Chapter 8
Heavy Industry: Heavy Industrialization and Its Evaluation

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Abstract This chapter inspects the heavy industrialization during the Mao era and examines its legacy to the Deng era. Heavy industrialization in the Mao era laid the foundations of heavy industry, providing favorable conditions for economic development in the reform and opening-up era. The presence of heavy industry was maintained during the Deng era. Moreover, during the Mao era, the embryonic forms of some of the reform and opening-up policies could be found in the policies related to heavy industrialization, such as the utilization of foreign plants, technology, and funds, and the exploration for a better SOE management system. On the other hand, heavy-industry-oriented development strategy during the Mao era aimed at strengthening national defense, and as a result, investment efficiency was not improved. However, the challenge of improving investment efficiency was also a difficult issue during the Deng era.

Introduction

Industrialization during the Mao era centered on heavy industry.[1]

The First Plenary Session of the Chinese People's Political Consultative Conference was held in Beijing in September 1949. The "Common Program of the Chinese People's Political Consultative Conference" was passed at this meeting as a provisional constitution, and the establishment of the People's Republic of China was declared. The Common Program stated that "systematically, and in order, we will create a foundation for China's industrialization by focusing on the recovery and development of heavy industry, such as mining, the iron and steel industry, power industry, machine-making industry, electrical industry and the main chemical industry." Thus, from its very inception, the People's Republic of China was keenly aware of the importance of heavy industry to its industrialization.

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However, in 1949 China, agriculture accounted for approximately 60% of its gross output value, whereas industry accounted for just 25%. Moreover, heavy industry only accounted for about one-quarter of the gross output value of industry (NBS, 1983). The production of electricity, crude steel, metal-cutting machine tools, and chemical fertilizers was far less than that of the United States, or even Japan which had just finished the war. For China, which at the time was an agricultural nation, it was a tremendous challenge to lay the foundations for heavy industry.

During the Mao era, China concentrated funds in heavy industry. The extreme cases are the "Great Leap Forward (*da yuejin*)" and the "Third Front Construction (*sanxian jianshe*)". Importing plants from abroad was an important means for strengthening the fragile heavy industry. Even under the "self-reliance (*zili gengsheng*)" policy (self-reliance in building the economy), as much technology was imported from overseas as possible in the form of plant imports, including the Soviet-assisted "156 Projects (*156 gongcheng*)", and the "4-3 Development Strategy (*sisan fang'an*)" that focused on the technology and equipment of advanced Western countries.

Why did China during the Mao era pursue the heavy-industry-oriented development strategy? How did China develop its heavy industry? What did the heavy industrialization leave behind for the Deng Xiaoping era of the reform and opening-up? This chapter looks back at the heavy industrialization policies of the Mao era. We also use statistical data to examine heavy industrialization during the Mao era and compare it with the Deng era.

8.1 Historical Background Behind Heavy Industrialization

Why did the Communist Party of China (CPC) regime promote heavy industrialization rapidly?

Behind China's heavy industrialization was the goal of strengthening national defense. Their relationship can be traced back to the Republic of China period. In the latter half of the 1930s, when military tensions with Japan were rising, the ROC government focused state capital on heavy industry. For instance, just before the outbreak of the Sino-Japanese War in 1937, Chiang Kai-shek announced the "China Economic Development Plan," which set national defense as the primary objective of economic development, and established the segregation of investment, with private sector investment for light industry and central government investment for heavy industry (Xu, 2010). Therefore, heavy industrialization had been a dream since the days of the Kuomintang.

In 1949, after having defeated the Kuomintang-led government in the Chinese Civil War, the CPC established the People's Republic of China. However, the Communist China was politically isolated from, economically blockaded by, and threatened with war by Western developed nations, even after the Korean War (June 1950–July 1953). Strengthening of national defense was a matter of life or death to the Mao government. For instance, in September 1953, at the enlarged 49th meeting of

the Standing Committee of the First National Committee of the Political Consultative Conference, Premier Zhou Enlai said, "The national defense industry will develop on the basis of heavy industry. We are still unable to manufacture tanks, planes, cars, tractors, or good artillery. We must further accelerate the development of heavy industry and strengthen our national defense." As this impatient statement shows, Chinese leaders recognized heavy industrialization as a prerequisite for strengthening national defense (Zhou, 1984).

For China, which was isolated from the West, the Soviet Union's experience as a socialist powerhouse capable of competing with the United States was attractive. In June 1949, in the "On the People's Democratic Dictatorship" paper commemorating the 28th anniversary of the founding of the CPC, Mao Zedong outlined his vision of the soon-to-be-established People's Republic of China and said, "We must lean to one side. The Communist Party of the Soviet Union is our best teacher and we must learn from it," and launched a policy of "leaning to the side of the Soviet Union" (Mao, 1951).

To China, the Soviet Union's socialist industrialization was to serve as a model for its economic development. The theoretical basis for socialist industrialization was the "Law of the Precedence of Production-means' Production" developed by Lenin. As discussed in Chap. 1, the "socialist industrialization debate" arose in the mid-1920s, which led Stalin to promote heavy-industry-oriented development. As can be seen from the "Common Program of the Chinese People's Political Consultative Conference" introduced at the beginning of this chapter, China also sought to achieve the development of heavy industry by concentrating investment into this industry.[2]

8.2 Development of Heavy Industry

However, China lacked the conditions for the development of heavy industry. To concentrate scarce resources such as capital into heavy industry, China—which lacked capital—planned the allocation of resources, nationalized the industrial sector, and collectivized agriculture (Lin et al., 1994).

The State Planning Commission—the headquarters of the planned economy—was established in November 1952. One of its key responsibilities was to develop Five Year Plans (FYPs) for economic development. Next, let us look at the FYPs to review the importance of heavy industry in economic planning.

8.2.1 The Five Year Plans

Four FYPs were drawn up and implemented during the leadership of Mao Zedong, who passed away in 1976.[3] These were the First FYP (1953–57), the Second FYP (1958–62), the Third FYP (1966–70), and the Fourth FYP (1971–75). The First FYP period was preceded by the economic recovery period immediately following

the Communist China's founding (1949–52), while an economic adjustment period (1963–65) was between the Second and Third FYP periods.

