

**WAGE REFORMS & WORK EFFORT
IN CHINESE STATE ENTERPRISES**

by

Li Binsheng, East-West Center
Calla Wiemer¹, University of Hawaii

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ABSTRACT

Two types of wage reform are analyzed in this study: bonuses, which were originally paid to workers on an individualized basis out of a fixed enterprise fund, and profit-sharing, which linked worker wages in a more egalitarian fashion to team or enterprise performance. We test for the effectiveness of these reforms in stimulating work effort using a sample of 335 large state industrial enterprises, and conclude that the reforms were indeed successful.

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I. Introduction

State wages in pre-reform China bore little connection to work effort or productivity, with dismal consequences for work incentives (Granick 1987; Xiang 1982). Although moral suasion may have served to stimulate effort in the early years of Communism, the extremism of the Cultural Revolution discredited this form of motivation (Henley and Nyaw 1987). In the absence of strong ideological conviction, the Chinese system of permanent employment and rigid wages was poorly equipped to motivate effort and prevent shirking.

Since 1978, wage reforms aimed at linking payment with performance have been implemented. Two types of reforms are analyzed in this study: bonuses and profit sharing. As the bonus system was originally conceived, payments were to be made from a fixed total fund with individual rewards determined according to merit, "tournament" style. The profit sharing system introduced a few years later, by contrast, involved the linking of aggregate wage payments to earnings, with the rewards shared more equally among workers within an enterprise or work-team. Our purpose is to assess the effectiveness of these reforms in stimulating work effort.

In Section II, we provide historical background on wage reforms in Chinese state enterprises. In Section III, we consider Chinese incentive pay schemes in the context of the economics literature on agency. Section IV presents an econometric model for testing the relationship between wage reforms and worker productivity, and describes data from 335 large state enterprises used to estimate the model. The results and a concern regarding their interpretation are discussed in Section V. Section VI assesses the cost-effectiveness of the wage reforms, and Section VII offers conclusions.

II. Wage Reform History

In Chinese state enterprises, work-related income includes not only money wages, but welfare benefits, such as health care and education, and access to subsidized food, housing, and other commodities.² As bonuses were abolished in 1966, and subsidized commodities and welfare benefits are generally distributed independently of work effort, the only component of employment compensation that might conceivably have been linked to performance in the pre-reform period was the money wage. In fact however, money wages were virtually frozen from 1963 to 1977 (Walder 1987, 23), severing even this tie. With wages of existing workers fixed, substantial wage compression occurred as new workers were hired at the bottom of the wage scale and promotions were rare (Hu and Li 1993).

Beginning in 1977, the Chinese government took steps to address the motivational problems inherent in stagnant and uniform wages by offering merit-based wage increases to a limited proportion of state employees (Shirk 1981, 581).³ Recipients of the increases were chosen by their work groups, subject to the approval of enterprise authorities, on the basis of technical skills, work habits, and political conduct. Rather than promoting greater worker commitment to the job however, the process precipitated conflict and hard feelings. All workers believed they deserved pay increases after a decade and a half of frozen nominal – and declining real – wages.⁴ A large backlog of pay-related grievances had accumulated. In this context, the process used to assign wage increases was widely regarded as unfair. The first stage of the process involved face-to-face small group

²Additional subsidized commodities have included such items as cooking fuel, bus passes, insurance, theater tickets, baths, funerals, child care, and the list goes on.

³The proportions were 40% in 1977-78, 2% in 1979, and 40% in 1980.

⁴Walder (1987, 27) calculates that real wages did not return to their 1956 level until 1984.

discussions in which vague criteria of performance were applied to a period stretching back more than a decade. The resulting evaluations were fraught with controversy. The ultimate verdict on each worker's case rested with enterprise leaders who often used their power to benefit themselves and/or their friends. Problems with the decision-making process were compounded by workers' expectations that their new wages would remain frozen for a long time to come. The whole wage setting endeavor thus took on unbearably great moment.

The Chinese leadership decided that over the longer term, a restoration of bonuses would better address the motivation problem. In 1978, bonuses re-emerged to account for 2.3% of the total state wage bill. By the end of the 1980s, bonuses had risen to a stable 17% of the wage bill, or about four months pay (ZTN 1992, 125).⁵

From the outset, efforts were made to design a bonus system that would resist subversion. Because managers had little recourse to "stick" methods of extracting effort from workers, workers were in a strong position to demand any "carrot" management had at its disposal. To prevent managers from falling hostage to worker demands, the state imposed ceilings on the ratio of bonus pay to total wages.⁶ In addition, authorities stipulated that bonuses must not be distributed equally among workers (Shirk 1981, 585). The intent of this restriction was to encourage workers to compete among themselves for the largest possible piece of a fixed pie. Finally, release of bonus funds was conditioned on an enterprise fulfilling a variety of quantitative and financial targets (Hu and Li 1993).

⁵Standard wages accounted for just short of 50% of the total wage bill in the late 1980s, with subsidies amounting to more than 20% of the total and piecework wages to nearly 10% (ZTN 1992, 125).

