

Strategic Investment, Uncertainty and Distribution Reform in the P.R. China: Why a Gradual Reform Strategy Works

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Abstract

This paper attempts to provide an explanation to the success of the gradual reform strategy of China by showing that such a strategy can minimize the uncertainty created in the process of transition from a centrally-planned economy to a market economy. In a commitment versus flexibility game, low uncertainty motivates enterprises to adopt a strategy of pre-committing their investment which is crucial in sustaining a faster growth rate in the industry. In addition, the China's successful use of market forces of competition and entry is also an important factor in the transition process.

Introduction

Since the collapse of the Berlin Wall in 1989, one-third of the world population have been struggling to reform their economies by shifting away from central planning towards largely market-based resource allocation. Such a process involves strengthening incentives that link material rewards to economic performance by moving towards private ownership and reforming management incentives within systems that maintain extensive social ownership (Gelb, Jefferson and Singh 1993). The success or failure of these economic reforms is going to have tremendous impacts on the future of the world. In Asia, since the People's Republic of China implemented her economic reform in 1978, her economy has been making substantial progress. Although problems exist, China is the only former centrally-planned

economy that has had a relatively high and sustainable economic growth for the past fifteen years.

There are two economic reform models: (1) the 'revolutionary' model or called the East European model, (2) the 'evolutionary' model or called the Chinese model (McMillan and Naughton 1992, Weitzman 1993). The East European model contains the so-called 'reform troika': marketization, privatization and democratization. In addition, it involves making a transition to the 'West European market economy' as quickly as possible, with a focus of an aggressive establishment of well-defined private property rights. To achieve this goal, massive privatization is the major tool used by the East European governments. Since the 'reform troika' was carried out at the same time in

most of East and Central European countries, it created big shocks or changes to these societies. Therefore, this reform strategy is also known as 'shock therapy' or 'big bang' strategy.

On the other hand, the Chinese model emphasizes competition over privatization. The Chinese government did not attempt to privatize the state-owned enterprises. Instead, it allowed or encouraged the non-state sector to compete with and outgrow the state sector gradually. The majority of this non-state enterprises is the collective enterprises which are basically a communal organization or a 'vaguely defined cooperative' suggested by Weitzman (1993). The collective enterprises are like the exact opposite of the type of private organization at the centre of the East European model. Although the performance of the state sector also improves under the competitive pressure, it may not be enough to save them in the long run. In contrast to the East European model, the Chinese model stresses more on the design of competitive market structure which, in turn, exerts pressure gradually on the inefficient state enterprises to improve their productivity so as to survive in the market. Such an approach is not supported by western academics and businesspeople as they have all preferred privatization to any other means for shifting an economy from central planning to market-based resource allocation. However, the success of the Chinese model seems to have puzzled the academics and policy-makers. McMillan and Naughton (1992) summarizes the Chinese reform strategy into the following three stages: (1) massive entry of non-state enterprises; (2) a dramatic increase in competition; (3) improvements in the performance of state-owned enterprises resulting from state-imposed market-like incentives. China has demonstrated how she has successfully used the fundamental market forces of entry and competition in moving her centrally-planned economy toward a market economy. For 14 years from 1979 to 1992, economic reforms in China have generated a significant growth: her GDP (Gross Domestic Product) grew at an average annual rate of 9.0%.

Although there are some differences between China and her East European counterparts

in terms of social and economic structure, China's success may still provide useful experience for them. As indicated by MacDonald (1993), the East European state-owned enterprises require more than just privatization. They need the support from strong and capable shareholders and managers. These free market skills and tenacity can only be acquired through active training and learning from competing in either domestic market or the world market. China's successful use of the market forces of entry and competition provides valuable insight for the East European governments in designing a competitive environment for their newly privatized or state-owned enterprises. Through competition, the managers of privatized enterprises can learn and acquire the skills to survive in market competition.

By contrast, the East European model would like to carry out all the steps of reform the same time. In addition, these East and Central European governments also implemented democratization in their political systems. Unfortunately, the results of the East European reform model are quite disappointing. The average GDP growth rate of Hungary was 1.8% between 1981 and 1985 and almost zero in 1988 and 1989. In Poland, the average GDP growth rate was less than 2% between 1981 and 1989 (Qian and Xu 1993). From 1989 to 1992, all East and Central European countries have suffered from modest to drastic drops in national output (Bruno 1992; Borensztein, Demekas and Ostry 1993; Calvo and Coricelli 1993). The issue here is why the Chinese model based on vaguely-defined cooperatives seems to be significantly outperforming the East European model based on well-defined private property.

Economic reform involves changes in different parts of the economy. Among them, distribution reform plays a very crucial role. The failure of Gorbachev's perestroika was primarily due to a breakdown in the economy's distribution system (empty store shelves, widespread hoarding of goods, etc.). Such a breakdown in the distribution was actually both cause and effect of a general loss of public confidence in the former Soviet Union's economy (Holtzman 1991) which finally contributed to the fall of Gorbachev and the collapse of

the Soviet Union. Contrary to the former Soviet's failure, China's success is partly due to her successful liberalization of distribution system suggested by Gelb, Jefferson and Singh (1993). Moreover, although China has been practising her open-door policy and welcoming overseas corporations to form joint ventures, the cooperation was limited to the export sector in the past. This was to allow China to earn more foreign exchange. Her domestic markets (including retail markets), however, remained firmly closed to overseas businesses¹. Consequently, all the growth and development in the Chinese retail sector are basically indigenous development and China's distribution reform becomes a controlled experiment of her reform strategy under little external interference. This paper attempts to explain why the distribution reform in China is successful by pointing out that privatization, albeit important, may not be the necessary and sufficient way in reforming a centrally-planned economy.

In order to explain why the Chinese distribution reform is so successful with her total retail sales (deflated by the national retail price index) growing at an annual rate of 6.4% from 1978 to 1992, one must explain by showing how a gradual pace of reform and market forces of entry and competition can contribute to China's success. This paper attempts to construct a simple game-theoretic model which endogenizes the choice of pre-commitment versus flexibility and the following results are obtained: (1) Reforming the distribution sector at a gradual pace has an advantage of reducing uncertainty in the transition process. A reduction in uncertainty can encourage enterprises to commit more investment which is crucial for the further development of enterprises and the whole industry. On the other hand, the rapid transition proposed under the East European model may create higher uncertainty which may damage the incentive to commit investment by enterprises. As a result, the whole industry is going to suffer from less or even no long term growth. If these governments cannot encourage their own enterprises to commit their investment, foreign corporations will not be likely to commit their investment as well. (2) The entries of non-state enterprises make the competition keener. Competition gradually reduces

the equilibrium prices of goods and the market share of the state-owned enterprises. In addition, in response to the pressure of competition, state enterprises have to improve their own efficiency in order to survive in the market. All these changes are likely to improve the welfare of the society.

