

Soft budget constraint and inflation cycles: a positive model of the macro-dynamics in China during transition

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Abstract

In this paper we develop a positive, general equilibrium model consistent with China's institutional and political environment to explain the growth and inflation cycles during transition. Central to our explanation is the government's use of the monetary and financial system to support the state sector, and the growing tension between a long-running commitment to the sector and economic decentralization. Given this commitment, we show how the cycles emerge as a product of the government's imperfect control over credit allocation under decentralization and the high costs of implementing administrative credit control. © 2001 Published by Elsevier Science B.V.

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1. Introduction

China's impressive growth since 1978 is well documented.¹ An important feature of the growth process during reform is that it exhibits a marked cyclical pattern. Periods of rapid growth, accompanied by accelerating inflation, are

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¹ See, for example, Perkins (1994).

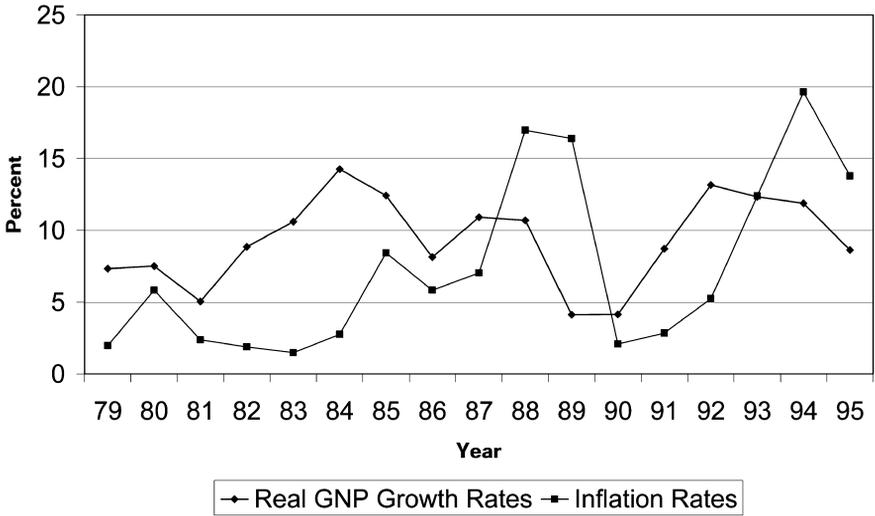


Fig. 1. Inflation and GNP growth in China.

followed by periods during which the growth rate and the rate of inflation decline in tandem. This “boom–bust” or “stop–go” feature of the reform economy is widely recognized.² China has gone through three cycles, with peaks in 1985, 1988 and 1994, and with the annualized rate of inflation topping 50% in each of the booms (see Fig. 1). A unique feature of this growth is the high positive correlation observed between the growth and inflation over the cycles. In other transition economies in Eastern Europe and several Latin American countries that have also experienced boom–bust cycles, the correlation is negative or zero.

An extensive literature, largely descriptive in nature, exists analyzing the problem of inflation in China. Most of it is confined to single inflationary episodes, and does not deal with the problem of cycles per se.³ A major theme that runs through the literature, however, is a tension between central and local governments and problems of “investment hunger”. This theme figures prominently, for example, in recent analysis by Naughton (1996) and the World Bank (1995) of the most recent inflationary episode in 1993–1994. Both suggest that a high and rising desired level of investment by the central government, much of it in infrastructure, but declining financial resources lead to inflationary finance. Only the threat of hyperinflation compelled coordination between the central and

² See, for example, Deng (1994), Fan and Woo (1993), Jin (1994), Naughton (1992), Yusuf (1994) and World Bank (1995).

³ See Lin et al. (1996) and the World Bank (1995) for more general examinations of the problem of inflation in China.

local levels of government and a reduction in investment. In a recent paper (Brandt and Zhu, 2000), we offered an alternative explanation for the cycles and provided detailed empirical support for our interpretation. Central to our story is the government's use of the monetary and financial system to support the state sector, and the growing tension between a long-running commitment to this sector and economic decentralization. Contrary to much of the conventional wisdom, our analysis suggests that the fundamental contradiction is not between localities and the center, but rather between the state and non-state sectors.⁴

Our objective in this paper is to formalize that discussion and develop a dynamic general equilibrium model consistent with key features of China's institutional and political environment to explain the cyclical nature of China's growth. In doing so, the paper helps to bridge a large gap between an extensive literature analyzing macro-economic behavior and business cycles in industrialized countries and the largely descriptive literature for China. Differences in political and economic institutions prevent the models developed for analyzing industrialized countries from being directly applicable to China. Mindful of some unique institutional features, however, the same methodology and analytical tools can be used to analyze the dynamics of growth and inflation in China.⁵ By using an analytical framework similar to that used in modern macro-economic theory, our analysis helps highlight the key political and institutional factors underlying the cycles.

In Section 2 of the paper, we briefly examine several features of China's institutional and political environment that are central to our explanation of the cycles. In Section 3, we extend a model developed by Dewatripoint and Maskin (1995) to analyze the effects of one of these features—the government's commitment to the state sector—on enterprise budget constraints and productivity. Following Shleifer and Vishny (1994), politicians value state-controlled firms for their political support, which commits them to bailing out failing state firms through the use of transfers. We link the required transfers to the relative size of the state sector, and the level of productivity and investment in the non-state sector. In Section 4, we analyze the dynamic implications of this commitment to the state sector. We show that as long as the government does not have perfect control over credit and investment, it faces a trade-off between growth and macro-stability. In Section 5, we analyze the effect of decentralization on the banks' credit allocation decisions and on the government's ability to control investment allocation. In Section 6, we show how the costs associated with

⁴ The non-state sector is not to be confused with the private sector. Although it does include private enterprises and joint ventures, until recently the non-state sector was primarily made up of urban collectives and township and village enterprises (TVEs), which are owned and run by local governments and communities.

