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OUTPUT-INFLATION TRADEOFF IN CHINA

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I. INTRODUCTION

THE Chinese economy has been growing at a remarkably high rate since the beginning of economic reform in 1979. The mean annual growth rate of aggregate output during the 1979–96 period jumped to 9.9 per cent, 4.2 per cent higher than the preceding twenty-four years.[1] Rapid output expansion, however, has been accompanied by an upsurge of inflation. During the eighteen years of reforms, the mean growth rate of the consumption goods price index (CGPI-based rate of inflation) climbed to 7.8 per cent from 1.0 per cent in the pre-reform period.[2] The rate of inflation also exhibits considerable short-term variability. Following the two economic booms, double-digit inflation was registered during five recent years (1988–89 and 1993–95). Is there a systematic positive relationship in the short run between inflation and output growth in the Chinese economy? The objective of this paper is to investigate how the output-inflation tradeoff arises and what are the numerical relationships behind it during China's reform period.

According to one standard explanation for the tradeoff, rapid output growth led by strong aggregate demand during a boom generates inflation, because output is already near its capacity. As output is pushed above its capacity, prices move upward along the aggregate supply curve. Because the economy's potential growth rate is determined fully by supply-side conditions, such as the growth rates of pro-

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[1] Because GDP data is available only from 1978, the growth rates cited are based on the real net material product (NMP) for the 1955–78 period and real GDP for the 1979–96 period (SSB, *Zhongguo tongji nianjian*, 1993 ed., p. 34; 1996 ed., p. 42; *Renmin ribao*, January 23, 1997).

[2] The consumption goods price index (CGPI), the largest sub-category of the retail price index (RPI), comprises the retail prices of consumption goods after excluding agricultural producers' goods from the general retail price index. The year-to-year growth rate of RPI is the most commonly used measure of the rate of inflation in China. The weights of the CGPI and RPI are based on retail value (Ma 1982, pp. 495–96). The growth rate of the consumption goods price index is very similar to that of the retail price index. The numbers cited are for the 1979–96 and 1955–78 periods. Because CGPIs for 1994, 1995, and 1996 have not been published, the growth rate of RPI is used to extend CGPI from the 1993 level. See Appendix B for the sources.

ductivity and factor inputs, output growth for an extended period higher than the potential rate brings about increases in the rate of inflation.

Another common explanation is the accelerationist hypothesis (Friedman 1968, pp. 8–11). The potential growth rate in this hypothesis represents the highest output growth rate achievable while maintaining a stable rate of inflation; above (below) this, the rate of inflation accelerates (decelerates). Accordingly, the tradeoff appears not with the rate of inflation but with its acceleration. At the potential growth rate, the labor market is in equilibrium, leaving the rate of unemployment at the NAIRU (nonaccelerating inflation rate of unemployment). Additional demand for labor to achieve high output growth would, therefore, push the rate of unemployment below the NAIRU and set off a wage-price spiral through the expectations-augmented Phillips curve.[3]

The Chinese economy during its economic reform period has seen a series of strong economic booms, interrupted occasionally by sharp but short downturns. The demand-side factors contributing to inflation, which have been acknowledged officially, include expansion of fixed investment, increases in household incomes, and rapid growth of the money supply (Liu 1988; Li 1995; Tian 1986).[4] Because these three variables generally move with aggregate output, one may expect some output-inflation tradeoff there. Nevertheless, the Chinese economy during its reform period has shown structural and institutional characteristics dissimilar to those upon which the standard explanations are based. Among these are the large

[3] For the two explanations and how they have been used in the monetary policy debate during the current U.S. boom, see three *New York Times* articles published in 1994 (Bradsher 1994; Nasar 1994; Uchitelle 1994). Frisch (1983) offers a formal treatment of the Phillips curves. Bradsher (1994) reports, "When experts like Mr. Greenspan estimate the economy's fastest sustainable growth at full capacity to be about 2.5 per cent, they are adding together annual productivity gains of about 1.5 per cent and annual increases in the labor force of 1 per cent or so" and "Federal Reserve officials are concerned that growth in the coming years may consistently exceed 2.5 per cent, their best estimate of the economy's speed limit at full capacity. Break the speed limit for too long, and sooner or later the penalty will be inflation, they warn."

[4] Tian (1986, pp. IX–X) acknowledged "the problems of inordinate price increases" in 1985, and the party and the government have begun strengthening "overall control over the scope of capital investment and consumer funds" to eliminate "destabilizing factors from the national economy." Commenting on the rising rate of inflation in 1988, Liu (1988, p. 14) states: "From 1984 to 1987, the money supply grew at a far greater rate than actual economic growth, leading to devaluation and price hikes" and "at the same time, there has been a large expansion in demand for investment and consumption, stemming from the impulse to pursue high-speed growth." Li (1995, p. III) attributes the high rate of inflation in 1994 to "objective reasons and to mistakes of governments at all levels." Along with (i) poorly planned and implemented hikes in official prices and price decontrol of grain, cotton, crude oil, and others and (ii) the short supply of agricultural products partially associated with crop damage due to natural calamities, Li (1995) points out demand-side factors: "There had been a rapid growth of investment in fixed assets and consumption funds, and too much currency had been put into circulation for several years running. The government took no emergency measures to stop these practices …, in order to prevent a sharp decrease in economic growth, but thereby the difficulty in curbing price rises increased" (p. III).

size of the agricultural sector, whose output has high variability, the presence of a labor surplus, underdeveloped labor markets, and the government's direct and indirect management of labor incomes. It is my view that these characteristics have modified significantly the nature of the tradeoff, mostly from the supply and cost sides.

The basic idea proposed in this paper is that the output-inflation tradeoff arises from inflationary pressures originating mainly in the expansion of fixed investment. The three demand-side factors—increases in fixed investment, household incomes, and the money supply—act together in generating demand inflation, and the mode of China's wage determination reinforces the inflationary process from the cost side. I have constructed a macroeconomic model based on the salient features of the Chinese economy, estimated structural equations, and performed dynamic simulation of the model, in order to derive numerically the implied tradeoff. I review the macroeconomic data of the post-1979 period and discuss the structural and institutional characteristics underlying the tradeoff in Sections II and III. The macroeconomic model, estimated structural equations, and simulation results are presented in Sections IV and V. The main findings are summarized in the last section.

II. CHINA'S INFLATION: A REVIEW

Table I tabulates the annual growth rates of some macroeconomic variables associated with inflation during the reform period. The mean growth rates of these variables and standard deviations for the 1979–92 period are listed at the bottom. (The values may be cited in this section without specifying the period.) The Chinese economy achieved GDP growth rates of higher than 7 per cent in all but three years (1981 and 1989–90, which can be regarded as two periods of recession) since economic reform began in 1979. There have been two long booms, one from 1982 to 1988 and the current boom, which began in 1991. The rate of inflation, based on the consumption goods price index, began to rise and then remained high during the second half of the boom in the 1980s. Two double-digit inflationary spells (1988–89 and 1993–95) appeared, and the rate of inflation has exhibited conspicuous cyclical patterns since then. There seems to be three noteworthy elements that affected the behavior of prices during the reform period. The first is investment expansion.

Among the series listed in Table I, variability is by far the highest in fixed investment. The standard deviations of the growth rates of total (1982–96) and state (1979–92) fixed investment are 11.2 and 13.4 per cent, respectively. While not only unstable in the short run, fixed investment has also exhibited high growth, particularly since the beginning of the boom which began in 1982. Total fixed investment expanded by 14.8 per cent during the 1982–96 period, and state fixed

TABLE I

MACROECONOMIC DATA

(Growth rate, %)

Year	Real GDP	CGPI	Industrial Output	Agricultural Output	Fixed Investment			Personal Consumption	Nominal Wage	Labor Productivity
					Total	State	Total/GDP (Share, %)			
1979	7.6	2.1	8.2	6.1	—	2.9	—	8.1	18.9	5.3
1980	7.8	7.0	13.6	−1.5	—	2.8	—	10.8	20.8	4.4
1981	5.2	2.6	1.9	7.0	—	−12.1	19.8	8.3	6.8	2.0
1982	9.1	2.0	5.6	11.5	26.2	24.8	23.2	6.7	5.0	5.2
1983	10.9	1.2	10.4	8.3	13.3	9.8	24.1	8.4	11.5	8.2
1984	15.2	1.7	14.5	12.9	23.2	19.7	25.6	12.5	20.6	11.0
1985	13.5	9.4	18.6	1.8	30.3	33.2	28.4	14.8	23.3	9.7
1986	8.8	6.5	10.2	3.3	11.0	10.1	29.6	5.8	14.4	5.9
1987	11.6	7.4	13.7	4.7	14.7	10.5	30.4	7.4	15.4	8.4
1988	11.3	19.0	14.5	2.5	11.0	8.1	30.1	8.5	23.9	8.1
1989	4.1	17.5	3.8	3.1	−14.0	−14.2	24.5	0.8	8.7	2.2
1990	3.8	1.6	3.2	7.3	2.4	9.6	24.0	3.7	4.6	1.3
1991	9.2	2.9	13.9	2.4	16.7	17.1	25.5	9.7	10.8	6.2
1992	14.1	5.6	21.2	4.7	23.7	26.0	29.5	13.0	21.6	12.2
1993	13.5	13.0	19.9	4.7	25.3	14.7	36.0	10.5	—	12.0
1994	12.6	21.7[a]	18.4	4.0	23.9	13.8	36.6	—	—	10.4
1995	10.5	14.8[a]	14.1	5.0	10.9	7.0	34.4	—	—	8.9
1996	9.7[b]	6.1[a,b]	12.3[b]	5.1[b]	11.8[b]	—	34.9[b]	—	—	—
1979–92 (%):										
Mean	9.4	6.0	10.8	5.2	14.8[c]	9.8	—	8.4	14.5	6.4
S.D.	3.6	5.7	5.8	3.9	11.2[c]	13.4	—	3.7	6.9	3.3

Sources: See Appendix A for real GDP (under *Y*), CGPI (*P*), total fixed investment (*x*), state fixed investment (*x*), nominal wage (*W*), and labor productivity (*V*). For industrial and agricultural output, personal consumption, and nominal GDP, *Renmin ribao*, January 23, 1997; SSB, *Zhongguo tongji nianjian*, 1996 ed., p. 42; 1994 ed., p. 41; SSB 1993, p. 8.