Concerning the first result of investment undertaken by enterprises, numerous studies in the field of financial economics have explored the relationship between investment and uncertainty (Dixit and Pyndick 1992; Ingersoll and Ross 1992; MacDonald and Siegel 1986). Investment decision is sensitive to the magnitude of uncertainty faced by investors. The value of retaining flexibility and waiting for the uncertainty to be resolved is generally increasing in the magnitude of uncertainty. When enterprises are facing high uncertainty, they would like to wait until the uncertainty is resolved in order to avoid pre-committing too early. Unfortunately, these studies do not consider the strategic aspects of investment. The role of pre-commitment is especially important for enterprises to strategically maintain or even increase their market shares by deterring any entries. For example, a low-cost enterprise can pre-commit to build a large enough capacity and prices their products so low that it can drive competitors or potential entrants out of the market. In addition, the enterprise which is the first to pre-commit will naturally be the market leader. As a result, there is a trade-off between pre-commitment and flexibility (Appelbaum and Lim 1985; Spencer and Brander 1992). However, if enterprises are willing to pre-commit their investment so as to build a bigger capacity, these enterprises can later be benefited by selling their goods at a lower cost and consumers can receive more goods for their consumption. Consequently, encouraging enterprises to pre-commit their investment is a welfare-improving policy.

II. The General Model

In this section, a simple game-theoretic model is constructed to capture what is going on in the Chinese economy during the economic reform.² Since the Chinese model emphasizes the market forces of entry and competition, this model focuses on the market structure instead of the internal or-

ganizational structure of enterprises. From this model, some predictions are generated in order to explain why the Chinese reform works. There are three players, namely, one state enterprise, one collective enterprise and numerous tiny and competitive individual enterprises in this model. All enterprises are producing a homogeneous product and competing non-cooperatively in the output market. The demand for the product is assumed to be linear; without loss of generality, the slope of demand is assumed to equal one. The inverse demand function is as follows:

$$p = a - Q + u = a - (x + y + z) + u \quad (1)$$

where Q is the total provision of goods, x is the output of state enterprise, y is the output of collective enterprise, z is the aggregate output of individual enterprises, and u is a random variable with mean zero and variance σ^2 . The density function $f(u)$ is defined on support $[\underline{u}, \bar{u}]$ where \underline{u} is assumed to be sufficiently large so that enterprises can have positive output. This random variable u captures all the uncertainty of the macroeconomic and political environment. If the macroeconomic or political situation is unstable, it will be reflected in an increase in the variance σ^2 . There is a continuum of identical individual enterprises indexed by $z \in [0, \bar{z}]$. \bar{z} is assumed to be large enough that z is always less than \bar{z} . Increases or decreases of z imply the entries or exits of individual enterprises. The aggregate marginal cost function of individual enterprises which are all price takers and do not have any strategic behavior is simply assumed to be linear in z

$$MC_i = b + z \quad (2)$$

This model assumes that the state and collective enterprises are relatively much bigger than individual enterprises so that they can strategically choose their supplies of goods in order to achieve their targets. This assumption is based on Figure 1a in which the state and collective enterprises have much bigger market shares than what the individual enterprises have. The individual enterprises are all small producers; therefore, they are all price takers.

Since investment is the major element that determines the sustainability of growth and future successes of enterprises, investment is a key strategic variable chosen by the state and collective enterprises. As a result, a simple game theoretic model of pre-commitment versus flexibility like Spencer and Brander (1992) is considered. Briefly, this model can be described as follows: For state and collective enterprises, there are two major decisions: (1) a pre-commitment decision which determines whether enterprises should pre-commit their output capacity and (2) an output decision which determines the quantity of goods that the enterprise should produce. Both state and collective enterprises have the option of pre-committing their capacity before uncertainty is resolved. If only one enterprise pre-commits, it will naturally be the (Stackelberg) market leader. The capacity is linearly related to capital investment.

There are three stages in this game. In stage one, the state or collective enterprise decides whether to commit its capacity before uncertainty is resolved, or to retain the flexibility to make its output decision after observing the realization of u . The outcome of this timing decision is observed by other enterprises. In stage two, if either enterprise has decided to pre-commit, it can decide how much to supply at this stage. Uncertainty is resolved in the final stage, individual enterprises and the enterprise which has chosen to retain its flexibility can decide how much to supply. If both state and collective enterprises have chosen to pre-commit their output capacity, only individual enterprises will choose how much to supply in this stage.

In order to illustrate the effects of competition in the market structure, only the competition among producers are modeled in details since the major characteristic of the Chinese model is the keen competition that forces enterprises to improve their productivity and profitability⁴. To simplify our analysis, both state and collective enterprises are assumed to have profit-maximization behavior, i.e. their strategic pre-commitment decisions are based on whether the decisions can increase their future profits. This behavioral objective is supported by Woolridge and Snow's (1990) study. They conclude that the US stock market generally

reacts positively to any strategic investment project which have positive net present value. To simplify the analysis, the marginal cost of an enterprise is affected by its own investment decision but not affected by the investment decisions of other enterprises. If both state and collective enterprises do not pre-commit, their marginal costs will be c^h . If both enterprises pre-commit, both can achieve a lower marginal costs, c' with $c' < c^h$. This is a reasonable assumption because workers' productivity can be raised when they are working with more machines and equipment. Therefore, the operational efficiency of enterprises is improved. If only one enterprise pre-commits (it acts as a leader), it will operate at a even lower marginal cost, c with $c < c' < c^h$. This assumption is due to the fact that the enterprise which has pre-committed can have a larger market share.

In this three stage game, there are three possible cases: (1) If both state and collective enterprises pre-commit their output capacity before uncertainty is resolved, a Cournot-Nash equilibrium is resulted. It is called "committed Cournot-Nash" equilibrium. (2) If only one enterprise pre-commits its output capacity, then a Stackelberg equilibrium is resulted. The enterprise which has pre-committed its output capacity is called "committed leader". The enterprise which has chosen to wait until uncertainty is resolved is called "flexible follower". (3) If both enterprises choose not to pre-commit their output capacity, another Cournot-Nash equilibrium is resulted. It is called "flexible Cournot-Nash" equilibrium. For all Cournot-Nash equilibria, only the symmetric equilibrium case is considered. The solutions of all these equilibria are reported in Tables 1, A1, A2, and A3. The derivations are in the Appendix.