These four FYPs all emphasized the development of heavy industry. The First FYP stated, "The capital construction (*jiben jianshe*) for heavy industry shall be the main focus of this FYP. The objective behind adopting heavy-industry-oriented development policy is the creation of a strong national defense capability, the satisfaction of the needs of the people, and the achievement of a material foundation for the socialist transformation of the national economy," clearly indicating that national defense was an important objective for the development of heavy industry (State Planning Commission, "First Five Year Plan," passed at the Second Session of the First National People's Congress in July 1955).

The Second FYP also pursued "the building of a strong, independent, and a complete industrial system at the national level," instructed the appropriate dispersal of enterprises for "national security," and called for "bringing the production of steel and some other important industrial products close to that of the United States" (State Planning Commission, "Opinions on the Second Five Year Plan," passed by the Enlarged Meeting of the CPC Central Committee Political Bureau in August 1958).

In order to prepare for possible invasion by enemy nations, the Third FYP called for "Third Front Construction," which aimed at constructing an industrial production base centered on heavy industries, including military industry, within the Third Front area, located mainly in the southwest and northwest regions of China. It stated, "We must stand on a war footing, and actively prepare for war from the view of early and large-scale war. We must prioritize national defense construction, accelerate Third Front Construction and steadily improve the distribution of industry," "We must strengthen the development of basic industry and transportation," and "We must concentrate the nation's human, material and financial resources to steadily build the national defense industry and various industries including raw materials, processed materials, fuel, power, machinery and chemicals, as well as the transportation sector in the Third Front regions" (State Planning Commission, "Report Syllabus about the Arrangement of the Third Five Year Plan (Draft)," submitted to the Central Work Conference in September 1965).

The Fourth FYP also called for "resolutely strengthening preparations for war" and "continuing the construction of the Big Third Front (*da sanxian*) regions with an unwavering concentration of strength," to enable "the ten economic cooperation zones," which were similar to military zones, to "plan their own military strategies and undertake large-scale cooperation" and cited the goal of an "independent and fairly complete industrial system and economic system" (State Planning Commission, "Outline of the Fourth Five Year Plan (Draft)," submitted to the Second Plenary Session of the 9th CPC Central Committee in August 1970). The development of agriculture and light industry was also mentioned in connection with war preparedness and strategic rear construction, but emphasis was concentrated on the production of steel, coal, oil, natural gas, machinery, and equipment.

Figure 8.1 shows the industrial distribution of capital construction investment from 1953 to 1975. Capital construction investment, i.e. the investment for new construction, expansion, and replacement in fixed assets, is the most important form of capital investment. According to China's industrial sector classification, (1) the electric power industry, (2) coal industry, (3) petroleum industry, (4) metallurgy industry, and (5) building materials industry are all classified as heavy industry, whereas (6) the food industry, (7) textile, wearing apparel and leather industry, (8) paper, cultural and educational articles industry are classified as light industry. However, (9) the chemical industry, (10) machinery industry, (11) forestry-related industry, and (12) other industries contain both heavy and light industries. In terms of gross output value, the majority of chemical, machinery, and forestry-related industries belong to heavy industry, whereas most of other industries belong to light industry.

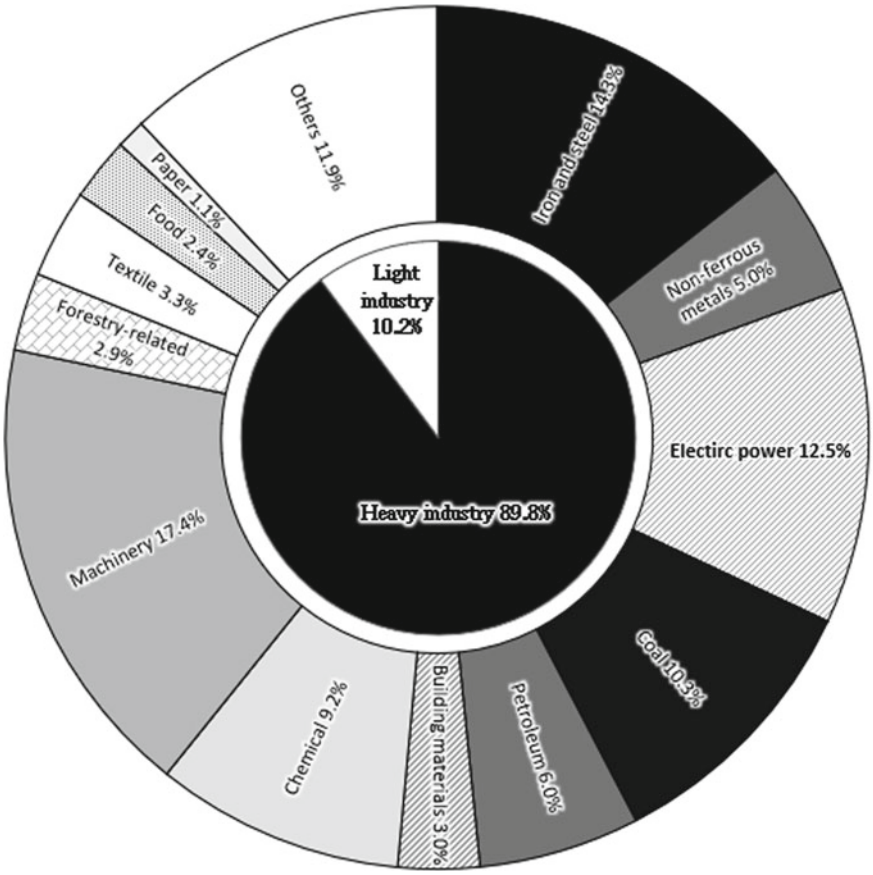

Fig. 8.1 Industrial capital construction investment share by industry (1953–75).
Sources Author's calculations based on DSIFA (1997)

This figure shows that approximately 90% of investment was allocated to heavy industry. Investments were especially concentrated in iron and steel, electric power, coal, petroleum, chemical, and machinery industries. Investment in typical light industries, such as textile, food, and paper, was extremely low.

During the Mao era, China invested extremely vigorously in heavy industries. What exerted decisive influences on the development of heavy industry were the Soviet-assisted "156 Projects," the Great Leap Forward, and the Third Front Construction.

8.2.2 The "156 Projects"

In the first two FYPs of 1953–1962, the most important construction projects were the so-called "156 Projects" assisted by the Soviet Union. The First FYP instructed clearly that "we will concentrate our efforts with the highest priority on the construction of industry, consisting of 694 'above designated size' large-scale construction units which centered on the 156 industrial projects designed and assisted by the Soviet Union." More than half the industrial capital construction investment within this FYP was assumed to be allocated to these projects. The Soviet-assisted "156 Projects" can be said to have served as a guide for China, which had little experience in heavy industrialization at the time.