Note: CGPI is the consumption goods price index. Mean is the geomotric-mean growth rate. *S.D.* is the standard deviation of the growth rate. Industrial output and agricultural output are, respectively, the output of the secondary and primary sectors in GDP in constant prices. Total fixed invenstment / GDP is based on the nominal series. Personal consumption in constant prices is from the NMP accounts.

[a] Retail price index.

[b] Preliminary estimates by the State Statistical Bureau.

[c] 1982–96.

investment grew by 9.8 per cent during the 1979–92 period. These growth rates are higher than the GDP growth rate (10.5 and 9.4 per cent, respectively). Another notable aspect of fixed investment is that its turning points coincide generally with those of economic cycles. The two recessions of 1981 and 1989–90 were matched by sharp deceleration in fixed investment, and subsequent economic recoveries were accompanied by marked accelerations in investment.

State fixed investment, most of which comprises the capital formation of state enterprises, makes up about 60 per cent of total fixed investment. Moreover, total investment's share of GDP has been increasing, reflecting its high growth rate, fluctuating between 25 and 35 per cent during the past decade. In contrast to fixed investment, personal consumption, the largest demand component of GDP, has a relatively low variability (standard deviation of the growth rate, 3.7 per cent) and growth rate (8.4 per cent). Figure 1 shows deviations in the annual growth of GDP and total fixed investment (in 1978 prices) from their trends since 1982.[5] Despite the small size of total fixed investment relative to GDP, it is clear from Figure 1 that the bulk of GDP deviations is attributable to the deviations in total fixed investment. Fixed investment can therefore be regarded as the main driving force behind China's output cycles during the reform period and, because of this role, it should have had a strong bearing on the rate of inflation.

The second major element that affects prices is the relatively tight supply capacity of consumption goods. Although the steady increase of employment and the rapid rise of real income enabled households to increase spending, personal consumption appears to have been constrained by the productive capacity of the consumption goods sectors throughout the reform period. The slow growth of agricultural output kept demand pressures in the consumption goods market high, because spending for food still accounted for about half of household cash expenditures in recent years.[6] Under such conditions, the government has adopted a policy of decontrolling food prices and scaling down rationing at a cautious pace.[7] To the extent that the consumption goods market is supply-constrained, the growth of nominal wages should lead to higher prices.

[5] A positive deviation indicates that the actual annual increment of the variable is greater than it would be if the variable grew at its geometric-mean growth rate through the 1982–96 period.

A deviation is defined as:

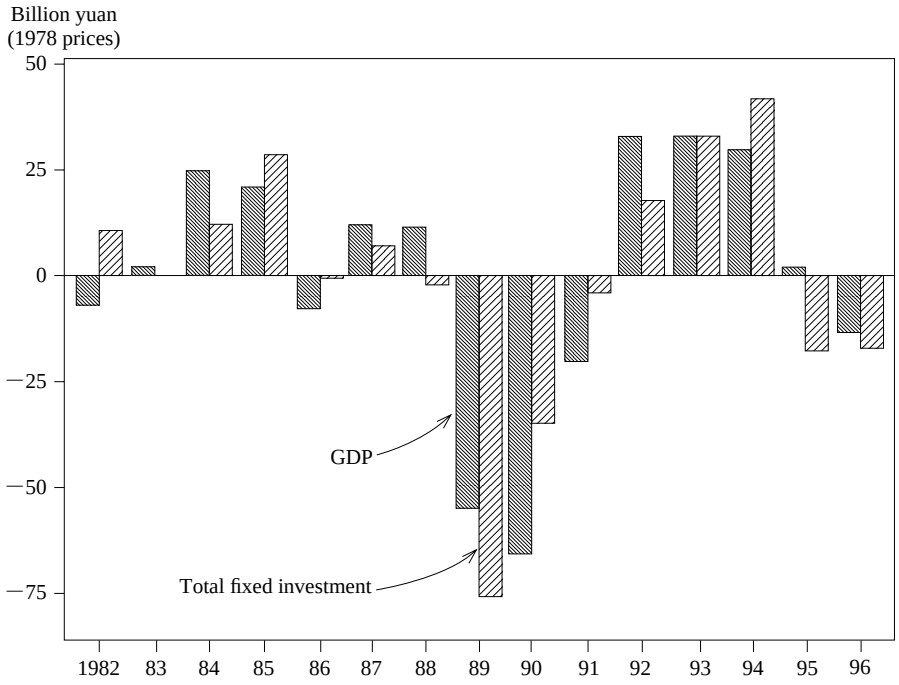
$$\text{Deviation} = (Z_t - Z_{t-1}) - (ZTD_t - ZTD_{t-1}),$$

where Z_t = variable (GDP or total fixed investment) in 1978 prices, ZTD_t = trend value based on the geometric mean growth rate in the 1981–96 period, and t, t–1 = current and previous years, respectively.

[6] Food accounted for 54.9 per cent of consumption goods sales in 1993 (SSB, *Zhongguo tongji nianjian*, 1994 ed., p. 498). Also, a substantial proportion of nonfood consumption goods contains materials of agricultural origin.

[7] For the government's policy on food prices and rationing during the reform period, see Wiemer and Lu (1993).

Fig. 1 GDP and Total Fixed Investment: Growth Deviations



Source: See *x* and *Y* in Appendix A.

Whether agricultural output affects personal consumption by restricting market supply can be assessed through the correlation of the two variables. Short-run correlation between agricultural output and personal consumption, if confirmed, would underline that the consumption goods market is supply-constrained. Although the correlation coefficient of the growth rates of personal consumption and agricultural output in the same year is very low (1979–93, –0.065), that of the current year's personal consumption and the previous year's agricultural output is sizable (1980–93, 0.482), presumably on account of the timing of harvests. Harvest fluctuations in China often stem from random variations in climatic conditions. The correlation implies that such disturbances in supply conditions are transmitted to personal consumption and consumption goods prices. A corollary is that this tight, varying supply leaves the consumption goods market susceptible to demand pressures when household money incomes increase abruptly.

The third element that affects prices is the rapid increase of nominal wages. Table I indicates that nominal wages grew annually by 14.5 per cent and that the variability of the growth rate has been high, with a standard deviation of 6.9 per

cent (nominal wage in Table I is earned cash income per worker). The growth rate of nominal wages was more than twice as fast as that of labor productivity (real GDP per worker), which increased at 6.4 per cent, indicating clearly that wage increases resulted in significant rises in production costs. Note that continuous rapid growth of nominal wages during the reform period took place in the face of labor surpluses in both the urban and rural areas.[8] Despite the difference in growth rates, the nominal wages and labor productivity appearing in Table I seem to have moved along with GDP. It is reasonable to consider that the procyclical movement of labor productivity affected wage levels rather than the other way around.

This brief review suggests that the behavior of prices during the reform period was subject to three main elements: strong aggregate demand led by fixed investment, tight supply conditions in the consumption goods market, and increases in wage costs. In the next section, I will investigate the first and third elements further and draw some conclusions about the nature of the output-inflation tradeoff during China's reform period.

III. EXPLANATORY FRAMEWORK

A. *The Demand Side*

Of the three demand-side causes of inflationary spells commonly cited (increases in fixed investment, household incomes, and the money supply), a significant part of the increases in household incomes originates from wage growth. If we set aside this cost-side source of inflationary pressures for the time being, the three demand-side causes are largely related to each other, and for this reason can be analyzed together.

Under China's current, partially reformed economic system, fixed investment moves more autonomously than household incomes or the money supply and can influence the level of household incomes. Rapid expansion of fixed investment

[8] *Nihon keizai shinbun* has reported recently an estimate presented by the Ministry of Labor staff at a government conference on the agricultural labor force. The labor surplus in rural areas was approximately 120 million by the end of 1995, 20 million higher than five years before. This number may rise to 140 million by 2000 (*Nihon keizai shinbun*, October 21, 1996). The number of employed in rural and urban areas was 450.42 million and 173.46 million, respectively, at the end of 1995 (SSB, *Zhongguo tongji nianjian*, 1996 ed., p. 87).