The equilibrium prices and total provision of goods can be ranked as follows:

Proposition 1 $E(Q_1^{sc}) = E(Q_2^{sc}) > E(Q^{cc}) > E(Q^{fc})$ and $E(P_1^{sc}) = E(P_2^{sc}) < E(P^{cc}) < E(P^{fc})$.

The proof is in the Appendix. This result suggests that the Stackelberg equilibrium in which the state/collective enterprise is willing to pre-commit its investment delivers the lowest price and the

largest total provision of goods. On the contrary, if neither are willing to pre-commit their investment, it will end up in the flexible Cournot-Nash equilibrium which delivers the highest price and the smallest total provision of goods.

In the first stage, the timing decision of whether to pre-commit or to wait is based on the expected profits made in different equilibrium situations. The selection of equilibria depends on the magnitude of uncertainty.

Proposition 2 (I) Under low uncertainty, the unique Nash equilibrium is the committed Cournot-Nash equilibrium. This is also the dominant strategy equilibrium. (II) Under medium uncertainty, there are two Nash equilibria: (1) a Stackelberg equilibrium with the state enterprise being the leader, (2) another Stackelberg equilibrium with the collective enterprise being the leader. (III) Under high uncertainty, the flexible Cournot-Nash equilibrium is the unique Nash equilibrium. This is also the dominant strategy equilibrium.

This proposition is a re-statement of proposition A2 reported in the Appendix.⁵ The intuition of this result is clear that both the state and collective enterprises are/are not willing to commit their investment as long as the uncertainty is low/high (σ^2). From proposition 1, to consumers, Stackelberg equilibrium in which the state/collective enterprise is the leader is the most favourable outcome. However, in case of high uncertainty, all enterprises are not willing to commit their investment and they would like to wait until the uncertainty is resolved. Flexible Cournot-Nash equilibrium emerges and it is the worst outcome to consumers. In addition, enterprises also received less improvement in efficiency as there was less investment undertaken to increase their productivity.

In this model, the small individual enterprises have been playing a passive role. However, the presence of a competitive fringe of small individual enterprises is crucial in affecting the market structure. The improvement in their efficiency by reducing the parameter b of their aggregate marginal cost over time can have the follow impacts.

Table 1
Equilibrium prices, output, and profits of enterprises

equilibrium quantity	state enterprises	collective enterprises	individual enterprises
1. Committed Cournot-Nash equilibrium			
firm's output	$(a + b - 2c')/4$	$(a + b - 2c')/4$	$(a - 3b + 2c')/4 + u/2$
firm's profit	$(a + b - 2c')^2/16$	$(a + b - 2c')^2/16$	zero
total output	$(3a - b - 2c')/4 + u/2$		
price	$(a + b + 2c')/4 + u/2$		
2. Stackelberg equilibrium: collective is leader			
firm's output	$(a + b - 4c^h + 2c)/5 + u/3$	$2(a + b + c^h - 3c)/5$	$(a - 4b + c^h + 2c)/5 + u/3$
firm's profit	$(a + b - 4c^h + 2c)^2/25 + \sigma^2/9$	$2(a + b + c^h - 3c)^2/25$	zero
total output	$(4a - b - c^h - 2c)/5 + 2u/3$		
price	$(a + b + c^h + 2c)/5 + u/3$		
3. Stackelberg equilibrium: state is leader			
firm's output	$2(a + b + c^h - 3c)/5$	$(a + b - 4c^h + 2c)/5 + u/3$	$(a - 4b + c^h + 2c)/5 + u/3$
firm's profit	$2(a + b + c^h - 3c)^2/25$	$(a + b - 4c^h + 2c)^2/25 + \sigma^2/9$	zero
total output	$(4a - b - c^h - 2c)/5 + 2u/3$		
price	$(a + b + c^h + 2c)/5 + u/3$		
4. Flexible Cournot-Nash equilibrium			
firm's output	$(a + b - 2c^h + u)/4$	$(a + b - 2c^h + u)/4$	$(a - 3b + 2c^h + u)/4$
firm's profit	$[(a + b - 2c^h)^2 + \sigma^2]/16$	$[(a + b - 2c^h)^2 + \sigma^2]/16$	zero
total output	$(3a - b - 2c^h + 3u)/4$		
price	$(a + b + 2c^h + u)/4$		

Notes: The output of individual enterprises is the aggregate output of all individual enterprises.

Proposition 3 *When the small individual enterprises improve their operating efficiency by a reduction of marginal costs (represented by a reduction in b), it will (1) reduce the prices (p), output and profits of the state and collective enterprises ($x, y, E\pi_s, E\pi_c$) and (2) increase their own aggregate output (z) and the total provision of goods (Q) at all equilibria.*

The proof of this proposition is obvious by observing the solutions at each equilibrium. As these individual enterprises increase their productivity by reducing their marginal cost, b , it benefits the whole society by delivering a lower price but more goods to consumers at all equilibria. The presence of individual enterprises simply makes the market more competitive and pressurizes the state and collective enterprises to match the increases in the productivity of individual enterprise in order to keep their market shares.

III. Distribution Reform In China

Because the distribution sector of China was closed to overseas corporations until the end of 1992, this sector grew rapidly under little external influence. As a result, the economic reform in the distribution sector becomes a controlled experiment for testing whether China's gradual reform strategy can work or not. In addition, one can also apply the results obtained in the previous model to explain the development patterns in China's distribution sector.

Before the economic reform, China like other communist countries was a shortage economy. Production and distribution of commodities were all planned by the central planning bureau. Nearly all the existing marketing channels at that time were state-owned. The distribution system was established not according to the economic functions, but according to political and administrative functions (Mun 1988; Qiang and Harris 1990). At least five problems were resulted from this system: (1) The marketing channel was long

and steeped in red-tape. The final retail price that consumer paid was several times the initial price as the product had to pass through many government middlemen. Moreover, it was difficult for industrial products manufactured in cities to reach consumers in rural areas; similarly, agricultural products also took weeks to reach consumers in nearby cities. (2) The system was highly rigid and impervious to changes. (3) All products were bought and sold by the state distribution system according to the prices set by the planning bureau. There was no correlation between the profits or losses of the state distributors and their performance. (4) Products offered to consumers were of limited variety and were of inferior quality. Opportunities for enterprises to vary the quality or quantity of their products were highly restricted. Managers were also unwilling to allow for such opportunities because of the absence of incentives. (5) With insufficient and backward storage facilities, a poor transportation network, and a long marketing channel, a lot of the goods were simply 'lost' in the waiting or shipping processes. The problems that existed at that time were similar to what Gajewski (1992) and Iwinska-knop (1992) discussed in the case of Poland or the case of Soviet Union mentioned by Holtzman (1991) under central planning. The whole system is basically driven by a central planner rather than by consumer sovereignty. Compounded by the monopolization of distribution by state enterprises, marketing simply has no role to play in such a shortage economy (Ennew, Filatochev, Wright and Buck 1993; Hooley 1993).

