



NO.E2006017

2006-11

**Needham Puzzle, Weber Question and China's Miracle:  
Long Term Performance since the Sung Dynasty<sup>1</sup>**

**Justin Yifu Lin**

**CCER, Peking University**

NO. E2006017 November 22, 2006

---

<sup>1</sup> Paper prepared for the " World Economic Performance: Past, Present and Future -- Long Term Performance and Prospects of Australia and Major Asian Economies " , Seminar on the Occasion of Angus Maddison's 80th Birthday, 5-6 December, 2006 at School of Economics, University of Queensland, Australia. I am grateful for the help of Shengyu Yi and Yong Chen in the preparation of this paper.

**Needham Puzzle, Weber Question and China's Miracle:  
Long Term Performance since the Sung Dynasty<sup>2</sup>**

**Justin Yifu Lin**

**CCER, Peking University**

NO. E2006017 November 22, 2006

---

<sup>2</sup> Paper prepared for the “ World Economic Performance: Past, Present and Future -- Long Term Performance and Prospects of Australia and Major Asian Economies ” , Seminar on the Occasion of Angus Maddison's 80th Birthday, 5-6 December, 2006 at School of Economics, University of Queensland, Australia. I am grateful for the help of Shengyu Yi and Yong Chen in the preparation of this paper.

## **I. Introduction**

Since the start of reform and open-door policy in 1978, Chinese economy has achieved a miraculous GDP growth of 9.6% annually. Such an economic success has aroused world-wide interest. However, it is worth mentioning that Chinese economy had also achieved great success in ancient times. According to the estimation of Maddison, in the first century A.D. the development of Han Dynasty in China was on the same level as that of the Roman Empire.<sup>3</sup> Until 1820, Chinese economy had maintained its status as the largest economy in the world. Its GDP accounted for 32.4% of the world total (Maddison, 1998, p.40). However, after Chinese economy reached its peak in the Sung Dynasty, its per capita income remained stagnant ever after<sup>4</sup>. While Chinese economy remained stagnant, through the Renaissance that started in the 14<sup>th</sup> century, the Europe gradually walked out of the darkness of medieval age. In the eighteenth century, the industrial revolution first broke out in the Great Britain, which led to a rapid increase in per capita income. According to the Purchasing Power Parity (PPP), the aggregate GDP of the European countries comprised 26.6% of the world total in 1820; in 1890, the ratio increased to 40.3%. Their average annual growth rate of GDP per capita increased from 0.22% in 1700-1820 to 1.03% in 1820-1952. The percentage of Chinese GDP in the world total, however, dropped dramatically to 13.2% in 1890 (Maddison, 1998, p.40). Moreover, during its whole period of modern history (1840-1949), Chinese economy had been stagnant. Its GDP per capita even dropped during the period of 1820-1952. During the same period, its GDP as a percentage of the world total decreased from 32.4% to 5.2%.

In the whole century after the Opium War in 1840, the social turbulence had been the major reason for the Chinese economic stagnation. However, after the People's Republic of China was established in 1949, there had been no major wars fought in China, but its economic development had not gone smoothly, despite the strenuous efforts of a whole generation that were devoted to the industrialization and modernization and

---

<sup>3</sup> Based on Goldsmith's work (Goldsmith, 1984), Maddison estimated that in 50 A.D. the per capita GDP in China was at about the same level of that in Europe (Maddison, 1998, p.25).

<sup>4</sup> Many scholars agree that Chinese economy reached its peak in the Song Dynasty (960 A.D.-1280 A.D.). In the period, economic activities were very lively (Hartwell, 1962, 1966 and 1967; Shiba, 1970; Elvin, 1973; Gernet, 1982; Jones, 1988 and 2003). According to the estimation by Maddison, Chinese per capita income level in 960 A.D. was about the same as that in 50 A.D., but in Song Dynasty, it increased by approximately one third. During the long period between 1280 A.D. and 1820 A.D. there had been essentially no growth at all (see Maddison, 1998, p. 25).

despite of all the efforts and plans of the government. Its GDP per capita on average increased only 2.34% annually, which was lower than the 2.56% world average at the time. The percentage of its GDP in the world total decreased slightly from 5.2% in 1952 to 5% in 1978. Its economic growth rate was not only far lower than the 6.66% rate of Japan but also lower than that of the Four Little Dragons (South Korea, Singapore, Chinese Taiwan and Chinese Hong Kong). The miraculous economic growth of China started at the end of 1978 when Chinese government adopted its reform and open-door policy. During the 27 years between 1978 and 2005; its GDP increased by 11.7 times, its average annual growth rate was as high as 9.6%. According the official exchange rate, its GDP reached US\$2,225.7 billion in 2005, ranked the fourth in the world. Its per capita GDP increased from US\$220 in 1978 to US\$1,730. Its total value of foreign trade reached US\$ 1421.9 billion in 2005, and its ranking in the world jumped from the 27<sup>th</sup> in 1978 to the 3rd. It has become and will continue to be a major driving force of the world economy (NBS, 2006). During its rapid economic growth in the reform period, a series of problems also emerged, which could possibly jeopardize its development. Such problems include cyclic economic fluctuation (which is also occurring in the developed countries), the slow reform in the state-owned enterprises, the fragile financial system, the widening income disparities and so on. All these problems could possibly lead to sudden emergence of crisis. Will Chinese economy survive all these problems, accomplish its transition to market economy and maintain its rapid economic growth? Will it be as predicted by Prof. Maddison in his preface to the Chinese version of *The World Economy: A Millennial Perspective*? That is: by 2015, Chinese GDP will reach the level of US and account for 20% of the world total and it will continue to grow rapidly after that. Will it gradually regain its status in the world as happened in the ancient history?

The rest of paper is organized as follows: Section II discusses Chinese long economic stagnation since the Sung Dynasty and explores the reasons why it was quickly lagged behind western countries since 1800s; Section III explains why the industrialization and modernization led by Chinese government in 1949-1978 failed to narrow the gap between China and developed countries. It also discusses the coexistence of Chinese rapid economic growth and the various social and economic problems;

Section IV is a brief summary, which also discusses whether China will continue its rapid economic growth in the future.

The basic argument in this paper goes as follows: long term economic growth depends on the continuous technological innovation. For countries at the technical frontier, innovation can only be achieved through invention on their own. Before the industrial revolution in the 18<sup>th</sup> century, technological innovations were mainly realized through accidental discoveries in production process by craftsmen and peasants. Because China had a large population, it had a large amount of craftsmen and peasants. Because of this, China had advantages in this kind of experience-based technological innovations. This is the major reason that China was more developed than western countries in pre-industrial times. However, as technology gradually improved, the room for such technological innovations gradually shrunk. The speed of such technological innovation eventually slowed down and the economy became stagnant. In the western countries, scientific revolution occurred at around 15<sup>th</sup> -16<sup>th</sup> century. At the mid 18<sup>th</sup> century, the traditional experience-based technological inventions began to be replaced by science-cum-experiment based inventions. Because of this, the rate of technological innovation accelerated, so did their economic growth. At the same time, China failed to realize such a transformation. Therefore, in a relatively short period, its technology was quickly lagged behind western countries, so was its international economic status. In 1949, the People's Republic of China was founded. For the first time in the 100 years, it was possible for China to develop its economy in a relatively peaceful environment. Compared with the technological level of developed countries, that in China was very backward. With the “advantage of backwardness” in technology, China could have accelerated its technological innovation and promoted rapid economic growth through borrowing technologies from the outside world. However, in order to overtake the developed countries, China chose to adopt a comparative-advantage-defying strategy (CAD strategy). It hoped to first develop advanced capital-intensive industries, which was the comparative advantages of developed countries. Because this was inconsistent with the comparative advantages determined by its endowment structure at the time, the enterprises in these industries were not viable in a free and open market. It became indispensable that government distorted the factor prices to low the costs of construction

and operation of the nonviable enterprises and allocated resources through administrative means directly to those enterprises. On the one hand, such a planned economic system helped to build up a modern industrial system on a basis of extreme poverty and backwardness. On the other hand, it also led to low resource-allocation efficiency, insufficient working incentives and poor economic performance. At the end of 1978, China began to its gradual reform and introduced a double-track pricing system. On the one hand, the necessary subsidies for non-viable enterprises in capital-intensive industries were continued. In accordance with the progress of reform and other coordinating conditions, these distortions under traditional system were gradually reformed. The continuation of these traditional practices contributed to the maintenance of economic stability. On the other hand, in order to provide workers and peasants with more working incentives, the government increased the resources that could be freely disposed by peasants and enterprises. At the same time, it relaxed the restrictions on the entrance of labor-intensive industries which China had the comparative advantage in but had long been suppressed. These measures have contributed to the rapid economic growth in China. However, this gradual reform inevitably led to institutional incompatibility between two economic systems (traditional planned economic system and the market economic system). Such institutional incompatibility was the main reason for many economic problems, such as the cyclic economic fluctuations, the fragile financial system and the deteriorating income disparities. In order to complete transition to a market economy, China needs to completely abandon the CAD strategy and accomplish the reform in the nonviable enterprises in industries that serve this goal. Only in this way, will China be able to eliminate the root for all its distorted institutions and measures, accelerate the capital accumulation and upgrade its endowment structure rapidly. If during the change of its comparative advantages, China, as a developing country, is able to utilize “the advantage of backwardness”, relying on borrowing of technology from the developed countries as the main mechanism for its technological innovations, it will, as Prof. Maddison has predicted, be able to maintain its rapid economic growth for another couple of decades and regain its economic status as in the pre-modern times by the mid of this century.

## **II. Needham Puzzle, Weber Question and Dramatic Decline of China since the 18<sup>th</sup> Century**

In the 1000 years before the industrial revolution, China had always been the country with most advanced technology and most prosperous economy.<sup>5</sup> From the 9<sup>th</sup> century onward, the area of cultivated land increased rapidly, as large amounts of population migrated from the north to areas south of Yangtze River<sup>6</sup> and new production technologies (such as the use of farm cattle and crop rotation) were invented. At the beginning of the 11<sup>th</sup> century, a new variety of rice with high productivity was introduced from Vietnam, along with innovations in the cropping system and instruments.<sup>7</sup> Chinese agricultural productivity remained as the highest in the world until the 13<sup>th</sup> century. The high agricultural surplus provided the industrial and commercial development with raw materials, labor and funds. The industrial sector in China developed quite well since its Han Dynasty and reached its peak in the Sung Dynasty.<sup>8</sup> Take the utilization of iron, a fundamental material for industrial development, as an example, Chinese output of iron reached 150,000 tons by the end of 11<sup>th</sup> century, whose per capita level was 5-6 times larger than that in Europe.<sup>9</sup> The well salt industry and textile industry were also quite prosperous. For instance, water-powered spinning machine was already used in the production of linen thread in the 13<sup>th</sup> century, whose technology was no inferior than the

---

<sup>5</sup> Please refer to Needham (1954, 1969, 1981, 1986) and Elvin (1973) for supporting evidences. Maddison doubts whether the economic and technological level in China's Han Dynasty (206 BC-AD 220) was higher than that in Europe in the 5<sup>th</sup> Century before the collapse of West Roman Empire (Maddison, 1998, P.38). But we are confident that at least in the 1000 years between the 5<sup>th</sup> and 15<sup>th</sup> century, while the Europe was in the dark medieval times, China had a more advanced technology. It is worth noting that, according to Francis Bacon (1561-1626), gunpowder, magnetic compass, paper and printing were the most important inventions that facilitated the transformation of Europe from the Dark Ages to the modern world. What he did not know was that these inventions all originated from China (Jones, 2003, p. 58).

<sup>6</sup> According to Balazs' estimates, at the mid 8<sup>th</sup> century (the early period of Tang Dynasty), only 24% of Chinese population lived in the south of Yangtze River (Balazs, 1931, p. 20). By the end of 13<sup>th</sup> century, the ratio increased to 85% (Elvin, 1973, p. 204).

<sup>7</sup> Because the newly introduced rice was drought-resistant and early maturing, its cultivation area could be easily extended. As for the innovations in farm-tools induced by this shift from dry-land farming to the cultivation of paddy, please refer to Chao, 1986. It is worth mentioning that many of the elements of Arthur Young's scientific (conservation) agriculture, which led to the agricultural revolution in England in the eighteenth century, had become standard practices in China before the thirteenth century (Tang, 1979).

<sup>8</sup> For a brief discussion on the technological achievements in the industrial sector during this period, please refer to Elvin (1973, p. 179).

<sup>9</sup> See Jones, 2003, p.202. Hartwell believes that, in the Song Dynasty (806 A.D-1078 A.D.), the output of iron increased 9 times and its per capita level increase 6 times. Because of this, he regards it as an "early industrial revolution" (Hartwell, 1966, p.29). However, Maddison was suspicious about the validity of his estimation, because it was based only on the iron production in the capital of Song Dynasty (Maddison, 1998, p.37).

similar machines used in Europe in 1700 (Elvin, 1973, p.195; Jones, 2003, p.202). Because of the highly developed agriculture, industry and commerce, the Chinese urban prosperity in the 13<sup>th</sup> century astonished even the Venetian, Marco Polo, who came from a place famous for its prosperity in commerce (Elvin, 1973, p.177). The market economic system was established in China as early as 300 B.C. in the Period of Warring States. Such a market economic system included private ownership and free trade of land, highly specialized and mobile labor and highly developed product and factor markets (Chao, 1986, p.2-3). Most scholars believe that, as early as in the early period of Ming Dynasty (14<sup>th</sup> century), China had acquired all the major elements that were essential for the British industrial revolution in the 18<sup>th</sup> century (Eberhard, 1956; Elvin, 1973; Tang, 1979; Needham, 1981; Chao, 1986). However, industrial revolution occurred in Britain instead of China and Chinese economy was quickly overtaken and lagged behind by western countries. Why did the industrial revolution not originate from China, the place that first acquired all the major conditions? This is the Weber Question<sup>10</sup>, which was reinterpreted by Joseph Needham in the following paradox: First, why had China been so far in advance of other civilizations? Second, why is not China now ahead of the rest of the world? (Needham, 1986, p.6)

Several hypotheses have been proposed by many scholars. A widely accepted hypothesis is called “high level equilibrium trap”<sup>11</sup>. It attributes the stagnancy in Chinese technological innovation to the unfavorable man-to-land ratio. According to this hypothesis, in the pre-modern society, China’s early acquisition of advanced social, economic system and scientific technology enabled it to achieve a high level of economic prosperity. However, under the influence of Confucian school, Chinese family's obsession with male heirs to extend the family lineage encouraged early marriage and high fertility, resulting in a rapid expansion of population. But the possibility for continued expansion of the amount of cultivated land was limited. This led to the

---

<sup>10</sup> See Weber, "Confucian Politics in China and the Sprout of Capitalism in China: Cities and Industrial Associations" from *Collected Works of Max Weber: The Historical Steps of Civilizations*, Shanghai, Shanghai Sanlian Bookstore, 1997. and Max Weber, *The Religion of China: Confucianism and Daoism*, Translated from the German and Edited by Hans H. Gerth with an Introduction by C.K. Yang (Paperback edition; New York and London: Free Press, 1968)

<sup>11</sup> This hypothesis was first proposed by Elvin (1973) and was further elaborated by Tang (1979) and Chao (1986). Elvin and Tang emphasized on the insufficient agricultural surplus for accumulation, while Chao put more emphasis on the insufficient demand for labor-saving technology.