According to Gu (1995), excess workers in the urban state sector recently numbered about 30 million, out of a total of 109 million. He mentions that in some state enterprises as many as half of the workers were redundant. From around 1994, state enterprises began to furlough some employees for an extended period with reduced wages. The number of these workers in virtual layoff was reported to be about 3 million in mid-1995 (*Renmin ribao*, June 15, 1995). These workers were not classified as unemployed in China's labor statistics. Urban-registered unemployment was 5.20 million and the urban unemployment rate was 2.9 per cent at the end of 1995 (SSB, *Zhongguo tongji nianjian*, 1996 ed., p. 114).

during the reform period can be thought of as one of the consequences of the gradualist reform policy applied to the state sector, in which investment decision making has been decentralized without imposing strict financial accountability on enterprises (Naughton 1995b, pp. 322–33). State enterprises bear little risk when embarking on investment projects, because the probability of being forced into bankruptcy as a result of poor investment decisions is very low.[9] Expanded enterprise autonomy in investment activity under the economic reforms has therefore led to the high growth of fixed investment. Since investment growth necessitates higher labor input in the investment sector, it leads to greater total wage bills through increased employment. Given the gestation period of investment projects and the tight supply conditions of agricultural products, the immediate effect of investment expansion on the consumption goods market would be an increase in demand pressures. As fixed investment grows rapidly along the cyclical path, pressures in the consumption goods market appear in the form of high and varying rates of inflation. This shows up as an output-inflation tradeoff that accompanies output growth driven by fixed investment.

The growth of the money supply also follows investment in this process because the state banking system, lacking managerial independence, finances fixed investment passively with loans. In his comments on monetary policy in China, Perkins (1993, pp. 135–37; 1994, pp. 41–43) points out that the causation governing the money supply in China works in reverse from what is expected in a market economy. Easy money brings about high investment in a market economy. In China, however, after years of reform in banking and state enterprises, "the direction of causation still started with enterprise investment demand, and the banking system basically accommodated this demand" (Perkins 1993, p. 137).[10] Under these circumstances, fixed investment, household income, and the money supply

[9] During the first half of 1996, 215 state enterprises were merged with other enterprises following bankruptcy. Bankruptcies between 1987 and 1994 numbered 940 (*Nihon keizai shinbun*, December 5, 1995; August 19, 1996). These figures are low; for there were 118,000 state enterprises in the industrial sector alone at the end of 1995 (SSB, *Zhongguo tongji nianjian*, 1996 ed., p. 401). The number of bankruptcies is bound to grow, however. The government recently announced it would spend 30 billion yuan in 1997 to facilitate restructuring of state enterprises with deficits through mergers and bankruptcies in 110 pilot cities (*Renmin ribao*, January 31, 1997).

[10] Perkins cautions that this system may lead to "a price spiral caused by a combination of excess demand and cost-push pressures": "In the Chinese case, it is probably more realistic to expect that the monetary authorities will lack the political independence needed to hold the line on monetary expansion. In that case credit will expand rapidly, prices will rise, enterprises will raise wages to keep workers from being hurt by inflation, which will increase demand further and lead to more increases in prices" (Perkins 1991, p. 164). Implied here is a reinforcing mechanism which goes with demand inflation through those wage hikes intended to compensate the increased cost of living. This mechanism is discussed in the text below. Naughton explains in a more general context why and how the weakness of the state banking system makes macroeconomic management ineffective and inflation control difficult (Naughton 1991, pp. 153–58).

move together, as observed always during past inflationary spells, indicating that a strong demand inflation is at work.[11]

B. *Wage Costs*

As the growth of fixed investment accelerated during the reform period, a series of policies adopted from 1977 in the field of labor compensation appears to have provided reinforcement mechanisms for demand inflation. Central among the policies was wage reform in state enterprises implemented in two stages from 1977. Wage reform contributed greatly to the rapid growth of cash income per worker during the reform period by raising the labor compensation of state sector workers.[12] In the first stage of wage reform (1977–84), the government restored piece rates and bonus payments, which had been suspended during the Cultural Revolution (1966–76), and implemented several rounds of promotions and upward adjustments to wage scales. Furthermore, state enterprises that fulfilled plan targets were allowed to establish reserves from profits (Enterprise Reserve Funds) to be applied to bonus payments, workers' welfare expenditures, and fixed investment in 1979. In 1983, the Substitution of Tax for Profits Program was introduced to replace the enterprise reserve fund system. Under this program, enterprises were allowed to retain after-tax profits, half of which could be applied to bonuses and workers' welfare spending. In the second stage of the reform (1984–86), state enterprises adopted a wage system that linked the total wage bill, bonuses, and benefits to such indices of performance as increases in labor productivity, remitted profits and taxes, and retained earnings. Ceilings on bonuses were phased out, and a bonus tax with a graduated-rate structure was introduced.

These new measures under wage reform have provided state enterprises with greater discretion in determining labor compensation and have allowed these enterprises to expand wage and bonus payments rapidly. As mandatory wage plans and uniform wage scales have been replaced by a complex set of indirect regulations, enterprise managers have, on the one hand, found much room to negotiate with the authorities for favorable treatment, or to circumvent regulations.[13] On the other

[11] Demand inflation in China can be seen as a consequence of the saving-investment imbalance. Intended investment exceeds intended savings during an investment-led boom. As the banking system issues money to finance growing investment, the prices must rise to regain the saving-investment balance ex-post. High inflation here is an indication of forced saving.

[12] The details of wage reform measures in this paragraph are based on Hu and Li (1993).

[13] Walder cites a few examples. Enterprises whose profits fall short of targets or run a temporary deficit can still pay out substantial bonuses if managers can convince the supervisory authorities that the losses are due to objective factors (Walder 1987, p. 35). Objective factors can be anything beyond the direct control of enterprise managers, and include "price rises that unexpectedly increase the costs of production, supply shortages, old and worn out capital equipment, changes in state foreign-trade policy that affect the enterprise, and low state prices for products" (Walder 1989, p. 258). Enterprises often keep covert cash reserves to use for bonuses. These reserves are generated through various violations of accounting rules (Walder 1987, p. 37).

hand, the greater power granted to managers by the authorities has created more expectations and pressures on them from workers. The new regulatory environment has unwittingly strengthened the power of workers relative to that of the state in setting labor compensation.

Kornai and Walder consider the new power relations and nominal wage drift as inevitable consequences of the reformed socialist system. While wage reform relaxed centralized control, "wage discipline imposed by private ownership, market competition, and unemployment" (Kornai 1992, p. 533) has been slow to develop in the economy. Also, enterprises are still able to find "cover for losses from any increase in wage costs" (Kornai 1992, p. 532) by the state (soft budget constraint). Because the hiring and dismissal of workers is still subject to various formal and informal restrictions, cooperation by workers on payrolls is indispensable to enterprise managers in organizing production smoothly. This leaves managers more dependent on workers than in the pre-reform period, and consequently there emerges "a tacit alliance … between managers and workers, both of whom have an interest in retaining the highest amount of incentive funds while distributing it relatively equally" (Walder 1987, p. 22). Within such an environment, managers are held responsible for increasing employees' incomes and benefits (Walder 1989, p. 244).

Is the growth of the nominal wage per worker in Table I consistent with wage trends in state enterprises? Woo et al. (1994, p. 433) report findings from a survey of 300 large and medium-sized state industrial enterprises. Total labor compensation increased from 31.8 per cent of value added in 1984 to 48.8 per cent in 1988. The share of taxes and remitted profits declined from 31.5 per cent to 13.7 per cent during the same period as a consequence. A study by Li et al. (1993, p. 64) indicates a similar rise in labor compensation over a broader category. The labor share of GNP based on their reconstructed factor-cost data grew from 43.2 per cent in 1978 to 55.3 per cent in 1990. This leads one to suspect that the benefit of the dramatic distributional change in favor of labor during the reform period went beyond state sector workers to workers in non-state enterprises and the agricultural workforce.

Wage reform in the state sector has been part of a comprehensive policy concerning labor compensation. Wage-related conventions in collective enterprises, therefore, followed the changes implemented in the state sector. Policies directed toward the income of the nonagricultural workforce also have some link to policies regarding the income of the agricultural workforce, because the government acts to keep urban-rural income gaps from widening. In addition to decollectivizing agriculture in the early 1980s, the government implemented periodic hikes in the purchase prices of agricultural products, to augment the income of peasants. Consequently, an intended modest realignment of the wage system and distributional policies in the early years of the reform period appears to have set off continued

strong drives for high income from a wide spectrum of the workforce. Wage increases during the reform period, in addition to raising the labor share of output, continually generated inflationary pressures by pushing production costs upward.

As mentioned in the preceding section, the growth rate of the nominal wage per worker not only stayed high, but also fluctuated widely, following the procyclical movement of the growth rate of labor productivity. This parallel movement of the two variables appears to reflect the wage-setting convention in the state sector. Total wage bills, bonuses, and benefits in state enterprises are linked with some performance criteria, one of which is the increase in labor productivity during the reform period. Note that other performance criteria commonly used, such as increases in remitted profits and taxes and retained earnings, tend to move procyclically along with labor productivity. Therefore, whichever criterion is adopted, the new mode of wage determination generally leads to the parallel movement of nominal wages and labor productivity.