⁵ The model also provides a basis for making a longer-term assessment of key aspects of China's growth strategy, which we plan to do in a subsequent paper.

implementing direct credit control give rise to inflation cycles in equilibrium. Section 7 concludes.

2. Institutional environment

There are three key features of China's institutional and political environment that are central to our explanation of the macro-economic dynamics. These include:

- Economic decentralization,
- The government's commitment to the state sector,
- The credit plan and credit control.

In this section, we briefly discuss each of these features. A more detailed examination is provided in Brandt and Zhu (2000).

2.1. *Economic decentralization*

Since reform began in the late 1970s, China has undergone substantial economic decentralization. Much attention has been paid to the market and price reforms that allowed for the entry of non-state enterprises into most sectors of the economy, and enterprise reforms that gave state-owned firms more autonomy and all but eliminated the plan in most non-financial sectors (Naughton, 1995). Equally important for our purposes are fiscal and financial reforms. Fiscal reforms allowed local governments to retain a larger share of the revenue they collect. An unexpected consequence of the decentralization is the sharp reduction in the government's budgetary revenues as a percentage of GNP (Wong et al., 1995). Financial reforms, on the other hand, transferred responsibility for investment funds allocation from the Ministry of Finance to a decentralized state-owned banking system, and allowed for the introduction of new financial institutions and markets. Simultaneously, more discretion in lending was extended to local branches of state-owned banks, and inter-bank markets were set up to allow funds to flow more freely within the financial system.

2.2. *The government's commitment to the state sector*

With the entry and rapid growth of the non-state sector, the state sector's share of total output steadily declined. Productivity growth in the state sector also lagged that in the non-state sector. Despite a sharp drop in its output contribution, the state sector's share of total employment and total fixed investment remained fairly constant up through 1993. Average wages in the state sector also remained nearly a third higher than those in the non-state sector. Over this period, employment and wage growth in the state sector were maintained by government transfers, which

took three basic forms: (1) direct subsidies from fiscal authorities; (2) cheap credits from the state-banking system; and (3) policy loans from the central bank financed with money creation. Because of fiscal constraints related to fiscal decentralization, transfers in the form of direct subsidies were limited and declined as a percentage of GNP. As a result, allocation of cheap credits and money creation were the main methods used to finance transfers to the state sector.

2.3. *The credit plan*

Higher returns in the non-state sector and reforms in the financial sector gave banks the incentives and means to allocate an increasing percentage of credit to the non-state sector. To ensure that a large portion of total credit was directed to the state sector, the credit plan was used by the central government to control the banking system's credit allocation. In each year's credit plan, the state banks were given credit quotas, which subject to the availability of funds from deposits and other sources, put ceilings on the amount they could lend in total, in each province, for fixed investment or working capital, and to state-owned firms or non-state firms.⁶ In most years, the credit plan was used as an indicative plan. In the indicative plan, mandatory credit quotas only covered part of the plan, and the rest of the plan consisted of credit quotas that were not strictly enforced. As a result, state-owned banks had some discretion under the indicative plan. In order to control the leakage of credit outside of the state sector, the central government resorted on several occasions to the use of an administrative credit plan. Under the administrative credit plan, credit allocation was centralized and implemented through administrative means. Key measures taken by the central bank as part of the implementation of the administrative credit plan include: (1) an elimination of all discretionary lending by state-owned banks and the replacement of indicative credit quotas with mandatory quotas; (2) strict restriction on the flow of funds outside the state-owned banks and lending to projects outside the credit plan; and (3) local leaders and heads of branches of state-owned banks and ministries were held individually responsible for credit plan fulfillment.

3. A model of two sectors

In this section, we extend a model developed by Dewatripoint and Maskin (1995)⁷ by embedding it into a dynamic search model. We then use this model to study how the government's commitment to the state sector results in the soft

⁶ For a detailed discussion on the features and implementation of the credit plan, see Zhongguo Jinrong Shiwu Daquan (1991) edited by Zhou Zhengqing, former deputy governor of China's central bank.

⁷ See also Qian (1994).

budget constraint for state firms and gives rise to a productivity differential between the two sectors.

Consider an economy with two sectors: The state sector and the non-state sector. There is only one good that can be either consumed or invested. Investment is done by the firms in both sectors. All agents are assumed to be risk-neutral. Time is discrete and is indexed by $t = 0, 1, 2, \dots$

3.1. The firms and technology

The firms in both sectors are endowed with the same technology. For simplicity, we assume that each firm has only one employee who we call a manager. Managers' economic activities include picking and possibly searching for investment projects.⁸ There are two types of investment projects: Good projects and bad projects.

(I) Good project: Investing i units of the good in one period yields $A_g i$ units of output in the next period. In addition, the manager of the project enjoys a private employment benefit Bi .

(II) Bad project: Investing i units of the good yields no output. Without further investment, the firm will have to be closed, in which case the manager will become unemployed and lose her employment benefit. But with additional i units of investment (refinancing), the project can be completed and yields $A_b i$ units of output and a private benefit Bi for the manager.