⁶During 1977 and 1978, the bonus fund was limited to 5% of an enterprise's total wage bill. The ceiling was raised to 10-12% of the wage bill in 1979. Through the early 1980s, bonuses were steady at 2.5 to 3 months pay. And from 1985 onward, a highly progressive tax was aimed at limiting bonuses to 4 months pay (World Bank 1992, 35-39).

The decision on how bonuses would be apportioned was entrusted to the collective judgment of the workers. Under the best of circumstances, managers' ability to monitor job performance is imperfect; in the Chinese case, normal difficulties were compounded by the inexperience of managers and the disarray of enterprise internal accounts.⁷ It was thought therefore that peer groups would possess greater insight than managers on the respective contributions of group members.

The system did not function as smoothly as might have been anticipated however. Much time was consumed by group meetings which had a tendency to degenerate into bickering. Everyone believed they deserved bigger bonuses, and criteria for making judgments were too ambiguous to prevent disputes. Rising tensions threatened to destroy the harmonious functioning of the workplace.

Given the expectation of lifetime tenure in the same enterprise, preservation of amicable relations within the workplace was important to workers. By comparison, the potential benefit to be derived from assessing one's peers negatively was small given the fractional impact on one's own bonus from diminishing the bonus of another, the tendency for others to respond to harsh judgments in kind, and, in early years, the small size of the bonus pot relative to total wages. Workers realized as well that by competing with each other through working harder, they would all expend more effort for the same collective reward.

To circumvent the system, workers formed coalitions. Within these coalitions they agreed to rotate high bonuses from one period to the next so that wages would be equalized over time. The rules of the game thus did more to encourage expenditure of

⁷Walder (1987, 31) notes that "especially in the early years, many managers had virtually no experience in managing incentive systems. In a number of plants there were no existing quotas, and basic records and shop statistics were in the process of being restored."

effort on engineering alliances with co-workers than on improving factory performance.

By 1981, many enterprises had abandoned small group face-to-face assessments in favor of more objective indicators of performance (Walder 1987, 25). If evidence were available that a person's work was clearly sub-standard, for example if he arrived late, caused accidents, or failed to meet production quotas, his bonus would be withheld. Walder (1987, 29-33) argues that over time, however, workers became increasingly sophisticated in intimidating supervisors into joining their coalitions to tokenize bonuses, even to the extent of inducing diversion of monies from funds earmarked for other purposes. If supervisors failed to meet their demands, workers slacked-off on the job, took sick leave, hid tools, and generally disrupted factory operations. Given this climate of manipulation and abuse, the impact of bonuses was likely eroded through the early 1980s.

The most critical flaw in the bonus system was that with the total bonus fund fixed, workers as a group had no incentive to improve firm performance. Recognizing this, the state in 1983 took another approach to infusing incentives into the workplace. General remission of profits to the state was replaced by a profits tax under a reform known as *ligaishui*. The retained portion of profits could be used by enterprises for product development, reinvestment, emergencies, and employee welfare, as well as worker bonuses, all within state-set limits (World Bank 1992, 37).⁸

Unfortunately, profit retention increased opportunities, legal and illegal, to pad bonuses and raise wages generally. Money wages of state workers jumped by 19.5% in 1984 (after having risen at an average annual 2.5% rate during the preceding three years), while bonuses climbed to 14.4% of the total wage bill from 11.1% in 1983 (ZTN 1987, 688).

⁸The sum of the welfare and bonus funds was initially restricted to a maximum of 40% of after-tax profit. In 1984, the restriction was modified to allow up to 20% of after-tax profits to be placed in the welfare fund and 30% in the bonus fund (World Bank 1992, 37).

Acting through legal channels, enterprise managers were able to "negotiate" substantially higher-than-authorized bonuses. Chen and Wang (1987, 469) report that for a sample of 429 enterprises, negotiations succeeded in raising the 1984 bonus disbursement as a proportion of retained profits from 25.4% to 36.7%. Beyond the legal realm, Chen and Wang found that their sample enterprises "employ more than 40 different methods to dodge wage control and secure more bonuses and benefit."⁹

To block the wage and bonus inflation, sharply progressive taxes on labor compensation payments were introduced in 1985 (World Bank 1992, 39). Wage increases up to 7% and bonuses up to four months pay were tax free. Wage increases of 7-12% and bonuses of 4-5 months pay were taxed at a 30% rate. The tax rate then rose to 100% for wage increases of 12-20% and bonuses of 5-6 months pay and to 300% for wage increases in excess of 20% and bonuses above 6 months pay. The World Bank (1992, 42) maintains that as a consequence, "all but the most poorly run enterprises" were able to offer wage increases and bonuses to the tax free limits, but that few enterprises crossed into the taxable range. With regard specifically to bonuses, Walder (1987, 35) concurs in this impression based on his personal interviews. The implication is that the bonus system degenerated to the point that it no longer functioned to stimulate incentives. The sample of 335 state industrial enterprises used in this study shows more variability than these observers suggest, however. While on average the sample enterprises paid bonuses only slightly less than four months wages in 1987, 24% paid them in excess of five months

⁹These include, inter alia, transferring funds through labor service companies or auxiliary companies, unmerited disbursement of income, illicitly diverting funds from the set purposes, disbursing administrative appropriations to benefit individuals and adding the amount thus spent to the cost, using the bank accounts of collective enterprises to escape detection, unauthorized marketing of products by enterprises and omitting part of the returns from account books, awarding shares to individuals and paying them dividends, and increasing the disbursement of tax-free bonuses." (Chen and Wang 1987, 470)

wages and 13% in excess of six months wages. At the opposite end of the spectrum, 38% paid bonuses at less than three months wages and 22% at less than two months wages.