Initially, 156 industrial projects were planned; however, because of the duplicate accounting and the cancellation of plans, only 150 projects were actually implemented. All were plant imports, of which civilian and military industries accounted for 106 and 44 projects, respectively.

In the 104 civilian projects that began construction during the First FYP period, the number of projects and investment value are distributed by industry as follows: coal (25 projects, 1.46 billion yuan), petroleum (2 projects, 369 million yuan), electric power (25 projects, 2.24 billion yuan), iron and steel (7 projects, 5.66 billion yuan), non-ferrous metals (11 projects, 1.76 billion yuan), machinery (24 projects, 2.84 billion yuan), chemical products (7 projects, 1.08 billion yuan), medicine (2 projects, 95 million yuan), and paper (1 project, 102 million yuan). Only three projects belonged to light industry, namely, medicine and paper manufacturing.

The two civilian projects that began construction during the Second FYP period were both related to non-ferrous metals.

Of the above 106 civilian projects, 30 were completed during the First FYP period, and 75 projects were completed in the Second FYP period, with the exception of the Sanmenxia Dam (DSIFA, 1987).

The value of investments in the 44 military industry projects was not announced, but the number of projects was distributed by industry as follows: weapons (16 projects), aviation (12 projects), electronic equipment (10 projects), shipbuilding (4 projects), and space (2 projects). The Shanxi 874 Works began construction in 1958 and came into operation in 1966, whereas the other 43 projects were all started during

the First FYP period, of which 19 were completed during the First FYP period, and the remaining 24 came into operation in the Second FYP period (Chen, 2004).

Through the "156 Projects," China built up the foundations of its heavy industries and gained the capability to produce many heavy industry goods, including motor vehicles, tractors, 10,000-ton class marine vessels, high-capacity power generation machinery, and new machine tools. Compared with newly increased production capacity (through capital construction) during 1950–75, the "156 Projects" accounted for approximately one-quarter of the crude steel production capacity at Anshan Iron & Steel, Wuhan Iron & Steel, and Baotou Iron & Steel, and approximately 30% of the motor vehicle production capacity at First Automobile Works (DSIFA, 1987). The "156 Projects" greatly promoted the construction of China's heavy industrial base.

8.2.3 The Great Leap Forward

The Great Leap Forward policy was formally put into effect at the Enlarged Meeting of the CPC Central Committee Political Bureau held at the summer resort of Beidaihe in August 1958. This meeting voted to establish the People's Commune, called for a doubling of crude steel production in 1958 over the previous year—as Mao had directly instructed—and approved the State Planning Commission's "Opinions on the Second Five Year Plan."

The FYP approved at that meeting first set a target for crude steel production of 80 million tons in 1962. Then basing on this production target, it set the production targets for other heavy industries, including electric power, coal, crude oil, copper, aluminum, chemical fertilizers, plastics, synthetic rubber, metal-cutting machine tools, motor vehicles, tractors, marine vessels, logs, and cement. Production target of grain crops was also set at 650 to 750 million tons, and the government planned to mechanize agriculture and use large amounts of chemical fertilizers and pesticides to achieve this goal.

In fact, the "Recommendations for the Second Five Year Plan" had already been approved at the 8th Party Congress in September 1956, approximately two years before the Great Leap Forward. This proposal set the production target in 1962 at approximately 10.5 to 12 million tons of crude steel and 250 million tons of grain crops. The FYP approved at 1958 was really a "great leap forward."

The Second FYP, modified by the Great Leap Forward, was obviously not a meticulously calculated and feasible plan. Unable to secure adequate supplies of materials, energy, transport, labor, grain crops, and equipment, the government attempted to rely too heavily on local government and people's enthusiasm. As a result, economic management was thrown into chaos. With additional disruption from massive natural disasters, China was plunged into a famine that killed tens of millions of people, causing the collapse of the Great Leap Forward plan (see Table 1.8). In 1962, crude steel and grain crops production achieved only 6.67 million tons and 160 million tons, respectively (Table 8.1).[4]

Table 8.1 Plan target and actual output of the FYPs (last year) in the Mao era

Items		1957	1962	1970	1975
Crude steel (million tons)	Plan target	4.12	80	16	35–40
	Actual output	5.35	6.67	17.79	23.9
Electricity generation (billion kwh)	Plan target	15.9	300	110	200–220
	Actual output	19.3	45.8	115.9	195.8
Coal (million tons)	Plan target	112.985	900	280–290	400–430
	Actual output	131	220	354	482
Crude oil (million tons)	Plan target	2.702	50	18.5	70–100
	Actual output	1.46	5.75	30.65	77.06
Metal-cutting machine tools (thousand units)	Plan target	12.72	500	65	150
	Actual output	28	22.5	138.9	174.9
Tractors (thousand sets)	Plan target	NA	300	73.6	215–225
	Actual output	NA	7.2	83.3	287.8
Chemical fertilizers (million tons)	Plan target	NA	60	18	32–35
	Actual output	0.151	0.464	2.435	5.247
Chemical fibers (thousand tons)	Plan target	NA	NA	105	350
	Actual output	0.2	13.6	100.9	154.8
Cotton yarn (million bales)	Plan target	5	26	9	13–14
	Actual output	4.65	2.912	9.742	10.309
Grain crops (million tons)	Plan target	192.81	650–750	220–240	300–325
	Actual output	195.05	160	239.96	284.52

Sources Author's calculations based on "First Five Year Plan," "Opinions on the Second Five Year Plan," "Report Syllabus about the Arrangement of the Third Five Year Plan (Draft)," "Outline of the Fourth Five Year Plan (Draft)," DIS (1995), DIS (2013) and NBS (1983)
Notes NA indicates that data were not available to the author in constructing this table

However, even during this difficult period, China continued to build a base of heavy industry. Most of the "156 Projects" were completed during this period, including Anshan Iron & Steel, Wuhan Iron & Steel, Baotou Iron & Steel, and Luoyang Tractor. Besides the "156 Projects," many other heavy industry projects, such as the Daqing Oil Field and Maanshan Iron & Steel, were also started or completed. The production of most heavy industrial products, although far from the planned targets, still grew significantly (Table 8.1).