Firms do not have capital and they rely on bank loans for investment financing. Let $R < A_g$ be the gross real interest rate on investment loans charged by the banks. When a project is good, the bank that finances the project receives a per unit return R and the firm (or the manager) retains the residual profit, $A_g - R$. When a project is bad, the firm defaults on its debt. If the bank refinances the project, all of the output of the project will go towards debt repayment to the bank.

Thus, a manager's per unit return from a good project is:

$$\pi_g = A_g - R + B,$$

and a manager's per unit return from a bad project is:

$$\pi_b = \begin{cases} B; & \text{if the project is refinanced} \\ 0; & \text{if the project is not refinanced} \end{cases}$$

In each period $t \geq 0$, the probability of finding a good project depends on managers' search effort. If a manager does not search but picks a project randomly, the probability of getting a good project in the next period is Q_1 . If the

⁸ We concentrate on modeling the investment behavior of enterprises for two reasons: (1) Growth of fixed investment has been an important factor in determining the output growth in both the state and non-state sectors; (2) Difference in investment efficiency has been the most significant difference in performance between the state-owned and the non-state owned enterprises. See, e.g., Jefferson et al. (1992, 1995).

manager searches at the disutility cost of $a > 0$ (per unit of investment, measured in the output unit), the probability of getting a good project is:

$$Q_t = Q_h^\delta Q_{t-1}^{1-\delta} \quad (1)$$

where $\delta \in (0,1)$, $Q_h > Q_1$, and Q_{t-1} is the probability of finding a good project for a manager who searched in period $t-1$. The search technology assumes that search by managers in one period has a positive spillover effect in the next period, but only those who search benefit from this effect. Let $Q_0 = Q_1$. Then, we have that:

Proposition 1. For any $t \geq 1$, $Q_1 < Q_t < Q_{t+1} < Q_h$ and $\lim_{t \rightarrow \infty} Q_t = Q_h$.

In other words, the return to search, represented by Q_t , rises over time and converges to Q_h .⁹

The ex ante expected return for a manager in period t is:

$$\pi_t^e = \begin{cases} Q_1 \pi_g + (1 - Q_1) \pi_b; & \text{if does not search} \\ Q_t \pi_g + (1 - Q_t) \pi_b - a; & \text{if searches} \end{cases} \quad (2)$$

The managers are risk-neutral, and their objective is to maximize the expected return.¹⁰ From Eq. (2), a manager will search in period t if and only if $(Q_t - Q_1)(\pi_g - \pi_b) \geq a$, i.e., the return to search is higher than the disutility cost of search.

Assumption 1. $(Q_h - Q_1)(A_g - R) < a < (Q_h^\delta Q_1^{1-\delta} - Q_1)(A_g - R + B)$.

Assumption 1 implies that a manager's search effort depends on the possibility of project refinancing. She will search if she expects no refinancing when her project turns out to be bad, and will not search if she expects that a bad project will be refinanced. In the latter case, we say that the manager has a *soft budget constraint*.

3.2. The political role of the state firms and the soft budget constraint

Following Shleifer and Vishny (1994), we view state firms as a means for the government to obtain political benefits. The government builds up its *political capital* in the state firms by continually providing the managers in these firms with employment and above market wages. In return, it receives their political support.

⁹ Since we assume that the benefit of search is reflected in a higher probability of finding a good project, the return to search is always bounded. If search improves both the probability of finding a good project and the quality of projects, the return to search can be unbounded.

¹⁰ It is arguable whether the objective of the managers in the state firms is to maximize expected economic returns. What we want to emphasize is that even if the managers are maximizing economic returns, inefficiency will still arise in the state sector because of their soft-budget constraints. Modeling non-profit maximizing behavior will only lead to more inefficiency in the state sector and strengthen our results.

The political capital that the government accumulates in a state firm will be lost, however, if the firm is closed.¹¹ This implies that the political cost of closing a state firm is much higher than that of closing a non-state firm. Because of this difference in the political cost of closing firms in the two sectors, the government is more likely to bail out a state firm than a non-state firm.

Banks are controlled by the government and, therefore, their financing decisions reflect the government's political objectives. Specifically, the banks' decision on whether to refinance a bad investment project will be based on the total return from refinancing, including the potential political cost of closing firms. Let μi , for some $\mu > 0$, be the political cost of closing a state firm that had invested i in a bad project. Then, the per unit return of refinancing a bad project in the state sector is $\mu + A_b - 1$, while that in the non-state sector is $A_b - 1$. The larger the political cost μ is, the higher the return of refinancing a bad project in the state sector, and the less likely that the banks will let the state firms with bad investment projects be closed.

The next assumption says that the political cost is high enough so that it is always optimal for the banks to refinance bad projects in the state sector, but it is not optimal for the banks to refinance bad projects in the non-state sector.

Assumption 2. $A_b < 1 \leq \mu + A_b$.

Thus, the managers in the state sector have a soft budget constraint while the managers in the non-state sector have a hard budget constraint. From the discussion in the last section, we know that the managers in the state sector will never search and the managers in the non-state sector will always search.

Proposition 2. *Under Assumptions 1 and 2, (i) the managers of the state firms will never search and their probability of getting a good project is always Q_1 ; and (ii) the managers of the non-state firms will always search and their probability of getting a good project in period t is $Q_t (> Q_1, \text{ for } t \geq 1)$, which rises over time.*

Part (i) of Proposition 2 implies that the productivity in the state sector remains constant over time. This is not critical to our analysis. What is important is the implication that the productivity level in the state sector is lower than that in the non-state sector because of the soft budget constraint of the state firms, and that the productivity gap between the two sectors widens over time.