continuous decrease in the man-to-land ratio. As labor became cheaper, the demand for labor-saving technology declined. Because of this, although China reached the threshold for industrial revolution as early as in the 14<sup>th</sup> century, its “population had grown to the point where there was no longer any need for labor-saving devices” (Chao, 1986, p.227). Meanwhile, the rising man-to-land ratio also reduced surplus per capita. As a result, China did not have the surplus to be tapped for sustained industrialization (Tang, 1979, p.7). On the contrary, Europe enjoyed a favorable man-to-land ratio and a legacy of unexploited, traditional economic potential. By the time sufficient knowledge was accumulated to the threshold of an industrial revolution, “a strong need to save labor was still acutely felt”, and a large agricultural surplus was still available to serve “as the principal means of financing industrialization”. (Tang, 1979, p.19)

However, the above logic is intrinsically flawed. The argument that “as population increases and man-to-land ratio decreases, the labor will become relatively cheaper and per capita surplus will reduce” is based on the assumption that technology is fixed or improving at a very slow rate. With a continuously improving technology, the above argument does not hold. Furthermore, the hypothesis is not supported by the empirical evidence. It is true that many labor-saving tools were invented before the 12<sup>th</sup> century and only a few later (Chao, 1986, Chapter 9). However, empirical evidences show that the area of cultivated land per capita in the 14<sup>th</sup>, 15<sup>th</sup> and 17<sup>th</sup> century was significantly higher than that in the 11<sup>th</sup> century.<sup>12</sup> According to this hypothesis, the demand for labor-saving technologies should have been stronger in the above mentioned periods; and the per capita surplus should have also been higher. It should have been particular so in the peaceful 1368 A.D., when Ming Dynasty was just established. What we can observe in data, however, is only the population growth, instead of a surge of labor-saving technologies. In addition, in the early decades of the 20<sup>th</sup> century, although man-to-land ratio was even more unfavorable, labor resources were far from adequate. In the irrigated parts of southern China, there were hardly any periods during the year which

---

<sup>12</sup> Population in China continued to grow until around 1200 A.D.; declined between 1200 A.D. and 1400 A.D.; recovered to the level of 1200 A.D. at around 1500 A.D. In period of 1600 A.D. – 1650 A.D., the population decreased again. Therefore, the estimated per capita acreage in the 14<sup>th</sup>, 15<sup>th</sup>, and 17<sup>th</sup> century should be higher than that in the 11<sup>th</sup> century. As for the trend of Chinese population growth, please see Feuerwerker, 1990, p.227. As for historical evidence for the area of cultivated land per capita, please see Chao, 1986, p.89.

farming households were not fully occupied in agricultural activities (Buck, 1937). Therefore, Chao (1986)'s argument that "population has grown to the point where there was no longer any need for labor-saving devices" does not hold. According to the estimation of Riskin, about one third of Chinese GDP in 1933 could potentially be allocated to investment, which was much higher than the 11% of GDP for investment considered by Rostow and other economists as the threshold for getting out of "the equilibrium trap" and starting economic take-off (Rostow, 1960). During the First Five-Year Plan in China (1953-1958), agricultural technology was still traditional (Perkins and Yusuf, 1984, Chapter 4), but the annual accumulation rate was as high as 24.2% (NBSC, 1988, p.60). This puts into question the argument that Chinese agricultural production cannot provide sufficient surplus for accumulation. Finally, from 14<sup>th</sup> century onward, technological innovations in China had not been completely stagnant. The period between 14<sup>th</sup> and early 20<sup>th</sup> century still had many new inventions (Elvins, 1973, p.289). Without technological innovations, it is impossible that per unit yield of grains could have doubled in the period from the end of 10<sup>th</sup> century to the early 19<sup>th</sup> century.<sup>13</sup> Therefore, the arguments for the "high level equilibrium trap" (that is, the unfavorable man-to-land ratio led to insufficient agricultural surplus and insufficient demand for labor-saving technology, which then led to technological stagnancy) is logically inconsistent and invalidated by the empirical evidences.<sup>14</sup>

If the technological innovation in China had not been completely stagnant after the 14<sup>th</sup> century, why it was quickly lagged far behind by the western countries? The key fact lies in the change in the relative pace of technological innovations. After the 14<sup>th</sup>

---

<sup>13</sup> During this period, population increased 5-6 times, and output of grains increased accordingly. The contribution of the increase in the per unit yield were just as important as the increase in the area of cultivated land. This indicates that per unit yield of grains should at least double in the period. See Perkins, 1969, p.13-17. Furthermore, based on the materials provided by Chao (1986, p.89), from the end of the 10<sup>th</sup> century to the end of the 14<sup>th</sup> century, both the area of cultivated land and population had doubled; in the period from the end of the 14<sup>th</sup> century to the 19<sup>th</sup> century, the area of cultivated land doubled again, while the population increased by 6 times. If we adopt the hypothesis of Perkins (1969) that the ratio between the per capita consumption of grains and the area of grain-growing land were basically unchanged, the above evidences show that the per unit yield of grains should at least double in the period from the 14<sup>th</sup> century to the 19<sup>th</sup> century.

<sup>14</sup> Although changes in the man-to-land ratio may influence the type of technological innovations, it cannot explain the slow-down of the overall innovation activities in the whole economy. In fact, bottle-neck constraint imposed by the increased man-to-land ratio also occurred in the Europe. The boycott of labor-saving technologies was first recorded in Europe (Cipolla, 1993, pp. 140, 198). It could be due to the insufficient supply of technological innovations instead of insufficient demand (Schultz, 1964).

century, technological innovations in China slowed down while that in Europe accelerated rapidly. The change in the way to create technological innovations was the key. (Lin 1995)

In both the pre-modern and modern society, the mechanism of technological innovation is essentially the same: through “trial and error”. Before the industrial revolution, in both China and the western countries, new technologies were mainly invented by peasants and craftsmen through accidentally deviations from routines during their daily work. After the industrial revolution, technological innovations were mainly provided by inventors who did experiments in the laboratory through intentional “trials and errors”. Since the 19<sup>th</sup> century, the traditional experience-based inventions were replaced by science-cum-experiment based inventions.

Before the industrial revolution, the experiences of craftsmen and peasants were the major source of technological innovations. This kind of innovation was a byproduct of their production process and was not done intentionally. Neither was it a result driven by economic motives. The innovation was mainly minor modification of existing technology (Musson, 1972, p.58; Cipollar, 1993, p.149). In terms of probability, if a country has a larger population, the number of random “trial and error” experiments done by the craftsmen and peasants will be higher. Its rate of technological innovations will be faster than a country with less population, so will be its economic development (Simon, 1986, Chapter 1). The quality of soil in China was not the richest compared with drainage areas of other rivers (Ho, 1969). However, because it had a topography that had higher elevation in the west and lower elevation in the east, and because the precipitation brought by the monsoon from the Pacific Ocean concentrated between March and October when the light and heat conditions were favorable, the land in China could produce highly-productive grains to support larger population, if right farming tools and technologies were applied (Temple, 1986). Because of this, Chinese population had been far larger than that of Europe. Such a larger population put China in an advantageous position in the development of technologies in pre-modern periods. The mobility of government officials in ancient China, the print and distribution of agricultural books and the circulation of products and labor in a free market also helped to disseminate new technologies (Maddison, 1998, p.23). During the 8<sup>th</sup> century to 12<sup>th</sup> century, as people in

northern China continued to migrate in large scale to the south where there were more rains and had a wetter climate, major transportation vehicle was transformed from horses to boats, and major type of grains were changed from sorghum and millet to rice. Major transportation vehicles and production tools were changed accordingly. Because of this, the rate of technological innovation and economic growth were quite fast in the period (Chao, 1986, p.224). For the same reason, China maintained its lead in the world civilizations for more than 1000 years. However, the room for this traditional type of technological innovation (the one that based mainly on experiences) became smaller and smaller as technological level kept upgrading. Eventually, both the technological innovation and the economic growth slowed down to stagnancy.

In pre-modern society, because the Europe had a smaller population size than China, the number of craftsmen and peasants and the corresponding working experiences were relatively less. It was in a disadvantageous position in the technological innovation in pre-modern society. However, after the scientific revolution in the 15<sup>th</sup> and 16<sup>th</sup> century, experimental method became widely used (Mathias, 1972). The number of “trials and errors” were no longer constrained by the numbers of craftsmen and peasants in the production process and thus increased dramatically. More importantly, science and technology became more and more closely related. By the mid 1800s, science began to play a crucial role in the inventions of new technologies (Carmen, 1989, p.165). When there were bottle-necks for technological innovations, efforts in scientific research increased people's knowledge of nature, helped to overcome the bottle-neck and expanded the scope of new technological innovations. This made it possible to maintain an ever accelerating speed of technological innovation. (Kuznets, 1966, pp.10-11; Hicks, 1932, p.145)

By the mid 18<sup>th</sup> century, after the British industrial revolution, technological innovation in the western countries had gradually become an intentional practice: experiments were done with specific goals in mind. This kind of experiments was more costly and economic consideration of cost and benefit was necessary. In this sense, the institutional setups in Europe to protect private properties and commercial interests might have encouraged these experiment-based technological innovations. However, without the scientific revolution in the 15<sup>th</sup> and 16<sup>th</sup> centuries, the advantage brought about by the

change in the method of technological innovation could not have lasted for long. As the technological level upgraded, the room for further inventions would have become narrower and narrower. Without the help of scientific research that broke down the bottle-necks in technological innovation, the accelerating speed of technological innovation in Europe after the industrial revolution would have gradually died away as it had occurred in other civilizations; and the technological innovation and economic growth would have become stagnant in the end. Therefore, the key reason for the sudden decline of China was that scientific revolution occurred in Europe at around 15<sup>th</sup> and 16<sup>th</sup> century, but it had not occurred in China.

Science is a systematic knowledge of the natural phenomena. The primitive of sciences before the 15<sup>th</sup> and 16<sup>th</sup> centuries originated from observations of curious scientists. Scientific revolution is itself a revolution of methodology. Since the 15<sup>th</sup> and 16<sup>th</sup> centuries, scientists that were curious about natural phenomena began to formalize their hypothesis about nature into “mathematical” forms. They also began to test inductions derived from their mathematical models through controlled experiments. (Needham, 1969, p.15) This revolution in the scientific methodology accelerated the elimination of false hypotheses and facilitated the dissemination and accumulation of hypotheses that had not been invalidated. The knowledge of nature exploded after this methodological revolution. However, before the 19<sup>th</sup> century, scientific research was mainly driven by the curiosity felt by the scientists. The new scientific discoveries had not been directly used in the innovations of new technologies. Its contribution to the advances in technology and economic growth was limited. Thus, scientific revolution was different from industrial revolution in that there were no apparent economic incentives. Curiosity should be an innate endowment just like intelligence and therefore should be distributed equally in the population. Since China had a larger population in the history, the number of people with high curiosity should be higher than that in Europe. In the pre-modern times, Chinese scientific achievements were no inferior to those of Europe. Moreover, China had a relatively higher mathematical achievement and a relatively more systematic method for experiments in ancient times (Needham, 1969, p.211). Why did the many curious geniuses in China fail to initiate a scientific revolution,

formalize their hypothesis in mathematical forms, and test hypotheses under controlled experiments, so as to explore the nature and satiate their curiosity more effectively?

Joseph Needham believed that because Chinese bureaucratic system emphasized on the agricultural production and discriminated against merchants and artisans, it failed to combine its craftsmen's technology with scholar's mathematical and logical inference method. He believed that this was the reason for the absence of scientific revolution in China (Needham, 1969, p.211). Qian and others held that it was China's imperial and ideological unification that prohibited the growth of modern science (Qian, 1985; Boulding, 1976; Feuerwerker, 1990). However, discrimination against merchants and artisans and the politico-ideological authority in pre-modern China was not absolute. The political environment in Europe right before the scientific revolution was no better than that in China (Monter, 1985): Copernicus, Kepler, Galileo, and other pioneers of the Scientific Revolution in Europe had to contend with schoolmen who upheld the dogma of the authority and omniscience of the classics, and even risk their lives in religious courts.<sup>15</sup> I believe the real reason of the absence of scientific revolution was not due to the adverse political environment that prohibited the creativity of Chinese intellectuals, but due to the special incentives provided by the civil-service examination system. Because of this examination system, curious geniuses were diverted from learning mathematics and conducting controllable experiments. Because of this system, the geniuses could not accumulate crucial human capital that was essential for the scientific revolution. As a result, the discoveries of natural phenomena could only be based on sporadic observations, and could not be upgraded into modern science which was built upon mathematics and controlled experiments.

Since Qin unified China in 221 B.C., the bureaucratic system of provinces, prefectures and counties (system of local administration) was established. Government

---

<sup>15</sup> In the early period of Han Dynasty, merchants were treated equally (Ho, 1962, p.42). During the medieval times in China, those young men who were not interested in books and learning but had an adventurous type of personality could find socially-approved outlet in commerce (Eberhard, 1956). During the Ming and Qing Dynasty, it even became a common practice for people to "donate" money in exchange for a position in government (Ho, 1962, p.51). The ideology in China was not absolutely rigid: Wang Yangming's revolutionary challenge of the official Neo-Confucian philosophy by Zhu Xi left a permanent imprint on the development of Chinese Confucianism (Ho, 1962, pp.198-202). In ancient China, no one was persecuted as in Europe because they proposed a view about a natural phenomenon that was different from his contemporaries.

officials of all levels were selected from non-hereditary bureaucrats. During the several hundred years from the Han Dynasty, the recommendation system was used in the selection of government officials. During the selection of government officials, the pool of candidates was determined by the recommendations from government officials of all levels. In the ideal case, they should have recommended individuals with both talent and virtue, which could include both their relatives and their foes. In real practices, nepotism inevitably became one major factor for the recommendations of officials at all levels and lost the crucial element for the selection of talents: fair competition. Furthermore, through this recommendation system, it was possible for some powerful families to acquire enough strength to even threaten the throne of the emperor. Sui Dynasty (589-618) established the civil-service examination system, which selected talents through fair and impartial examination. This system was continued until the end of Qing Dynasty and was abolished in 1904. (Ho, 1962, p.32)

In the early period of Tang Dynasty (618-906), the civil-service examination provided examination of different knowledge and skills for people with different specialties. For instance, examination of “Ming Suan” was to select people with strong mathematical skills, examination of “Xiu Cai” was intended to select people with unusual capabilities. In addition, it was also possible that people with comprehensive talents could be recommended through other channels (Ho, 1962, p.12). But soon the examination became focused on the contents of “Jing Shi” (Miyazaki, 1976 p.9; Chagge, 1985, p.184; Liu and Li, 2004, p.156).<sup>16</sup> This civil-service examination system was further improved in the Sung Dynasty. The coverage of the tests was limited only to the teaching of the Confucian school, basically its most fundamental readings: the Four Books and the Five

---

<sup>16</sup> Ho (1962, pp.13-16) listed many reasons for the narrowing down of examination contents. For instance, the examination of “Xiu Cai” set too high a standard compared to the reality; the examination on knowledge of mathematics and laws were too specialized for the selection of government officials; the examination of “Ming Jing” was too focused on memorization and was relatively too simple, and so on. But the key reason was that the examination of “Jing Shi” tested on their literary attainments and their familiarity with the wisdom of ancient sages. These two elements were considered closest to the ethnic and intellectual standards specified by Confucianism as essential talents necessary for the management of state affairs. Moreover, compared with other specialties, these two elements could most effectively facilitate the administration of government officials. Finally, compared with the recommendation system, it was much more objective and fair.