After the economic reform was introduced to the rural areas in 1978, the original distribution system showed difficulty in coping with the pace of reform in agricultural production. From 1983 to 1984, the central government finally undertook serious measures to resolve the problems⁶. The reform involved the following: (1) The government re-organised the supply and marketing cooperatives and other state distribution enterprises to provide better link between urban and rural economies by introducing a performance-related reward system into state enterprises. (2) Using the established state-owned distribution system as the backbone, the government introduced secondary channels operated by other enterprises to achieve a multi-form,

multi-layer system. It allowed other enterprises like collective, individual and joint enterprises⁷ to compete with and complement the state marketing channel. The government hoped that the new measures would overhaul the existing system and that the targeted system would provide various services like distribution, storage, processing and transportation to the economy.

The introduction of these measures saw rapid changes in the retail sector as observed by Wortzel and Wortzel (1987), Chow and Tsang (1994), Chow (1995,b, 1996). Small and primitive secondary marketing channels, like numerous free markets which developed initially in rural areas and later spread to urban areas, were established autonomously by individual traders and other small private enterprises. Figures 1a, 1b, and 1c show the relative performance of different retailing enterprises during the economic reform.

In Figure 1a, market shares of state enterprises (SE), collective enterprises (CE), individual enterprises (IE) and joint enterprises (JE) are reported. The steady declines of state and collective enterprises are in contrast to the rapid growth of the individual enterprises. Proposition 3 can nicely explain how the growth of individual enterprises has brought all these problems to the state and collective enterprises since the implementation of the economic reform in 1978. The market share of joint enterprises is negligibly small; therefore, the joint enterprises are skipped in this study. In Figure 1a, the market share of individual enterprises was close to zero in 1978 and it has grown, at the expense of the state and collective enterprises, rapidly to more than 20% in 1992! Since the individual enterprises did not receive any aid from the government, such an autonomous development was achieved mainly by their own efforts in improving their productivity in providing better services to consumers. Moreover, this development is improving the social welfare not only by reducing prices and increasing product provision but also by forcing the state and collective enterprises to match their efficiency in order to survive in a more competitive market.