The conspicuous procyclical movement of labor productivity, which is transmitted to wage growth fluctuations, appears to be associated with the presence of surplus workers in the industrial sector, those in state enterprises being most evident. To maintain high employment in urban areas, the government until recently encouraged enterprises to increase their workforces over time. Surplus labor kept on payrolls allows the industrial sector as a whole to expand output with a less than proportional increase in workers during a boom.

TABLE II

WAGE FUNCTION

Independent Variables	Dependent Variable: Growth Rate of Nominal Wage (%)			
	I	II	III	IV
	Period: 1981–92			
Estimation method	3SLS	OLS	3SLS	3SLS
P's growth (%)	0.526**	—	0.772*	0.606
	(4.585)		(2.546)	(1.092)
P_{t-1}'s growth (%)	—	0.246	–0.189	0.095
		(1.827)	(–1.066)	(0.106)
P_{t-2}'s growth (%)	—	—	—	–0.200
				(–0.277)
V's growth (%)	1.563**	1.866**	1.457**	1.591**
	(13.090)	(11.804)	(7.875)	(3.511)
R^2	0.998	0.740[a]	0.997	0.996
D.W.	2.777	1.817	2.630	2.446

Note: The numbers in the parentheses are *t* statistics. * and ** indicate statistically significant at the 5 per cent and 1 per cent levels, respectively.

[a] Adjusted R^2.

C. *The Wage Function*

To assess the underlying numerical relationships in wage setting during the reform period, I have estimated the wage function in four different specifications, as reported in Table II. The data used for the wage function is from Table I. When the current-year rate of inflation is included as an independent variable (I, III, and IV), the wage function and the price equation are estimated together by three-stage least squares (3SLS). In this case, the two equations are thought of as a block in a (block-recursive) macroeconomic model. The macroeconomic model to be introduced later includes one of the equation sets estimated here. The price equation in the macroeconomic model will be represented by the household consumption goods demand function. The dependent variable of the wage function is the growth rate of the nominal wage. The explanatory variables are the rate of inflation, based on the consumption goods price index (P) in the current and/or past years, and the growth rate of labor productivity (V) in the current year. Labor compensation for state sector workers includes partial compensation for the rise in the cost of living and, as mentioned above, is linked with such performance criteria as the increase in labor productivity.[14] We therefore anticipate positive relationships between the nominal wage growth rate and the current-year rate of inflation and the labor productivity growth rate.

The coefficients of the rate of inflation in the previous two years (P_{t-1} and P_{t-2}) are not significant at the 5 per cent level, whether the current-year rate of inflation is excluded (II) or not (III and IV). The signs of coefficients vary depending on the specification. If one assumes adaptive expectations, the wage function should include lagged rates of inflation as explanatory variables. The low levels of significance reported appear to suggest that expected inflation has not systematically affected nominal wages during the reform period. The Chinese economy lacks well-functioning labor markets; it has a sizable labor surplus (inside and outside of the state sector); and labor compensation in the nonagricultural sector reflects the interplay of complex bargaining relations and government regulations. We may conclude that any of these characteristics keeps expected inflation from affecting wages in any predictable manner.

The coefficients of the current-year rate of inflation (I, 0.526; III, 0.772) are positive and significant at the 1 per cent level when past years' rates of inflation are excluded (I) and at the 5 per cent level when the previous year's rate of inflation is included (III). The coefficient becomes statistically insignificant in IV, but the co-

[14] State sector workers are paid cost-of-living allowances and subsidies in order to offset price rises. According to a household survey in July 1988 cited by Hu and Li (1993, p. 166), these allowances and subsidies made up 18 per cent of the total household wages of staff and workers. Also, enterprises, out of a wish to protect workers' interests, may award high wages in reaction to a rise in the rate of inflation, in addition to increasing cost-of-living allowances.

efficients of the past two years' rates of inflation are also insignificant in this specification. The coefficients of labor productivity are positive and highly significant in all four equations. It can be inferred that the government's intention has been to keep the growth of nominal wages close to that of labor productivity. The estimated coefficients of the labor productivity growth rate, which are substantially higher than unity, seem to attest to the strong bargaining position of workers within the new institutional environment.

The positive coefficients of the current-year rate of inflation imply the presence of a reinforcing mechanism through wage determination. Starting from a stable wage level, any new inflationary pressures will set off an upward adjustment of the wage level. The larger-than-unity coefficients of the growth rate of labor productivity imply another reinforcing mechanism. When output fluctuates by demand shocks, the subsequent procyclical fluctuation of labor productivity turns into an even wider movement of nominal wages, amplifying the initial impact on prices from demand shocks. If one adopts wage function I as the baseline, the sizes of the two estimated coefficients indicate that during the reform period, the nominal wage growth rate has been approximately 0.5 times the rate of inflation plus 1.6 times the growth rate of labor productivity.

D. *Short-Run Inflation Dynamics*

Combining the demand-side factors and the mode of wage determination, one can construct the dynamics of China's inflationary spells during the reform period. The process begins with investment expansion, which generates new employment and brings about increases in aggregate output. Labor productivity rises as surplus labor within enterprises is used effectively. Such productivity gains and a cost-of-living adjustment bring about sizable nominal wage hikes through the prevailing mode of wage determination. Household money income grows, thanks to the rise in both wages and employment. In the face of slow supply increases, particularly in agricultural products, augmented household income exerts demand pressures in the consumption goods market. Prices rise as a result of these pressures, allowing some producers to meet increased wage bills. While the expansion of fixed investment is serving as a demand shock that raises output, its positive initial impact on prices (demand inflation) is amplified as the shock triggers cost increases through wage hikes (cost inflation). An output-inflation tradeoff emerges as this process is repeated.

This basic mechanism governed by the combination of demand and cost inflation during an investment-led boom is modified by a number of exogenous factors. Depending on these factors, the rate of inflation and the extent of the tradeoff observed vary. These exogenous factors include short-term variation of agricultural output, household saving-consumption choices, and such external economic variables as trade balance and the volume of direct foreign investment.

IV. THE MACROECONOMIC MODEL

I have constructed a small calendar-year-based macroeconomic model that incorporates the above features and can be solved recursively. This model is designed to reproduce the core of the dynamics behind China's inflationary spells and to be used for dynamic simulation in order to derive the magnitude of the output-inflation tradeoff during the reform period.[15] The model has two sectors, the household sector and the business sector, the latter being either directly owned, controlled, or regulated by the government, and considers the markets for two goods (consumption and investment goods), an asset (money), and labor. The business sector operates two industries, producing consumption and investment goods, and the banking system. A sizable underemployed workforce is assumed.[16]

A. *Notation*

Numerical subscripts with minus signs are used to indicate past years (hence −1 denotes the previous year). Δ denotes the first difference. Endogenous variables are represented by capitals; exogenous variables are denoted by either lower case or Greek letters.

[15] Note that the model is not designed to address all of the important elements associated with inflation in China. Also it is not intended to be used for the simulation of actual paths of endogenous variables since 1979. The number of endogenous variables and equations have been kept small, partly for analytical clarity and partly due to limited data and the complexity of China's economic structure now in systemic transition. For example, the model omits foreign trade. While the nominal wage and the consumption goods price are determined endogenously, fixed investment and the interest rate on money held by households are exogenous in the model. In assessing the impact of investment surge on output and prices, one need not explain why investment grows. In the absence of solid knowledge about how households react to interest rate changes and how the interest rates are chosen and set by the Chinese government, one may opt to assess the impact of investment on prices by holding deposit interest rates constant.

[16] With plenty of low-skill labor mainly in rural areas, the Chinese economy may be regarded as a labor-surplus economy to which the Lewis (two-sector labor-surplus) model applies (Lewis 1954). Those underemployed in rural areas are ready to be transferred to nonagricultural sectors. The state sector also has a sizable labor surplus, which could be transferred to other sectors. This characteristic may remain for sometime to come, as about 15 million new workers will join the workforce each year and the working life of urban workers will be extended. The mandatory retirement age of state sector workers has typically been between fifty and sixty in recent years.

In view of China's resource endowment, the strong nominal wage drift observed in urban areas might be an anomaly supported by the availability of easy credit from state banks. Nominal wage increases may not be able to deviate greatly from labor productivity growth in the industrial sector if state bank lending policy is restrictive and labor markets function well. This does not rule out, however, the appearance in the future of acute shortages in some categories of skilled workers and accompanying rapid increases in their nominal wages.

Endogenous variables:

G = nominal household income (expenditures of the business sector); annual aggregate.

K = capital stock in the consumption goods industry in 1978 prices; value at year-end.

M = nominal money supply held by households; outstanding balance at year-end.

P = price of consumption goods (base year = 1978, 1978 level = 1).

Q = output of consumption goods (also the demand for consumption goods) in 1978 prices; annual aggregate.

V = labor productivity (annual average value product per worker) in 1978 prices.

W = nominal annual wage rate.

Y = aggregate output in 1978 prices.

Exogenous variables:

r = interest rate on money held by households.

x = gross fixed investment (output of investment goods industry, annual aggregate) in 1978 prices.

α = random supply shocks (mean = 1).