3.3. The size of the state sector and transfers

The government is committed to maintaining a certain level of employment in the state sector. By making lump-sum transfers to the managers in the state firms,

¹¹ When a state firm is closed, the manager of the firm will be unemployed and lose all the benefits of being in the state sector. As a result, the manager's political support to the government will be reduced.

the government also ensures that the value of being a manager in the state sector is higher than the value of being a manager in the non-state sector. The difference in the two values represents the rent that is enjoyed by the managers in the state sector. The magnitude of this rent is a function of the political benefits that they can provide to the government. The larger the political benefits, the higher the rent. Because we do not explicitly model the political process that gives rise to the political benefits provided by the state firms to the government, we cannot endogenize the size of the rent. Instead, we simply assume that the government equalizes the average monetary income in the state and the non-state sectors. Thus, the rent enjoyed by the state firm managers is simply the job security and the associated private employment benefits.¹²

There is a continuum of managers who are identical *ex ante*. For simplicity, we normalize the number of the managers in the non-state and the state sector to one and α , respectively. In this way, α can be interpreted as the relative size of the state sector.

Let I_t^s and I_t^n be the investment (not including refinancing) made in period t by the two sectors, respectively. Then, the investment per firm in the state and the non-state sector is $i_t^s = I_t^s/\alpha$ and $i_t^n = I_t^n$, respectively. Thus, the average income in period $t + 1$ for a manager in the state sector is:

$$w_t^s = Q_1(A_g - R)i_t^s,$$

and the average income for a manager in the non-state sector (not including the private employment benefits) is:

$$w_t^n = Q_1(A_g - R)i_t^n.$$

The size of the lump-sum transfers to the state sector that is needed to equalize the average income between the two sectors in period $t + 1$ is:

$$Z_{t+1} = (Q_t I_t^n \alpha - Q_1 I_t^s)(A_g - R). \quad (3)$$

The output in period $t + 1$, on the other hand, is:

$$Y_{t+1} = Q_t A_g I_t^n + [Q_1 A_g + (1 - Q_1) A_b] I_t^s. \quad (4)$$

Let $\lambda_t = I_t^n / ((2 - Q_1) I_t^s + I_t^n)$ be the investment in the non-state sector as a percentage of total investment in period t . Then, the amount of transfers to the state sector as a percentage of output is:

$$z_{t+1} = \frac{\alpha Q_t \lambda_t (1 - \lambda_t)^{-1} (2 - Q_1) - Q_1}{A_g Q_t \lambda_t (1 - \lambda_t)^{-1} (2 - Q_1) + [Q_1 A_g + (1 - Q_1) A_b]} (A_g - R), \quad (5)$$

which is an increasing function of α , λ_t and Q_t . That is, the amount of transfers to the state sector increases in the relative size of the state sector the government

¹² This most likely underestimates the rent since the employees in the state sector generally enjoy both job security and a premium in monetary wages over those in the non-state sector.

wishes to maintain, the share of investment in the non-state sector, and the productivity in the non-state sector. The latter two variables have a positive effect on the required transfers because their increase leads to a larger output gap between the state and the non-state sectors.

3.4. Equilibrium

To complete the model, we now describe how investment in the two sectors is determined and financed, and how the transfers to the state sector are financed. Since investment is financed by bank loans, the distribution of investment between the two sectors is determined by the banks' credit allocation. In this and the next section, we take credit allocation as given and study how it affects output growth, money supply and inflation. The question of how credit allocation is determined is addressed in Section 5.

Let M_t be the supply of reserve money in period t , and p_t the price level. Then, the total amount of loans that can be generated by the banks is $l_t = (\gamma - 1)M_t$, where γ is the money multiplier. These loans will be used to finance the investment in the non-state sector I_t^n , the investment in the state sector, I_t^s , and to refinance bad projects in the state sector, $(1 - Q_1)I_t^s$. Thus, we have:

$$(\gamma - 1)M_t/p_t = I_t = I_t^n + (2 - Q_1)I_t^s.$$

The transfers to the state sector are financed directly by the government (or the central bank) through money creation, thus:

$$M_{t+1} - M_t = p_{t+1}Z_{t+1}. \quad (6)$$

The households in this economy hold money because they face a cash-in-advance constraint: $p_t C_t \leq M_t$, where C_t is the consumption of the representative household. We consider only the case when the cash-in-advance constraint always binds.¹³ Thus:

$$p_t C_t = M_t. \quad (7)$$

Finally, the economy's resource constraint is $Y_t = I_t + C_t$, which combined with Eq. (7) implies that:

$$Y_{t+1} - I_{t+1} = \frac{M_{t+1}}{p_{t+1}}. \quad (8)$$

Eqs. (3)–(8) are the equilibrium conditions of this model economy.

¹³ Under the assumption that the household is risk-neutral, the cash-in-advance constraint is always binding if $p_{t+1}/p_t > \beta$, where β is the time discount factor.

4. Dynamic implications of the commitment to the state sector

It is widely recognized that a state sector adversely affects growth and macro-stability. On one hand, they have lower efficiency. On the other hand, their deficits are often financed by money creation that is inflationary. In this section, we analyze the dynamic impact of the government's commitment to the state sector.