Concurrent with the tax increases and perhaps of more importance in constraining wage and bonus payments, the authorities undertook to formalize the link between wages and enterprise performance under a tighter, although more decentralized, administrative structure. The link between wages and performance was specified in growth terms under a system known as *gongxiao guagou* (wage-efficiency linkage). A 1% increase in a firm's performance indicator permitted it to raise wages by some percentage less than one to be determined through negotiation with supervising agencies. By defining the wage-performance link in growth terms, incentives were focused on achieving productivity gains above a baseline. Since the baseline was influenced by capital and technology differences across firms and by state-controlled prices, total or average measures of firm performance were considered a poor basis on which to reward workers. The specific performance indicator to which wages were linked varied by sector. Physical output was used in the coal mining and transportation sectors, output value in the construction sector, and in manufacturing, either the sum of taxes and profits remitted or gross profits realized (Pan 1990, 50).

Local governments were granted authority to negotiate the firm-specific terms of the *gongxiao guagou* system. This authority was circumscribed by limits on wage aggregates by locality, set under contract with higher-level governments (World Bank 1992, 32). Monitoring of wage payment activity was facilitated by a requirement of long standing that each firm's wages (but not its bonuses) be paid from a bank account specially designated

for the purpose.¹⁰

By the end of 1987, the *gongxiao guagou* system encompassed 60% of large and medium-sized state enterprises (Xin and Pan 1989, 68) and 70% of employment for all such enterprises or about 20 million workers (Hu and Li 1993). The package of reforms introduced in 1985 – consisting of bonus taxes, negotiated linkages between firm wage growth and performance, and local government monitoring – was successful in reining in wage expansion. Bonuses as a share of the total wage bill dropped slightly from their 1984 peak. For enterprises participating in the link system, taxes and remitted profits rose by 13.5% a year during the 1985-87 period while wage bills rose by a relatively restrained 11.3% (ZTN 1987, 688). By contrast, for state enterprises not participating in the system, taxes and remitted profits rose by 6.8% a year and wage bills by 15.5% (Hu and Li 1993).¹¹

The *gongxiao guagou* system was aimed at more closely associating an enterprise's aggregate wage fund with its performance. Important concurrent reforms within the enterprise focused on more effectively utilizing wage and bonus payments to stimulate individual incentives. This was accomplished through the "internal contract system," which is described by Lee (1990) as "a web of multi-tier sub-contracting inside the enterprise." The system defines output or financial targets at the sub-enterprise level and links bonuses to the over-fulfillment of these targets. Lee's empirical tests for the steel industry indicate that the internal contract system, when implemented in conjunction

¹⁰In light of the large degree of discretion conferred on local authorities, the World Bank (1992, 41) concluded that the "wage-efficiency linkage actually boils down to giving some appearance of objectivity to the arbitrariness of wage planning at the provincial level."

¹¹Employment also rose much faster for the non-participating firms. Without more information on why firms did or did not participate in the wage-linkage system, Hu and Li caution that any inferences must be drawn with caution.

with the managerial responsibility system, yielded discernible improvement in enterprise productivity (*ibid.*, 17).

III. Agency Theory and Chinese Incentive Pay Systems

Both the bonus system and the profit sharing system constituted attempts to motivate workers by rewarding effort. The reward systems were designed to reduce problems of agency that arise generally in situations where the objectives of principal and agent conflict and information about agent behavior is asymmetric.¹² In the case of the Chinese enterprise, the enterprise manager – or perhaps the state, with the manager acting as intermediary – wishes to maximize enterprise output (where the term output is used loosely and may refer to gross output, value added, profits, or some combined indicator of performance). Output is a function of the effort of agent-employees, who prefer rest to exertion and will offer effort only if properly coaxed. Although output is observable by the principal, effort is not; nor can it be precisely inferred, either because the effort of a single agent commingles with random shocks in generating output or because multiple agents produce a joint product in which their individual contributions are indistinguishable.

The principal can extract more effort from agents by linking wages to output than by paying fixed wages. In the case of a single agent producing output subject to a random shock, the optimal payment scheme, provided the agent is risk neutral, would involve a fixed claim on the part of the principal with the agent receiving the residual and thus recouping the full expected return to effort at the margin. If the agent is risk averse however, he may prefer a marginal share less than one in exchange for a higher

¹²For a good survey of agency theory, see MacDonald (1984).

guaranteed base wage but lower expected total compensation. Such a package would be appealing to the principal as well, provided he is less risk averse than the agent. If multiple agents are involved, reliance on an output-linked wage becomes more palatable since risk can be shared. The drawback to risk sharing is that when workers partake in returns to each others' effort but receive only a fraction of the expected marginal return to their own effort, they are inclined to free ride, with effort and output consequently dropping below their social optima.