γ = allocation ratio of new capital to the consumption goods industry.

ζ = rate of depreciation.

Coefficients:

β = reciprocal of the capital-output ratio in the consumption goods industry.

δ_{-1} = distributed lags describing a pattern in which current and past years' investment fully contributes to the expansion of capital stock.

B. *The Model*

$$\Delta K = \gamma \sum_{i=0}^{j} \delta_{-i} x_{-i} - \zeta K_{-1}, \tag{1}$$

$$K,\ x,\ \gamma > 0, \quad 0 < \delta_{-i} < 1, \quad \sum_{i=0}^{j} \delta_{-i} = 1, \quad 0 < \zeta < 1.$$

$$Q = \alpha \beta K, \tag{2}$$

$$\bar{\alpha} = 1, \quad \alpha,\ \beta > 0.$$

$$\left(\frac{V}{V_{-1}} - 1\right) = \theta_1 + \left(\frac{Q_{-1}}{Y_{-1}}\right)(\alpha - 1) + \theta_2 \left(\frac{x_{-1}}{Y_{-1}}\right)\left(\frac{x}{x_{-1}} - 1\right), \tag{3}$$

$$\theta_1,\ \theta_2 > 0.$$

$$G = W\left(\frac{\alpha \beta K + x}{V}\right) + r_{-1} M_{-1}, \tag{4}$$

$$W,\ r,\ M > 0.$$

$$\left(\frac{W}{W_{-1}} - 1\right) = \lambda_1\left(\frac{P}{P_{-1}} - 1\right) + \lambda_2\left(\frac{V}{V_{-1}} - 1\right), \quad (5)$$

$P,\ \lambda_1,\ \lambda_2 > 0.$

$$\Delta Q = \mu\Delta\left(\frac{G}{P}\right), \quad (6)$$

$\mu > 0.$

$$M = f(G,\ P,\ r,\ \ldots). \quad (7)$$

$$G = PQ + \Delta M. \quad (8)$$

$$Y = Q + x. \quad (9)$$

Equation (1) describes the delay in transforming current and past investment into new capacity in the consumption goods industry. Equation (2) indicates that consumption goods output is subject to random supply shocks and is constrained by capital stock. Random shocks here are harvest fluctuations stemming from variation in climatic conditions. The consumption goods industry uses Leontief technology with two inputs, labor (measured in the efficiency unit) and capital.[17] The investment goods industry, unlike the consumption goods industry, has slack capacity, and its output is therefore not constrained by capital stock. Equation (3) indicates that the growth rate of labor productivity depends on the trend growth (θ_1) and the weighted sum of both the random supply shock in the consumption goods industry (second term) and the output growth rate in the investment goods industry (third term). The investment goods industry hoards labor, so labor productivity in this industry moves procyclically to its output. The expenditures of the business sector consist of wage payments (first term) and interest paid by the state banking system on money held by households (second term) in equation (4). The parentheses in the first term represent the number of workers employed. The business sector, guided by government planners, sets the rate of increase in the annual wage in accordance with the growth rates of the price of consumption goods (rate of inflation) and of labor productivity (equation 5).[18]

[17] When there is a labor surplus, the Leontief technology should serve as a good approximation, because the output level would be the same as under the Cobb-Douglas technology, the most general form. The presence of a large labor surplus in China's consumption goods sector during the reform period implies that the marginal product of labor and the labor elasticity of output are close to zero for that sector. So the output would be proportional to capital stock whether the technology follows Cobb-Douglas or Leontief form. This does not mean that wages are driven down to the subsistence level, however. As discussed above, China's wage setting institutions coupled with underdeveloped labor markets can bring about strong wage drifts.

[18] As discussed in the previous section, nominal wage increases in the state sector from the 1980s have depended on the rate of inflation and labor productivity growth. The compensation schemes

Equation (6) is the household consumption goods demand function. This is a modified version of Hall's consumption function (1978, pp. 974–76) as formulated by Campbell and Mankiw (1989).[19] Note that this function determines the price of consumption goods in the model.[20] Equations (5) and (6) (together with equation 4) form a block in the model mentioned in Section III and are identical to the equations reported in Table II (under I).

Equation (7) is the household money demand function in general form. Equation (8) is the budget constraint of households. Equation (9) defines aggregate output. There are nine equations for eight endogenous variables in this block-recursive

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of urban collective enterprises follow closely those in the state enterprises. Therefore, nominal wages set in state and urban collective enterprises serve as the market norm for other nonagricultural sectors, such as township and village, private, and foreign-capital-funded enterprises. There are a couple of reasons why wage increases in state and urban collective enterprises affect strongly those of other enterprises. Enterprises in the non-state sector find it easy to raise prices, when state and urban collective enterprises increase prices to cover higher wage costs. The resulting profit increases allow township and village, private, and foreign-capital-funded enterprises to raise wages by adopting the same kind of wage policies adopted in state enterprises. In addition, some of those enterprises in the non-state sector, when they expand their workforces, may compete with state and urban collective enterprises in the labor market.

One can consider a similar ripple effect for farm cash income. Wage and price hikes in the nonagricultural sectors bring about a higher demand, and therefore higher market prices, for agricultural products. Furthermore, the government has been periodically raising the purchase prices of agricultural products to keep the urban-rural income gap from widening. Needless to say, labor productivity growth in the agricultural sector also leads to income growth. It appears plausible, therefore, that the mean wage growth rate of the entire workforce depends on the rate of inflation and labor productivity growth, as equation (5) specifies. The estimated wage function (Table II) underscores such a relationship.

One notable finding is that the estimated coefficients of labor productivity growth are significantly higher than unity. A World Bank study cites a government survey on wages in state enterprises in 1995. During the January–September period 1995, the year-on-year rates of increase in nominal wages at both profit-making and loss-making state enterprises were almost the same, 22.6 and 21.3 per cent, respectively (World Bank 1996, pp. 17–18). When enterprises making profits award workers wage hikes based on labor productivity growth, such wage hikes are repeated by enterprises with deficits and slow productivity growth. Because loss-making enterprises can also increase wages rapidly due largely to the availability of easy credit from state banks, one observes, based on aggregate data, that nominal wages have increased faster than labor productivity during the reform period. It appears that low profitability and increased layoffs in state enterprises during the past few years have yet to begin making a strong impact on the nominal wage drift.

[19] The consumption function proposed by Campbell and Mankiw allows for two groups of consumers: one spending rationally, following the permanent income hypothesis, and the other acting myopically by spending all current income. Because changes in current income do not affect the consumption level under the permanent income hypothesis, μ becomes zero when all consumers follow the hypothesis. If all consumers act myopically, μ becomes unity. The value of μ therefore represents the income share of the myopic consumers in an economy. μ's estimates with the post–World War II data in the United States, Canada, and Japan are 0.478, 0.616, and 0.553, respectively (Campbell and Mankiw 1989, pp. 186–90, 197).

[20] See footnote 21 for the order of iteration of the model.

model. Omitting equation (7), the eight endogenous variables are determined fully by the remaining eight equations.[21]

C. *Estimation of Structural Equations*

There are five equations with unknown coefficients (equations 1–3 and 5–6) in the eight-equation model. In the absence of capital stock data, however, the first two equations cannot be estimated. The remaining three equations are estimated with the data for the post-1979 period. The sources of the data are listed in Appendix A. Assuming that the second term is absorbed by the error term, equation (3) is estimated by ordinary least squares (OLS):[22]

[21] The table below shows the structure of the eight-equation version of the model.

Equation Number	Endogenous Variables								
	K	*V*	*Q*	*G*	*W*	*P*	*M*	*Y*	
(1)	x								I
(3)		x							I
(2)	o		x						II
(4)	o	o		x	o				III
(5)		o			x	o			III
(6)			o	o		x			III
(8)			o	o		o	x		IV
(9)			o					x	V

x denotes endogenous variables that are associated with the equations, and o denotes other endogenous variables that appear in the equations. Roman numerals in the right column indicate the order of iteration. (Note that III is a block of three simultaneous equations.)

Although the money demand equation (7) implicitly holds, it is redundant. In this eight-equation version, by dropping equation (7), the nominal money supply (M) is computed from the budget constraint (equation 8). According to the order of iteration, M is determined after G, P, and W. Because China's state banking system plays a passive role in the economy, the banking system in general accommodates to money demand from the state sector and households by issuing new money. Also prices and wages rise and fall largely reflecting production, spending, and the wage-setting behavior of the state sector and households. Therefore, the money supply must be determined after prices and wages in a recursive macroeconomic model despite these three variables move at the same time in reality.

[22] This specification was chosen because α, random supply shocks for the consumption goods industry, in the second term of equation (3) are unobservable. In this estimation equation, the second term, which is excluded from the explanatory variables, moves to the error term. Therefore, the estimated θ_1 and θ_2 are biased, because the error term is no longer independent of an explanatory variable, $(x_{-1} / Y_{-1})(x / x_{-1} - 1)$. The biases originate from (Q_{-1} / Y_{-1}) in the error term, which is multiplied by the random variable with zero mean, $(\alpha - 1)$. Note that the estimated θ_1 and θ_2 would be unbiased if (Q_{-1} / Y_{-1}) was a constant. Because (Q_{-1} / Y_{-1}) represents the consumption goods' aggregate output share in the model, its value is relatively stable; therefore, we may expect the biases associated with it to be small.

$$\left(\frac{V}{V_{-1}} - 1\right) = 0.0424 + 0.859\left(\frac{x_{-1}}{Y_{-1}}\right)\left(\frac{x}{x_{-1}} - 1\right), \qquad (3)'$$
$$(4.574) \quad (4.787)$$

Adjusted $R^2 = 0.656$, $D.W. = 1.838$, period: 1982–95.
(The figures in the parentheses are *t* statistics.)