4.1. Co-movement of output and inflation

Solving for the inflation rate and the output growth rate from Eqs. (3)–(8), we have:

$$\frac{P_{t+1}}{P_t} = \frac{\gamma(\gamma - 1)^{-1}(\rho_t + 2 - Q_1)}{[A_g - \alpha\gamma(A_g - R)]Q_t\rho_t + [Q_1A_g + (1 - Q_1)A_b] + Q_1\gamma(A_g - R)} \quad (9)$$

and:

$$\frac{Y_{t+1}}{Y_t} = \frac{\gamma - 1}{\gamma} \frac{A_g Q_t \rho_t + [Q_1 A_g + (1 - Q_1) A_b]}{\rho_t + 2 - Q_1}, \quad (10)$$

where $\rho_t = (2 - Q_1)\lambda_t(1 - \lambda_t)^{-1}$. Taking partial derivatives of the inflation rate and the output growth rate with respect to Q_t , λ_t and α yields the following results:

Proposition 3. (i) *The output growth rate is increasing in Q_t , and it is increasing in λ_t if and only if*

$$Q_t A_g > [Q_1 A_g + (1 - Q_1) A_b](2 - Q_1)^{-1}. \quad (11)$$

(ii) *The inflation rate is an increasing function of α . In addition, it is increasing in both λ_t and Q_t if and only if*

$$\alpha > A_g(A_g - R)^{-1}\gamma^{-1}. \quad (12)$$

Part (i) of Proposition 3 is trivial. The economy grows faster the higher is the productivity in the non-state sector. Furthermore, if the average return to investment in the non-state sector ($Q_t A_g$) is greater than the average return to investment in the state sector ($[Q_1 A_g + (1 - Q_1) A_b](2 - Q_1)^{-1}$),¹⁴ the economy

¹⁴ This is true if, e.g., $Q_t A_g > 1$.

will also grow faster as a larger share of total investment is allocated to the more productive non-state sector.

Part (ii) of Proposition 3 says that if the size of the state sector is large, the inflation rate is also increasing in Q_t and λ_t , or the non-state sector's productivity and share of investment, respectively. When Q_t and λ_t increase, the economy grows faster and the demand for money increases as well. Higher money demand implies that a higher level of seigniorage revenues can be collected at any given inflation rate. Thus, if the transfers to the state sector remain fixed, then the inflation rate should fall as Q_t and λ_t increase and the economy grows faster. However, the (pre-transfer) income gap between the state and the non-state sector also widens with increases in Q_t and λ_t . Consequently, the transfers to the state sector must increase in order to maintain the size of the sector at a constant level α . When α is large, the increase in the required transfers is larger than the increase in the money demand. A higher inflation rate is needed, therefore, to finance the transfers.

Results in Proposition 3 provide an explanation for the positive correlation between the output growth rate and the inflation rate that was observed in China during the reform period. It is also clear from the discussion that the source of the inflation problem is not growth but the transfers to the state sector.

4.2. The need for credit and investment control

There is an upper limit on the amount of transfers that can be financed with money creation or inflation. If productivity and the share of investment in the non-state sector continue to rise, the required transfers will exceed this limit and the government will not be able to effect enough transfers to the state sector to maintain its size at α . To keep its commitment to the state sector, the government must control the ratio of investment between the two sectors, λ_t , below some threshold. As the productivity in the non-state sector improves, i.e., Q_t increases, the income gap between the two sectors widens and the required transfers increase at any given level of λ_t . As a result, to prevent the transfers from exceeding the upper limit, the government must impose tighter controls on the investment in the non-state sector. Thus, we have:

Proposition 4. *For any α that satisfies condition (12), there exists a threshold level, $\lambda^*(\alpha, Q_t) \in (0, 1)$, such that an equilibrium exists if and only if $0 \leq \lambda_t < \lambda^*(\alpha, Q_t)$, with inflation accelerating into hyperinflation as λ_t approaches the threshold from below. Furthermore, the threshold level, $\lambda^*(\alpha, Q_t)$, is a decreasing function of Q_t and α .*

Proof. The proofs of Propositions 4–8 are given in an appendix that is available as a pdf file on the website <http://www.economics.utoronto.ca/xzhu/paper/sbcapdx.pdf>.

Proposition 4 highlights the long-run consequences of the government's commitment to a large state sector. It implies that the more productive the non-state sector is, the tighter the government's controls on the resource flow into the non-state sector must be in order to avoid hyperinflation. It follows that the welfare cost of maintaining the commitment to the state sector increases over time.

Somewhat surprisingly, the progressively tighter control on investment in the non-state sector does not necessarily imply that the economy's growth rate will decline. In fact, if the government has perfect control over investment allocation, it can keep the rate of inflation constant by continually reducing the relative amount of investment in the non-state sector without causing the growth rate to decline. The key here is that the decline in the share of investment in the non-state sector is offset by the continued increase in productivity in the non-state sector so that on net the economy's growth rate continues to increase. Let:

$$\bar{\tau} = \frac{\gamma(\gamma - 1)^{-1}(2 - Q_1)}{Q_1 A_g + (1 - Q_1) A_b + \gamma Q_1 (A_g - R)}$$

be the inflation rate when $\lambda_t = 0$, which is also the lowest possible inflation rate when $\alpha > A_g(A_g - R)^{-1}\gamma^{-1}$. Then, we have:

Proposition 5. *Assume that α satisfies condition (12). For any constant $\tau > \bar{\tau}$, there exists a function $\hat{\lambda}(\tau, \alpha, Q_t)$, which is decreasing in Q_t , such that if $\lambda_t = \hat{\lambda}(\tau, \alpha, Q_t)$ for all $t > 0$, then the equilibrium inflation rate is at the constant level τ in every period and the output growth rate is increasing over time.*

The main reason behind Proposition 5 is the unrealistic assumption that the government can control investment allocation perfectly without affecting productivity in either the state or the non-state sector. Given the widening productivity gap between the state and the non-state sector, however, the incentive for agents such as the banks is to direct more, not less resources to the non-state sector. This makes the need to reduce continually the relative amount of investment in the non-state sector incompatible with the banks' incentives. This incentive incompatibility suggests that the government's control over investment allocation cannot be perfect.