A formal agency model will aid in the interpretation of China's wage reform policies. Suppose that worker i maximizes utility, U_i , by choosing effort level x_i . A minimum effort level \bar{x}_i is extracted through employer monitoring even in the absence of an incentive pay system, and compensation for this level of effort is set at \bar{w} . Profit sharing occurs out of net revenues generated above base output, so that $x_i - \bar{x}_i$ is rewarded. The rate of payment above the base is sP , where P is marginal net revenue product per unit of work effort and s is the share of net revenue distributed to workers. Altogether n workers share in the distributed profits, of whom m respond to a demonstration effect or peer pressure and put forth effort equal to that of agent i and $n-m$ free ride. Finally, the agent's utility function is assumed additively separable in money income and the disutility of work effort, $-x_i^\sigma$, where $\sigma > 1$.

The worker's decision is captured with the following maximization problem:

$$\begin{aligned} \max_{x_i} U_i &= \bar{w} + \frac{sPm}{n}(x_i - \bar{x}_i) - x_i^\sigma \\ \text{s.t. } x_i &\geq \bar{x}_i. \end{aligned} \tag{1}$$

For an interior solution, optimal work effort is:

$$x_i^* = \left(\frac{sPm}{\sigma n} \right)^{\frac{1}{\sigma-1}}. \quad (2)$$

A corner solution, where $x_i^* = \bar{x}_i$, will result if at the minimum bound on work effort, marginal returns to effort under the share payment system fail to match the marginal disutility from effort:

$$\frac{sPm}{n} \leq \sigma \bar{x}_i^{\sigma-1}. \quad (3)$$

Two general approaches to increasing effort are available to the principal within this framework. One is to raise m/n by reducing free rider behavior. The other is to increase sP/σ by raising the money payment made to work effort. Whether either of these approaches is actually effective in stimulating effort will depend on whether worker effort is being chosen at an interior optimum. If not, and the minimum effort constraint is binding, the incentive pay scheme will not produce results.

The free-rider problem is aggravated in Chinese enterprises by the heterogeneity of the labor force and the near impossibility of firing lazy workers. One standard solution to the free-rider problem is to impose a penalty contract under which no worker receives output-linked pay unless a specified group performance threshold is reached (MacDonald 1984, 424). The Chinese bonus system was by the mid-1980s structured in precisely such a way in that bonus funds were not to be released unless enterprise or work-team production quotas were met.

Another way of reducing free-rider behavior is to create circumstances that facilitate workers reaching agreements among themselves to cooperate in exerting effort. For cooperation to occur, the game of choosing an effort level must be repeated. In a repeated

game, as long as the individual player finds that the outcome associated with cooperation is an improvement over the outcome associated with all other players conspiring against him – in this case by withholding their effort and thereby reducing the group's incentive pay to zero – the "folk theorem" says that he will be motivated to cooperate (Kreps 1990, 508).¹³ Workers will more readily reach a welfare-improving cooperative equilibrium if the transactions costs associated with arriving at and enforcing an agreement are low (or more specifically, if the transactions costs are less than the expected gain from the agreement). One of the best ways to reduce transactions costs is to shrink the size of the group that shares in an incentive pay scheme. This was the intent of the Internal Contract System introduced in Chinese state enterprises in the mid-1980s. By linking bonuses and wages to the performance of small teams within an enterprise, an environment conducive to cooperation was fostered.

In the extreme case, if internal contracting could be implemented at the level of the individual worker, the incentive pay system would be reduced to a piece-rate and the free-rider problem would be eliminated entirely. Such a limiting case of internal contracting may not, however, be optimal if workers are risk averse and group incentive-pay schemes allow for risk pooling or spreading. Risk pooling occurs when the productivity of each member of a group is subject to an independent random shock, and the effects of these shocks are averaged among group members. Risk spreading takes place when the productivity of an entire group – in this case a work team – is affected by a shock, and the number of individuals sharing in the outcome of the group's efforts is enlarged – potentially, to include all employees of the enterprise. In either case, the premium a

¹³If workers discount the future or there is some non-zero probability that the game will end in a future period, then the gains from cooperation must exceed the worker's welfare under the punishment scenario by some positive margin in order for the worker to cooperate.

worker would demand to participate in the incentive pay scheme is smaller as the number of workers involved grows larger (Layard and Walters 1978, 363).

Chinese workers have a reputation for being particularly risk averse. A survey of 1,341 urban residents revealed that roughly half would prefer being assigned a low-paying job by the authorities to seeking work independently with a possibility of unemployment (Huang and Yang 1987, 150). The need to shelter wages from output variability is compounded by the high degree of uncertainty endemic to a reforming socialist economy. Cauley and Sandler (1992, 49) trace this uncertainty to the technical difficulties of planning inputs and outputs, administrative glitches (or abuses) in plan execution, transportation and energy bottlenecks, and machine failure arising from poor maintenance. Given the high variability in exogenous forces bearing on production, reticence on the part of workers to link wages to output in too individualized a manner is to be expected. This sentiment works against the principal reducing m/n by prompting workers to seek a higher n in order to pool or spread risk.