Newly increased production capacity also expanded substantially. As evidenced by the share of newly increased production capacity within various sub-periods during 1950–75, this FYP period made the greatest contribution among the four FYP periods of the Mao era in many industries, such as crude steel (35%), iron smelting (32%), electrolytic copper (33%), metal-cutting machine tools (48%), smelting tools (60%), mining tools (72%), petroleum-chemical tools (46%), cotton spindles (25%), sewing machines (27%), coal mining (29%), machine-made paper and paperboard

(52%), refined sugar (42%), and raw salt (63%). This period also made significant contributions to the expansion of production capacity for tractor manufacturing (34%), synthetic rubber (28%), cement (27%), trucks (24%), and power generating capacity (22%) (DSIFA, 1997). Considerable production capacity was built up across a wide range of industries, including iron and steel, machinery, energy, building materials, paper, and food, which laid the foundation for subsequent economic development.

8.2.4 Third Front Construction

As previously described, in September 1965, the State Planning Commission submitted the Report Syllabus about the Arrangement of the Third Five Year Plan (Draft) to the Central Work Conference, placing Third Front Construction at the center of the FYP. Report Syllabus (Draft) placed top priority on national defense construction through the Third Front and called on other regions to provide people, technology, materials, and equipment.[5]

Of the 85 billion yuan budget in capital construction, this FYP called for concentrated investment in (1) the national defense industry (8.7 billion yuan); (2) heavy industries: iron and steel (5.7 billion yuan), non-ferrous metals (4 billion yuan), coal (5 billion yuan), petroleum (3.5 billion yuan), electric power (9 billion yuan), machinery (4.2 billion yuan), chemicals (4.2 billion yuan), forestry-related (2.9 billion yuan), and building materials (1.3 billion yuan); and (3) transportation (13.3 billion yuan). Of the capital construction budget, at least 33.3 billion yuan or 40% was assigned to the Third Front.

However, in May 1964, the State Planning Commission had already submitted the Preliminary Tentative Plan of the Third Five Year Plan (Report Syllabus) to the Central Work Conference. The Preliminary Tentative Plan proposed to use agricultural production as the base of the plan, and to plan heavy industry and basic industries after fully taking into account the agricultural demand for chemical fertilizers, chemical fibers, electric power, and drainage and irrigation machinery, as well as national defense demand.

Why did the sudden shift in planning policy observed in the Great Leap Forward Policy occur again? The most significant factor was the ever-increasing military tensions at the time, including the U.S. military intervention in Vietnam, the Soviet Union's presence in Mongolia, the Taiwanese regime's plan for a counterattack against the Mainland, and the border dispute with India, while the Gulf of Tonkin incident in August 1964 decisively shifted the FYPs back to an arms-centric focus.

Likewise, in 1970, when the State Planning Commission prepared the "Outline of the Fourth Five Year Plan (Draft)," and called for "continuing the construction of the Big Third Front with an unwavering concentration of strength," as the Sino-Soviet border dispute intensified, and the Vietnam War expanded.[6]

Although political turmoil continued for a long time from May 1966 when Mao launched the Cultural Revolution, manufacturing and R&D bases for conventional weapons, military electronic equipment, fighter aircraft, military ships, nuclear weapons, missiles and rockets continued to develop in the Third Front regions during the next 10 years, including satellite launch centers in Jiuquan and Xichang that remain active today. Moreover, 124 large-scale machinery industry projects were implemented, including the establishment of the Second Automobile Works (presently Dongfeng Motor) and Dongfang Electric Machinery (presently Dongfang Electric), which are still among the country's top companies. Large-scale energy and metallurgy projects, such as the Daqing Oil Field, Liupanshui Coal Base, the Gezhouba Water Conservancy Project, and Panzhihua Iron & Steel, were carried out. The construction of railways, which was extremely difficult in the Third Front regions, such as the Chengdu-Kunming Railway, also achieved success.

Capital construction investment in industry during this decade amounted to 151.9 billion yuan, accounting for 56% of investment between 1953 and 1975. These two FYP periods contributed more than 80% of newly increased production capacity during 1950–75 in petroleum extraction, more than 70% in synthetic ammonia, wristwatches, plastics, chemical fibers, internal-combustion engines, and chemical fertilizers, and more than 60% in synthetic rubber, power generating capacity, electrolytic aluminum, cement, and tractor manufacturing (DSIFA, 1997).

8.3 Legacy and Evaluation of Heavy Industrialization

During the Mao era, the heavy industry's share of industrial output value increased from 26% to approximately 50–60% (Fig. 8.2).

Although heavy-industry-oriented planning has often brought chaos to the Chinese economy, heavy industrialization also recorded significant achievements during the Mao era. Comparing the planned production targets and actual results, it is clear that the plans were reckless. Nonetheless, the expansion of production also stands out (see Table 8.1). What did the heavy industrialization leave behind for the reform and opening-up era, and how shall we evaluate it?

The radical heavy industrialization of the Mao era laid the foundations of heavy industry and built a primary complete industrial system in China. Many industrial products were newly developed, such as crude petroleum and natural gas extraction, petroleum processing, large-scale metal-cutting machine tools, motor vehicles, ships, locomotives, aircraft, synthetic fibers, plastics, and industrial equipment for mining, electric power, metallurgy, textile and other industries.[7] The coal mining, metallurgy, and chemical industries were also greatly strengthened. China's production of electricity, crude steel, metal-cutting machine tools, and chemical fertilizers, which were only a few hundredths to approximately one-hundredth of those of the United States by 1949, rapidly expanded to approximately one-tenth, one-quarter, three-quarters, and one-third of those of the United States by 1975, respectively (DITMS, 1985).