The coefficient in the second term (θ_2) of equation (3)′ is highly significant, suggesting labor-hoarding in the investment sector as the source of the procyclical movement of labor productivity. Although the θ_2 estimate (0.859) is large, the below-unity value implies that the investment goods industry would still have to add substantial numbers of workers to increase output.

The wage and household consumption goods demand functions, equations (5) and (6), are estimated jointly. See wage function I in Table II for the estimated wage function, here called equation (5)′. The estimated household consumption goods demand function, equation (6)′, has a positive coefficient for the increment of incomes, as anticipated.

$$\Delta Q = 0.712\Delta\left(\frac{G}{P}\right), \qquad (6)'$$
$$(10.661)$$

$R^2 = 0.992$, $D.W. = 1.653$.

D. *Long-Run Rate of Inflation*

The coefficient estimates of equation (5)′ allow one to compute the approximate long-run rate of inflation during China's reform period. Because long-run growth depends solely on the expansion of productive capacity, the demand-side factors for inflation need not be considered. The Leontief or Cobb-Douglas production function yields the rate of inflation function (equation 10),[23]

$$\left(\frac{P}{P_{-1}} - 1\right) = \left(\frac{W}{W_{-1}} - 1\right) - \left(\frac{V}{V_{-1}} - 1\right). \qquad (10)$$

Equation (11) can be obtained by solving equation (10) for the growth rate of the nominal wage, substituting this into equation (5), and then solving the new equation for the rate of inflation,

$$\left(\frac{P}{P_{-1}} - 1\right) = \left(\frac{\lambda_2 - 1}{1 - \lambda_1}\right)\left(\frac{V}{V_{-1}} - 1\right). \qquad (11)$$

The peculiar mode of wage determination during China's reform period implies that the long-run rate of inflation depends positively on the growth rate of labor

[23] For the derivation of the function, see Branson (1989, p. 484).

productivity, according to equation (11). The value of the multiplicative term on the right-hand side is 1.188, based on the estimates of λs (see wage function I in Table II). Because the mean growth rate of labor productivity during the 1979–92 period was 6.4 per cent, equation (11) yields 7.6 per cent as the long-run rate of inflation. The computed value is somewhat higher than the actual mean growth rate of the consumption goods price index for the period, 6.0 per cent.[24]

V. DYNAMIC SIMULATION

Because the causality running from output and fixed investment to the price level is complex, I have derived the output-inflation tradeoff by dynamic simulation instead of solving the model for the consumption goods price. Let us trace the gist of the underlying relationship in the model. A rise in fixed investment leads to higher labor productivity, through equation (3), and employment, by augmenting the value in the parentheses in equation (4). High productivity further brings about wage hikes through equation (5). Because nominal household income grows as a result of increases in employment and the nominal wage, the consumption goods price must rise to the market-clearing level. Price, nominal wage, and nominal household income move together in this process on account of simultaneity. The initial impact on the price is magnified as the wage adjusts successively to new price levels. Because fixed investment (the output of the investment goods industry) is a component of aggregate output, high output and the high consumption goods price are linked. As fixed investment fluctuates widely, one should observe a short-run output-inflation tradeoff.

A. *Simulation*

Upon running dynamic simulations of the eight-equation model, estimated coefficients were inserted in the respective equations. See Appendix B for the details. For the first simulation (Case 1) the random supply shocks in the consumption goods industry were suppressed (α is set to unity). The simulation was run for seventeen years. The first-year observations were set aside, because there were some leaps in endogenous variables at the outset. Accordingly, the second and third years were labeled as Years 0 and 1 and the seventeenth as Year 15. The simulated growth rates of the five variables (aggregate output, Y; the consumption goods price, P; consumption goods output, Q; the nominal wage, W; and labor productivity, V) in Cases 1 and 2 are reported in Table III. Also listed are the two

[24] Note that equation (10) assumes a single industry in the economy. The macroeconomic model in this paper has two industries, consumption and investment goods, and the rate of inflation is based on the price of consumption goods. The long-term rate of inflation obtained from equation (11), therefore, may deviate from that based on the consumption goods price index.

TABLE III

SIMULATED PATHS

(Growth rate, %)

Year	*Y*	*P*	*Q*	*W*	*V*	Exogenous	
						x	$\alpha - 1$ (%)
Case 1:							
1	3.2	–4.7	6.3	2.6	3.3	–3.6	
2	8.2	9.9	5.9	17.3	7.8	14.0	
3	8.5	11.2	5.7	18.6	8.1	14.6	
4	3.1	–2 .9	5.9	3.9	3.5	–2.6	
5	12.0	19.5	6.1	27.3	10.9	25.1	
6	9.8	12.4	6.8	20.3	8.8	15.5	
7	11.7	15.0	7.7	23.5	10.0	18.6	
8	7.5	2.6	8.6	11.0	6.2	5.8	
9	11.1	10.0	9.2	19.0	8.8	14.1	
10	9.1	4.8	9.6	13.6	7.1	8.5	
11	8.0	2.1	9.6	10.6	6.1	5.5	
12	8.3	3.4	9.4	11.7	6.4	6.5	
13	16.2	22.7	9.4	32.3	13.0	27.6	
14	8.3	2.9	9.9	11.4	6.3	6.0	
15	11.4	9.4	10.3	18.5	8.7	13.0	
Case 2:							
1	2.2	–4.2	4.8	1.4	2.3		–1.4
2	7.0	10.2	4.0	14.1	5.6		–3.1
3	10.1	8.0	8.1	16.0	7.5		–1.0
4	4.8	–4.4	8.4	4.6	4.4		1.4
5	12.8	19.3	7.4	29.9	12.6		2.6
6	6.3	17.3	1.7	20.4	7.2		–2.3
7	14.5	11.0	12.1	23.3	11.2		1.7
8	8.1	3.2	9.5	13.7	7.7		2.6
9	8.6	13.6	5.3	19.7	8.0		–1.1
10	10.5	3.1	11.8	13.6	7.6		0.9
11	11.7	0.5	15.5	15.8	9.9		6.3
12	1.9	11.6	–0.8	12.3	4.0		–3.6
13	17.1	20.6	10.7	29.0	11.6		–2.5
14	10.7	–0.2	14.0	10.9	7.0		1.1
15	8.6	12.4	5.8	17.2	6.8		–3.0
Case 1:							
Mean	9.0	7.6	8.0	15.8	7.6	10.9	
S.D.	3.3	7.7	1.7	8.1	2.6	8.8	
Case 2:							
Mean	8.9	7.8	7.8	15.9	7.5		—
S.D.	4.2	8.1	4.5	7.8	2.9		2.8
Corresponding values (1979–92):							
Mean	9.4	6.0	8.4	14.5	6.0		
S.D.	3.6	5.7	3.7	6.9	3.3		

Note: Mean is the geometric-mean growth rate (%). *S.D.* is the standard deviation of the growth rate (%).

exogenous variables, the growth rate of fixed investment (x) and the percentage deviation of the random shock term (α; for Case 2 only). The mean growth rates of the five endogenous variables in Case 1 do not appear to be distant from those of corresponding variables in the 1979–92 period listed at the bottom (Y for real GDP, P for CGPI, Q for personal consumption, W for the nominal wage, and V for labor productivity, all from Table I). The growth rates of aggregate output and the consumption goods price are 9.0 and 7.6 per cent, while their values in the 1979–92 period are 9.4 and 6.0 per cent. The standard deviations of the five variables in Case 1 fall largely around those of the 1979–92 period, except for the consumption goods output.

For Case 2, the random shock term (α) in the consumption goods industry is reinstated to consider the inflationary impact of random supply shocks. As a result, the standard deviation of the growth rate of consumption goods output (Q) rises from 1.7 in Case 1 to 4.5. The behavior of the other four variables is largely similar.

B. *Implied Tradeoff*

To derive the output-inflation tradeoff from the simulated paths, the equation for the rate of inflation was estimated by OLS with simulated growth rate values for the fifteen-year period. The dependent variable is the growth rate of the consumption goods price (P). The independent variables are a constant with either the growth rate of aggregate output (Y) or fixed investment (x). Table IV shows that the estimated coefficients of the two growth rate variables have correct signs (positive) and are significant statistically at the 1 per cent level in four out of five equations. This suggests the presence of a tradeoff, given the structural and institutional characteristics of the reform-period Chinese economy.