Classics.<sup>17</sup> The contents that had to be memorized included 431286 Chinese characters, not to mention the annotations which were several times longer, and other related historical, literary classics (Miyazaki, 1976, p.16). But memorization was not the most difficult part of this examination. The real difficulties lied in the ability to write creatively, this constituted the intellectual contest element of the exam<sup>18</sup>. Only those with outstanding talents and devoted most of their efforts into the Confucian study could stand out in the rounds and rounds of competition.<sup>19</sup> Generally, twenty years were needed simply to participate in all these examination.<sup>20</sup> Although the process was long and painful, students still had enough incentive to devote their efforts into it. This was because government officials were regarded as the most honorable and most profitable occupation<sup>21</sup>. Traditionally, being a government official was regarded as the shortest path to the upper class (Ho, 1962, p.92). At the same time, the civil-service examination system also provided students with strong incentives: students who passed examinations

---

<sup>17</sup> After Han Wu Emperor (156 B.C. -87 B.C.) promoted only the Confucian school and rejected all other schools of philosophy, Confucianism became the orthodox philosophy for Chinese bureaucratic system (Ho, 1962). According to the Confucianism, society in essence is hierarchical (James, 1960, p. 132). A country should be administered by intelligent and virtuous people. In order to find such people, equal educational opportunities should be provided to all the population and use their educational performances as an indicator for their talents. In this way, it believed that social hierarchy could be maintained. This concept was widely accepted as early as in the Period of Warring States (Ho, 1962, p.7).

<sup>18</sup> Ho (1962, p.14) believed that the most difficult part in the examination of “Jing Shi” was the requirement of creative writing. During the Ming Dynasty, the civil-service examination gradually established a tradition of “eight-part essay”. To write a beautiful article following a strict format was a highly skillful game. It was believed that this kind of examination could test the intelligence of people and thus considered as the ideal form of civil-service examination (Liu and Li, 2004, pp.350-352).

<sup>19</sup> Civil-service examination system reached its highest prosperity in the Ming and Qing Dynasties. A complete set of civil-service examinations included: preliminary stage, county examination, prefecture examination, academy examination, provincial examination, state examination and final imperial examination. In addition, there were many qualification exams before state examinations and additional exams after country examination and metropolitan examinations. Those who passed the preliminary stage were called “Tongsheng”; those who passed the prefectural examination were called “Shengyuan”; those who passed the provincial examination were called “Juren”; those who passed the final imperial examination were called “Jinshi” (Miyazaki, 1976).

<sup>20</sup> Elementary education for the civil-service examination usually began when children were three years old. They entered school at the age of eight and finished the study on the classics of Confucianism. The learning process was extremely boring and exhausting (Miyazaki, 1976, pp.14-16). This was only the preparatory stage for civil-service examination. According to Zhang (1991), in the late Qing Dynasty, the average age of “Shengyuan” was 24; that of “Juren” was 31, “Jinshi” 34. This means that it generally took 26 years from entering school to become a “Jinshi”. Although a couple of extremely talented people could become “Jinshi” at their earlier ages (Qian, 2004, pp.128-130), the above figures were quite representative. In Ming Dynasty, the average age of “Jinshi” was around 30 years old (Qian, 2004, p.132).

<sup>21</sup> In the western countries, bureaucrats never enjoyed such a high social status and authority as in China. (Maddison, 1988, p.22)



could receive special treatment in accordance with the level of exam they passed<sup>22</sup>. Government also took various measures and create a variety of channels to attract capable people to participate in the civil-service examination and become a government official<sup>23</sup>. Governments even publicly advocated the benefits that could be gained through civil-service examination, so as to create a wide enthusiasm in the society for the examination.<sup>24</sup>

Such a special incentive structure created a human resource distribution that was only observed in China. It is unique not only because the final success of the few scholars who acquired the high ranking officials was achieved at the expenses of the enormous amount of time and effort of those who failed<sup>25</sup>. More importantly, the fierce competition for this high profitability made numerous ingenious minds devoted all their time and efforts to memorize Confucian classics and acquire literary skills. They were so obsessed in the civil-service examination that they had no time for the other braches of knowledge, like mathematics and other useful techniques in real life (Liu and Li, 2004, pp.317, 404). Because China was a large and populous country, there were numerous intermediate ranks from the lowest local government officials to a minister, the highest ranking official. For those who were lucky to pass the exams and acquired government positions, they still had to behave in accordance with the teachings of the Confucianism, so as to be promoted. Therefore, even those winners in the civil-service examination had no time for

---

<sup>22</sup> For the special treatment of “Xiucui”, “Juren” and “Jinshi”, please see Miyazaki, 1976, pp. 36, 59, 83-92; Liu and li, 2004, pp. 283, 287, 293.

<sup>23</sup> When the Song Dynasty was first established (970 A.D.), in order to win over the support from the scholars, a special examination was carried out for those who have failed continuously. In this way, it hoped to encourage their continued efforts in the preparation for the civil-service examination. In the early period of Tang, Song, and Qing Dynasties, special examinations were carried out to select people with various specialties, as a supplement for “Jinshi” (Liu and LI, 2004, pp. 158, 387).

<sup>24</sup> The “Quan Xue Poem” by Emperor Zhenzong of Song Dynasty, which has been read through all ages, induced people to participate in civil-service examination by direct resort to money, beauties and social status. See Miyazaki, 1976, p.17; Liu and li, 2004, p.163.

<sup>25</sup> When the empire entered a period of social stability, vacancies for government officials could not increase further. Ho (1962, p.259) estimated that between the 16<sup>th</sup> century and the first half of the 17<sup>th</sup> century, the total amount of government officials were ranged between 10,000 and 14,000. Therefore, there was a severe surplus in the supply of scholars taking the civil-service examination. The admission ratio in the Ming Dynasty was 4% in the provincial examination and around 10% in state examination. For a “Shengyuan”, he only had a 1/3,000 probability ever became a “Jingshi”. Under the level of “Shengyuan”, there were a still a far larger population who received no government subsidies. Because the civil-service examination tested only one particular branch of knowledge, most of the scholars could barely make a living on their own (Qian, 2004, pp. 68, 110, 209). At the end of Ming Dynasty, the population of “Shenyuan” was about 500,000, comprising 0.33% of the national population (Qian, 2004, p.137), which was far larger than the population of government officials.

the exploration for other knowledge.<sup>26</sup> As a result, there were only a few scientists in China during the period.<sup>27</sup>

In summary, because the civil-service examination system focused only on the Confucianism and the literary skills, most of the talented people in China were fully devoted to either the civil-service examination or the research of humanities. They lacked the incentives to learn and accumulate skills in mathematics and controlled experiment, not to mention the ability to combine the two, formalize the knowledge in mathematical forms and test through experiments. As a result, scientific revolution could not spontaneously take place in China, even though China had satisfied many of the crucial conditions for the industrial revolution and capitalism had sprouted as early as in the 14<sup>th</sup> century. Without scientific revolution, the development of its science and technology could not break up the bottle-necks for further development once they reached certain level. Thus its technology could not continue to progress and its capitalism could not be deepened. The further development of capitalist production relation was suppressed. At the same time, after industrial revolution took place in the Europe in the 18<sup>th</sup> century, capitalism developed rapid in Europe. When the door of China was knocked open by warships and cannons in the 19<sup>th</sup> century, China was still in the embryonic stage of capitalism.

With the help of scientific and industrial revolution, the science and technology developed rapidly in the following century; whereas in China, because it had experienced neither scientific nor industrial revolution, the once glorious country was quickly lagged behind both economically and politically. The international status between China and western countries was quickly reversed. In 1840, the British army forced China opened its door with bombardment of cannons and warships. After that, under the threat of

---

<sup>26</sup> The incentive mechanism of the civil-service examination had an extremely important impact on the structure of Chinese human capital. In particular, it led to the lack of talents who would devote to the exploration of natural sciences. The comment by Sung Ying-Hsing (Song Yingxing), author of the famous 1637 technology book *T'ien-kung k'ai-wu* (A Volume on the Creations of Nature and Man), to his book is the best footnote to this point. He wrote: "An ambitious scholar will undoubtedly toss this book onto his desk and give it no further thought: it is a work that is in no way concerned with the art of advancement in officialdom."

<sup>27</sup> According to the studies of Shen and Du (2006), there were a total of 51,561 "Jinshi" in Ming and Qing Dynasty, among which only 925 were considered as the top elites (the first four in the final imperial examination and the first in the state exam). During the same period, the best experts in all areas were estimated to be 1,000, among which only 86 were scientists and philosophers. Although there is concern for the reliability and comparability of the data, the estimates can roughly reflect the situation in the period.

western powers, treaties of forfeiting sovereignty and national humiliation were signed one after another. The cession of territory and payment of indemnities became routine<sup>28</sup>. Grown up under the nurture of Confucianism, Chinese scholars had always regarded the well-being of the country as their own responsibilities. Faced with the cruel reality and realized the weakness and fragility of China, they began to introspect Chinese culture. As their introspection went deeper and deeper, the focus of social movements gradually shifted from the surface of Chinese culture to its intrinsic institutions and kernel values<sup>29</sup>. The Opium War made Chinese realized that the tools of western countries were far more advanced, but they were still in fond illusion of Chinese culture's superiority. Guided by the principle of "maintaining the Chinese culture as the body and learning the western technology to improve the function"<sup>30</sup>, many government officials in the Qing Dynasty initiated the Westernization Movement. They purchased guns, cannons, warships and other more advanced instruments from the western countries, established modern enterprises, and hoped to "learn from the westerners and use their technology to defeat them". However, the dream was completely crashed in the Sino-Japanese War of 1894-1895. Chinese scholars realized that China was not only backward in technologies, but also in institutions and organizations<sup>31</sup>. Because of this, constitutionalists initiated the Reform Movement of 1898 so as to establish constitutional monarchy in China<sup>32</sup>. In 1911, the capitalist revolutionist initiated the revolution of 1911 in the hope to establish democratic republicanism in China. However, such efforts to change the Chinese institutions failed to change the backwardness of China. China was still continuously defeated by western countries. Although the Qing Dynasty was overthrown in 1912, and

---

<sup>28</sup> For Chinese modern history, please read Maddison 1998, Chapter 2, or *The Cambridge History of China*, v. 10-13.

<sup>29</sup> According to the definition of Malinowski, (tr. By Fei, 2002), culture consisted of three integrated layers: tools, organizations, values

<sup>30</sup> It held that the Confucianism was still superior to the western culture, but its technology was not as good as that of the western countries. Therefore, Chinese people should learn the advanced technologies from the western countries.

<sup>31</sup> Chinese political and cultural influence on Japan had been profound for hundreds of years. However, after its Meiji restoration, it began to learn comprehensively from the western countries in all areas, including both the technology and institutions. This process strengthened its power and defeated China in the Sino-Japanese War of 1894-1895.

<sup>32</sup> The Reform Movement of 1898 took the maintenance of imperial authority as a prerequisite. It was intended to establish a new educational system, create a modern administrative system and develop modern industries. However, it was soon defeated by the bureaucrats in power. This movement is also called Hundred Days of Reform.

the Republic of China was founded, it was soon obsessed with the war among warlords. Chinese people were driven into more destitute state. Inflicted by the humiliation in the Treaty of Versailles (1919)<sup>33</sup>, for the first time in history, Chinese people realized that the backwardness was not only in the technology and institutions, but also in the ethnics and values.

In 1928, although the Nationalist Party nominally unified the China, it suffered from factions and cliques. It was faced with numerous internal conflicts. Since the September 18<sup>th</sup> Incident in 1931, China began to suffer from the Japanese invasion. In 1937, the national war against Japan began. After 8 years' struggle, China finally won the war. However, China soon involved in its domestic war, which lasted for another three years. Amidst the flames of wars, Chinese people were driven homeless; China was still unable to get out of the trap of poverty and backwardness.<sup>34</sup>

The 100 years' humiliation inflicted on China brought about anti-western complex among many Chinese people<sup>35</sup>. Chinese intellectuals also observed the many social economic problems in the early stage of capitalist development in the western powers, like the cyclic economic fluctuations, unemployment, income disparities, and slums in urban areas and so on. They realized that although the capitalist system in the western countries was superior to Chinese traditional system, it was far from perfect. Many Chinese intellectuals were still pursuing a more advanced system that would lead them toward a society with great harmony, a dream they had hoped for thousands of years. They hoped that such a system could make China strong and prosperous, and at the same time, to make the nation belong to the people<sup>36</sup>. Because of this, when the Russian Revolution succeeded in 1917, socialism rapidly spread over China, because of its pursuit of prosperity and equality. At the same time, the Soviet Union unilaterally abolished all the unequal treaties and declined all the privileges in China. It also helped Chinese

---

<sup>33</sup> During the Paris Peace Conference of 1919, Chinese concession Qingdao was transferred from Germany to Japan instead of returning to China, although China was among the victorious nations.

<sup>34</sup> The long-standing wars cut the Chinese per capita GDP in 1952 down to the level of 1890. See Maddison, 1998, p.48.

<sup>35</sup> Some people held that China should learn from the western countries, some even believed that China should abandon all its traditions and embrace every aspect of western society. In practice, it is simply impossible for Chinese people to completely abandon its traditional culture.

<sup>36</sup> That is, the concept of fair and justice is well accepted by everyone. The life of every individual was intended for the interest of all the people in the nation.

Nationalist Party to carry out the national revolution. With the socialist planned economy, the Soviet Union rapidly realized industrialization and became a major industrial country in the world. This transition occurred while the capitalist world was experiencing the great depression in the 1930s. Under such a background, more and more Chinese people accepted the socialism. In 1921, the Communist Party was established in China and finally won the support of the majority of Chinese people and defeated the Nationalist Party. In 1949, the People's Republic of China was founded.

In retrospect of this one-hundred-year history of China, despite all the attempts of Westernization Movement, the Reform Movement of 1898 and the capitalist revolution, none administrations adopted effective measures to deal with the challenges of the western advanced technology. The modernization of Chinese economic structure was slow (Maddison, 1998, pp.48-49). Wars and foreign aggressions deprived China of many economic sovereignty rights (such as tariffs and railroads) and caused vast damage to its economy; the huge amount of war indemnities further depleted its capital<sup>37</sup>. Wars also caused huge damages on labor resources. Poverty and lack of education formed a vicious cycle and led to low human quality (Maddison, 1998, pp.47, 63). Throughout this one-hundred-year history, Chinese economy lacked a stable and peaceful social environment which was crucial for its development<sup>38</sup>. In short, economic growth was deterred by the backward technology, war damages, war indemnities and foreign aggressions. A peaceful environment came only after the founding of the People's Republic of China in 1949. For the first time in the one hundred years, China could promote its industrialization and modernization under a relatively peaceful environment.