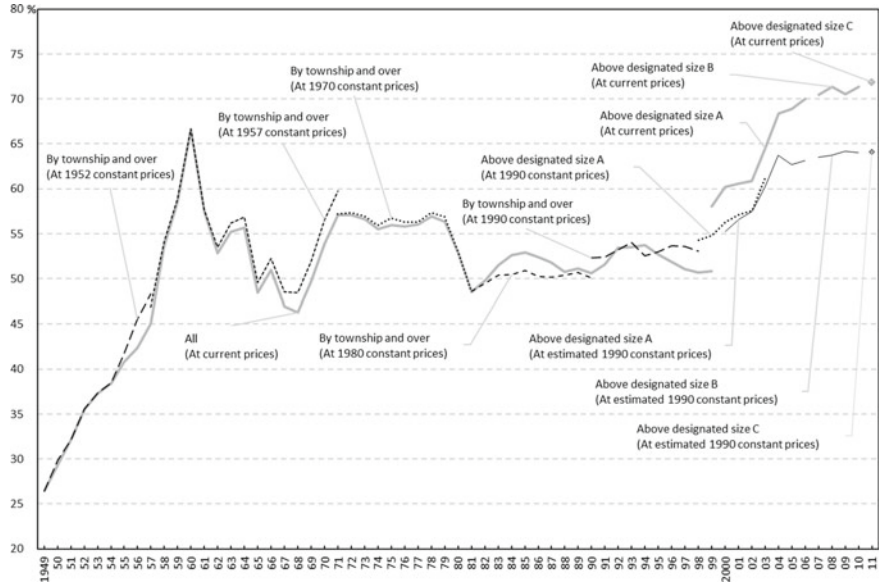

Fig. 8.2 Heavy industry's share of gross industrial output value.
Sources Author's calculations based on DITMS (1985), DIS (various issues), NBS (various issues) and NBS (1984).
Notes Enterprises above designated size A refer to all state-owned industrial enterprises and the non-state-owned industrial enterprises with revenue from principal business over 5 million yuan. Enterprises above designated size B refer to all industrial enterprises with revenue from principal business over 5 million yuan. Enterprises above designated size C refer to all industrial enterprises with revenue from principal business above 20 million yuan. Gross industrial output value at constant prices during 1988–93 was aggregated within the enterprises with independent accounting systems. The "at estimated 1990 constant prices" was calculated by the industrial products producer price indices

Engineer training and R&D organization establishment were also of great significance during the heavy industrialization of the Mao era. For instance, during the implementation of the "156 Projects," Chinese engineers, under the guidance of Soviet experts, actively acquired and imitated technologies, which moved China toward developing the capacity to produce and develop the equipment independently. The Soviet Union dispatched more than 10,000 experts to China to offer technical guidance, provided China with a large number of plant blueprints and technical data on product design and manufacturing, and assisted Chinese design departments in plant installation and design work. The Soviet Union also accepted more than 8,000 Chinese technical trainees. As a result, approximately 20–30% of the design of the "156 Projects" was completed by Chinese design departments, while approximately half of the equipment was manufactured by China, based on technical documents that obtained from the Soviet Union (Dong, 1999). The Soviet Union also helped China to establish research institutes for technologies including nuclear energy, electronics, automation, and semiconductors. Thus, even after the Soviet Union withdrew its

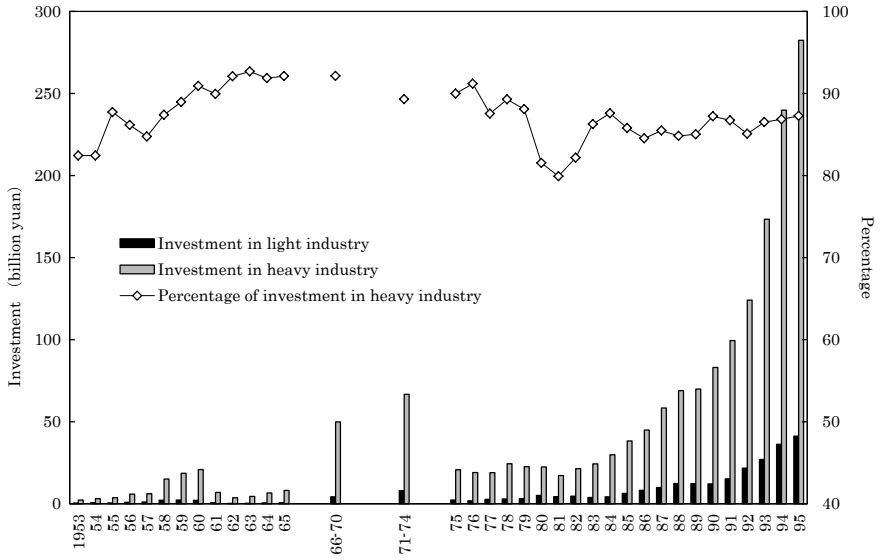

Fig. 8.3 Industrial capital construction investment (1953–95).
Sources Author's calculations based on DSIFA (1987, 1997)

experts from China, China was able to complete 66 projects under construction by emulating Soviet technology and plants.

Therefore, in both hard and soft aspects, the heavy industrialization during the Mao era laid the foundations for industrialization in the Deng era.

In the Deng era, China kept on concentrating the investment on heavy industry (Fig. 8.3). Heavy industry's share of capital construction investment declined only briefly in the early 1980s. Subsequently, its investment share swelled. Although the heavy industry's share of investment has not reached the Mao era's highest level of 92%, it has almost recovered to a level near 90%.

Looking to the heavy industry's share by gross output value (see Fig. 8.2), it is certainly true that heavy industry development advanced rapidly in the 1950s. However, during the later Mao era, heavy industry's share of gross output value mostly settled in the range of approximately 50–57%. On entering the Deng era, although the share dropped significantly in the 1980–81 period, it still mostly hovered at 50–54% until the end of the 1990s—only slightly lower than the Mao era. From 1999, the heavy industry's share began to increase rapidly to a level resembling that of the Great Leap Forward period.

Thus, the Mao era laid the foundations for industrialization in the reform and opening-up era; however, heavy industrialization not only accelerated during the Mao era, but continued into the reform and opening-up era.