The second avenue available to the principal to motivate workers lies in raising the payment to work effort relative to the disutility of effort, sP/σ . Higher profit sharing rates are one way of accomplishing this, although the limits posed by worker risk aversity are again relevant. Another potential impediment to increased reliance on share payments is the "cultural and political orientation toward egalitarianism" (Lee forthcoming) that stands to be violated when productivity differences are reflected in wages. How deeply rooted any egalitarian beliefs are in China is perhaps questionable. Cauley and Sandler (1992, 52) argue that the appearance of egalitarianism is in fact traceable to the "arbitrary and capricious manner" in which incentive pay schemes have been administered. With proper incentives to managers to act fairly and responsibly in applying productivity-linked wage systems, worker resistance to such systems might be substantially diminished.

Higher marginal net revenue product of labor P would provide the same stimulus to work effort as an increase in the share payment rate s . Many factors that bear on P lie beyond the control of enterprise management, however. One of the most crucial determinants of P across sectors is relative prices for inputs and outputs, which still bear the mark of a system designed to tax agriculture and direct profits to light industry (Lu and Wiemer 1993). At the enterprise level, another factor impinging on marginal productivity of labor is the employment of redundant workers who nevertheless cannot be dismissed. Finally, differences in technical substitution possibilities across industries, and within industries across capital vintages, affect the marginal productivity of labor. In many industries, or enterprises, external factors thus conspire to undermine the impact of profit sharing on incentives. Nevertheless, there is some scope for enterprise managers to enhance the effectiveness of the profit sharing system through their capacity to influence P . Possible tactics include investment in physical or human capital, diversification of product lines, or improvement in product marketing.

IV. Production Function Estimation

How successful have incentive-based wage reforms been in motivating work effort in Chinese state enterprises? Have potential impediments to success – such as the free-rider problem or effort corner solutions in the face of a guaranteed base wage – been overcome? Impressionistic judgments are mixed. The World Bank (1992, 42-44) concludes that wage reform "had the immediate effect of turning a passive labor force into a contentious and calculating one." Given the lack of incentive for managers to champion the interests of capital, "managers' dominant objective would be to maximize benefits and job security of their employees rather than enterprise profit." The implication is that workers would be

able to extract the rents from reform without great pressure to increase work effort.

Jefferson and Xu (1991, 52-54) concur that there are problems related to "the maintenance of satisfaction among a workforce over which management can enforce little discipline." Nevertheless, they find that surveyed enterprise managers overwhelmingly cited raising enterprise profits as their "most important" objective. As "important" and "somewhat important" objectives, managers most often chose raising worker incomes.¹⁴ Jefferson and Xu interpret the worker-income objective as indirectly serving the profit objective insofar as managers seek "to pay an efficiency wage for the purpose of raising worker satisfaction and productivity."

Chen and Wang (1987, 463) conclude from enterprise accounting data that "reform of the distribution system has highly motivated enterprises to generate profit." Their conclusion rests on strong observed correlations between bonuses, retained profits, and gross profits for a sample of 429 enterprises. The implications for effort incentives remain somewhat ambiguous, however, given the multifarious routes to garnering profits these authors enumerate (see fn. 9). Nevertheless, it is worth noting that any economic notion of effort must include both mental and physical exertion and that even profit-augmenting activities in circumvention of rules may result in efficiency gains if resources are diverted from less to more productive uses.

We propose to test empirically for a relationship between reform and worker productivity based on an incentive-based model of wages and bonuses. Enterprise output is assumed to be a function of effective labor, capital, scale, and sector. Effective labor in turn depends on wages and bonuses, such that

¹⁴Thirteen state enterprise managers and six collective managers were surveyed. Other objectives specified in the survey were: expanding sales and scale; producing excellent products using modern techniques; fulfilling directives of superiors; raising product quality; and innovating new products.

$$E = W^a B^b L \quad (4)$$

where E is effective and L physical labor measured in number of workers, W is enterprise average wage and B average bonus, and a and b are effort elasticities with respect to wages and bonuses respectively.

Effective labor enters a Cobb-Douglas production function with capital, K , where the elasticities of the two factors are assumed to sum to one so that the relationship may be expressed in labor-intensive terms. Scale effects are incorporated through a Hicks-neutral shift factor, G . Industry intercept dummies capture sector-specific price distortions and technology differences. The production function to be estimated is thus

$$\ln(VA/L) = C_t + \alpha_t \ln(W) + \beta_t \ln(B) + \delta_t \ln(K/L) + \gamma_t \ln(G) + D_{it} + \epsilon \quad (5)$$

where VA is enterprise value added, t denotes year and i industrial sector, δ is the elasticity of output with respect to capital, α and β are output elasticities with respect to wages and bonuses respectively such that $\alpha = a(1-\delta)$ and $\beta = b(1-\delta)$, γ is a scale elasticity, C and D_i are the sample intercept and sectoral deviations from it respectively, and ϵ is an error term. The error terms are assumed correlated by enterprise across years, hence a "Seemingly Unrelated Regression" technique is used to obtain efficient estimates.

The data used to estimate Equation (5) are taken from a sample of 335 state industrial enterprises with observations for 1980 and 1987. As of 1980, a bonus system had been implemented on the principle of a fixed pool of funds being distributed according to merit. By 1987, wages were linked to profits, and bonuses in turn to wages, with more equal sharing among workers than under the original tournament-style bonus system.