Although the market share of state enter-

Figure 1a
Market Shares

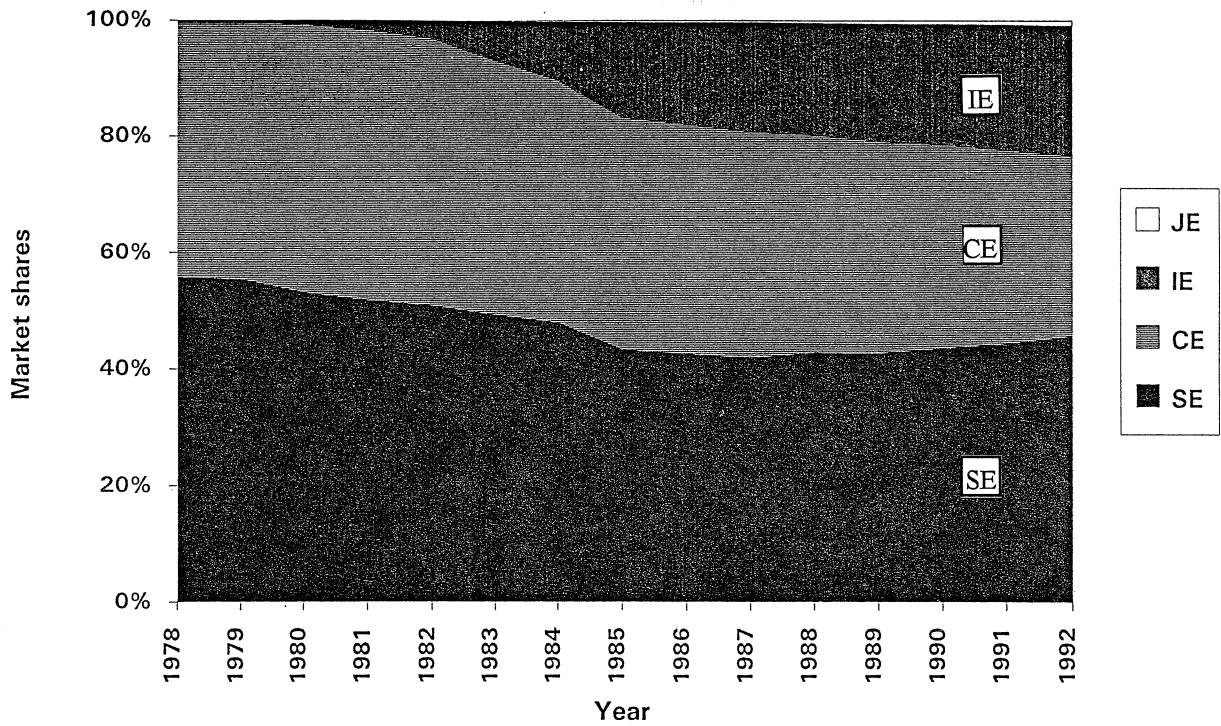


Figure 1b
Profits and Investment

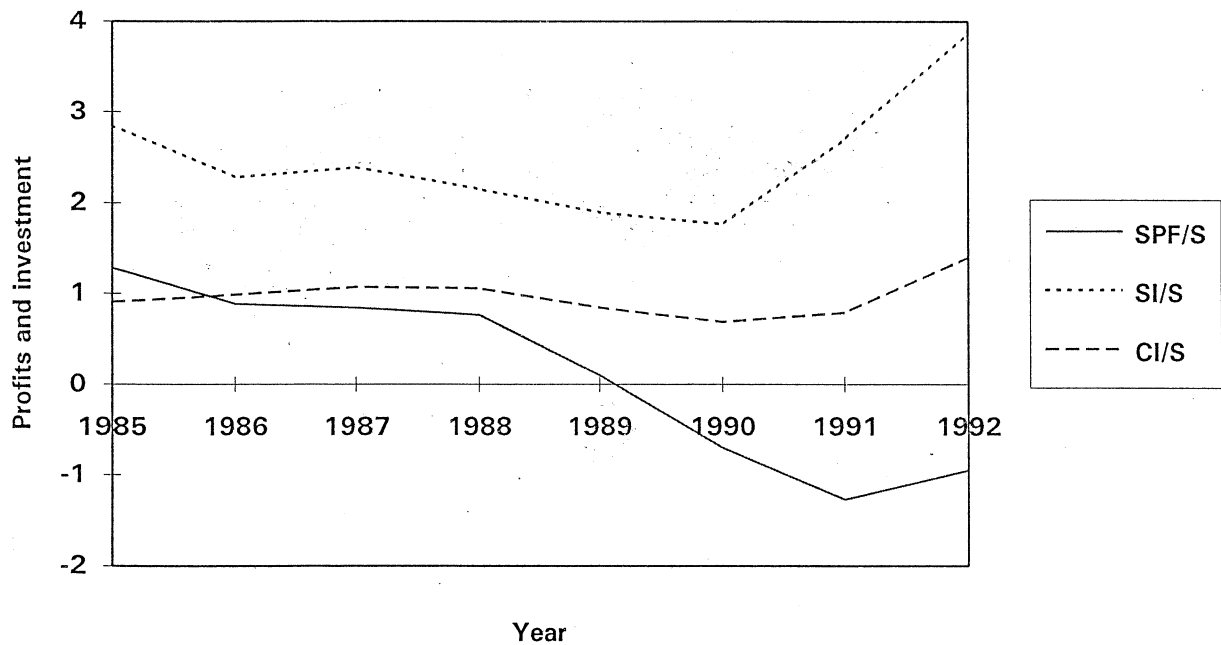
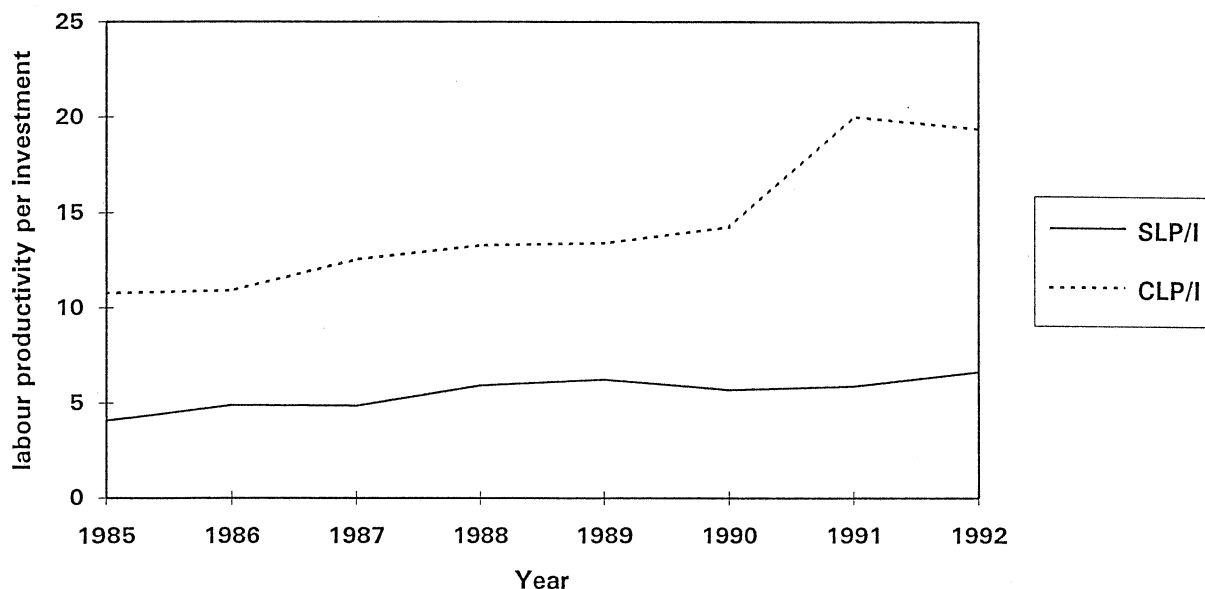


Figure 1c
Labour Productivity



prises is slightly increasing after 1987, it does not imply that the efficiency of state enterprises is improving. In Figure 1b, the profit per 100 yuan of sales (SPF/S) of state enterprises is steadily declining. After 1989, they have been suffering losses despite their rapid increase of investment per 100 yuan of sales (SI/S) which doubles the amount of investment (CI/S) (measured by investment per 100 yuan of sales) made by the collective enterprises! This result suggests that the strategy of simply increasing market share cannot guarantee the profitability of the state enterprises. In addition, Figure 1c suggests that the collective enterprises are generally performing better with their investment as the labour productivity (measured by the sales per worker) per one dollar of investment (CLP/I) of the collective enterprises is more than twice of the labour productivity per investment (SLP/I) made by state enterprises. Unfortunately, there is no detailed investment data of the individual enterprises; therefore, it is impossible to compare the investment performance of individual enterprises with those of state and collective enterprises.

Proposition 2 can nicely explain why the Chinese distribution reform is successful. The Chi-

nese reform strategy is to adopt a gradual pace in changing the political and economic environment. This approach can minimize the shocks which are inevitably created in the process of transition from a centrally-planned economy to a market economy. Under low uncertainty, therefore, enterprises are more willing to commit their investment and they can experience a higher growth later. Moreover, by creating a pool of fast-growing competitive individual enterprises, the Chinese government has successfully used the market forces of entry and competition in reforming her distribution sector.

In contrast to the Chinese model, the "shock therapy" or "big bang" approach of the East European reform model had created big changes in the political and economic environment which subsequently created high uncertainty in the market. Such an approach was highly unfavourable for investors or enterprises to commit their investment. The industries, therefore, grew at a much slower pace. Moving hastily from a centrally-planned economy to a market economy may sound like a good idea but it may create problems of underinvestment. High uncertainty may further delay or even damage the development of the sector due to the lack of productive investment which is capable

of sustaining its growth. With a depressing distribution sector, it can jeopardize the whole economic reform. The failure of Gorbachev's perestroika is a typical example of this problem.