### **III. Successes and Failures of Planned Economy and the Economic Miracle after the Reform and Open-up**

The founding of the People's Republic of China ended the turbulent times of modern China. In 1949, China was still a poor backward agricultural country with a spectacle of devastation everywhere (Maddison, 1998, p.56). At the time, all developed

---

<sup>37</sup> As for the estimation on the amount of war indemnities, please see Xiao, 2004, p.12. Because of scarcity of government revenues (Young, 1971, p.146), government had to default on the foreign debt (Maddison, 1998, p.49).

<sup>38</sup> In its modern history (1840-1949), China experienced 12 major wars. That is, on average, there was one major war in every nine years. See Xiao, 2004, p.7.

countries had strong heavy industries, which were commonly regarded as a sign and goal for a strong and prosperous nation<sup>39</sup>. The success of Soviet Union in the 1930s under its highly concentrated planned economic system provided Chinese leaders with an attractive example and a strong incentive to follow its step. It was believed a country comprised of mainly poor agricultural population could not provide sufficient demand for industrialization and that the self-servicing and circulation properties of the heavy industry could help to overcome this problem<sup>40</sup>. Because of the Korean War (1950-1953), the western countries began their boycott and economic punishment on China. This put China in a dying thirst for its own independent heavy industry, especially its own national defense and military industrial system. Right after the Korean War, the development strategy that prioritized the development of heavy industries was accepted as the guiding principle for the first Five-Year Plan (1953-1957)<sup>41</sup>.

However, developing heavy industries had the following disadvantages: the construction period was long<sup>42</sup>; large amount of equipments had to be imported (especially the key equipments in the early period); the lump-sum investment was huge. These features were in exact conflict with Chinese endowment structure at the time. At that time, China had severe scarcity in capital<sup>43</sup>, limited export (so the amount of

---

<sup>39</sup> Hoffman (1958) proposed to distinguish the industrialization level according to the ratio between light and heavy industry. He discovered that in countries with higher industrialization level, the heavy industries had a higher ratio in the economy.

<sup>40</sup> Before the implementation of its economic plans that prioritized the development of heavy industry, in the Soviet Union, agricultural production constitutes a major part of its economy, which was similar in China. It was believed that through its own accumulation, it was difficult for the Soviet Union to accelerate its capital formation. Because of this, some Soviet economists constructed economic growth models where heavy industries could form a close circulation. See Domar, 1983; Jones, 1976.

<sup>41</sup> The development of heavy industry was the focus of the first Five-Year Plan (CPCCC, 1955, pp.160-161). The first Five-Year Plan was built around the heavy industry projects supported by the Soviet Union. The infrastructure investment in heavy industry accounted for 85% of the total industrial investment, and 72.9% of the total infrastructure investment in both agriculture and industry (NBSC, 1992, p.158).

<sup>42</sup> The construction period of light industry projects usually need 1-2 years, whereas that for heavy industries is generally longer. For instance, construction period of metallurgical plant on average took 7 years, chemical plant 5-6 years, machine tool plant 3-4 year. See Li and Zheng, 1989, p.170.

<sup>43</sup> Right after 1949, China was still a backward agricultural country. Agriculture still comprised 58.6% of its GDP (Maddison, 1998, p.56). In 1952, its per capita income was only RMB¥ 104. Even based on the official exchange at the time (US\$ 1 = RMB¥ 2.23), it was still less than US\$ 50. Capital was in extreme scarcity. In the early 1950s, the market annual interest rate was 30% (monthly rate was 2-3%). Under this interest rate, every RMB¥ 1 investment in heavy industry, should produce a repayment of at least RMB¥ 3.71 in 5 years and RMB¥ 13.79 in 10 years. Such a high interest rate severely impeded the development of heavy industries. See Lin, Cai and Li, 2003, p.38.

available foreign exchanges was limited)<sup>44</sup>, social funds were scarce and dispersed<sup>45</sup>. In order to overcome these difficulties, interest rate and exchange rate had to be lowered so as to reduce the cost of heavy industry investment and import. At the same time, prices of raw materials and wages had to be lowered so as to reduce the cost of heavy industry inputs and increase its rate of return and accumulation. The price of daily necessities also had to be lowered to ensure that workers in the urban areas could make a living with their suppressed wage rates<sup>46</sup>. These comprised the macro policy environment for the comparative-advantage defying (CAD) strategy that prioritized the heavy industry. These policies led to shortage for capital, foreign exchange, raw materials and daily necessities<sup>47</sup>. In order to insure that resources could effectively flow into the prioritized heavy industries, the government monopolized the supply of resources and distributed them through administrative planning. It also transformed private enterprises into state-owned, so as to prevent them from investing in light industries and affecting the implementation of CAD strategy<sup>48</sup>. Because the market allocation system was distorted in all aspects, profit could no longer be an effective criterion for the economic performance. Under information asymmetry, managers of state-owned enterprises could pursue their personal benefits at the cost of national interests and harm the development of heavy industries. In order to prevent this from happening, managers were deprived of the autonomy in all aspects, including the employment of workers, the use of profits and

---

<sup>44</sup> In 1950, export was only 1.9% of Chinese GDP, its per capita value was less than US\$12 (based on the 1990 fixed price) (Maddison, 1995, pp.38, 115, 237). To develop heavy industries in large scale requires large scale import of technologies and instruments. The limited foreign exchange gained through export could in no way meet the large demand of import.

<sup>45</sup> At the time, there were very few funds, the agricultural surplus was dispersed, but the construction of heavy industry required continuous and large amount of capital input. In 1952, the total asset in state-owned banks was only RMB¥ 11.88 billion, the balance of deposit was only RMB¥ 9.33 billion, comprised only 20.2% and 15.8% of the GDP in 1952 (Sheng and Feng, 1991, p.521).

<sup>46</sup> Rural residents could not enjoy the cheap services provided in urban areas, like the cheap consumption goods, housing, medical and educational services. In essence, these policies transformed agricultural surplus into industrial accumulation. For the implementation of low interest rate, low exchange rate, low wage rate and low price for consumption goods, please see Lin, Cai and Li, 2003, pp.41-45.

<sup>47</sup> Shortage of commodities does not only occur in the socialist countries, which is a fact acknowledged by Kornai (1986, p.12), an expert on the shortage economy of socialist countries, but in any countries with price depressions.

<sup>48</sup> These practices were not originated from the socialist doctrines of public ownership, but from the practical incentives. Even though numerous distortional macro policies were implemented to favor the development of heavy industries, the period needed to make profit was still 4-5 times longer than that of light industries (Li, 1983, p.37). Because of this, for private enterprises, investment in light industries was their optimal choice.

materials, the plan of production, the supplies of inputs, and the marketing of their products.<sup>49</sup> Because agricultural products were both daily necessities and raw materials for industrial production, the state monopolized the procurement and marketing of agricultural products<sup>50</sup>. Moreover, because agricultural products were the major source of export and therefore generated most of the foreign exchanges at the time<sup>51</sup>, the government initiated the collectivization movement in agricultural production, in order to increase its production capacity without increasing capital investment, on the one hand, the government built water conservancy projects through large-scale labor inputs; on the other hand, it increased the unit yield through the application of traditional methods like close planting, weed control, increase fertilization and so on. The collectivization also facilitated the implementation of the procurement system that government controlled the procurement and the distribution of agricultural goods (Luo, 1985)<sup>52</sup>. In order to accumulate more social surplus for the investment in heavy industry, it was necessary to have more and more agricultural surplus transferred into industrial investment. As a result, the government accelerated the pace and enlarged the scale of collectivization of agricultural sector, which finally gave birth to the huge people's communes (Lin 1990). With all these measures, the planned economic system (characterized by the trinity of macro-policy environment, resource allocation system and the micro-management institution) was established in China to promote the development of heavy industries in an agricultural economy with scarcity in capital.<sup>53</sup>

---

<sup>49</sup> The production goods and capital were rationed to enterprises according the government plans; product circulation was under state control; the profits and deficits of enterprises were included into the government financial budget; the employment of workers and the distribution of wages were all implemented according to the national plan. During the early reforms in 1978-1981, enterprises were granted part of autonomous right, which soon affected the profit turned over to the state because firms were overpaying their workers. (Lin, Cai and Li, 2003 pp. 55, 151)

<sup>50</sup> In order to maintain the low price of agricultural supplies in urban area, a planned allocation system had to be implemented in the urban areas (Lin, Cai and Li, 2003, p.51). In order to secure cheap supplies of agricultural products for urban low-price rationing, a compulsory procurement policy was imposed in the rural areas since 1952. This policy obliged peasants to sell certain quantities of their produce to the State at government-set prices (Perkins 1966, chap. 4).

<sup>51</sup> Agricultural products comprised 40% of total export in 1950's. If processed agricultural products are included, it comprised more than 60% of exports until 1970s. (Lin, 2004, p.21)

<sup>52</sup> Through the collectivization movement in agriculture, the government could more directly control the agricultural production. It also facilitated government's procurement of large amount of agricultural products at low prices.

<sup>53</sup> Many other developing countries also implemented strategies that prioritized the development of heavy industries (some explicitly stated the priority of heavy industries, some called import substitution but essentially required the development of heavy industries). These economies had similar features as in



This development strategy had mobilized resources to the largest possible extent, which was evident through the changes of industrial structure. The average annual accumulation rate was as high as 29.5% in 1952-1978. During the first Five-Year-Plan period, investment in heavy industries was 5.7 times as much as that in light industries; in 1976-1978, it increased to 8.4 times in 1953-1979, the average growth rate of heavy industries was 1.47 times that of light industries. The proportion of industry in GDP increased from 12.6% in 1949 to 46.8% in 1978. This shows that China had increased the proportion of manufacturing industries in its economy even though its per capita income was still low (Lin, Cai and Li, 2003, pp.70-77). This high ratio of manufacturing industries also contributed to China's possession of atom bomb and hydrogen bomb in the 1960s and its successful launch of man-made satellite in 1970s. In terms of mobilizing all available resources to establish and accelerate the development of heavy industries in a poor agrarian economy, Chinese planned economic system implemented after 1952 was successful.

However, such a success was only achieved at a huge cost. China was abundant in labor but scarce in capital. With this endowment structure, labor-intensive industries were consistent with its comparative advantages, and thus had a lower cost and were more competitive. The development strategy that prioritized heavy industries, on the contrary, was in conflict with Chinese comparative advantage and impaired the competitiveness of the whole economy. Moreover, because the micro-agents lacked the autonomous discretion and sufficient working incentives<sup>54</sup>, production was actually inside the production frontier. Because of this, such a development strategy in effect suppressed China's economic growth (Lin, Cai and Li, 2003, pp.79-80), and the efficiency in

---

China: such as distorted macro-policy environment, highly controlled resource allocation system and so on. This shows that the economic system in China was not necessarily unique to of socialist countries. Therefore, the analysis of Chinese development strategy and economic system has some general implications. For detailed discussion, please see Lin, Cai and Li, 2003 pp.60-67.

<sup>54</sup> Wage rate of state-owned enterprises was not based on worker's performance, but on education, age, position and other national criteria (Lin, 2004, p.21). In the people's communes, although wages were distributed according on the actual work days, because of the high supervision cost (this is because agricultural production usually involves peasants working in a large area, with long production period, and with output easily affected by various factors), the distribution in reality had to be based on egalitarianism. Because peasants were forced to join the people's communes and were deprived of the right to withdraw, their working incentives were severely dampened (Lin, 1988). Lin (1990) holds that the big decrease in the agricultural production after 1959 was closely related to such an allocation system, which initiated a debate in the American academia (See Journal of Comparative Economics, vol. 17, June, 1993).

resources allocation and production were low.<sup>55</sup> In 1952-1981, the average annual growth of total factor productivity was only 0.5% even based on the most favorable estimation, comprising only one fourth of the average of the 19 developing countries under study (World Bank, 1985a). If only the state-owned enterprises were considered, the figure became negative (World Bank, 1985b). In 1978, the per capita GNP in China was only US\$210, less than the cutoff level of low-income developing countries (US\$265)<sup>56</sup>. Most of the labor forces were held-up in the rural areas<sup>57</sup>, urbanization level was far lower than the normal level<sup>58</sup>. The economy became less and less open<sup>59</sup>. In fact, all the countries that adopted the CAD strategy were facing the similar problems: low economic growth rate, distorted economic structure, low efficiency, loss of social welfare, deterioration in the government finance, inflation and so on (Lin, Cai and Li, 2003, pp.92-95).

At the end of the World War II, the economies of Japan and the Four Little Dragons were at a similar level of other developing countries. However, they managed to maintain a rapid economic growth for several decades and became newly industrialized economies. Their economies have reached or become close to the level of developed countries. Their goals of catching-up with the developed countries had been realized. (World Bank, 1993) What makes their economic performance so much better than countries that adopted CAD strategies? Economists have proposed three classes of hypotheses: success of free market economy (World Bank, 1993; Jams Naya and Meier, 1987); success of government intervention (Johnson, 1982; Amsden, 1989; Wade, 1990);

---

<sup>55</sup> The consumption of energy and raw materials per unit of GDP in China were not only significantly higher than developed countries, but also higher than India, Korea and Brazil. So was the volume of good transported and the amount of working capital used per unit GDP in China. See World Bank, 1985a.

<sup>56</sup> World Bank (1992, p.184) estimated that Chinese per capita GNP was \$220. The US\$265 (US dollar in 1975) criterion was set up by the United Nations Industrial Development Organization (UNIDO, 1980, p.49).

<sup>57</sup> In 1952-1978, the proportion of agriculture in GNP reduced by 25 percentage points, while the proportion of agricultural labor in the total labor force reduced only 10 percentage points. Because of the strategy that prioritized the development of heavy industries, economic growth could not absorb as much agricultural laborers into non-agricultural sectors.

<sup>58</sup> In 1980, the urbanization rate in China was 19.4%, only 6.9 percentage points higher than that in 1952, which was lower than the general prediction of Chenery (1988).

<sup>59</sup> The value of foreign trade as a proportion of total value of agricultural and industrial output decreased from 8.16% in 1952-1954 to 5.89% in 1976-1978. The priority given to the development of heavy industries reduced the import of capital goods. At the same time, although the labor-intensive industries had the comparative advantages, they did not have sufficient resources for production and the export of these labor-intensive products also decreased. As a result, the total value of import and export decreased relatively and the economy became less and less open. (Lin, Cai and Li, 2003, p.83)

success of export-oriented development policy (Krueger, 1992). These hypotheses have indeed grasped different aspects of the real story. However, the most essential reason for their successes is that these economies had successfully utilized their comparative advantages at each stage of their development processes. Except for Hong Kong, these economies also adopted CAD type of import-substitution oriented policy in the first place. However, because of either small population size or scarcity of per capita resources, such a policy could not be sustained in these countries<sup>60</sup>. Because their governments soon abandoned the CAD strategy with government interventions along with government subsidies, enterprises in these economies had to act in accordance with their comparative advantages so as to increase their competitiveness. Namely, in the selection of industries and technologies, they started from the labor-intensive industries. As capital accumulated, the economic endowment structure was upgraded, and the industries were gradually upgraded to capital- and technology-intensive ones accordingly. This mode of economic development can be called as “comparative-advantage-following strategy” (CAF Strategy) (Lin 2003).