Features of the sample enterprises are summarized in Table 1. The enterprises are large: indeed, average gross output for the sample in 1987, at ¥127.52 million, corresponds

closely to the ¥122.16 million reported for the 2,888 independent-accounting industrial enterprises officially classified as "large" in the national statistics (ZTN 1988, 318; ZGJTN 1988, 324). By contrast, the 6,071 "medium-sized" enterprises had an average gross output of ¥32.39 million and the 408,154 "small" enterprises an average gross output of ¥1.38 million. National statistics by enterprise size encompass both state- and non-state-owned enterprises operated at township and higher levels. For state-owned enterprises only, of all sizes, 1987 gross output averaged ¥8.45 million (ZTN 1988, 301, 310). Even by the standards of state enterprises then, the sample enterprises are very large.

Gross output for the sample enterprises nearly doubled in nominal terms between 1980 and 1987. Growth rate comparisons with national samples are not possible since reported national data pertain to samples that change in composition over time. In particular, the emergence of new firms at the small end of the scale tends to dilute growth rates calculated from such changing samples.

Average employment for the sample enterprises was nearly 4,000 by 1987, with the smallest enterprises employing around 200 workers and the largest over 200,000. As with gross output, the large size of the sample enterprises is apparent: average employment for all state industrial enterprises in 1987 was 419 workers (ZTN 1988, 155, 301). For "large" industrial enterprises of diverse ownership types, employment slightly exceeded that for the sample enterprises at 4,674 workers per firm (ZGJTN 1988, 324).

Employment for the sample enterprises was about ten times that of all state enterprises, while gross output was roughly 15 times larger. This would suggest that large firms may be more capital intensive than small firms. In fact, for "large" industrial enterprises in general, net value of fixed assets per worker averaged ¥20,279 in 1987, somewhat higher than the ¥16,799 of the sample enterprises, and much higher than the combined average ¥3,835 of "small" and "medium-sized" enterprises (ZGJTN 1988, 324).

Value added per worker was slightly higher for the sample enterprises, at ¥11,509, than for "large" enterprises generally which registered at ¥9,511; by contrast, value added per worker in "small" and "medium-sized" enterprises was a much lower ¥3,835.

The sample enterprises experienced employment growth between 1980 and 1987 of 26%. Capital stock and value added growth rates were substantially higher than employment growth, giving rise to per worker increases in both variables of about 43%. Employee compensation grew faster still, with the wage rate rising by 66% and per worker bonuses by more than 200%. In absolute terms nevertheless, the ¥823 per worker increase in wage and bonus payments was amply covered by the ¥3444 gain in per worker value added.

Combined wage and bonus payments were a bit higher in the sample enterprises than in state industrial enterprises generally. Total compensation figures were, for 1980, ¥947 per worker for the sample enterprises versus ¥826 for all enterprises, and for 1987, ¥1771 for the sample versus ¥1557 generally (ZGJTN 1988, 27). Bonuses accounted for a larger share of total compensation for the sample enterprises than was more broadly the case: in 1980, 14.6% for the sample versus 9.1% for state enterprises in all sectors, and in 1987, 24.2% for the sample versus only 16.8% for state industrial enterprises and 14.7% for state enterprises in all sectors (ZTN 1988, 182).

In sum, the sample enterprises exhibit a profile fairly typical of large industrial enterprises. They are far more capital-intensive and yield higher value added per worker than state enterprises generally. Worker compensation is nevertheless only slightly higher than for state industrial enterprises as a whole, but with a greater proportion deriving from bonuses. Large state enterprises are generally regarded as suffering the most intractable worker motivation problems. If, therefore, econometric analysis of our sample of 335 enterprises reveals wage reforms to have been successful in inducing greater

work effort for these enterprises, this result would bode well for the broader effectiveness of the wage reform program.

V. Hypothesis Tests

Regression estimates for Equation (5) are presented in Table 2. Our hypothesis with respect to the wage coefficient is that it will take on a value of zero in 1980, prior to any reform in wages narrowly defined, and if reforms were successful in the ensuing years, a value greater than zero in 1987. Such a pattern is indeed manifested at the 1% level of significance. This result supports a claim that reform, by linking wages to incremental profits, led to greater work effort and higher labor productivity in connection with higher wages paid. Problems with free-rider behavior or degeneration of the wage-effort link if given wages were taken too much for granted apparently did not stifle incentives.

With respect to bonuses, we hypothesize that a powerful motivational effect would be exhibited in 1980 since bonuses were assessed on an individual basis in the early years of reform, and thus free-rider behavior was precluded. As the original specificity of bonuses was undermined by coalitions among workers and between workers and managers, however, the potency of bonuses may have tended to slip after 1980. By the mid-1980s though, with the total bonus fund linked to enterprise performance indirectly through the wage bill, or perhaps more directly through negotiations with higher-ups, the incentive power of bonuses may have been restored. The bonus elasticity estimates yielded by the regression are significant at the one percent level for both 1980 and 1987. A modest decline in the point estimate is evident over time, although the difference being on the order of one standard deviation, the decline cannot be taken as statistically meaningful.