IV. Conclusion

The economic reform pursued by the Chinese government is remarkably different from what the East European countries have implemented. The Chinese model emphasizes competition over privatization. The loss-making state enterprises are replaced not by extensive privatization in the short run, but by being gradually outcompeted and outgrown by other non-state enterprises in the long run. Such a reform strategy has been working well in China although it is not advocated by many western economists and businesspeople. The purpose of this paper is to explain why the gradual reform strategy of China is working well in her retail sector.

Before the economic reform, the Chinese economy was a centrally-planned economy. Distribution was monopolized by the state enterprises. Managers merely took orders from the ministries in meeting output targets and were not concerned with consumer preferences. This paper suggests that the success of the economic reform in her distribution sector is due to at least two factors: (1) a successful use of market forces of entry and competition by introducing non-state enterprises like collective and individual enterprises into the distribution sector; (2) a gradual pace of reform which encourages enterprises to commit more investment which is important for the rapid development of the sector. The model of this paper predicts that the 'big bang' approach may create more uncertainty which keeps enterprises from committing their investment.

V. Suggestions for Further Research

Further research should be undertaken to empirically test the validity of the hypothesis that uncertainty can have a significant and negative effect on investment. There are at least two areas of empirical research: Testing this hypothesis within a country and across a number of countries. If this

hypothesis can pass both tests, it will be a strong indicator for its validity. However, It may be difficult to quantify uncertainty and our suggestion is to use inflation rate to approximate this uncertainty. Since most of transition economies are suffering from high inflation which major impact is the uncertain changes in relative prices for retailers. As a result, higher inflation should lead to higher uncertainty to retailers and retailers' investment should react to this uncertainty provided that the hypothesis is true. If such a proposition is valid, one should measure the impact of uncertainty on investment for each type of enterprises.



Endnotes

1. All data in this study are obtained from *Statistical Yearbook of China*.
2. In late 1992, the Chinese government pushed its distribution reform to a new stage with the announcement that foreign businessmen could establish joint ventures in the retail sector of Beijing, Tianjin, Shanghai, Gaungzhou, Dalian, Qingdao and the five special economic zones of Hainan, Shenzhen, Zhuhai, Shantou and Xiamen. Therefore, from 1979 to 1992, there had been little foreign involvement in the distribution sector.
3. Collective enterprises are basically communal organizations with a vaguely defined property rights. Most of them are located in townships or villages. Therefore, they are also known as township-village enterprises (TVE). Individual enterprises are run by individual or a family. They are allowed to employ only one to two helpers and no more than five apprentices. Typical examples of individual enterprises are hawkers, neighbourhood stores, small traders, etc.
4. The organizational structure and ownership of state and collective enterprises usually induce complicated incentive structure in these enterprises and their objectives may not simply be profit-maximizing.
5. For the details of proposition 2, please refer to the statement and proof of proposition A2 in the appendix.
6. The vice-premier, Tian Jiyun ordered to re-

structure the distribution system in the national economic meeting held on Feb 17, 1984.

7. Joint enterprises are basically joint ventures of state and collectives, state and individuals, Chinese and overseas investors, etc.
8. Since the individual enterprises are all tiny, their investment is relatively much smaller than those made by state and collective enterprises. Even the investment of individual enterprises is missing in this model, the impact on the empirical results will be limited.

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Appendix

Committed Cournot-Nash Case

In this case, both state and collective enterprises pre-commit their output capacity before uncertainty is resolved. In stage 3, only tiny individual enterprises are making decision. These tiny individual enterprises are all competitive firms which take prices given. They will continue to enter the market until they make no profit at equilibrium,

$$p(x, y, z, u) = a - (x + y + z) + u = MC_I = b + z$$

In stage 2, the state enterprise solves the following problem

$$\max_x E(\pi_x) = E[a - c' + u - (x + y + z)]x + \theta \quad \text{s.t. } y, z, c', u \text{ given.}$$

where θ is the government subsidy with the property that $\theta = 0 (> 0)$ if $px - c' \geq 0 (< 0)$. It means that the government subsidy is positive/zero as long as the *ex post* profit is negative/positive. However, this model does not assume the presence of bankruptcy; therefore, θ can be dropped in all cases. The state enterprise solves the following problem

$$\max_x E(\pi_x) = E[a - c' + u - (x + y + z)]x \quad \text{s.t. } y, z, c', u \text{ given.}$$

The first order condition is

$$x = x(y, z, u) = \frac{(a - c') - (y + E(z))}{2}$$

Similarly, the collective enterprise also solves this problem

$$\max_y E(\pi_y) = E[a - c' + u - (x + y + z)]y \quad \text{s.t. } x, z, c', u \text{ given.}$$

The first order condition is

$$y = y(x, z, u) = \frac{(a - c') - (x + E(z))}{2}$$

The committed Cournot-Nash equilibrium is defined as follows: $\{x^{cc}, y^{cc}, z^{cc}\}$ solves both enterprises' problems and z^{cc} satisfies

$$p(x^{cc}, y^{cc}, z^{cc}, u) = b + z^{cc} \quad \text{if } z^{cc} > 0 \quad (\leq b + z^{cc} \quad \text{if } z^{cc} = 0)$$

The equation above suggests that individual enterprises will stop moving into the market when the equilibrium price equals the marginal cost of the marginal individual enterprise, i.e. zero profit condition. All individual enterprises with marginal costs bigger than the equilibrium price are forced out of the market. By choosing a sufficiently small b , z^{cc} can always be positive. Consequently, it is impossible to completely drive out all individual enterprises by pre-committing a sufficiently large output capacity. The committed Cournot-Nash equilibrium in this model is

$$x^{cc} = y^{cc} = \frac{a + b - 2c'}{4}, \quad E(\pi_x^{cc}) = E(\pi_y^{cc}) = \frac{(a + b - 2c')^2}{16}.$$

The aggregate output of individual enterprises, equilibrium price and total provision are

$$z^{cc} = \frac{a - 3b + 2c'}{4} + \frac{u}{2}, \quad p^{cc} = \frac{a + b + 2c'}{4} + \frac{u}{2}, \quad Q^{cc} = \frac{3a - b - 2c'}{4} + \frac{u}{2}.$$

Stackelberg Case

Case 1: Collective enterprise is the leader

In stage 3, the state enterprise which is assumed to be the follower solves the following problem

$$\max_x \pi_x = [a - c^h + u - (x + y + z)]x \quad \text{s.t. } y, z, u \text{ given.}$$