The malpractices of the CAD strategy all originated from the fact that the enterprises in the priority sectors of a CAD strategy lack the viability. Viability refers to “the ability of a normally-managed enterprise to obtain a socially-accepted level of normal profits in a free, open and competitive market, without outside subsidies or protections” (Lin, 2003). In a free, open and competitive market, the viability of a firm depends on whether its selection of technology, product and industry is consistent with the comparative advantages determined by the endowment structure in the economy. For countries with low level of economic development, the endowment structure is characterized by the relative scarcity of capital and relative abundance in labor or natural resources. Therefore, viable firms in these countries are those in labor- or natural resource-intensive industries. As the economy develops, only after the economic endowment structure have upgraded, will the enterprises in the relatively capital- or technology-intensive industries become viable (Lin, 2003). In socialist countries that

---

<sup>60</sup> As will be discussed below, because CAD strategy defies the comparative advantages to develop the heavy industry, resource requirement per unit GDP is high and the economic efficiency is low. The sustainability of such a policy depends on the relative abundance in per capita resources (the extent to which natural resources could be exploited freely) and population size (the per capita share of the waste of resources).

adopted CAD strategies, so as in other developing countries, because the government defied the comparative advantages of the economy and tried to establish capital-intensive industries, the enterprises lacked the viability<sup>61</sup>. Their investment and operation had to rely on the government's subsidies or protections through various intervention measures, such as the distortion in the relative prices, the administrative allocation of resource, the provision of direct subsidies, the favorable taxation policies, the creation of trade barriers and monopolies. Furthermore, because this lack of viability was due to the fact that these enterprises were asked to shoulder the policy burdens of the government (such as achieve the goal of "catching-up with the developed countries"), government was accountable for their losses and obliged to provide them with various subsidies. Under information asymmetry, the government could not distinguish losses due to policy burdens from those due to mal-management. Because of this, these enterprises had the incentives to ask for more protections and subsidies, which then led to the rent-seeking activities and soft-budget problems<sup>62</sup> (Lin and Tan, 1999). At the same time, enterprises in labor-intensive industries that were competitive in both domestic and international market could not fully develop because they could not get sufficient capital and other resources, even though they were in sectors consistent with the comparative advantages determined by the economy's endowment structure. The implementation of this CAD strategy led to low economic efficiency and slow economic growth.

The only way for a developing country to catch up with developed countries in terms of industrial structure and per capita income is to upgrade its endowment structure and narrow the gap in this respect. Because it is difficult to change the endowment structure of natural resources and because the growth rate of labor force does not differ significantly from country to country, the upgrade of endowment structure mainly lies in the speed of capital accumulation, which depends on the surplus and accumulation rate of the economy in every production period. When economic development follows the comparative advantages of the economy, a normally-managed firm will select the technology, product and industry in accordance with the comparative advantages

---

<sup>61</sup> According to Heckshere-Ohlin (Ohlin, 1968) model, countries abundant in labor have comparative advantages in labor-intensive industries. Therefore, when resources are allocated by the market mechanism, it is difficult for the capital-intensive enterprise to acquire the average profit that is socially acceptable.

<sup>62</sup> Losses due to rent-seeking activities were probably larger than the losses due to inappropriate resource allocation, just as the estimation of Brazil in 1967 (Griffin, 1992, p.153).

determined by the endowment structure of the economy. Such a choice will make the firm viable in a free and competitive market. It will be able to produce at the minimum cost, earn the maximum surplus and get the highest marginal rate of return of capital. Consequently, the economy will be able to accumulate capital, upgrade its endowment structure and narrow the industrial and technological gap with the developed countries at the fastest speed.

Firm's selection of technology, product and industry depends on the relative price of the product and production factors. In order to make the enterprises follow the principle of comparative advantages in the selection, the relative price of production factors should fully reflect the relative scarcity of the factors in the endowment structure. This can only be achieved through competition of supply and demand and where all the prices are determined by the market. Therefore, a well-functioning market system is a prerequisite for the implementation of comparative-advantage-following strategy.

Based on the experiences of East Asian countries, a developing country that follows its comparative advantages in the development process has a better economic performance. Its upgrade of endowment structure is fast, so are its upgrade of industrial, product and technological structure. As the economy undergoes such changes, it is necessary that informational and coordinate services be provided to individual firms. Because the successes and failures of these upgrades in individual firms have externalities over the decision of other firms, in addition to the maintenance of social and economic order, government should provide information and coordination for firms through its industrial policies. Some taxation or financial support might be necessary to address the externality problem during the upgrade.<sup>63</sup>

Following its comparative advantages, a country will mainly import products that they do not have comparative advantages. As its resources are mainly used to develop industries with comparative advantages, its export of the corresponding product will also increase. Compared with countries that defy their comparative advantages, both its import and export will be higher and thus the economy is more open. In fact, the amount

---

<sup>63</sup> The demarcation between an industrial policy that follows comparative advantages and that defies them lies in the viability of firms that are supported by these policies. Although both policies have subsidies, the amount necessary for these subsidies differs. For the former kind of policy, subsidies is only intended to compensate externality involve, thus the amount is limited. For the latter kind, subsidies is to address the viability of firms, thus a large amount of subsidies are necessary.

of import and export is endogenously determined by the comparative advantages of the economy.

The above analysis shows that the three characteristics of the “East Asian Miracle” are actually the consequences of the fact that their economic development follows their comparative advantages. (Lin, 2003)

The achievement of Chinese economy since 1979 is exactly due to the shift from a CAD strategy to a CAF strategy.<sup>64</sup> In 1978, revolutionaries like Deng Xiaoping, Chen Yun and others, who were sidelined during the Cultural Revolution, regained leadership after the defeat of the “Gang of Four”. They initiated the reform so as to accelerate economic development and improve people’s living standards. At the beginning, there was no well-defined blueprint for the reform (Perkins, 1988, p.601). The reform started from the micro-level and took a gradual approach through the introduction of a dual-track system (McKinnon, 1995).

At that time, the immediate and observable reason for the poor economic performance was the lack of autonomy in micro-management units and the resultant inadequate working incentives among workers and peasants. Because of this, the reform started from micro-management. It was intended to improve the economic performance by increasing the autonomy of micro-agents and therefore increase their working incentives. The most important change in the micro-management system was the replacement of collective farming with a household-based system in rural areas, now known as the household responsibility system. This household responsibility system granted the peasants with claims over the residuals<sup>65</sup>, which provided them with great working incentives and led to huge improvement in the economic performance (Lin, 1988, 1992). In the urban areas, the reform of the state-owned enterprises was characterized by the increase in the autonomy and the introduction of profit retention, which allowed the enterprises to enjoy part of its incremental profits. Up till now, the reform of state-owned enterprises has undergone three phases. In the first phase (1979-

---

<sup>64</sup> Before 1978, China had also carried out some reforms on its planned economic system. Those reforms were mainly restricted in the decentralization and recentralization of administrative authorities among different government divisions and local governments. Because they had not changed the CAD strategy, they were not successful. (Wu and Zhang, 1993, pp.65-67)

<sup>65</sup> It was commonly phrased as: “turn over an enough amount for the state procurement, retain a sufficient amount for the collective, and the rest are all one’s own”. For detailed description of its implementation, please see Xiao, 2004, p.210.

1983), the reform introduced profit retention and performance-related bonuses; and enterprises that involved in exports were allowed to retain part of their foreign exchange earnings for use at their own discretion<sup>66</sup>. In the second stage (1984-1992), the reform was mainly focused on the establishment of contract responsibility system for firms<sup>67</sup>. In 1984, state-owned enterprises were allowed to sell output in excess of quotas at negotiated prices and to plan their output accordingly, which led to the introduction of the dual-track price and resource-allocation system. In the third phase (1993-present), it privatizes small-and-medium-sized state-owned enterprises. At the same time, it tries to establish modern corporate system in large state-owned-enterprises, some of which have been listed on the domestic and/or international capital markets<sup>68</sup>. During the process, government intervention has been gradually reduced and autonomous right of enterprises has been gradually increased.

The reform in the micro-management has greatly improved the economic efficiency. In 1978-1984, Chinese agricultural production experienced an unprecedented high annual growth rate of 7.7%, almost half of which were due to the increased working incentives brought about by the household responsibility system (Fan 1997; Huang and Rozelle 1994; Wen 1993; Lin 1992; McMillan, et al. 1980)<sup>69</sup>. Meanwhile, the productivity of state-owned enterprises also improved significantly (Chen et al. 1988; Gordon and Li 1989; Dollar 1990; Jefferson et al. 1992; Groves et al. 1994; Li 1997)<sup>70</sup>. These reforms in the micro-management improved the production efficiency and created large amount of new resources. Because these measures increased the total amount of available resources (just like increasing the size of a cake), they facilitated economic growth and further reforms.

---

<sup>66</sup> However, because of the distortion in macro-policy environment, the problem of soft-budget constraint still existed. The increase in the autonomy led to activities that sacrificed state interests, such as understatement of outputs, failure to achieve the planned production target and excessive distribution of bonuses. (Lin, Cai and Li, 2003, p.151)

<sup>67</sup> This was related to the thriving of town-and-village enterprises. In order to compete for the scarce resources, it was necessary that state plans be reduced and state-owned-enterprises be given more autonomy so as to make a better use of comparative advantages.

<sup>68</sup> The modern corporate system is characterized by: “clear definition of property rights, unequivocal specification of authorities and responsibilities, separation of government and enterprises, and scientific management”. See Xiao, 2004, p.288.

<sup>69</sup> Similar improvement in economic performance was also observed in the agricultural reform in Vietnam. See Pingali and Xuan, 1992.

<sup>70</sup> Similar improvement in economic performance was also observed in the reform of state-owned enterprises in Vietnam. See Sun, 1997, pp.3-4.

In urban areas, because state-owned enterprises were allowed to produce and sell their product in excess of quotas so as to acquire more profits, additional resources had to be allocated to the enterprises outside the planned channels. This forced the government to gradually relax its control over the resource allocation process, such as in the supply of goods and materials and in the sales of various products. This gradually reduced the planned track of resource allocation and enlarged the market track. The proportion of market allocated resources gradually increased. In rural areas, the implementation of household responsibility system created large amount of new economic surpluses. At the same time, the relaxing state control over resource allocation provided non-state-owned enterprises with access to raw materials and gave them great market opportunities. All these facilitated the development of town-and-village enterprises and other non-state-owned enterprises. The investment of these non-state-owned enterprises was mainly focused on labor-intensive industries that had been constantly suppressed under traditional development strategy. Because the products of these industries were in short supply and had high rate of return, these enterprises (especially the town-and-village enterprises) quickly thrived. In 1981-1991, the number of non-state-owned enterprises and their employment increased at an average annual rate of 26.6% and 11.2% respectively. In the same period, their output value increased at an average annual rate of 29.6%, which was 3 times that of state-owned enterprises. Its proportion in the total value of industrial goods increased rapidly from 7.2% in 1978 to 38.1% in 1993 (NBSC, 1995, p.73). This was regarded by some economists as the most remarkable achievement since the adoption of reform and open-up policy (Sun, 1997).

Because the non-state-owned enterprises were not part of the traditional economic system, they could neither obtain resources from nor sell their product through the planned track. They had to act competitively through the market track, which hardened their budget constraints and made their economic performance dependent on the management of the firm. Because of these, their productivity was higher than the state-owned enterprises (Weitzman and Xu 1995; Sun 1997). Faced with this great competition pressure from non-state-owned enterprises, the state-owned enterprises were granted more autonomy. The government was forced to learn from the non-state-owned enterprises and reform the state-owned enterprises. At the same time, it was also forced to



reduce price-distortional administrative measures that were intended to increase the profit of state-owned enterprises (Jefferson and Rawski 1995). These reform measures improved the productivity in state-owned enterprises (Li 1997). In this sense, the growth of non-state-owned enterprises contributed to the growth of the market outside the planned-track and gradually pushed the state-owned enterprises to the market. Moreover, because they had to select technology, product and technology according to market prices, which reflected the relative scarcity of production factors, most of the non-state-owned enterprises operated in the labor-intensive industries<sup>71</sup>. This partly corrected the imbalanced economic structure and partly improved the low efficiency in resource allocation (Lin, Cai and Li, 2003, pp.184-196). Consequently, the improvement in micro-management pushed forward the reform in resource allocation system, so as to satiate the need to invest newly created resources to labor-intensive industries, which were consistent with Chinese comparative advantages and had higher rate of returns. As a result, the proportion of resources allocated through the planned track gradually diminished, while that for the market-track increased. The reform was pushed further from micro-management to the resource allocation system.

Resource allocated outside the planned track was priced by market; those allocated through the planned track was priced by the government. This gave rise to the emergence of double-track price system. This system provided state-owned enterprises with marginal incentives through relatively higher market price. At the same time, it provided protection and subsidies for non-viable state-owned enterprises through relatively cheaper resources that were allocated through the planned track. In this way, it was hoped that the state-owned enterprises could continue to help realizing the government goal of “catching-up with the developed countries”. One advantage of such a double-track system was to avoid large-scale bankruptcy of non-viable enterprises in capital- and/or technological-intensive industries. This helped to maintain the stability of the economy. At the same time, this double-track system provided room for the development of viable enterprises in labor-intensive industries that were consistent with China’s comparative advantages. This helped to invigorate the economy.

---

<sup>71</sup> Take 1986 as an example, the average investment per employee in industrial enterprises was RMB¥ 7,510 (CIESM, 1987, p.3), while that for the town-and-village enterprises was only RMB¥ 1,709 (NBSC, 1987, p.205).

At the beginning, the prices of the two tracks differed a lot. But as time went by, the difference was gradually reduced and the convergence of the two prices created favorable conditions for the final convergence of the two tracks. In the process, the following factors contributed to the price convergence and the growing market track: government adjusted planned-prices according to the market-price level, the rapid growth of non-state-owned enterprises and the increasing state-owned enterprises' production in excess of state quotas. By 1996, prices of most commodities and services were completely determined by the market (SPCPAB, 1997). The reform in exchange rate follows the similar track: at first, there was only the suppressed official exchange rate to reduce the cost of developing heavy industries; then there was the coexistence of the official rate and the "internal settlement rate" which was designed to encourage enterprises to export and earn foreign exchanges; then government lowered the official rate gradually and established a foreign exchange swap centre<sup>72</sup>; finally the double-track in the foreign exchange rate was converged to the market track and foreign exchange rate began to have a managed floating system<sup>73</sup>.

The reform in the interest rate was the slowest among all these reforms. Although it has been adjusted several times, it is still controlled by the government instead of the market. This phenomenon not only reflects the need of those nonviable state-owned enterprises in capital- and/or technology-intensive industries, but also reflects the fact the government has not fully abandoned the CAD development strategy. Low interest rate leads to excess demand for capital. After delegation of credit approval authority to local banks, local governments, various government divisions and all enterprises began to compete for the loans for investment, so as to expand production. This then led to excess demand for energy, raw materials, transportation and other infrastructure sectors. A 'bottle-neck' of development was thus formed. At the same time, because demand of credit exceeded the planned supply, money was issued to make up for the balance, which

---

<sup>72</sup> By the end of 1980s, over 80% of the foreign exchanges were swapped in this system. See Sung 1994.