In the next section, we study the impact of decentralization on the banks' credit allocation decisions and on the government's ability to control investment allocation.

5. Decentralization and credit allocation by the banks

Two aspects of decentralization are studied in this section: Decentralization in the real sector and financial decentralization. The former leads to a higher

productivity growth rate in the non-state sector¹⁵ and, therefore, a stronger incentive for the banks to direct resources to the non-state sector, while the latter makes it easier for the banks to do so.

5.1. Decentralization in the real sector

The degree of decentralization in the real sector can be captured by the parameter δ , which determines the return to search. The idea behind this is that when markets are highly regulated, it is difficult for managers to find good projects even when they search. Thus, a lower degree of decentralization is reflected in a lower value of δ .

From Eq. (1), we have:

$$Q_t/Q_{t-1} = [Q_b/Q_{t-1}]^\delta.$$

Since $Q_b/Q_{t-1} > 1$ (Proposition 1), the equation above implies that the growth rate of Q_t increases with δ . Thus, a higher degree of decentralization will lead to faster productivity growth in the non-state sector, which gives the banks a stronger incentive to direct resources to the non-state sector.

5.2. Decentralization in the financial sector

Under financial decentralization, banks are given discretionary power in deciding which projects they will finance. In period t , a bank's ex ante expected profit per unit of investment from financing a project in the non-state sector is $\nu_t^n = Q_t R - 1$, and the expected gain ν^s from financing a project in the state sector equals the expected profit, $Q_1 R + (1 - Q_1)A_b - 1$, minus the expected cost of refinancing bad projects, $(1 - Q_1)$.¹⁶ Since $Q_1 < Q_t$, it is clear that $\nu^s = Q_1 R + (1 - Q_1)A_b - (2 - Q_1) < \nu_t^n$. Thus, a bank would lend exclusively to projects in the non-state sector if it is allowed to allocate its loans freely.¹⁷ This implies that $\lambda_t = 1$, and from Proposition 4, the government would not be able to maintain its commitment to the state sector. In other words, a fully decentralized financial sector is incompatible with the government's commitment to the state sector.

¹⁵ Arguably, decentralization also affects productivity in the state sector as well, but presumably by a smaller amount so that the productivity differential between the state and non-state sector widens.

¹⁶ Note that the cost of refinancing bad projects is a result of the soft budget constraint faced by the state-owned firms. The soft budget constraint itself is a product of the state ownership of the bank, and the government's concern for the political cost of closing down state-owned firms.

¹⁷ This implication of the model should not be taken literally. If there is heterogeneity among firms in both sectors, an expected return maximizing bank may lend to some good state-owned firms and not lend to bad non-state firms. Since we ignore heterogeneity within a sector for simplicity, it implies that in the model the bank will always prefer to lend to the non-state sector. What we try to capture in the model here is the following two features: (1) The state-owned banks had incentives to allocate credit on the margin to those projects with highest returns; and (2) on average, returns are higher in the non-state sector. These features are consistent with the fact we document in Brandt and Zhu (2000) that during non-retrenchment periods, an increasing share of bank credit flowed into the non-state sector.

Now consider the case of partial financial decentralization: The banks are allowed to allocate credits to the non-state sector up to a limit, and a bank that makes loans to the non-state sector beyond the limit incurs a cost. In addition, lending to the non-state sector is subject to an adjustment cost associated with rebalancing loan portfolios. Formally, let λ_t be the share of total loans that the representative bank lends to the non-state sector in period t , $\bar{\lambda}_{t-1}$ the average percentage of credits allocated to the non-state sector by the banks in period $t-1$, and λ_p the limit set by the government, then, the cost of financing investment in the non-state sector is measured by the following cost function:

$$\frac{1}{2}d^{-1}\left[\nu(\lambda_t - \lambda_p)^2 + (1 - \nu)(\lambda_t - \bar{\lambda}_{t-1})^2\right], \quad d > 0, \quad 0 < \nu < 1. \quad (13)$$

Here, ν and d are two constant parameters. The parameter d can be interpreted as a measure of the degree of financial decentralization. The larger the value of d is, the less costly for the bank to lend to the non-state sector and, thereby, the more decentralized is the financial sector. The bank's lending to the non-state sector is also influenced by the limit set by the government, λ_p .¹⁸ The smaller is the limit, the more costly it will be for the bank to lend to the non-state sector. The parameter ν measures the relative importance of this cost to the adjustment cost.

Let $R_t^n = v_t^n$ and $R^s = \nu^s / (2 - Q_t)$ be the bank's expected return of lending to the non-state sector and the state sector, respectively. The representative bank's credit allocation problem is to choose λ_t to maximize the expected return net of the costs specified in Eq. (13). That is:

$$\max_{0 \leq \lambda_t \leq 1} \left\{ R_t^n \lambda_t + R^s (1 - \lambda_t) - \frac{1}{2}d^{-1} \left[\nu(\lambda_t - \lambda_p)^2 + (1 - \nu)(\lambda_t - \bar{\lambda}_{t-1})^2 \right] \right\}.$$