The first order condition is

$$x = x(y, z, u) = \frac{(a - c^h + u) - (y + z)}{2}.$$

Those tiny individual enterprises enter the market until they make no profit at equilibrium,

$$p(x, y, z, u) = a - (x + y + z) + u = MC_I = b + z.$$

In stage 2, the collective enterprise which is assumed to be the leader solves the following problem

$$\max_y E[\pi_y] = E[a - c + u - (x(y, z, u) + y + z)]y \quad \text{s.t. } c, u \text{ given.}$$

The first order condition is

$$y = y(x, z, u) = \frac{a + c^h - E(z) - 2c}{2}.$$

The Stackelberg equilibrium of this model is defined as follows: $\{x^{se}, y^{se}, z^{se}\}$ solves the leader's and follower's problem and z^{se} satisfies

$$p(x_f^{se}, y_l^{se}, z_1^{se}, u) = b + z^{se} \quad \text{if } z^{se} > 0 \quad (\leq b + z^{se} \quad \text{if } z^{se} = 0)$$

The Stackelberg equilibrium is shown as follows:

$$x_f^{se} = \frac{a + b - 4c^h + 2c}{5} + \frac{u}{3}, \quad E(\pi_{x,f}^{se}) = \frac{(a + b - 4c^h + 2c)^2}{25} + \frac{\sigma^2}{9}.$$

The leader's output and profit are

$$y_l^{se} = \frac{2(a + b + c^h - 3c)}{5}, \quad E(\pi_{y,l}^{se}) = \frac{2[(a + b + c^h - 3c)^2]}{25}.$$

The aggregate output of individual enterprises, equilibrium price and total provision are

$$z_1^{se} = \frac{a - 4b + c^h + 2c}{5} + \frac{u}{3}, \quad p_1^{se} = \frac{a + b + c^h + 2c}{5} + \frac{u}{3}, \quad Q_1^{se} = \frac{4a - b - c^h - 2c}{5} + \frac{2u}{3}.$$

Case 2: State enterprise is the leader

By symmetry, the solutions are as follows:

$$x_i^{se} = \frac{2(a + b - 3c + c^h)}{5}, \quad E(\pi_{x,i}^{se}) = \frac{2(a + b - 3c + c^h)^2}{25}.$$

The follower's output and profit are

$$y_i^{se} = \frac{a + b + 2c - 4c^h}{5} + \frac{u}{3}, \quad E(\pi_{y,f}^{se}) = \frac{(a + b + 2c - 4c^h)^2}{25} + \frac{\sigma^2}{9}.$$

The equilibrium price, total output and aggregate output of individual enterprises are the same as what are obtained in the previous case.

Flexible Cournot-Nash Case

In this case, both state and collective enterprises have chosen to wait until the uncertainty is resolved. In stage 3, the state enterprise solves the following problem

$$\max_x \pi_x = [a - c^h + u - (x + y + z)]x \quad \text{s.t. } y, z, c^h, u \text{ given.}$$

The first order condition is

$$x = x(y, z, u) = \frac{(a - c^h + u) - (y + z)}{2}$$

The collective enterprise also solves a similar problem

$$\max_y \pi_y = [a - c^h + u - (x + y + z)]y \quad \text{s.t. } x, z, c^h, u \text{ given.}$$

The first order condition is

$$y = y(x, z, u) = \frac{(a - c^h + u) - (x + z)}{2}$$

Those tiny individual enterprises enter the market until they make no profit at equilibrium,

$$p(x, y, z, u) = a - (x + y + z) + u = MC_I = b + z$$

The flexible Cournot-Nash equilibrium is defined as follows: $\{x^{fc}, y^{fc}, z^{fc}\}$ solves both enterprises' problems and z^{fc} satisfies

$$p(x^{fc}, y^{fc}, z^{fc}, u) = b + z^{fc} \quad \text{if } z^{fc} > 0 \quad (\leq b + z^{fc} \quad \text{if } z^{fc} = 0)$$

At flexible Cournot-Nash equilibrium, the output and profits of state and collective enterprise are

$$x^{fc} = y^{fc} = \frac{a + b - 2c^h + u}{4}, \quad E(\pi_y^{fc}) = E(\pi_x^{fc}) = \frac{(a + b - 2c^h)^2 + \sigma^2}{16}.$$

The aggregate output of individual enterprises, equilibrium price and total provision are

$$z^{fc} = \frac{a - 3b + 2c^h + u}{4}, \quad p^{fc} = \frac{a + b + 2c^h + u}{4}, \quad Q^{fc} = \frac{3a - b - 2c^h + 3u}{4}.$$

Proof of Proposition 1

$$E(Q_i^{se} - Q^{cc}) = \frac{(a + b - 4c^h + 2c) + 10(c' - c)}{20}, \quad i = 1, 2$$

$$E(Q^{cc} - Q^{fc}) = \frac{c^h - c'}{2} > 0$$

The numerator of the first term of $E(Q_i^{se} - Q^{cc})$ is equal to $x_f^{se} > 0$ or $y_f^{se} > 0$; therefore, $E(Q_i^{se} - Q^{cc}) > 0$ $i = 1, 2$. As a result, $E(Q_1^{se}) = E(Q_2^{se}) > E(Q^{cc}) > E(Q^{fc})$. Since the demand curve is linear, the equilibrium prices follow the reverse order, $E(P_1^{se}) = E(P_2^{se}) < E(P^{cc}) < E(P^{fc})$. \square

Proposition A2 I) Given $A = a + b - 2c' > B = a + b - 2c^h > 0$ and sufficiently small $k = c^h - c = 2\epsilon > k' = c^h - c' = \epsilon > 0$, if $\sigma^2 \leq 9(5A + 4B - 8k')(5A - 4B + 8k')/400$ (low uncertainty), the unique Nash equilibrium is the committed Cournot-Nash equilibrium. This is also the dominant strategy equilibrium. II) If $9(5A + 4B - 8k')(5A - 4B + 8k')/400 < \sigma^2 \leq [7B^2 + 192Bk + 288k^2]/25$ (medium uncertainty), there are two Nash equilibria: (1) a Stackelberg equilibrium with the state enterprise being the leader, (2) another Stackelberg equilibrium with the collective enterprise being the leader. III) If $[7B^2 + 192Bk + 288k^2]/25 < \sigma^2$ (high uncertainty), the flexible Cournot-Nash equilibrium is the unique Nash equilibrium. This is also the dominant strategy equilibrium.

Proof of Proposition A2

There are four equilibria reported in the Table A1.