<sup>73</sup> Vietnam and Laos adopted a similar dual-track system to reform their price and foreign exchange system. They almost completely relaxed government control in these two areas in 1989 and 1988 respectively. This was considered as evidence for the shock therapy (Sachs and Woo 1997; Popov 1997). However, because Vietnam had not completely abolished its trading barriers, nor had it started privatization, its relaxation of price control in 1989 can only be regarded as partial reform instead of shock therapy.

then led to inflation<sup>74</sup>. In order to tackle inflation, the government had to use the administrative measures to strictly control the investment and the size of credit supply. As a result, the central government withdrew some of the delegated authorities. Such a retrenchment led to a return to the planned economy. As state control tightened, non-state-owned enterprises were affected more severely than the state-owned enterprises. Even though they enjoyed comparative advantages, they could not acquire key economic resources like credit, energy and raw materials because they were excluded from the planned track. Consequently, the economic growth rate fell down dramatically. Because the state-owned enterprises were in conflict with China's comparative advantages and lacked viability, their poor economic performance could not generate enough profit, the state finance became more and more dependent on the non-state-owned sector who was much more efficient (Lin, Cai and Li, 2003, p.199). As non-state-owned sector was badly hurt by the retrenchment, the state budget became inadequate. At the same time, the centralization of the delegated authorities was resisted by agents at the micro-management level. In face of all these problems, the government had to re-delegate authorities again and relax its control over credit and investment. Following the same logic, a new round of economic cycle began. This shows that the economic cycles since the adoption of reform and open-up policy are intrinsically different from those in developed countries. The economic cycles in China originates from the inconsistency between its macro-policy environment and its micro-management and resource allocation system. The immediate cause is the government control over interest rate<sup>75</sup>. Because of this government control over interest rate and other administrative measures left over

---

<sup>74</sup> Through rent-seeking activities, non-state-owned enterprises obtained the credit intended for the state-owned enterprises. Because government wanted to sustain the development of state-owned enterprises, it had to increase the money supply to make up for the credit. This is called "endogenous inflation". This is also the cause for all the inflations in China since 1978. (Lin 2003, p.242)

<sup>75</sup> This is also the source for corruption-related rent-seeking activities. The dual-track price system made the price difference between two tracks a target for rent-seeking activities. From 1987 to 1988, the rent reached RMB¥ 2,000 billion and RMB¥ 3,500 billion respectively, which accounted for 20%-25% of the GNP (Hu, 1989). In 1992, the rent for the difference in interest rates alone reached RMB¥ 2,200 billion (Hu, 1994). Because of these corruption-related rent-seeking activities, state-owned enterprises could not get the low-priced resources from the planned track, which aroused wide-spread social discontent. In 1986 and 1988, the government tried to regain its control over the resource allocation system. The measures severely damaged the development of non-state-owned sectors. For the same reason mentioned above, the government had to abandon such efforts soon after.

from the planned economy, rent-seeking activities were rampant and income disparities aggravated.

Since all the distortional measures were intended to service the nonviable state-owned enterprises, in order to eradicate government control over interest rate and other administrative interventions, the viability of state-owned enterprises has to be enhanced<sup>76</sup>. The existence of information asymmetry blurred the distinction between losses due to government policy burdens and the losses due to mal-management. This gave rise to the moral hazard problem that firms would report all the losses as incurred by the government policies and let government bear all the loss, thus created the soft-budget-constraint for state-owned enterprises. (Lin, Cai and Li, 1998 and 2001; Lin and Tan, 1999) This further dampened the firm's incentives to improve its management, encouraged opportunist activities, and led to the governance problem. If privatization were implemented before the firms were relieved from government policy burdens, government subsidies would be embezzled directly with the lack of supervision. It would also encourage firms to seek for more subsidies. Because of their strategic importance and the concern for dramatic increase in unemployment in case of their bankruptcy, the government had to continue its protection and subsidies for these firms. Consequently, government subsidies would increase rather than decrease. After large-scale privatization, government revenue would decrease while its subsidies would increase. This would lead to high government deficit, which would then result in increase in money supply and inflation (McKinnon 1995). In fact, this was exactly what happened in the former Soviet Union and the East European countries.<sup>77</sup>

Under traditional planned economic system, the state-owned enterprises lacked viability because they shouldered the responsibilities assigned by the government, that is,

---

<sup>76</sup> The shock therapy considers the rapid privatization as a prerequisite for reform (Sachs and Lipton, 1990; Sachs, 1992), and a prerequisite for the restructure of state-owned enterprises (Blanchard et al, 1991). The empirical studies on the East European countries and the former Soviet Union show that the performance of enterprises does not solely depend on the arrangement of property rights. It also depends on the incentive structure and the market competition. State-owned enterprises can also achieve high efficiency (see Pinto et al, 1993; Sereghyova, 1993; Brada et al., 1994 and 1997; Mencinger, 1996; Frydman et al., 1996; Jones, 1997).

<sup>77</sup> After large-scale privatization in Russia, although the direct subsidies decreased, there were still numerous indirect subsidies. Even in Poland, default in tax payment was still as before (World Bank, 1996, p.45). After the privatization of state-owned properties, various government regulations, protection and subsidies were still in practice (see Brada, 1996; Frydman et al. 1996; Lavigne, 1995; Stark, 1996; Sun, 1997). For description on inflation, please see World Bank 2002; Lin, Cai and Li, 2003, pp.4-7.

to catch up with the developed countries. Before these state-owned enterprises are transformed into viable firms, the implementation of shock therapy<sup>78</sup> and the maintenance of macro-economic stability will be in irreconcilable conflict<sup>79</sup>. The big-bang approach suggests that all price distortions and market interventions should be abolished at once along with a rapid privatization in large-scale; while at the same time, it hopes that social stability could be maintained in the process. This approach is doomed to failure<sup>80</sup>. The transformation of nonviable state-owned enterprises to viable enterprises is the key in the transition from planned economy to market economy. Its resolution requires that the elimination of their policy burdens (Lin, Cai and Li, 1998 and 2001). When firms have no policy burdens, it will be unnecessary for the government to maintain low-interest policy loans, favorable taxation treatment and financial subsidies, because it is no longer responsible for the losses of the firms. Then the market determination of interest rate and the commercialization of banks will become feasible (Lin, 2000); and so will the coordination between the macro-policy environment and the micro-management and resource allocation system.

In retrospect, Chinese reform has proceeded gradually through trials and errors along the way, which is best described by a Chinese saying: “to cross a river by groping the stones”. Because the trinity of the traditional planned economic system originates from the CAD strategy that prioritized the heavy industry, although Chinese gradual approach of reform has no well-defined blueprint, its transition process has followed an intrinsic logical process. The reform started from the micro-management system which, under the traditional system, deprived micro-agents of all autonomy and resulted in poor

---

<sup>78</sup> Macro-stability, liberation of price, and rapid and large-scale privatization were considered to be the prerequisite of a successful transition from a planned economy to market economy. See Gomulka, 1989; Lipton and Sachs, 1990; Kahn and Richardson, 1991; Blanchard et al, 1991.

<sup>79</sup> As discussed above, because of the state-owned enterprises are nonviable, privatization and price liberalization will inevitably lead to deterioration in government revenue and high inflation. It is impossible to maintain macro-stability at the same time. Moreover, rapid and large-scale privatization was impractical, because of the capital immobility in heavy industries (Brada and King 1991). The retraining of workers and the establishment of new market system also takes time and resources (Lin, 1989; Murrell and Wang, 1993). The World Bank studies show that privatization usually takes several years to complete; the establishment of legal and financial system takes even longer. Therefore, even the shock therapy is a gradual process. (See Lavigne, 1995, Chapter 10; World Bank, 1996 and 2002)

<sup>80</sup> The countries that adopted shock therapy all experienced output decrease, high inflation and deteriorating social conditions (World Bank, 2002). Although the collapse of the Warsaw Treaty Organization exacerbated the decrease in production, the shock therapy was still doubtlessly the chief criminal (Brada and King, 1991; Csaki, 1994).

economic performance. Such reforms rapidly improved the economic efficiency and increased economic resources available. In order to encourage the micro-agents to invest resources into traditionally suppressed sectors that followed Chinese comparative advantages, the existence of market allocation system and market price outside the traditional planned economic system was necessary. The introduction of the market system further improved the allocation efficiency. As more and more resources were allocated through the market system, the planned-track price and allocation system finally converged to the market track. Therefore, this gradual approach is logically inherent and irreversible. It also makes it possible to bridge a chasm in two steps<sup>81</sup>. The consequent improvement in the micro-management and the increased new resources benefited most of the population. Without large-scale privatization, Chinese reform avoided the social conflict due to the reallocation of the existing stock of resources. Therefore, it is closer to the Pareto improvement (Lin, Cai and Li, 2003, p.327). The shock therapy based on neo-classical economics neglected the key issue that the state-owned enterprise lack viability, and thus encountered great difficulties in real practice (Lin 2005). On the contrary, the gradual approach can successfully address this issue: as managerial discretion and market competition pressure increases, the efficiency of the state-owned enterprises improves.

With the maintenance of planned allocation of resources, government can continue its provision of low-price resources to state-owned enterprises, so as to avoid the economic collapse and social turbulence. The rapid development of non-state-owned sector that follows the comparative advantages of the economy gradually reduces the opportunity cost of reforms in the state-owned enterprises. It not only facilitates the reform in state-owned enterprises but also provides further impetus for such a reform. Because of this, even though the gradual reform in China had not been highly regarded at first<sup>82</sup>, it has proved its effectiveness through the practice<sup>83</sup>. Its success has wider

---

<sup>81</sup> During the transition from planned economic system to comparative-advantage-following market economic system, because the extent and degree of distortion were large and severe, the direct reform of macro-policy environment and the attempt to achieve the goal in one stroke in the Soviet Union and the East European countries were doomed to failure. However, the dual-track system also has to pay the cost of rent-seeking activities. (Lin, Cai and Li, 1996)

<sup>82</sup> The gradual reform in China was believed to be intrinsically flawed, while the shock therapy was considered to be theoretically perfect and practically feasible (Sachs, 1993).

<sup>83</sup> The success convinced many economists that Chinese gradual reform is better than the shock therapy (see Singh 1991; Murrell, 1991 and 1992; Chen et al, 1992; Harrold, 1992; McMillan and Naughton, 1992; Perkins, 1992; McKinnon, 1994; Rana, 1995; Rawski, 1995; Jefferson and Rawski, 1995). If the cost of

implications to other countries as well. Because countries that adopted CAD strategy established the planned economic system following the same logic, they were faced with the same problems like distorted economic structure and poor performance of micro-management (Brada and King, 1991; Newbery, 1993; Sachs and Woo, 1994). This makes Chinese gradual approach to reform a good reference for these countries.<sup>84</sup>

However, although the gradual reform through the dual-track system has created the Chinese miraculous economic growth in the past 20 years, its large state-owned enterprises still lack the viability in the market competition. Because this viability problem has not been completely resolved, the reforms in macro-policy environment, especially that on interest rate, are still lagged behind. The conflict between this macro-policy environment and the micro-management and resource allocation system is still a major source of various economic and social problems such as economic fluctuation and rent-seeking activities. Therefore, in order to completely transform the nonviable state-owned enterprises into viable enterprises, Chinese government has to completely abandon its CAD strategy that prioritizes the heavy industry. Only in this way, will China be able to maintain its growth through the rapid development of sectors that are consistent with its comparative advantages. And only in this way, will China be able to carry out the gradual reform according to its own logic and accomplish its historic transition from planned economy to market economy.

#### **IV. Summary and Future Prospect of Chinese Economy**

In this paper, I have provided a brief overview of China's economic performance since Sung dynasty. The experience in the past millennium shows that continuous upgrade of technology is the key to a sustainable long-term economic growth. China's outstanding performance over the West in the pre-modern times was due to the

---

institutional changes and path dependence are considered, the gradual approach of Chinese reform is superior to the shock therapy both theoretically and empirically (Wei, 1993).

<sup>84</sup> Some economists attributed Chinese success in reform to its particular initial conditions: such as the huge agricultural population, the relatively small amount of subsidies, the relatively scattered economic system, large amount of oversea Chinese and so on (see Woo, 1993; Balcerowicz, 1994; Qian and Xu, 1993; Sachs and Woo, 1994 and 1997). Some economists regarded Chinese success in economic transition as a challenge to traditional economic theory (see Chow, 1997; Perkins, 2002). It is true that these particular conditions have contributed to the Chinese success, and every country should fully consider and utilize its particular conditions before and during its reform. However, the similarities in economic systems and difficulties make Chinese reform an important reference for other transitional economies.

advantages of large population in the era of experience-based technology inventions. The scientific revolution in the 15<sup>th</sup> century made it possible for the West to replace the experience-based technology inventions with a science-cum-experiment based inventions and ignited the industrial revolution in the 18<sup>th</sup> century. The incentive system embedded in the civil-service examination system in the pre-modern times made Chinese talents focusing on Confucian classics, prevented them from accumulating human capital in other areas and thus deprived China the opportunity of indigenous scientific and industrial revolutions. Because of these, after the industrial revolution when the speed of technological upgrade was accelerated, China was quickly lagged behind by the West.

In the modern times before 1978, as a less-developed economy, China could have utilized such advantages in its technological innovations if it had followed the comparative advantages in its industrial and technological selections. According to this comparative-advantage-following strategy, China would have learned the mature technologies from the developed countries, which could have enabled China to upgrade its technology at a lower cost and at a lower risk. However, like many other socialist and developing countries, after the World War II, China adopted a heavy-industry-oriented development strategy which defied China's comparative advantages. Because firms in these prioritized sectors were inconsistent with the comparative advantages of the economy, they were non-viable and had to rely on government subsidies, protections and other distortional and interventional measures. With this strategy, China was able to establish its own modern heavy industries. However, this was only achieved at the cost of economic inefficiency and the stagnant of low living standards of its people.

In 1979, China started its gradual transition from planned to market economy through a dual-track system. This approach led to a miraculous economic growth in the past 27 years. Since the per capita income in China was only US\$ 1,730 in 2005, there is still a large gap between China and the developed countries. Will China be able to maintain a dynamic growth in the coming decades? This is an important question not only for its own people but for the people of other countries as well. In 2005, its trade dependent ratio (that is, the export and import as a percentage of GDP) reached 64.1%. If China is able to maintain its growth, other countries will also benefit, due to the openness of Chinese economy and its large size.



If it is able to complete its transition to a market economy and continue to tap into the growth potential of “the advantage of backwardness”, it is very likely that China will maintain a dynamic GDP growth rate for several more decades. As argued, continuous technological innovation is the most important determinant of long-term economic growth. As a developing country, China’s technological level lags far behind that of developed countries. Therefore, it can adapt technological know-how’s from advanced countries at a lower cost and acquire the technological innovations necessary for its economic development. Because Japan and the four East Asian Tigers had effectively exploited their advantage of backwardness in technology after World War II, they were able to achieve the dynamic growth for about 40 years.

From all major indicators, the stage of China’s development today is very similar to that of Japan in the early 1960s.<sup>85</sup> China should have as large a growth potential as that of Japan in the early 1960s. If China realizes this potential, it will become the largest economy in the world in the early 21st century as predicted by Maddison in his preface to the Chinese edition of *the World Economy: A Millennial Perspective*. China will be the first major civilization to go from the zenith to nadir and then recover from it.

However, in order to bring this potential into full play, China needs to complete its transition from a planned economy to a market economy. China should also follow a right development strategy that promotes industrial development according to China’s comparative advantages (Lin 2003). At the same time, China also needs to integrate itself into the world economy so as to facilitate the borrowing of technology. China’s entry into WTO in 2001 is a commitment to such a transition, strategy and integration.