The solution to the optimization problem is $\min\{1, \nu\lambda_p + (1 - \nu)\bar{\lambda}_{t-1} + d(R_t^n - R^s)\}$. In equilibrium, $\bar{\lambda}_{t-1} = \lambda_{t-1}$. So, under partial financial decentralization, the evolution of the bank's credit allocation is given by:

$$\lambda_t = \min\{1, \nu\lambda_p + (1 - \nu)\lambda_{t-1} + d(R_t^n - R^s)\} \quad (14)$$

which is a mean-reverting process with a long-run mean $\lambda_t^b = \min\{1, \lambda_p + \nu^{-1}d(R_t^n - R^s)\}$. For any $\lambda_p < 1$, then, we have:

$$\lambda_t^b - \lambda_p = \min\{1 - \lambda_p, \nu^{-1}d(R_t^n - R^s)\} > 0. \quad (15)$$

Eq. (15) shows that under partial financial decentralization the government's control over the allocation of credits and, therefore, investment between the state

¹⁸ This limit can be thought of as the credit quota set by the government in an indicative plan.

and the non-state sector is limited. Because of the higher expected return in the non-state sector, the banks always have an incentive to “divert” resources to the sector, despite the costs they incur in the process. The more decentralized is the financial sector and the larger the return differential between the state and the non-state sector, the larger is the amount of diversion. Here the banks’ diversion of resources to the non-state sector can be measured by the variable $\sigma_t = \nu^{-1}d(R_t^n - R^s)$. (Note that, from Eq. (15), $\lambda_t^b - \lambda_p = \min\{1 - \lambda_p, \sigma_t\}$.)

If the degree of financial decentralization and the return differential between the two sectors are small enough so that the diversion of resources by the banks is limited, i.e., $\sigma_t < \lambda^*(\alpha, Q_t)$ for all t , then, there exists a $\lambda_p \geq 0$ such that $\lambda_t^b < \lambda^*(\alpha, Q_t)$ for all t . In this case, the government can maintain its commitment to the state sector without imposing direct control over credit allocation. However, if $\sigma_t < \lambda^*(\alpha, Q_t)$ for some t , then, $\lambda_t^b < \lambda^*(\alpha, Q_t)$ for any $\lambda_p \geq 0$, which implies that the equilibrium condition $\lambda_t < \lambda^*(\alpha, Q_t)$ will be violated. Thus, we have:

Proposition 6. *Under partial financial decentralization, an equilibrium without direct credit control does not exist if $\sigma_t = \nu^{-1}d(R_t^n - R^s) \geq \lambda^*(\alpha, Q_t)$ for some $t \geq 0$.*

Proposition 5 shows that if $\sigma_t = \nu^{-1}d(R_t^n - R^s) \geq \lambda^*(\alpha, Q_t)$ for some t , then, at some point in time the government has to impose direct control over credit allocation by centralizing the lending decisions to ensure that its commitment to the state sector is maintained. But imposing direct control over credit allocation through centralization is costly. When credit allocation decisions are decentralized, banks can use their information about local demands and investment returns to screen out some bad projects. Under centralization, however, projects in the state sector are directly chosen by the government and banks no longer have the authority to reject bad projects. This leads to a large increase in the number of bad projects in the state sector that will be financed and a significant reduction in the average quality of investment in the state sector. Because of this adverse effect on investment efficiency, the government has to make careful decisions on when to impose direct credit control and the duration of the control. In the next section, we show how such considerations can lead the government to adopt a cyclical control policy that results in growth and inflation cycles in equilibrium.

6. Direct credit control by the government and cycles

We formalize the cost of imposing direct credit control as follows:

Assumption 3. If the government decides to impose direct control over credit allocation in period t , the proportion of good projects in the state sector drops from Q_1 to $Q_1 - \eta$ for some $\eta > 0$.

The fixed cost η in Assumption 3 embodies the notion that for the direct control over credit allocation to be effective, a substantial amount of centralization is needed.

For various reasons, the central bank may want to restrict λ_t to a level that is below the threshold level $\lambda^*(\alpha, Q_t)$. One such reason is to prevent hyperinflation because inflation accelerates as λ_t approaches $\lambda^*(\alpha, Q_t)$. Let $\bar{\tau}$ be the highest rate of inflation that the central bank is willing to accept. Then, for $\alpha > A_g(A_g - R)^{-1}\gamma^{-1}$, the constraint $p_{t+1}/p_t \leq \bar{\tau}$ implies an equivalent constraint on λ_t .

Proposition 7. *Suppose that α satisfies condition (12). For any given $\bar{\tau} > \tau$, there exists a threshold function $\theta(Q_t, Q)$ such that $0 < \theta(Q_t, Q) < \lambda^*(\alpha, Q_t)$ and that $p_{t+1}/p_t \leq \bar{\tau}$ if and only if $\lambda_t \leq \theta(Q_t, Q)$ when there is no direct credit control in period t and $\lambda_t \leq \theta(Q_t, Q) - \eta$ when there is direct control in the period. Furthermore, the threshold function $\theta(Q_t, Q)$ is decreasing in Q_t and increasing in Q .*

Besides controlling inflation, the government also prefers to have a higher output growth rate. We model this by assuming that the government wants to maximize the following objective function¹⁹ subject to the constraint $p_{t+1}/p_t \leq \bar{\tau}$:

$$\sum_{t=0}^{+\infty} \beta^t \log(Y_{t+1}).$$

Note that Y_0 is pre-determined by the credit allocation in period -1 and is therefore not in the government's objective function. Solving the dynamic optimization problem explicitly is difficult.²⁰ Instead, we provide an analytical characterization of the government's optimal intervention rule to show that the resulting equilibrium exhibits cycles.