Regarding changes in industrial structure, many key heavy industries actually overlapped between the Mao era and the reform and opening-up era. Table 8.2 shows the structure of industry in 1955, 1979, 1995, and 2012. These four years were

Table 8.2 Percentage of output value by industry

Industry		1955	1979	1995	2012
(1) Heavy industry		34.1–40.2	55.3–56.8	56.9	69.1
Electric power	Electricity production and supply	1.6	3.9	4.5	5.6
Coal	Coal mining	3.0	2.6	2.1	3.6
	Coking, manufacture of gas	0.2	0.2	0.3	1.0
Petroleum	Crude petroleum and natural gas production	0.3	2.1	2.6	1.3
	Petroleum processing	0.8	3.3	3.5	3.2
Metallurgy	Ferrous metal	6.7	6.3	6.9	7.3
	Of which: Primary iron and steel manufacturing	6.5	6.1	6.7	6.5
	Non-ferrous metal	3.1	2.7	3.1	4.8
	Of which: Primary non-ferrous metals manufacturing	NA	2.3	2.5	4.2
Chemical	Mining of chemical minerals	0.3	0.1	0.1	0.1
	Manufacture of basic chemicals	1.6	1.6	1.2	0.9
	Manufacture of organic and synthetic basic chemicals		1.8	2.1	3.7
	Manufacture of chemical fertilizers	0.3	1.9	1.6	0.9
	Manufacture of chemical pesticides	0.2	0.4	0.4	0.2
	Manufacture of rubber products for production use	1.2	1.5	0.8	0.8
	Manufacture of plastic products for production use	NA	0.9	1.0	1.1
Machinery	Manufacture of machinery for production use	7.1	12.7	13.2	16.4
	Of which: Manufacture of agricultural machinery	0.9	1.8	0.9	0.3
	Of which: Manufacture of boilers, engines and turbines	1.5	2.1	2.5	2.8
	Of which: Manufacture of metalworking machinery	0.3	0.8	0.4	0.5
	Of which: Manufacture of special industrial machinery and equipment	1.3	2.3	1.5	1.6

(continued)

Table 8.2 (continued)

Industry		1955	1979	1995	2012
	Of which: Manufacture of motor vehicles	0.3	1.6	4.0	5.7
	Of which: Ship building	0.7	0.6	0.4	0.9
	Manufacture of electronic equipment	0.1	3.3	3.5	6.6
	Of which: Manufacture of radio and television transmitters, telecommunication equipment and computers	NA	NA	2.1	3.9
	Of which: Manufacture of electronic components	NA	NA	1.4	2.5
	Manufacture of metal products for production use	1.5	4.6	3.0	4.4
	Maintenance and repair of machinery and equipment	<1.6	<1.4	0.6	0.6
Building materials	Manufacture of building materials	2.8	3.7	5.6	5.2
Forestry-related	Logging and transport of timber, sawmills and manufacture of fiberboard	3.3	1.0	0.8	0.9
	Manufacture of forest chemical product	NA	0.2	0.1	0.1
Others	Of which: Heavy industry	NA	0.4	0.2	0.2
(2) Light industry		59.8–65.9	43.2–44.7	43.1	30.9
Chemical	Manufacture of paints, dyestuffs and printing ink	0.5	0.7	0.6	0.5
	Manufacture of pharmaceutical chemicals	1.5	1.4	1.3	1.1
	Manufacture of chemical products for daily use	1.3	0.8	0.9	0.6
	Manufacture of rubber products for daily use	0.9	0.5	0.4	0.1
	Manufacture of plastic products for daily use	NA	0.7	1.0	1.0
Machinery	Manufacture of machinery and equipment for daily use	0.5	1.8	2.3	1.4
	Of which: Manufacture of electronic appliances	NA	0.4	1.2	0.7
	Manufacture of metal products for daily use	1.2	0.5	1.9	1.5

(continued)

Table 8.2 (continued)

Industry		1955	1979	1995	2012
	Of which: Manufacture of household electrical appliances	NA	0.3	1.9	1.4
	Manufacture of metal products n.e.c	1.8	2.4	2.2	2.1
	Treatment and coating of metals	NA	NA	0.2	0.2
Forestry-related	Manufacture of wood products	NA	0.7	0.5	0.8
Food	Manufacture of food products	23.9	11.4	10.2	8.2
Textile, wearing apparel, and Leather	Manufacture of textiles	21.4	11.6	7.9	4.0
	Manufacture of artificial fibres	NA	0.2	0.2	0.2
	Manufacture of synthetic fibres	NA	0.6	1.2	0.5
	Manufacture of wearing apparel	1.4	2.2	2.7	1.8
	Manufacture of leather, fur and their products	0.7	0.8	1.6	1.0
Paper, cultural and educational articles	Manufacture of paper	2.3	1.3	1.3	0.8
	Printing industries, manufacture of articles for cultural activities, education, sports, arts and crafts	2.4	2.1	2.3	1.9
Others	Of which: Light industry	NA	NA	4.2	3.2

Source Author's calculations based on NBS (1957, 1981), firm-level data set for the enterprises in the Third National Industrial Census of PRC in 1995, firm-level data set for the enterprises as China's basic statistical units in 2012

Notes The percentage of output of 1955, 1979, 1995 and 2012 was calculated from gross industrial output value at 1952 constant prices, gross industrial output value at 1970 constant prices, gross industrial output value at current prices, and sales revenue at current prices, respectively. NA indicates data were not available to the author in constructing this table. Several industries could not be split into heavy industry and light industry precisely, because the industries could not be split further or these industries' output data were not available. The classification of industrial sectors is based on the Industrial Sector Classification (1972); however, we modified it minorly in order to unify the classification systems utilized in different years. Printing ink and matches originally belongs to paper, cultural and educational articles, and others respectively, was placed into chemical industry. Carbon and graphite products originally belong to others was placed into building materials

chosen because of data limitations. However, 1955 was the third year of the First FYP period and almost the beginning of heavy industrialization in the Mao era. In 1979, China had just changed course toward the reform and opening-up. By 1995, the marketization policies of the Deng era were advancing at a rapid pace. The year 2012 is approximately 10 years after China made rapid progress toward heavy industrialization in the reform and opening-up era.[8]

The period 1955–79 generally represents the Mao era. Comparing the share of output by industries in 1955 and 1979, it shows that the importance of light industry, particularly the two representative industries, food and textiles declined sharply. In contrast, Table 8.2 confirms the progress of heavy industrialization. The shares of electric power, petroleum, basic chemicals, chemical fertilizers, agricultural machinery, boilers, engines and turbines, metalworking machinery, special industrial machinery and equipment, motor vehicles, electronic equipment, metal products for production use, and building materials all increased significantly. Additionally, iron and steel, and coal generally maintained the high shares recorded in 1955. A wide range of heavy industries expanded significantly, including energy, iron and steel, special industrial machinery and equipment, chemicals, and electronic equipment.

