
Industry Dummies	no	no	no	no	no
Regional Dummies	no	no	yes	no	no
Constant	no	no	-0.947 (-1.811)	no	no
Hausman Test p-value	19.794 (0.006)	19.893 (0.006)	10.257 (0.175)	37.930 (0.000)	27.718 (0.001)
Adjusted R^2	0.856	0.891	0.904	0.938	0.890
No.Obs.	93	417	593	316	1067

Notes: 1. The table represents regression coefficients. Number in parentheses are the t statistics.

2. GLS indicates that the production function was estimated as a random-effects model by the generalized least squares method, and LSDV shows that the production function was estimated as a fixed-effects model by the least squares dummy variable technique.

3. Industrial dummy variables are introduced for the all industries combined sample, but not reported here.

4. Regional dummy variables are estimated for the random-effects model, but not reported here.

5. The Hausman test for each regression is performed based on the LSDV and GLS estimates by excluding time-invariant regressors.

Table 5: Summary Statistics of MPLs, Wages and the MPL-Wage Gaps[1]
Panel Data, 1980-1985

	Mean	Std. Dev.	Median	Quartiles		t-test[2]
				1st Qrt	3rd Qrt	p-value
All Industries Combined:						
MPLs (yuan)	8,252.5	1,150.1	4,931.7	2,939.9	8,934.6	41.46
Wages (yuan)	1,233.6	344.3	1,171.2	1,024.0	1,381.5	(0.00)
Gaps (%)	571.4	890.1	320.8	146.1	630.1	
Coal Mining:						
MPLs (yuan)	2,254.5	1,729.1	1,842.0	989.2	3,332.1	6.168
Wages (yuan)	1,551.4	403.6	1,482.4	1,267.4	1,754.3	(0.000)
Gaps (%)	45.5	121.0	15.8	-31.6	91.1	
Metallurgy:						
MPLs (yuan)	5,615.1	9,790.4	2,720.1	1,630.6	5,704.8	9.535
Wages (yuan)	1,265.3	310.3	1,223.1	1,061.1	1,416.2	(0.000)
Gaps (%)	326.3	666.9	132.3	46.5	305.5	
Building Materials:						
MPLs (yuan)	1,994.4	1,384.5	1,697.0	1,015.6	2,723.2	9.722
Wages (yuan)	1,286.6	267.7	1,248.7	1,087.7	1,471.1	(0.000)
Gaps (yuan)	54.4	105.1	33.1	-20.9	104.9	
Food, Beverage, and Tobacco:						
MPLs (yuan)	9,669.2	11,861.3	4,860.4	2,480.9	10,962.1	14.449
Wages (yuan)	1,183.3	401.7	1,103.8	981.0	1,342.5	(0.000)
Gaps (%)	704.9	1,020.0	306.7	131.7	887.2	
Textiles:						
MPLs (yuan)	8,058.3	8,839.6	5,554.5	3,280.8	8,265.9	16.306
Wages (yuan)	1,128.8	211.9	1,110.6	1,005.5	1,231.7	(0.000)
Gaps (%)	600.2	704.6	395.8	201.8	630.4	
Garments:						
MPLs (yuan)	5,181.3	7,577.1	3,463.3	2,508.5	5,800.9	5.332
Wages (yuan)	999.7	243.8	978.4	871.8	1,140.5	(0.000)
Gaps (%)	430.8	939.1	244.8	132.1	496.5	

Table 5: Summary Statistics of MPLs, Wages and the MPL-Wage Gaps (cont'd)

	Mean	Std. Dev.	Median	Quartiles		t-test
				1st Qrt	3rd Qrt	p-value
Paper and Printing:						
MPLs (yuan)	3,659.8	4,294.1	2,950.0	1,879.8	4,575.5	11.979
Wages (yuan)	1,162.4	280.2	1,107.0	973.8	1,285.9	(0.000)
Gaps (%)	215.9	347.0	166.6	74.7	299.9	
Chemicals:						
MPLs (yuan)	10.379.6	7,360.9	8,103.7	5,094.3	14,004.4	30.559
Wages (yuan)	1,234.2	305.6	1,175.8	1,020.2	1,389.4	(0.000)
Gaps (%)	747.3	571.5	594.1	343.6	1,053.3	
Pharmaceutical Products:						
MPLs (yuan)	4,598.6	3,919.5	3,449.5	2,250.2	5,345.6	16.620
Wages (yuan)	1,186.1	515.5	1,104.6	960.4	1,287.4	(0.000)
Gaps (%)	281.4	265.2	207.5	103.1	379.5	
Machine Building:						
MPLs (yuan)	9,099.0	10,090.1	6,068.0	3,925.7	10,373.7	25.623
Wages (yuan)	1,241.1	284.3	1,191.3	1,053.5	1,386.6	(0.000)
Gaps (%)	633.9	795.6	393.8	225.6	717.6	

Notes: 1. The MPL and MPL-wage gap estimates are derived from the regression coefficients reported in table 4.

2. The t-statistic is computed to test the null hypothesis that the state employed workers to the point where the MPL is equal to the wage rate based on paired samples.

Figure 1: Marginal Revenue Products and Real Wages
State Industry, 1952-1984