As we showed in the previous section, the government must impose direct credit control intermittently to maintain its commitment to the state sector. If the control cost measured by η is small, the government may want to impose direct credit control in every period. Even if the control cost is high the government may still have to impose direct control in every period if the amount of resources that are diverted by the banks to the non-state sector is so high that λ_t always exceeds the threshold level. In this case, the government is forced to impose direct credit control in every period in order to maintain its commitment to the state sector. Assumption 4 below identifies the conditions under which it is optimal for the government not to impose direct credit control in every period.

¹⁹ For analytical convenience, we use a logarithmic objective function. Qualitative results of the paper will not change if we assume a more general objective function.

²⁰ The problem is similar to but more complicated than the standard inventory control problem. The control cost function in our problem is nonlinear, and state- and control-dependent.

Let $\bar{\sigma} = \lim_{t \rightarrow +\infty} \sigma_t$ and $\bar{\theta}(Q) = \lim_{t \rightarrow +\infty} \theta(t, Q)$. Since both $\bar{\sigma}_t$ and $\theta(t, Q)$ are monotone in t and bounded, the limits are well defined.

Assumption 4. $\nu(1 - \nu)^{-1}\bar{\sigma} < \bar{\theta}(Q) - \bar{\theta}(Q - \eta)$.

Proposition 8. *Under Assumption 4, the government's optimal control policy is cyclical:²¹ for any $t \geq 0$, there exist t_1 and t_2 , both of which are larger than t , such that it is optimal to impose direct credit control in period t_1 but not in period t_2 .*

Thus, under Assumption 4, the equilibrium dynamics of λ_t exhibits cycles. From the discussion in Section 3, we know that the growth rate of output and the inflation rate are cyclical, and that the inflation rate is procyclical. The key features of the economy that lead to cycles are: First, without direct credit control by the government, the inflation rate will increase without bound and hyperinflation will occur. To avoid hyperinflation, the government must intervene. Second, since a fixed cost in terms of a loss of efficiency has to be incurred every time the government imposes direct credit control, the growth rate of output will be significantly reduced if the government imposes the control in every period. The trade-off between output growth and inflation leads to a cyclical control policy. Note that if controlling inflation is the overriding concern of the government, it can do so only by imposing credit control in every period. The result would be a low inflation rate but also a low growth rate of output. (This is probably the situation before the reforms started when the credit allocation was highly centralized.)

If Assumption 4 does not hold, the government may eventually start to impose direct credit control in every period. This will eliminate the cycles but result in very low growth rates for the economy. Since $\bar{\sigma}$, the desired amount of credit diversion by the banks in the long-run, is an increasing function of the return differential between the two sectors, $R_t^n - R^s$, the economy will likely converge to the case of frequent credit control and low growth if the investment efficiency gap between the state and the non-state sector becomes very large.

7. Conclusion

Our objective in this paper has been to develop a model consistent with China's political and institutional environment that explains China's boom–bust cycles. Central to our explanation is the government's commitment to the state sector and

²¹ Using numerical simulations, we found that the optimal intervention policy is generally a time-dependent (s,S) rule: intervene when λ_t reaches or exceeds the threshold level $\theta(t, Q_t)$ and push it down to $\theta(t, Q_t - \eta)$.

the growing tension between this commitment and economic decentralization. This commitment manifested itself in the form of the soft-budget constraints for SOEs, which we link to the widening productivity differential observed between state and non-state owned firms.

In the model, the key variable that determines the dynamics is the credit allocation. This affects the investment allocation, the rate of growth in the economy, the income gap between the two sectors, and the required transfers that need to be financed through seignorage.²² The positive correlation between growth and inflation arises because an increase in credit allocation to the non-state sector results not only in more rapid growth, but also in an increase in the transfers required to support the state sector.

The cycles are a product of the government's imperfect control over credit allocation and the costs of administrative credit control. Under an indicative credit-plan, the government cannot perfectly control the diversion of financial resources to the non-state sector, and is forced to resort to money creation to maintain its commitment to the state sector. There are limits to the amount of resources that can be transferred through the monetary system, however, and the threat of hyperinflation eventually requires the government to reassert full administrative control over credit allocation in the economy. While this enables the government to stop the leakage and end the inflation, it comes at the cost of lower economic growth as a lower percentage of resources go to the more productive non-state sector and all discretion in credit allocation is eliminated. We argue that the high costs associated with these administrative measures explain the delay in their implementation, and thus, the cycles.

In the paper, we only focus on the cycles and ignore the question of the sustainability of the government's commitment to the state sector. Two observations can be made however. First, as long as the budget constraints remain soft, the productivity differential between the state and non-state owned firms will widen. As a result, the transfers required to maintain the commitment to the state sector will also rise over time. Second, financial decentralization and the widening productivity between sectors make it increasingly difficult for the government to control the allocation of credit, and thus reduce the time that will pass before the government must re-implement the administrative plan. These observations suggest that the costs of the government's commitment to the state sector are rising over time, and raise the question: At what point does the government reduce its commitment to the state sector? In future work, we hope to endogenize this

²² In Brandt and Zhu (2000), we use regression analysis to examine three key links in our story: (1) The role of credit allocation in determining investment allocation between the two sectors; (2) the role of investment allocation between the two sectors in determining the real growth rate of GNP and the need for the government to use money creation to fill the "gap" between sectors; and (3) the impact of money creation on inflation. The analysis shows that our story is consistent with the behavior of credit allocation and investment allocation, growth, inflation and money creation observed in the data.

decision and analyze the forces underlying recent decisions in China to reduce the commitment to the state sector.

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