The estimation results indicate that the inclusion of the random supply shocks in Case 2 markedly lowers the statistical significance of the coefficient of the aggregate output growth rate. The t statistic of the coefficient falls from 33.928 (1-I) to 1.657 (2-I). This suggests that supply shocks, together with random errors in the structural equations (this latter element was omitted in the simulation), are capable of concealing the underlying output-inflation tradeoff. Take an adverse supply shock, for instance. Bringing about low output and high prices, it does not lead to a tradeoff. I have estimated the same rate of inflation equations by OLS with the reform-period data. The tradeoff was not confirmed with these data.[25]

To consider whether the growth of fixed investment has a lagged effect on

[25] The dependent variable of the estimation equation is the growth rate of the consumption goods price index. An OLS regression has been run with the growth rate of real GDP for the 1979–96 period as an explanatory variable, along with a constant. The estimated equation did not yield a solid relationship. The coefficient of the GDP growth rate had a t statistic below unity and the adjusted R^2 was close to zero.

TABLE IV

OUTPUT-INFLATION TRADEOFF: SIMULATED PATHS

Independent Variables	Dependent Variable: *P*'s Growth Rate (%)				
	Case 1			Case 2	
	1-I	1-II	1-III[a]	2-I	2-II
	Period: Year 1–15				
Constant	–15.95l**	–1.942**	–2.460**	0.923	–1.284
	(–5.418)	(–7.058)	(–5.156)	(0.193)	(–0.866)
Y's growth (%)	2.552**	—	—	0.801	—
	(33.928)			(1.657)	
x's growth (%)	—	0.874**	0.891**	—	0.838**
		(44.815)	(37.052)		(7.971)
x_{t-1}'s growth (%)	—	—	0.026	—	—
			(1.200)		
ρ	0.932	—	—	—	—
Adjusted R^2	0.972	0.993	0.992	0.111	0.817
D.W.	—	1.807	1.871	2.306	2.641

Note: The numbers in the parentheses are *t* statistics. ** indicates statistically significant at the 1 per cent level.

[a] The sample period is Year 2–15.

prices, an equation with the previous year's growth rate of fixed investment is estimated (1-III). The coefficient of the lagged term has a very small value (0.026) with a low level of significance (*t* statistic, 1.200). This suggests that any carry-over effect of fixed investment on prices is negligible.

Controlling for random supply shocks, the estimated coefficients under Case 1 represent the magnitude of the underlying output-inflation tradeoff driven by the fluctuation of fixed investment. The estimated coefficient of the growth rate of aggregate output in 1-I is 2.552, implying that economic growth 1 percentage point higher in a given year will bring about approximately a 2.6 per cent increase in the rate of inflation for that year. The coefficient of the growth rate of fixed investment in 1-II is 0.874, implying that 1 percentage point of higher investment growth will add about 0.9 per cent to the rate of inflation. The ratio of the two coefficients, 0.874/2.552 or 0.342, comes from the mean fixed investment share of aggregate output.

C. *The 1993–95 Inflationary Spell*

How plausible are these implied magnitudes? Thanks largely to the small variations in the growth rate of agricultural output during the first half of the 1990s, the underlying output-inflation tradeoff is most discernible in the last inflationary spell (1993–95)(see Table I). This inflationary spell is associated with a powerful investment-led economic boom that began in the spring of 1992. It would be worthwhile

therefore to examine the implied tradeoff against actual data for the 1992–95 period.

The geometric mean rate of inflation (CGPI-based), and the geometric mean growth rates of GDP and total fixed investment during the four-year period were, respectively, 13.6, 12.7, and 20.8 per cent. These three variables' mean growth rates during the 1982–96 period were, respectively, 8.5, 10.5, and 14.8 per cent. Taking the differences between these two periods, the upward deviations during the 1992–95 period from the trend growth rates during the 1982–96 period were 5.1 per cent for the rate of inflation, 2.2 per cent for GDP growth, and 6.0 per cent for fixed investment growth. The theoretical upward deviation of the rate of inflation originating from strong aggregate demand would be 5.6 per cent, if the number above for the growth rate of aggregate output (2.552) is used, and 5.2 per cent, if that of the growth rate of fixed investment (0.874) is used. Neither of these is distant from the actual value (5.1 per cent). The 1992–95 data thus appears to be consistent with the implied magnitudes, and also suggests that the surge in fixed investment explains almost fully the 1993–95 inflationary spell.

Needless to say, there were various exogenous factors which affected prices significantly during the 1992–95 period. It appears, nonetheless, that these factors largely cancel each other out if one considers the entire four-year span. The chronological review of the 1992–95 period (Appendix C) mentions specific factors and circumstances which modified price movements. The review seems to indicate that, along with these factors, the reform period inflation dynamics introduced in the previous section was in force.

D. *Is a Permanent Tradeoff Plausible?*

Past economic cycles in China have mainly been led by investment cycles. Policymakers appear to have exploited the output-inflation tradeoff by letting fixed investment grow rapidly when the rate of inflation is low (Imai 1994, p. 207). Because the peculiarities of the labor market and the mode of wage determination in China preclude wage-price dynamics of the accelerationist hypothesis, can policymakers in China permanently trade a high but constant rate of inflation for a high output growth rate propelled by investment expansion? This is essentially the same as questioning the feasibility of an inflation tax for the purpuse of rapid industrialization. High economic growth in China may not lead to a shortage of workers for some time to come because of a large labor surplus. Nevertheless, it is most unlikely that a high-investment/high-inflation growth strategy, if carried out for an extended period, would not face increasing resistance from the working population. The presence of excess workers does not prevent declining government popularity or work morale from compelling policymakers to award workers higher wages sooner or later. Such a conjecture leads one to conclude that the implied tradeoff in China is not incompatible with some nullification mechanism in a

longer time frame. Therefore, the tradeoff is contingent upon policymakers' prudence in operating within the "tolerance limits" (Kornai 1992, p. 168) of the public.

VI. CONCLUSION

The rate of inflation in China has behaved cyclically, and two inflationary spells have appeared in the past decade. I have investigated the short-run inflation dynamics during the reform period to derive numerically the output-inflation tradeoff. The high growth and wide fluctuations of fixed investment appear to be the main driving forces of the rate of inflation. The other two demand-side causes commonly cited, rapid growth of both household income and the money supply, are related to fixed investment and generally follow investment expansion. The tight supply of agricultural products constrains the consumption goods market and leaves it susceptible to demand pressures associated with the rapid increase of household income. Also, the prevailing mode of wage determination in China contains a cost-of-living adjustment and generally links nominal wages with labor productivity, where the former is allowed to grow more than proportionally to the latter. Under these circumstances, investment expansion generates strong demand pressures in the consumption goods market (demand inflation), and its inflationary impact is magnified further as it brings about higher wage costs (cost inflation).

I have constructed a small macroeconomic model, estimated structural equations, and performed dynamic simulations. The implied short-run tradeoff derived is that in a given year, each additional percentage point of output growth or investment growth leads to, respectively, a 2.6 or a 0.9 per cent increase in the rate of inflation that year. These numerical values and the data suggest that the 1993–95 inflationary spell is almost fully attributable to the investment-led economic boom that began in early 1992. Although various exogenous factors that affected prices were present, it appears that they largely canceled each other out over the inflationary period. My estimated wage function does not confirm for China the wage-price relationship of the accelerationist hypothesis. This, however, may not suggest the presence of a permanent output-inflation tradeoff, which policymakers can exploit, because other mechanisms to nullify it may exist.

Despite institutional differences, the Chinese government is facing basically the same kind of short-run macroeconomic tradeoff common to all market economies. Nevertheless, a large part of China's inflationary pressures during its reform period comes from two behavioral peculiarities of the state sector in systemic transition: high growth of fixed investment and of wage payments in state enterprises. Such spending behavior has been sustained largely by easy credit from state banks. These peculiarities can be corrected if the government grants the central bank more independence and privatizes state enterprises or imposes strict financial accountability on them. The nature of inflation may therefore change as economic reforms proceed.

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APPENDIX A

SOURCES OF DATA

G = (nominal household income) sum of Q and ΔM. This is an estimate of total household cash income.

M = (nominal money supply) sum of currency and savings deposits held by households (SSB 1993, p. 182).

P = (price of consumption goods) consumption goods price index in the retail price index (base year = 1978, 1978 level = 100) divided by 100 (SSB, *Zhongguo tongji nianjian*, 1994 ed., p. 235). The 1994 and 1995 indices have been obtained by extending the series with the growth rate of the retail price index (SSB, *Zhongguo tongji nianjian*, 1996 ed., p. 255; *Renmin ribao*, January 23, 1997).

Q = (output of consumption goods) sum of the nominal value of household expenditures for consumption goods (SSB, *Zhongguo tongji nianjian*, 1993 ed., p.

611) and services (SSB, *Zhongguo tongji nianjian*, 1986 ed., p. 443; 1991 ed., p. 582; 1993 ed., p. 602) divided by *P*.

r = (interest rate on money held by households) mean interest rate on one-year savings deposits (China Society for Finance 1993, p. 385). The starting value for the simulation was 0.026, two-thirds of the mean interest rate on one-year savings deposits in 1978.

V = (labor productivity) GDP in 1978 prices in *Y* divided by the number of employed (SSB, *Zhongguo tongji nianjian*, 1993 ed., p. 97; 1996 ed., p. 87). The starting value for the simulation was the sum of *Q* and state fixed investment divided by the number of employed in 1978.