By observing the industrial structure in 1995, we find that even in the Deng era, the share of food and textiles continued to decline. However, many other light industries, such as synthetic fibers, wearing apparel, leather, electronic appliances (e.g. TVs and radio-cassette recorders), and electrical appliances (e.g. refrigerators and fans) increased their shares. Within heavy industry, the shares of agricultural machinery, metalworking machinery, and special industrial machinery and equipment declined, whereas the shares of electric power, petroleum, organic and synthetic basic chemicals, boilers, engines and turbines, motor vehicles, electronic equipment, and building materials continued the upward trend begin during the Mao era. The share of the metallurgy industry, which was high during the Mao era, increased further. The presence of heavy industry was maintained.

The industrial structure in 2012 shows that energy (e.g. electric power), metallurgy (e.g. iron and steel), organic and synthetic chemicals, and machinery industries have continued to play an important role in heavy industrialization after 2000. Thus, even in the reform and opening-up era, the presence of heavy industries continued to expand. Heavy industrialization in the Mao era formed favorable conditions for the development of these industries.

Within the machinery industry, we see significant share growth in the production of motor vehicles and electronic equipment during the reform and opening-up era. The majority of motor vehicles are passenger cars, and typical products of electronic equipment not only include electronic components for production use, but also personal computers and mobile phones, many of which are used in daily life. In other words, heavy industry development after the reform and opening-up was partly the result of the growth in the output of consumption goods, which was evidently different from the national defense-oriented heavy industrialization during the Mao era.[9] Nonetheless, as previously stated, the motor vehicles and electronic equipment industries significantly had increased their share of output value even during the Mao

era. The development of these industries during the reform and opening-up era is not independent from the Mao era.

Although as a result, the heavy industrialization in the Mao era played a role in constructing industrial foundations for the reform and opening-up era, how should this policy itself be evaluated?

Lin et al. (1994) argued that although heavy industries grew faster than other sectors as a result of the heavy-industry-oriented investment policy, disregard for factor endowments resulted in a distorted industrial structure. It slowed economic growth, hindered the movement of labor from agriculture to other industries, impeded the improvement of people's living standards, and isolated the economy from the outside world. They also argued that the planned resource allocation system, the management of state-owned enterprises (SOEs) and People's Communes, which were adopted to support the heavy-industry-oriented development strategy, led to low allocative efficiency and poor work incentives.

Let us review the industrial investment efficiency in China. In Table 8.3, the incremental capital output ratio (ICOR) is calculated using the sectoral statistical data. Output value and capital are both deflated; however, gross output value is used for output and fixed capital for capital.

Because the ICOR is the amount of additional capital required to increase output by one unit, the higher its value, the greater the amount of additional capital—such as plant and equipment—required to bring about an increase in output of one unit; therefore, the lower the investment efficiency. Because industries such as mining tend to have a high ICOR, we focus on the time-series tendency of each industry rather than on comparisons between industries.

Most industries showed the most striking deterioration in investment efficiency during the Second FYP period, namely the Great Leap Forward period. In many industries, gross industrial output even shrank despite an increase in fixed capital.[10] The investment efficiency of most industries improved during the subsequent economic adjustment period of 1963–65; however, investment efficiency began to deteriorate again by the Fourth FYP period at the latest.

The low investment efficiency of the Mao era can also be observed in the state of progress of construction. The "rate of fixed assets transferred and put into use in capital construction" shows that, particularly during the Third Front Construction period when location conditions were poor and construction periods were considerably extended, the operation of new fixed assets encountered substantial delays. Because only recorded fixed assets were used to calculate the ICOR, investment efficiency during the Third Front Construction period must be lower than what the ICOR indicated.

As with growth rate of other economic indicators in Table 8.3, such as the dramatically fluctuating gross domestic product (GDP) growth rate, the ICOR for the entire industry also fluctuated greatly. However, these two indicators demonstrated inverse movements, confirming that the decline in investment efficiency hampered economic growth in the Mao era.

Table 8.3 ICOR by industry

Period	1953–57	1958–62	1963–65	1966–70	1971–75	1976–80	1981–85	1986–90
ICOR								
Total	0.34	2.69	0.18	0.20	0.51	0.43	0.28	0.40
Metallurgy	0.61	2.78	0.03	0.41	1.19	0.71	0.43	0.88
Electric power	2.32	3.10	1.02	1.16	1.42	2.15	2.18	2.66
Coal	1.53	4.01	20.51	1.23	2.89	3.18	3.88	4.44
Petroleum	0.85	0.95	0.34	0.15	0.42	0.77	1.25	2.47
Building materials	0.42	−2.83	0.21	0.41	0.64	0.70	0.46	0.65
Chemical	0.17	0.57	0.16	0.10	0.21	0.21	0.11	0.14
Machinery	0.39	1.85	0.22	0.16	0.36	0.42	0.07	0.12
Forestry-related	0.28	−0.92	0.90	−2.68	1.23	0.84	1.06	1.11
Food	0.11	−1.40	0.05	0.21	0.19	0.31	0.42	0.66
Textile	0.27	−0.59	0.06	0.09	0.29	0.19	0.29	0.51
Others	0.01	1.23	−0.09	0.02	1.14	0.09	0.25	0.23
Yearly-averaged growth rate (%)								
Industrial gross output value	18.0	3.8	17.9	11.7	9.1	9.2	10.7	10.7
Value-added of industry	19.8	2.1	21.4	11.6	9.0	9.6	9.9	9.2
GDP	9.2	−2.0	15.1	6.9	5.9	6.5	10.7	7.9
Rate of fixed assets transferred and put into use in capital construction (%)								
All industries	80.2	70.9	88.5	58.5	60.4	74.2	68.9	73.6

Sources Author's calculations based on DIS (various issues), DITS (2000), NBS (1991), GPDMF (1992), DNA (2007), Zheng and Ji (1993), Chen et al. (1993), DSIFA (1997)

Notes The capital input was calculated by using original value of fixed assets, net value of fixed assets, fixed assets depreciation rate of industrial enterprises, and deflated. The rate of economic depreciation is 5%. Gross industrial output value at constant prices was used as output. The yearly-averaged growth rate is at constant prices

The ICOR also shows that, even on entering the Deng era, investment efficiency declined in industries such as electric power, coal, petroleum, and food. The investment efficiency of the whole industry improved only for a while before deteriorating again. Improving investment efficiency has always been an issue in the Chinese economy even after the reform and opening-up.