The elasticity estimate for capital inputs is not statistically significant in 1980, but

becomes so in 1987 when it takes on a value of 0.08. Measurement problems likely confound these estimates. Attempts to adjust reported capital stock, by taking account of differences in productive versus non-productive assets (where the latter includes structures and equipment devoted to workers or other social purposes), or by adjusting for capital vintage based on the ratio of depreciated to original asset values, did not yield a more credible capital elasticity estimate for 1980; nor did the adjustments affect other parameter estimates.

The scale multiplier has a substantial effect on value added per worker. The point estimates of the regression coefficients are approximately 0.4, and their t-statistics exceed ten. Scale is thus a very important determinant of worker productivity both before and after the wage system reforms.

Coefficient estimates on the sectoral dummies reveal systematic differences in value added per worker across industry even when capital and aggregate scale effects are controlled for. At a one percent level of significance, value added is below the mean in the mining and steel sectors for both years, and additionally in the machinery sector for 1980. It is above the mean in food processing, wood and paper, and energy for both years, and in chemicals for 1980. Textiles and garments would be added to the list in 1980 if the test were conducted at the five percent level of significance. The patterns for 1980 are consistent with what would be predicted on the basis of price distortions (Lu and Wiemer 1993). In particular, unfavorable prices for mineral products and basic producer goods such as steel and machinery lead to low measured value added in these industries. Favorable prices have the opposite effect, most notably in light industries such as food processing and textiles, which take advantage of artificially cheap agricultural inputs, and in energy, due similarly to cheap raw material inputs. Sectoral intercept deviations show a general pattern of diminution between 1980 and 1987, quite possibly due to the

rationalization of prices that was part of reform.

The model of Section III predicts that in industries where worker productivity is relatively low, profit-sharing incentive systems will be less effective in motivating work effort. To test for an interactive effect between industrial sector and wages, sectoral dummies were entered multiplicatively with the wage rate. For 1980, this model specification yielded no significant wage effects for any industry, even at the ten percent level of significance. The conclusion that wage differences were ineffectual in motivating effort in 1980 is thus further substantiated. But in 1987, food processing and energy show wage effects significant at the ten percent level, and chemicals at the one percent level, suggesting wage-performance links were most effective in these industries. In all industries but minerals, the elasticity point estimates were positive in 1987, even if not significantly so for most sectors taken in isolation.

To sum up, our findings for the sample of large state industrial enterprises used in this exercise are that the linkage of wages to incremental profits and the implementation of a bonus system were effective methods for raising worker productivity. The success of the reforms tended to be greater in industries where initial high worker productivity made the link to profits more rewarding. Nevertheless, the pattern was widespread enough to be verified statistically when wage effects were specified in generalized form across all industries.

One obvious concern must be addressed. Causality could arguably run in both directions, that is, from value added to wages and bonuses as well as from wages and bonuses to value added. In principle, increases in wages and bonuses were not to be linked to absolute productivity, but to gains in productivity. Correlation coefficients calculated from the data indicate that official policy was effectively carried out. The correlation between growth in enterprise wage expenses and growth in value added for the 1980 to

1987 period was 0.26, and between growth in bonus pay and growth in value added, 0.17, both of which are significant at the one percent level. Part of the growth in enterprise wage and bonus payments was due to expansion in employment. The correlations between per worker wage and bonus growth and value added growth were somewhat lower at 0.13 and 0.11 respectively, but both remain significant at the five percent level. Neither wage nor bonus growth showed significant correlation with baseline value added, indicating that workers were not able to exploit more favorable initial conditions to extract higher compensation over time independent of productivity growth. Nor was growth in value added correlated with baseline value added.

These statistical patterns do not preclude the possibility that nominal value added growth achieved independently of effort, for example through a favorable shift in relative prices, might lead to higher labor compensation with causality thus running the reverse direction of that modeled. Nevertheless, government wage and bonus administrators were attentive to such windfalls and sought to prevent their arbitrary dissemination among workers; indeed, accounting records for the sample enterprises of this study explicitly report the magnitude of income gains and losses associated with price changes. Also not precluded by our correlation tests is the possibility that 1980 bonus magnitudes were the result rather than the cause of 1980 productivity differences. Evidence that bonus increases after 1980 were not related to 1980 productivity is, however, supportive of the contention that authorities were effective in circumscribing bonus funds and preserving their incentive character.

If the wage and bonus system worked as intended, ie., with compensation increases a function of productivity gains, while effort over the observed range depended directly on the magnitude of wages and bonuses, as modeled in Equation (4), estimation of the productivity/wage relationship should not be confounded by reverse causality. Summary

statistical evidence is supportive of such a maintained hypothesis. Thorough resolution of this issue would, however, require a more elaborate model than our data permit, one involving simultaneous wage and productivity equations and lagged values of the variables.

VI. Value Added Returns to Wage System Reform

The elasticity estimates reported in the foregoing section suggest that wage reform was successful in motivating work effort in Chinese state enterprises. Just how successful relative to the cost of paying higher wages and bonuses is revealed in Table 3. Figures in the Table represent the increase in value added per worker associated with a ¥1 increase in compensation per worker at mean values of the variables. Bonuses are shown to have been a very powerful incentive tool in 1980. For each additional ¥1 in bonus pay per worker offered by the mean enterprise, value added per worker rose by ¥12.27. Although the system of selectively rewarding individual workers came to be resented by those it was aimed at motivating, firms that relied more heavily on it in 1980 appear to have been successful in generating higher worker productivity. Wage variations across firms in 1980, by contrast, did not have an appreciable impact on productivity.