---

<sup>85</sup> The life expectancy in China was 72 for female and 68 for male in 1998; while it was 72.9 for female and 67.7 for male in Japan in 1965. The infant mortality rate was 31 per thousand births in China in 1999 and 30.7 per thousand in Japan in 1960. The primary sector’s share in GDP was 15.9% in China in 2000 and it was 16.7% in Japan in 1969 (Kwan 2002).

## References:

1. Amsden, Alice Hoffman. *Asia's Next Giant: South Korea and Late Industrialization*. New York : Oxford University Press, 1989
2. Balazs, Stefan. Beitrage zur Wirtschaftsgeschichte der T'ang-Zeit (618-906). *Mitteilungen des Seminars fur Orientalische Sprachen zu Berlin* ; Jahrgang xxxiv. Berlin : Gedruckt in der Reichsdruckerei, 1931
3. Balcerowicz, Leszek. "Common Fallacies in the Debate on the Transition to a Market Economy". *Economic Policy*. Vol. 9, Issue 19 (1994, supplement), pp. 16-50
4. Blanchard, O., Dornbusch, R., Krugman, P., Layard, R. and Summers, L. *Reform in Eastern Europe*. Cambridge, MA: MIT Press, 1991
5. Boulding, Kenneth. "The Great Laws of Change." in Anthony M. Tang, Fred M. Wsetfield and James S. Worley, eds. *Evolution, Welfare and Time in Economics*. Lexington: S.C. Heath Lexington Books, 1976
6. Brada, Josel C. "Privatization Is Transition, Or Is It?" *Journal of Economic Perspectives*. Vol. 10, No. 2 (1996), pp. 67-86
7. Brada, Josel C. and King, Arthur E. "Sequencing Measures for the Transformation of Socialist Economies to Capitalism: Is There a J-Curve for Economic Reform?" *Research Papers Series, No. 13*. Washington, D.C.: Socialist Economies Reform Unit, World Bank, 1991
8. Brada, Josel C., King, A.E. and Ma, C.Y. "Industrial Economics of the Transition: Determinants of Enterprise Efficiency in Czechoslovakia and Hungary". *Oxford Economic Papers*. Vol. 49 (1997), pp. 104-27
9. Brada, Josel C., Singh, Inderjit and Torok, Adam. "Firms Afloat and Firms Adrift: Hungarian Industry and the Economic Transition Series". *The Microeconomics of Transition Economies*. Vol. 1, Armonk, New York: M.E. Sharpe, 1994
10. Buck, John Lossing. *Land Utilization in China: a study of 16,786 farms in 168 localities, and 38,256 farm families in twenty-two provinces in China, 1929-1933*. New York : Paragon Book Reprint Corp., c1964. First edition published by the University of Nanking, 1937
11. Cameron, Rondo E. *A Concise Economic History of the World: from Paleolithic Times to the Present*. New York: Oxford University Press, 1989
12. Chaffee, John W. *The Thorny Gate of Learning in Sung China: Social History of Examination*. Cambridge: Cambridge University Press, 1985
13. Chao, Kang. *Man and Land in Chinese History: An Economic Analysis*. Stanford: Stanford University Press, 1986
14. Chen, K., Jefferson, G. and Singh, I.J. "Lessons from China's Economic Reform". *Journal of*

*Comparative Economics*. Vol. 16, No. 2 (June, 1992), pp. 201-25

15. Chen, K., Wang, H., Zheng, Y., Jefferson, G., and Rawski, T. "Productivity Change in Chinese Industry: 1953-1985". *Journal of Comparative Economics*. Vol. 12, No. 4 (December 1988), pp. 570-591

16. Chenery, Hollis B. et al. *Patterns of Development, 1950-1970*. Beijing: Economic Science Press, 1988.

17. Chow, Gregory C. "Challenges of China's Economic System for Economic Theory". *American Economic Review*. Vol. 87, No. 2 (May 1997), pp. 321-7

18. Cipolla, Carlo M. *Before the Industrial Revolution: European Society and Economy, 1000-1700*. Third edition. London: Routledge, 1993

19. CPC Central Committee, Documentation and Research Office. *Documents of the Second Session of the First National People's Congress of the PRC*. Beijing: People's Press, 1955

20. Csaki, Csaba. "Where is Agriculture Heading in Central and Eastern Europe? Emerging Markets and New Role for the Government". *Presidential Address to the XXII International Congress of Agricultural Economists*. Harare, Zimbabwe, August 22-28, 1994

21. Dollar, D. "Economic Reforms and Allocation Efficiency in China's State-Owned Industry". *Economic Development and Cultural Change*. Vol. 39, No. 1 (October 1990), pp. 89-105

22. Domar, E.D. "The Growth Model of the Soviet", in *Essays on the Theory of Economic Growth*. Chapter 9. Beijing: Commercial Press, 1983

23. Eberhard, Wolfram. "Data on the Structure of the Chinese City in the Pre-Industrial Period." *Economic Development and Cultural Change*. vol.5, October 1956

24. Elvin, Mark. *The Pattern of the Chinese Past*. Stanford: Stanford University Press, 1973

25. Evenson, Robert E. and Yoav Kislev. *Agricultural Research and Productivity*. New Haven: Yale University Press, 1975

26. Fan, Shenggen. "Effects of Technological Change and Institutional Reform on Production Growth in Chinese Agriculture". *American Journal of Agricultural Economics*. Vol. 73, No. 2 (May 1991), pp. 265-75

27. Feuerwerker, Albert. "Chinese Economic History in Comparative Perspective." in Paul S. Ropp, ed. *Heritage of China: Contemporary Perspectives on Chinese Civilization*. Berkeley: California University Press, 1990

28. Frydman, Roman, Gary, Cheryl W., and Rapaczynski, Andrzej eds. *Corporate Governance in Central Europe and Russia. Vol. 2: Insiders and the State*. Budapest: Central European University Press, 1996

29. Gernet, Jacques. *A History of Chinese Civilization*. New York : Cambridge University Press, 1982

30. Goldsmith, Raymond William. "An Estimate of the Size and Structure of the National Product of the Roman Empire." *Review of Income and Wealth*, September 1984

31. Gomulka, Stanislaw. "Shock Needed for Polish Economy". *Guardian*. No. 19 (August 1989), pp. 5
32. Gordon, R. and Li, Wei. "Chinese Enterprise Behavior Under the Reforms". *American Economic Review: Papers and Proceedings*. Vol. 81, No. 2 (May 1991), pp. 202-06
33. Griffin, Keith. *The Alternative Strategies for Economic Development*. Beijing: Economic Science Press, 1992
34. Groves, T., Hong, Y., McMillan, J., and Naughton, B. "Autonomy and Incentives in Chinese State Enterprises". *Quarterly Journal of Economics*. Vol. 109, No. 1 (February 1994), pp. 183-209
35. Haggard, S. "The Politics of Industrialization in the Republic of Korea and Taiwan". Hughes, Helen. Ed. *Achieving Industrialization in Asia*. Cambridge: Cambridge University Press, 1988
36. Harrold, Peter. "China's Reform Experience to Date". *World Bank Discussion Paper, 180*. Washington D.C.: the World Bank, 1992
37. Hartwell, Ronald Max, "A Cycle of Economic Change in Imperial China: Coal and Iron in Northern China, 750-1350", *Journal of the Economic and Social History of the Orient*, vol. X, leiden, 1967
38. Hartwell, Ronald Max, "A Revolution in the Chinese Iron and Coal Industries During the Northern Sung, 960-1126 AD", *Journal of Asian Studies*, February 1962
39. Hartwell, Ronald Max, "Markets, Technology and the Structure of Enterprise in the Development of the Eleventh Century Chinese Iron and Steel Industry", *Journal of Economic History*, March 1966
40. Hicks, John Richard. *The Theory of Wages*. London: Macmillan, 1932
41. Ho, Ping-ti. *Huangtu yu zhongguo nongye de qiyuan* (Loess and the origin of Chinese Agriculture). Hong Kong: Chinese University Press, 1969
42. Ho, Ping-ti. *The Ladder of Success in Imperial China: Aspects of Social Mobility, 1368-1911*. New York: Columbia University Press, 1962
43. Hoffman, Walter. *Growth of Industrial Economics*. Manchester: Manchester University Press, 1958
44. Hu Heli. "Three Measures for a Clean Government". *Corruption: Trading of Power for Money*. Beijing: China Outlook Press, 1989, pp. 36-43
45. Hu Shuli. "1994: Reforms Have No Romantic Melody", *Gaige (Reform)*, No. 1 (January 1994)
46. Huang, J. and Rozelle, S. "Technological Change: The Re-Discovery of the Engine of Productivity Growth in China's Rural Economy". *Journal of Development Economics*. Vol. 49, No. 2, (May 1996), pp. 337-69
47. Huang, Ray. *1587, A Year of No Significance: The Ming Dynasty in Decline*. New Haven: Yale University Press, 1981
48. James, Legge. ed. and tr. *The Chinese Classics: with a Translation, Critical and Exegetical Notes, Prolegomena, and Copious Indexes*. vol. 2. The Works of Mencius. Hong Kong : Hong Kong

University Press, c1960

49. James, William E., Naya, Seiji and Meier, Gerald M. *Asian Development: Economic Success and Policy Lessons*. San Francisco: ICS Press, 1987
50. Jefferson, G., and Rawski, T. "How Industrial Reform Worked in China: The Role of Innovation, Competition, and Property Rights". *Proceedings of the World Bank Annual Conference on Development Economics 1994*. Washington, D.C.: World Bank, 1995, pp. 129-56
51. Jefferson, G., Rawski, T., and Zheng, Y. "Growth, Efficiency and Convergence in China's State and Collective Industry". *Economic Development and Cultural Change*. Vol. 40, No. 2 (January 1992), pp. 239-66
52. Jefferson, G., Zhao, J.X., and Lu, Mai. *Reforming Property Rights in Chinese Industry*. Waltham, MA: Department of Economics, Brandeis University, mimeo, 1995
53. Jin Yaoji. "An Explanation of the East Asian Economic Development from a Cultural Perspective". *Information Newspaper Finance and Economic Monthly*, No. 11 (1987)
54. Johnson, Chalmers A. *MITI and the Japanese Miracle: the Growth of Industrial Policy, 1925-1975*. Stanford, Calif.: Stanford University Press, 1982
55. Jones, Derek C. "The Determinants of Economic Performance in Transitional Economies: The Role of Ownership, Incentives and Restructuring". *Research for Action 39*, UNU/WIDER, 1997
56. Jones, Eric Lionel. *Growth Recurring : Economic Change in World History*. New York : Oxford University Press, 1988
57. Jones, Eric Lionel. *The European Miracle: Environments, Economies, and Geopolitics in the History of Europe and Asia*. Third edition. New York : Cambridge University Press, 2003
58. Jones, Hywel G. *An Introduction to Modern Theories of Economic Growth*. New York: McGraw-Hill, 1976.
59. Kahn, Alfred and Richardson, Thomas J. eds. *What Is To Be Done: Proposals for the Soviet Transition to the Market*. New Haven: Yale University Press, 1991
60. Kornai, Janos. "Legal Obligation, Non-Compliance and Soft Budget Constraint". Newman, Peter K. Ed. *The New Palgrave Dictionary of Economics and the Law*. London: Macmillan Reference, 1998. pp. 533-39
61. Kornai, Janos. "The Soft Budget Constraint". *Kyklos*, 1986, 39(1), pp. 3-30
62. Kornai, Janos. *Shortage Economics*. Vol. 1. Beijing: Economic Science Press, 1986
63. Kornai, Janos. *The Socialist System: the Political Economy of Communism*. Princeton, NJ: Princeton University Press, 1992
64. Krueger, Anne O. *Economic Policy Reform in Developing Countries*. Oxford : Basil Blackwell, 1992
65. Kuznets, Simon. *Modern Economic Growth: Rate Structure, and Spread*. New Haven: Yale University Press, 1966

66. Kwan, C.H. "Overcoming Japan's China Syndrome," paper presented at "Asian Economic Integration: Current Status and Future Prospects" organized by Research Institute of Economy, Trade & Industry of Japan at Tokyo on April 22-3, 2002.
67. Lavigne, Marie. *The Economics of Transition: From Socialist Economy to Market Economy*. New York: St. Martin Press, 1995
68. Li Jingwen and Zheng Youjin. Ed. *Jishujinbu yu Chanye Jiegou Xuanze* (Technological Progress and the Choice of Industrial Structure). Beijing: Science Press, 1989
69. Li Wei. "The Impact of Economic Reform on the Performance of Chinese State Enterprises, 1980-89". *Journal of Political Economy*. Vol. 105, No. 5 (1997), pp. 1080-1106
70. Li Yue. *Zhongguo Gongye Bumen Jiegou* (The Structure of Chinese Industry). Beijing: China People's University Press, 1983
71. Lin, Justin Yifu. "Viability, Economic Transition, and Reflection on Neoclassical Economics," *Kyklos*, Vol. 58, No. 2 (2005): 239-64.
72. Lin, Justin Yifu. "Collectivization and China's Agricultural Crisis in 1959-1961," *Journal of Political Economy*, Vol. 98 (December 1990): 1228-1252.
73. Lin, Justin Yifu. "An Economic Theory of Institutional Change: Induced and Imposed Change". *Cato Journal*. Vol. 9, No. 1 (Spring/Summer 1989), pp. 1-33
74. Lin, Justin Yifu. "Development Strategy, Viability and Economic Convergence". *Economic Development and Cultural Change*. Vol. 53, No. 2 (January 2003), pp. 277-308
75. Lin, Justin Yifu. "Lessons of China's Transition from a Planned Economy to a Market Economy". *Distinguished Lecture Series, No.16*. Warsaw: Leon Kozminski Academy of Entrepreneurship and Management, 2004
76. Lin, Justin Yifu. "Rural Reforms and Agricultural Growth in China". *American Economic Review*. Vol. 82, No. 1 (March 1992), pp. 34-51
77. Lin, Justin Yifu. "The Household Responsibility System in China's Agricultural Reform: A Theoretical and Empirical Study". *Economic Development and Cultural Change*. Vol. 36, No.3. (Supplement, April 1988). pp.S199-S224
78. Lin, Justin Yifu. "The Needham Puzzle: Why the Industrial Revolution did not Originate in China." *Economic Development and Cultural Change*, January 1995
79. Lin, Justin Yifu. "What is the Direction of China's Financial Reform?" Hai, Wen and Lu, Feng eds. *China: Economic Transition and Economic Policy*. Beijing: Peking University Press, 2000
80. Lin, Justin Yifu and Li Zhou. "Choice of Development Strategy is the Key to Economic Development—Perspective View of the Successes and Failures of Economic Development in Capitalist Countries after World War II". *Comparison of Economic and Social Systems*. No. 1 (1992), pp. 1-5