W = (nominal annual wage) *G* net of interest incomes (total household earned cash incomes) divided by the number of employed. Interest incomes are the product of savings deposit balances at the end of the previous year and *r* in the previous year.

x = (gross fixed investment) nominal gross state fixed investment (1952–95) or nominal total fixed investment (1981–96) divided by the following deflators. The deflator for the 1952–1977 period was the mean of the deflators for industrial output and construction in the net material product (NMP) accounts (SSB, *Zhongguo tongji nianjian*, 1993 ed., pp. 33, 34, 149). For the 1978–91 period, the deflator was the mean of those of industrial output and construction in the GDP accounts (SSB, *Zhongguo tongji nianjian*, 1993 ed., pp. 31–32). For the 1992–96 period, the price index of investment in fixed assets was used as the deflator (SSB, *Zhongguo tongji nianjian*, 1994 ed., p. 243; 1995 ed., p. 250; 1996 ed., p. 272; *Renmin ribao*, January 23, 1997). Nominal state fixed investment and total fixed investment (SSB, *Zhongguo tongji nianjian*, 1988 ed., p. 559; 1993 ed., pp. 145, 149; 1994 ed., p. 139; 1995 ed., p. 137; 1996 ed., p. 139; *Renmin ribao*, January 23, 1997). Total fixed investment data was used for the estimation of equation (3) in Section IV.

Y = (aggregate output) GDP in 1978 prices (SSB, *Zhongguo tongji nianjian*, 1996 ed., p. 42; SSB 1993, p. 8; *Renmin ribao*, January 23, 1997). The starting value for the simulation was the sum of *Q* and state fixed investment in 1978.

APPENDIX B

SIMULATION SETUP

The starting values of lagged endogenous variables and the interest rate (r) are from 1978. The following assumptions are made in equation (1): (i) δ_0 to δ_{-4} are, respectively, 0.1, 0.3, 0.3, 0.2, and 0.1; and (ii) the values of γ and ζ are 0.5 and 0.05. Using these values and assuming the capital stock in 1956 to have been 100 billion yuan in 1978 prices, the time series of capital stock up to 1979 was recon-

structed based on equation (1) with state fixed investment data. The initial capital stock of the consumption goods industry for the simulation follows the computed 1978 value (271.3 billion yuan). Using the computed 1979 capital stock value and actual consumption goods output in 1979, and assuming α to be unity in 1979, β (0.506) is obtained as the reciprocal of the capital-output ratio that year. Considering that part of the money held by households is currency, the value of r (0.046) is set to two-thirds of the mean nominal interest rate of one-year savings deposits during 1979–92.

The lagged values of fixed investment (x) in equation (1) in the starting year follow those of state fixed investment from 1975 to 1978. The time series of x is extended for seventeen years from the 1978 value using a series of growth rates generated randomly. The mean of the growth rate generated follows the arithmetic-mean growth rate of state fixed investment for the 1979–92 period (9.8 per cent). The standard deviation of the growth rate generated follows that of total fixed investment for the 1982–96 period (11.2 per cent). Two separate series of fixed investment are referred to because the data for the more comprehensive of the two, total fixed investment, is available for a shorter period (from 1981). The supply shock term for the consumption goods industry (α) is represented by a generated series of a random variable whose mean and standard deviation are unity and 0.025. The standard deviation of the growth rate of personal consumption for the 1979–92 period is 3.7 per cent (Table I). I have assumed that 2.5 out of the 3.7 per cent deviation can be attributed to random supply shocks.

APPENDIX C

CHRONOLOGICAL REVIEW: 1992–95

The Chinese economy was in the early stage of a boom when Deng Xiaoping proposed the acceleration of economic growth in early 1992 (Deng 1994). Expansionary policy was adopted and a powerful investment boom followed immediately, as total fixed investment grew by 23.7 per cent in 1992 and by 25.3 per cent in 1993. This brought the fixed investment share of GDP to a very high level by 1993 (36.0 per cent), and the GDP growth rate reached 14.1 per cent in 1992 and 13.5 per cent in 1993, up from the 1991 figures of 9.2 per cent. This investment-led economic boom resulted in accelerating inflation and a deteriorating trade balance. The prices of construction materials began to rise in the summer of 1992, and consumer goods prices, led by food prices, followed suit by the year's end.[a] Increases in grain prices

[a] The market prices for steel, cement, lumber, and nonferrous metals began to rise rapidly in June 1992 (*Nihon keizai shinbun*, July 31, 1992).

were particularly pronounced, because the abolition of grain rationing in major cities coincided with this period.[b] Grain retail prices rose by 27.7 per cent in 1993, and the growth of the retail price index (RPI) accelerated to 13.2 per cent in 1993 from 5.4 per cent in 1992 (SSB, *Zhongguo tongji nianjian*, 1994 ed., p. 232). The increase of savings deposits slowed and currency in circulation expanded abruptly as households began hoarding cash or switching to other types of investment in the spring of 1993 (Naughton 1995a, p. 1098). The trade balance moved from a surplus in 1992 (U.S.$4.4 billion) to a deficit in 1993 (–U.S.$12.2 billion), reflecting mainly the surge in imports of producers' goods (SSB, *Zhongguo tongji nianjian*, 1996 ed., p. 580).

Reacting to these signals of macroeconomic imbalance, the government initiated a contractionary program, which included restraints on bank lending and state sector spending, in addition to interest rate hikes in the spring of 1993. New restrictions on state bank lending were imposed in the late spring and were tightened progressively to lessen the growth of fixed investment and wage payments.[c] The central bank raised deposit and lending rates in May and July of 1993,[d] and the yuan exchange rate was devalued from 5.8 to 8.7 yuan (official rate per U.S.$) in January 1994.[e]

The trade balance moved to a surplus (U.S.$5.4 billion) as exports expanded following the sizable currency devaluation (SSB, *Zhongguo tongji nianjian*, 1996 ed., p. 580). Although price hikes in producers' goods decelerated markedly during the second half of 1993, any impact of the contractionary program on fixed investment, wage payments, and retail prices was slow to appear. Rapid growth of net exports and direct foreign investment in 1994 seems to have blunted the effect of restrictive monetary policy, as foreign exchange receipts were converted into domestic currency.[f] The growth rate of total fixed investment fell only marginally (to 23.9 per cent), and high GDP growth continued (12.6 per cent) in 1994. The aver-

[b] Twenty per cent of counties and cities had already abolished grain rationing by early December 1992, and this figure reached 90 per cent by early July 1993 (*Renmin ribao*, December 10, 1992; July 8, 1993). Shanghai and Tianjin phased out grain coupons in April 1993 (*Renmin ribao*, April 3, 1993). Preceding the abolition of rationing, grain retail prices were raised in order to narrow the negative gaps between state purchase prices and retail prices. Rapid increases in grain retail prices began in 1992, as a result.

[c] Strong restrictions on bank lending began around May 1993 (*Nihon keizai shinbun*, June 20, 1993; *Financial Times*, May 24, 1993).

[d] The interest rate hikes in May were the first since February 1989 (*Renmin ribao*, May 15, 1993; July 11, 1993).

[e] "Then there was yuan" (*Economist*, January 8, 1994).

[f] As foreign exchange received was converted into domestic currency, official foreign exchange reserves more than doubled in 1994 (1993, U.S.$22.4 billion; 1994, U.S.$52.9 billion) (World Bank 1996, p. 79).

age wage of staff and workers increased by 34.6 per cent that year, following a 24.3 rise in 1993 (SSB, *Zhongguo tongji nianjian*, 1996 ed., p. 117). Grain retail prices rose sharply in 1994 (48.7 per cent), because (1) the hikes in purchasing prices implemented that year were passed along to retail prices and (2) the summer and fall harvests fell short of the previous-year levels (SSB, *Zhongguo tongji nianjian*,1995 ed., p. 236). The year-on-year monthly rate of inflation (RPI) peaked in October 1994 (25.2 per cent) before starting its descent (World Bank 1996, p. 104). The annual rate of inflation (RPI) peaked in 1994 (21.7 per cent), greatly overshooting the optimistic official target for that year (10 per cent) (Chen 1994, p. 24).

Restrictive monetary policy, after progressive tightening, began to overpower the strong investment demand and wage pressures by the end of 1994. Most enterprises were facing serious fund shortages by then. The growth rate of total fixed investment dropped to 10.9 per cent in 1995. As aggregate demand weakened, inflationary pressures subsided markedly. The growth of currency in circulation decreased by more than half that year from 142.4 billion yuan in 1994 to 59.7 billion yuan in 1995 (SSB, *Zhongguo tongji nianjian*, 1996 ed., p. 614). Also, good harvests and increases in grain imports helped to restrain food price hikes.[g] The GDP growth rate fell to 10.5 per cent in 1995, and the 15 per cent annual rate of inflation target (RPI) was achieved (actual record, 14.8 per cent). The drop in the rate of inflation was more pronounced in the year-on-year growth rate of the RPI in December (1994, 23.2 per cent; 1995, 8.3 per cent) (World Bank 1996, p.104).

[g] Grain imports grew from 9.2 million tons in 1994 to 20.8 million tons in 1994 (SSB, *Zhongguo tongji nianjian*, 1996 ed., p. 592).