By 1987, the incentive effect of bonuses on a per ¥1 basis had diminished considerably. This may have been simply a matter of the motivational potential of bonuses having been exhausted as reliance on them increased over time and the marginal disutility of work effort loomed more formidably. Or, the bonus system itself may have become less effectual as it evolved from the original tournament-style reward basis to more closely resemble the team profit-sharing embodied in the reform of narrowly defined wages. Indeed, the return to a ¥1 increase in either wages or bonuses yielded virtually the same result by 1987, as far as the limits of statistical accuracy can discern. Note that

although the elasticity estimate for wages substantially exceeded that for bonuses, the smaller magnitude of the bonus reduces the absolute cost of a one percent bonus increase relative to a one percent wage increase.

The value added return to higher labor compensation of either form in both years is in all cases greater than the cost. This does not necessarily indicate a failure to exploit incentive pay schemes to the optimal limit in a world of second best. If workers are more risk averse than other income claimants (enterprise managers or the state owner of capital), workers might prefer a less-than-full share of marginal returns to their effort in exchange for a higher guaranteed base wage even if expected total compensation were to be reduced. Other claimants on income would thus share with workers in the returns to labor effort at the margin. The sub-optimal effort offered under such circumstances is a reflection of the agency cost associated with incomplete information.

VII. Conclusions

Wage reforms involving the implementation of bonuses and the linking of wages to profits appear to have been effective in stimulating work effort in large state enterprises during the 1980s. The bonus system evolved over time from a tournament-style compensation of individuals to more egalitarian profit-sharing. Although the system as originally designed was not popular with workers, it appears to have been highly effective in stimulating work effort. Over time, productivity returns to an additional ¥1 spent on per worker bonuses diminished, but it is not clear whether this was due to a change in the nature of the reward system or to exhaustion of the marginal net benefits of the system as reliance on bonuses and other incentive pay expanded.

A profit-sharing system of the form used by the late 1980s to determine base wages

and to some extent bonuses is prone to deteriorate under free-rider pressures. There is also the possible danger that wage increases once established will be taken for granted so that worker effort over and above some accepted threshold is not sustained with the passage of time. The Chinese incentive wage system does not appear to have succumbed to these potential hazards by 1987. Enterprises that paid higher wages and bonuses achieved statistically significant improvements in labor productivity. For the average enterprise, the returns to higher labor compensation in either form were several times greater than the cost.

Very broadly, our analysis suggests that state enterprises are not incorrigible. Chinese industry has sustained extraordinarily rapid growth during the reform era without recourse to privatization, bankruptcy, or worker lay-offs in the state sector. By the early 1990s, state enterprises still accounted for more than half of all industrial output. That the state sector has not inhibited overall economic growth, and indeed has contributed to it, indicates that reform in incentive structures has stimulated improved performance. With regard particularly to labor and its remuneration, a linking of reward to effort has had demonstrable impact on state enterprise productivity.

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TABLE 1: Sample Enterprise Statistics

	1980	1987	change
Gross Output / Enterprise (mil ¥)	66.97	127.52	90%
Workers / Enterprise	3,156	3,981	26%
Value Added / Worker	8,065	11,509	43%
Wage / Worker	809	1,343	66%
Bonus / Worker	138	428	210%
Capital / Worker	11,704	16,799	44%

Number of Enterprises = 335

TABLE 2: Production Function Estimates

COEFFICIENT	VARIABLE	1980	1987
α	Wage / Worker	0.197 (0.196)	0.451* (0.123)
β	Bonus / Worker	0.213* (0.047)	0.170* (0.038)
δ	Capital / Worker	0.010 (0.042)	0.084* (0.042)
γ	Gross Output	0.451* (0.029)	0.385* (0.029)
<u>INTERCEPTS</u>	Sample	-2.752* (0.678)	-2.119* (0.440)
	Mining	-0.769* (0.157)	-0.924* (0.148)
	Food Processing	0.684* (0.090)	0.573* (0.084)
	Textiles & Garments	0.163 (0.108)	-0.013 (0.101)
	Wood & Paper	0.268* (0.109)	0.204* (0.103)
	Energy	0.568* (0.163)	0.495* (0.150)
	Chemicals	0.164* (0.085)	0.128 (0.080)
	Building Materials	-0.083 (0.136)	-0.074 (0.128)
	Steel	-0.557* (0.120)	-0.402* (0.115)
	Machinery	-0.365* (0.092)	-0.120 (0.089)
	Electric/Electronic Goods	-0.073	0.134

Standard errors appear in parentheses.

Sectoral intercept estimates represent deviations from the sample intercept. Since these deviations must sum to one, no standard error is generated for the final sectoral estimate.

* indicates significance at the one percent level.

TABLE 3: Per Worker Value Added Increase for Each ¥1 Compensation Increase

	1980	1987
Wage	1.89	3.86
Bonus	12.27	4.57