81. Lin, Justin Yifu and Tan Guofu. "Policy Burdens, Accountability, and the Soft Budget Constraint". *American Economic Review: Papers and Proceedings*. Vol. 89, No. 2 (May 1999), pp. 426-31
82. Lin, Justin Yifu, Cai Fang and Li Zhou. "The Lessons of China's Transition to a Market Economy". *Cato Journal*. Vol. 16, No. 2 (fall 1996). pp.201-31
83. Lin, Justin Yifu, Cai Fang, and Li Zhou. *The China Miracle: Development Strategy and Economic Reform*. Revised Edition. Hong Kong: The Chinese University Press, 2003
84. Lin, Justin Yifu, Fang Cai and Zhou Li. "Competition, Policy Burdens, and the State-owned Enterprise Reform". *American Economic Review: Papers and Proceedings*. Vol. 88, No. 2 (May 1998), pp. 422-7
85. Lin, Justin Yifu, Fang Cai and Zhou Li. *State-owned Enterprise Reform in China*. Hong Kong: the Chinese University Press, 2001
86. Lipton, David and Sachs, Jeffrey. "Privatization in Eastern Europe: The Case of Poland". *Brookings Papers on Economic Activities*. No. 2 (1990), pp. 293-341
87. Liu Hai-feng, Li Bing. *Zhongguo Keju Shi* (The History of Chinese Civil Service Examinations). Shanghai: Oriental Press Center, 2004
88. Luo Hanxian. *Economic Changes in Rural China*. Beijing: New World Press, 1985
89. Maddison, Angus. *Chinese Economic Performance in the Long Run*. Paris : OECD, 1998
90. Maddison, Angus. *Monitoring the World Economy, 1820-1992*. Paris: OECD, 1995
91. Maddison, Angus. *The World Economy: A Millennial Perspective*. Paris: OECD 2001.
92. Malinowski, Bronislaw Kaspar. *The scientific theory of culture*. Translated by Fei Hsiao-tung. Beijing: Huaxia Press, 2002
93. Mathias, Peter. "Who Unbound Prometheus? Science and Technical Change, 1600-1800." In A.E. Musson ed. *Science, Technology and Economic Growth in the Eleventh Century*. London: Methuent, 1972
94. McKinnon, Ronald I. "Taxation, Money and Credit in the Transition from Central Planning". Rana, Pradumna B. and Hamid. *From Centrally Planned to Market Economies: The Asian Approach*. Vol. 1. Hong Kong: Oxford University Press, 1995, pp. 35-72
95. McKinnon, Ronald I. "Gradual versus Rapid Liberalization in Socialist Economies: Financial Policies and Macroeconomic Stability in China and Russia Compared". *Proceedings of the World Bank Annual Conference on Developing Economics 1993*. Washington D.C.: World Bank, 1994, pp. 63-94
96. McMillan, John and Naughton, Barry. "How to Reform A Planned Economy: Lessons from China". *Oxford Review of Economic Policy*. Vol. 8, No. 1 (Spring 1992), pp. 130-143
97. McMillan, John, Whalley, J. and Zhu, L. "The Impact of China's Economic Reforms on Agricultural Productivity Growth". *Journal of Political Economy*. Vol. 97, No. 4 (August 1989), pp.

98. Mencinger, Joze. "Privatization Experiences in Slovenia". *Annals of Public and Cooperative Economics*. Vol. 67, No. 3 (September 1996)
99. Monter, William. "Forward." in Qian, Wen-yuan. *The Great Inertia: Scientific Stagnation in Traditional China*. London: Croom Helm, 1985
100. Murrell, Peter and Wang Yijiang. "When Privatization Should Be Delayed: The Effect of Communist Legacies on Organizational and Institutional Reforms". *Journal of Comparative Economics*. Vol. 17, No. 2 (June 1993), pp. 385-406
101. Murrell, Peter. "Can Neoclassical Economics underpin the Reform of Centrally Planned Economies?" *Journal of Economic Perspectives*. Vol. 5, No. 4 (1991), pp. 59-76
102. Murrell, Peter. "Evolutionary and Radical Approaches to Economic Reform". *Economic Planning*. Vol. 25 (1992), pp. 79-95
103. Musson, Albert Edward. ed. *Science, Technology and Economic Growth in the Eighth Century*. London: Methuen, 1972
104. National Bureau of Statistics of China. "The International Comparison of China's Economic and Social Development in the Tenth Five-Year Plan Period". *Retrospective Reports Series of China's Economic and Social Development in the Tenth Five-Year Plan Period*. Beijing: China Statistics Press, 2006
105. National Bureau of Statistics of China. *China Industrial Economy Statistical Material 1987*. Beijing: China Statistics Press, 1987
106. National Bureau of Statistics of China. *China Statistical Yearbook, 1992*. Beijing: China Statistics Press, 1992
107. National Bureau of Statistics of China. *China Statistical Yearbook 1987*. Beijing: China Statistics Press, 1987
108. National Bureau of Statistics of China. *China Statistical Yearbook 2005*. Beijing: China Statistics Press, 2005
109. National Bureau of Statistics of China. Urban Social and Economic Survey Team. *Zhongguo wujia tongji nianjian*, 1988 (China Price Statistical Yearbook, 1988). Beijing: China Statistical Press, 1988
110. National Bureau of Statistics of China. *Zhongguo Tongji Zhaiyao, 1995* (A Statistical Survey of China, 1995). Beijing: China Statistics Press, 1995
111. Needham, Joseph. "Introduction" in Robert K.G. Temple. *China Land of Discovery and Invention*. Wellingborough: Patrick-Stephens, 1986
112. Needham, Joseph. *Science and Civilization in China*. Volume 1. Cambridge: Cambridge University Press, 1954
113. Needham, Joseph. *Science in Traditional China: A Comparative Perspective*. Cambridge,



MA: Harvard University Press, 1981

114. Needham, Joseph. *The Grand Titration: Science and Society in East and West*. London: George Allen & Unwin, 1969

115. Ohlin, Bertil. *Interregional and International Trade*. Cambridge, MA: Harvard University Press, 1968

116. Perkins, Dwight Heald and Shahid Yusuf. *Rural Development in China* (A World Bank Publication). Baltimore: The Johns Hopkins University Press, 1984

117. Perkins, Dwight Heald. "China's 'Gradual' Approach to Market Reforms". Paper presented as a conference on "*Comparative Experiences of Economic Reforms and Post-Socialist Transformation*". El Escorial, Spain, July 6-8, 1992

118. Perkins, Dwight Heald. "Reforming China's Economic System". *Journal of Economic Literature*. Vol. 26, No. 2 (June 1988), pp. 601-45

119. Perkins, Dwight Heald. "The Challenge China's Economy Poses for Chinese Economists". *China Economic Review*. Vol. 13 (December 2002), pp. 412-8

120. Perkins, Dwight Heald. *Agricultural development in China 1368-1968*. Chicago: Aldine Pub., 1969

121. Perkins, Dwight Heald. *Market Control and Planning in Communist China*. Cambridge, MA; Harvard University Press, 1966

122. Pingali, Prabhu and Xuan, Vo-tong. "Vietnam: De-Collectivization and Rice Productivity Growth". *Economic Development and Cultural Change*. Vol. 40, No. 4 (July 1992), pp. 697-718

123. Pinto, B., Belka, M. and Krajewski, S. *Transforming State Enterprises in Poland: Microeconomic Evidence on Adjustment*. Washington, D.C.; Brookings Papers on Economic Activity, 1993, No. 1

124. Popov, Vladimir. "Hard Facts and Fancy Theories: A Fresh Look at the Transition Debate". *Wider Angle*. No. 2/96 (December 1996), pp. 1-3

125. Qian Mao-wei. *Guojia, Keju yu Shehui* (Nation, the Civil Service Examinations and Society). Beijing: Beijing Library Press, 2004

126. Qian Yingyi and Xu Chenggan. "Why China's Economic Reforms Differ: The M-Form Hierarchy and Entry/Expansion of the Non-state Sector". *The Economics of Transition*. Vol. 1, No. 2 (June 1993), pp. 135-70

127. Qian, Wen-yuan. *The Great Inertia: Scientific Stagnation in Traditional China*. London: Croom Helm, 1985

128. Rana, Pradumna. "Introduction: The Asian Approach to Reforming Transitional Economies". Rana, Pradumna B. and Hamid. *From Centrally Planned to Market Economies: The Asian Approach*. Vol. 1. Hong Kong: Oxford University Press, 1995, pp. 1-33

129. Rawski, Thomas G. "Implications of China's Reform Experience". *China Quarterly*, 1995,

pp. 1150-73

130. Riskin, Carl. "Surplus and Stagnation in Modern China." in Dwight H. Perkins ed. *China's Modern Economy in Historical Perspective*. Stanford: Stanford University Press. 1975
131. Rostow, Walt Whitman. *The Stages of Economic Growth*. Cambridge: Cambridge University Press, 1960
132. Sachs, Jeffrey D. and Lipton, David. "Poland's Economic Reform". *Foreign Affairs*. Vol. 69, No. 3 (Summer 1990), pp. 47-66
133. Sachs, Jeffrey D. and Woo, Wing Thy. "Structural Factors in the Economic Reforms of China, Eastern Europe and the Former Soviet Union". *Economic Policy*, No. 18 (April 1994), pp. 101-45
134. Sachs, Jeffrey D., and Woo, Wing Thy. "Understanding China's Economic Performance". *Manuscript*. May 1997
135. Sachs, Jeffrey. "Privatization in Russia: Some Lessons from Eastern Europe". *American Economic Review*. Vol. 82, No. 2 (May 1992), pp. 43-8
136. Sachs, Jeffrey. *Poland's Jump to the Market Economy*. Cambridge, M.A.: MIT Press, 1993
137. Schultz, Theodore W. *Transforming Traditional Agriculture*. New Haven: Yale University, 1964
138. Sereghyova, Jana. *Entrepreneurship in Central East Europe*. Heidelberg: Hpysica Verlag, 1993
139. Shen Deng-miao, Du shi-wei. Jin-shi, Wei-ke Renwu yu Rencai (Jin-shi and Its Top Elites vs. Other Specialists). *Keju Bai Nian* (A Century After the End of Civil Service Examinations). Beijing: Tong Xin Press, 2006.
140. Sheng Bin and Feng Lun. Ed. *Census Report on China*. Shenyang: Liaonin People's Press, 1991
141. Shiba, Yoshinobu. *Commerce and Society in Sung China*. Ann Arbor : University of Michigan, Center for Chinese Studies, 1970
142. Singh, I.J. "China and Central and Eastern Europe: Is There a Professional Schizophrenia on Socialist Reform". *Research Paper Series, No. 17*. Washington D.C.: Socialist Economies Reform Unit, World Bank, 1991
143. Stark, David. "Networks of Assets, Chains of Debt: Recombinant Property in Hungary". Frydman, Roman, Gary, Cheryl W., and Rapaczynski, Andrzej eds. *Corporate Governance in Central Europe and Russia. Vol. 2: Insiders and the State*. Budapest: Central European University Press, 1996
144. State Commission for the Restructuring of the Economic System. Ed. *China's Economic Restructuring Yearbook, 1992*. Beijing: Reform Press, 1992
145. State Planning Commission, Price Administration Bureau. "The Weights and Changes of Three Patterns of Prices". *Price in China*, No. 12 (1997), pp. 31-34

146. Sun Laixiang. Emergence of Unorthodox Ownership and Governance Structure in East Asia: An Alternative Transition Path. *Research for Action*, No. 38. Helsinki: UNU/WIDER, 1997
147. Sung Ying-Hsing. *T'ien-Kung K'ai-Wu* (Chinese Technology in the Seventeenth Century), published in Chinese in 1637, translated by E-tu Zen Sun and Shiou Chuan Sun. University Park, PA.: the Pennsylvania State University Press, 1966
148. Sung, Yun-wing. "An Appraisal of China's Foreign Trade Policy, 1950-1992". Srinivasan, T.N. eds. *The Comparative Experience of Agricultural and Trade Reforms in China and India*. San Francisco: International ICS Press, 1994, pp. 109-53
149. Tang, Anthony. "China's Agricultural Legacy." *Economic Development and Cultural Change*. vol.28, October 1979
150. Temple, Robert K.G. *China land of discovery and invention*. London: Multimedia, 1986
151. Twitchett, Denis Crispin. *The Cambridge History of China*. v.10, late Ching 1800-1911, pt.1. v.11, late Ching 1800-1911, pt.2. v.12, Republican China, 1912-1949, pt.1. v.13, Republican China, 1912-1949, pt.2. New York : Cambridge University Press, 1978-<2002 >
152. United Nations Industrial Development Organization. *Basics and Trends of Industrialization in World Countries and Regions*. Beijing: China Foreign Transition Publishing Co., 1980
153. Wade, Robert. *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*. Princeton, N.J.: Princeton University Press, 1990
154. Wei Shangjin. "Gradualism Versus Big Bang: Speed and Sustainability of Reform". *Working Paper Series, R93-2*. Cambridge, MA: John F. Kennedy School of Government, Harvard University, Faculty Research, 1993
155. Max Weber. "Confucian Politics in China and the Sprout of Capitalism in China: Cities and Industrial Associations". *Collected Works of Max Weber: The Historical Steps of Civilizations*, Shanghai, Shanghai Sanlian Bookstore. 1997.
156. Weber, Max *The Religion of China: Confucianism and Daoism*, Translated from the German and Edited by Hans H. Gerth with an Introduction by C.K. Yang (paperback edition; New York and London: Free Press, 1968)
157. Weitzman, Martin L., and Xu, Chenggang. "Chinese Township-Village Enterprises as Vaguely Defined Cooperatives". *Journal of Comparative Economics*. Vol. 18, No. 2 (1994), pp. 124-45
158. Wen, Guangzhong James. "Total Factor Productivity Change in China's Farming Sector: 1952-1989". *Economic Development and Cultural Change*. Vol. 42, No. 1 (October 1993), pp. 1-41
159. Woo, Wing Thy. "The Art of Reforming Centrally-Planned Economies: Comparing China, Poland and Russia". Paper presented at *the Conference of the Tradition of Centrally-Planned Economies in Pacific Asia*. San Francisco: Asia Foundation in San Francisco, May 7-8, 1993
160. Woo-Cumings, Meredith. *Race to the Swift: State and Finance in Korean Industrialization*.

New York : Columbia University Press, 1991

161. World Bank. *China: Economic Structure in International Perspective, Annex to China: Long Term Issues and Options*. Washington, D.C. : the World Bank, 1985 (a)

162. World Bank. *China: Long Term Issues and Options*. Oxford: Oxford University Press, published for the World Bank, 1985 (b)

163. World Bank. *The East Asian Miracle: Economic Growth and Public Policy*. New York: Oxford University Press, 1993

164. World Bank. *Transition: the First Ten Years, Analysis and Lessons for Eastern Europe and the Former Soviet Union*. Washington D.C.: the World Bank, 2002

165. World Bank. *World Development Report, 1996: From Plan to Market*. New York: Oxford University Press, 1996

166. World Bank. *World Table (1992)*. Baltimore: The Johns Hopkins University Press, 1992

167. Wu Jinglian and Zhang Zhuoyuan. Eds. *Zhongguo Jinji Jianshe Baikequanshu* (The Encyclopedia of China's Economic Construction). Beijing: Beijing Industrial University Press, 1993

168. Xiao Guoliang. Ed. *Zhonghua Renmin Gongheguo Jinji Shi* (The Economic History of the PRC). Beijing: Huawen Press, 2004

169. Young, Arthur Nichols. *China's Nation-building Effort, 1927-1937: The Financial and Economic Record*. Stanford, Calif. : Hoover Institution Press, 1971

170. Zhang, Zhongli. *Zhongguo Shenshi* (The Chinese Gentlemen). Shanghai: Press of Shanghai Academy of Social Sciences, 1991