The Stackelberg leader's profit is always larger than the profit of committed Cournot-Nash equilibrium. However, the rest depends on the magnitude of σ^2 . By setting $A = a + b - 2c' > B = a + b - 2c^h > 0$ and $k = c^h - c > k' = c' - c > 0$, the following results can be obtained (The details of algebra are skipped):

1) The state/collective enterprise prefers the Stackelberg leader's profit to the flexible Cournot-Nash profit if and only if

$$\frac{7B^2 + 192B' + 288k^2}{25} \geq \sigma^2.$$

2) The state/collective enterprise prefers the Stackelberg leader's profit to the flexible (Stackelberg) follower's profit if and only if

$$\frac{9[B^2 + 4B(3k + k') + 2(9k^2 - 2k'^2)]}{25} \geq \sigma^2.$$

3) The state/collective enterprise prefers the committed Cournot-Nash profit to the flexible Cournot-Nash profit if and only if

$$4Ak + 4k^2 \geq \sigma^2.$$

4) The state/collective enterprise prefers the committed Cournot-Nash profit to the flexible follower's profit if and only if

$$\frac{9(5A + 4B - 8k')(5A - 4B + 8k')}{400} \geq \sigma^2.$$

5) The state/collective enterprise prefers the flexible Cournot-Nash profit to the flexible follower's profit if and only if

$$\frac{9(5A + 4B - 8k')(5A - 4B + 8k')}{175} \geq \sigma^2.$$

To rank all the terms is tedious and difficult. Instead, the following case is considered: By assuming $k' = \epsilon$ and $k = 2\epsilon$ to be sufficiently small so that those terms involved k and k' can be

dropped. In addition, $A - B = 2(c^h - c') = 2\epsilon \simeq 0$ if ϵ is sufficiently small. As a result, term 1) to 5) become $7B^2/25 \geq \sigma^2$, $9B^2/25 \geq \sigma^2$, $4B\epsilon + 4\epsilon^2 \geq \sigma^2$, $81B^2/400 \geq \sigma^2$ and $81B^2/175 \geq \sigma^2$ respectively. These terms can be ranked as follows:

$$\frac{81B^2}{175} > \frac{9B^2}{25} > \frac{7B^2}{25} > \frac{81B^2}{400} > 4Bk + 4k^2 = 8(A\epsilon + 2\epsilon^2) \geq 0$$

The ranking of each equilibrium is reported in Table A2 from 1 (highest) to 4 (lowest). In Table A3, the first entry in each cell is the state enterprise's ranking of that cell, the second entry is the ranking of the collective enterprise. Proposition 3 is easily obtained by examining the Nash equilibria of each case. \square

Table A1
Profits of state and collective enterprises at all equilibria

Equilibria	State's profit	Collective's profit
se_1	F: $(a + b - 4c^h + 2c)^2/25 + \sigma^2/9$	L: $2(a + b + c^h - 3c)^2/25$
se_2	L: $2(a + b + c^h - 3c)^2/25$	F: $(a + b - 4^h + 2c)^2/25 + \sigma^2/9$
cc	$(a + b - 2c')^2/16$	$(a + b - 2c')^2/16$
fc	$[(a + b - 2c^h)^2 + \sigma^2]/16$	$[(a + b - 2c^h)^2 + \sigma^2]/16$

Table A2
Ranking of each equilibrium by state and collective enterprises

	CL (S,C)	CC (S,C)	FC (S,C)	FF (S,C)
(1) $\sigma^2 \leq 4Ak + 4k^2$	(1,1)	(2,2)	(3,3)	(4,4)
(2) $4Ak + 4k^2 < \sigma^2 \leq 9(5A + 4B - 8k')(5A - 4B + 8k')/400$	(1,1)	(3,3)	(2,2)	(4,4)
(3) $9(5A + 4B - 8k')(5A - 4B + 8k')/400 < \sigma^2 \leq (7B^2 + 192Bk + 288k^2)/25$	(1,1)	(4,4)	(2,2)	(3,3)
(4) $(7B^2 + 192Bk + 288k^2)/25 < \sigma^2 \leq 9[B^2 + 4B(3k + k') + 2(9k^2 - 2k'^2)]/25$	(2,2)	(4,4)	(1,1)	(3,3)
(5) $9[B^2 + 4B(3k + k') + 2(9k^2 - 2k'^2)]/25 < \sigma^2 \leq 9(5A + 4B - 8k')(5A - 4B + 8k')/175$	(3,3)	(4,4)	(2,1)	(2,2)
(6) $9(5A + 4B - 8k')(5A - 4B + 8k')/175 < \sigma^2$	(3,3)	(4,4)	(2,2)	(1,1)

Notes: CL, CC, FC, FF, S and C are committed leader, committed Cournot, flexible Cournot, flexible follower, state and collective enterprise respectively.

Table A3
Payoff matrices under all cases (Nash equilibrium is indicated by *)

<p>(1) $\sigma^2 \leq 4Ak + 4k^2$</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="2"></td> <td colspan="2" style="text-align: center;">Collective</td> </tr> <tr> <td colspan="2"></td> <td style="text-align: center;">Commit</td> <td style="text-align: center;">Flexible</td> </tr> <tr> <td style="text-align: right;">State</td> <td style="text-align: center;">Commit</td> <td style="text-align: center;">2, 2*</td> <td style="text-align: center;">1, 4</td> </tr> <tr> <td style="text-align: right;">State</td> <td style="text-align: center;">Flexible</td> <td style="text-align: center;">4, 1</td> <td style="text-align: center;">3, 3</td> </tr> </table>			Collective				Commit	Flexible	State	Commit	2, 2*	1, 4	State	Flexible	4, 1	3, 3	<p>(2) $4Ak + 4k^2 < \sigma^2 \leq 9(5A + 4B - 8k')(5A - 4B + 8k')/400$</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="2"></td> <td colspan="2" style="text-align: center;">Collective</td> </tr> <tr> <td colspan="2"></td> <td style="text-align: center;">Commit</td> <td style="text-align: center;">Flexible</td> </tr> <tr> <td style="text-align: right;">Commit</td> <td></td> <td style="text-align: center;">3, 3*</td> <td style="text-align: center;">1, 4</td> </tr> <tr> <td style="text-align: right;">Flexible</td> <td></td> <td style="text-align: center;">4, 1</td> <td style="text-align: center;">2, 2</td> </tr> </table>			Collective				Commit	Flexible	Commit		3, 3*	1, 4	Flexible		4, 1	2, 2
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