Although as previously mentioned, Lin et al. (1994) offered a general critique of the Mao-era heavy industrialization strategy, others disagreed. Yao and Zheng (2008) constructed a dynamic general equilibrium model composed of light and heavy industries, and compared the sum of the discounted utility of all residents realized under three cases: (1) a market-based strategy with no subsidy to heavy industry, (2) a strategy with an optimal term and subsidy rate for heavy industry development, and (3) actual Chinese practice with a high, long term subsidies. The results showed that, case (2), namely the optimal catch-up strategy, in which the

subsidy rate is somewhat reduced and the term of subsidy is substantially shortened as compared with case (3), offers the highest utility among these three cases. They affirmed that the "heavy-industry-oriented development strategy was correct" and argued that the problem was that the strategy's implementation period was overly long.

At the same time, Yao and Zheng (2008) noted the lack of analysis of military strategy in their study, and suggested that the mistakes of the Mao era were more about politics than economic policy.

Indeed, we have already seen that one of the major goals of heavy industrialization was to strengthen national defense. Moreover, Mao possessed great influence not only on the turmoil of the Great Leap Forward and the Cultural Revolution, but even on the preparation and decisions of the FYPs. These factors should also be taken into account as constraints when discussing the merits and demerits of heavy industrialization.

8.4 Another Legacy: Embryonic Reform and Opening-Up

Deng Xiaoping took over the reins of power at the end of the 1970s. On entering the Deng era, China gradually reformed state enterprises, expanded the scope of private capital activities, accepted foreign capital and technology, and adopted market mechanisms.

The reform and opening-up policy did not have a roadmap: the policy was formed through trial and error. However, prototypes of some of these policies had in fact already been explored during the Mao era. The rural household responsibility system, which was briefly implemented after the failure of the Great Leap Forward, is well known; however, we will review the policies more directly related to heavy industrialization.

8.4.1 Utilization of Foreign Equipment, Technology, and Funds

Even during the "self-reliant" Mao era, China had to aggressively adopt foreign plants to develop its extremely fragile heavy industry.

The most famous example is the already-mentioned introduction of plants from the Soviet Union under the "156 Projects." The implementation of the "156 Projects" strengthened China's extremely weak heavy industry in a fairly short period during the first two FYPs. In addition to the military industry, the "156 Projects" focused on the metallurgy (e.g. iron and steel), energy (e.g. coal and electricity), and machinery industry (e.g. metalworking machinery). The production capacity growth in machine

tools and special industrial machinery and equipment particularly boosted China's capacity to pursue an independent path of industrialization.

Mao did not reject imports even from the West. Even Mao Zedong's article, "On the People's Democratic Dictatorship," which called for China "to lean to the side of the Soviet Union," stated, "We are against no one except the domestic and foreign reactionaries who hinder us from doing business" (Mao, 1951). Nonetheless, amid the economic blockade imposed by the Western bloc immediately after its founding, China had no other choice but to "lean to the side of the Soviet Union."

However, in July 1960, in the midst of the Great Chinese Famine, the Soviet Union unilaterally notified China of plans to withdraw its experts and suspend its assistance. The deterioration of Sino-Soviet relations resulted in the halting of plant importation from the Soviet Union. Despite its commitment to "self-reliance", China had to turn to the introduction of plants from Western countries from then on.

Starting from a 1963 contract with Japan's Kurashiki Rayon (now Kuraray Co., Ltd.) for an integrated PVA/PVA fiber manufacturing plant, China planned to import 84 plant and technology items with a total value of approximately $270 million. These items included plant for synthetic ammonia, urea, ethylene, propylene, vinylon, acrylonitrile, polyethylene, polypropylene, and polyacrylonitrile, together with oil well-drilling machinery, underground mining equipment, top-blown rotary converter, and large electric steelmaking furnaces from Japan, the United Kingdom, France, West Germany, and other countries (Cheng, 2004; Niu, 2016). In addition to petrochemical equipment related to the production of agricultural and daily necessities (e.g. chemical fertilizers and synthetic fibers), China also enthusiastically imported advanced facilities and technologies across a wide range of industries, including organic and synthetic basic chemicals, metallurgy, machinery, and electronics.

The importation of these items from western countries was not easy. For instance, the above-stated Kurashiki Rayon's deferred payment export to China—was officially approved in August 1963; however, this approval provoked strong criticism from the United States and Taiwan. The United States declared that this plant export to China was "problematic in that it contributes to an increase in Communist China's industrial capacity." Taiwan also strongly opposed export by deferred payment to China through loans from the Export–Import Bank of Japan. As a result, the Japanese government stopped approving loans to China from this bank, and the second export contract, namely Nichibo (now Unitika Ltd.) vinylon plant export contract expired (Kimura, 2009).

Only in the 1970s, when the international environment had changed significantly, was China able to really import plants from advanced western countries. As the development of agriculture and the textile industry—closely connected to the lives of the people—lagged behind as a result of heavy-industry-oriented development strategy, in September 1972, by taking advantage of the development of the Daqing Oil Field, China decided to import plants from Japan to expand the production of synthetic fibers and chemical fertilizers. Subsequently, many other plants were also planned to be imported from Japan and other developed western countries, such as a 1700-mm rolling mill project, petrochemical plants, electric power plants, and alkylbenzene plants, totaling $4.3 billion in value during the three to five years from

1973 (State Planning Commission, "Consultation Paper on Increasing Equipment Imports and Expanding Economic Exchange," submitted in January 1973), which was the so-called "4-3 Development Strategy." The scale of the imports subsequently increased to $5.18 billion. These imported plants were used to construct 26 large-scale projects, including Wuhan Iron and Steel, Shanghai Petrochemical, Tianjin Petrochemical Fiber, Liaoyang Petrochemical Fiber, Jilin Chemical Industrial, Beijing Petrochemical, Guangzhou Petrochemical, and Nanjing Alkylbenzene, all of which came into operation in 1982.

The implementation of the "4-3 Development Strategy" contributed to a significant increase in the production of chemical fertilizers, synthetic fibers, and synthetic detergents. For instance, production volumes of synthetic ammonia and synthetic fibers in 1970 were 2.445 million tons and 36,200 tons, respectively, whereas the newly increased production capacity built under the "4-3 Development Strategy" was 3.57 million tons and 236,000 tons, respectively. The "4-3 Development Strategy" contributed to alleviating the problems of national life, such as food and clothing.[11]

The "4-3 Development Strategy" also sought to strengthen bottleneck industries, such as petrochemicals, iron and steel, coal, and electric power. For instance, in 1970, China's ethylene production was only 15,100 tons; however, the implementation of the "4-3 Development Strategy" created a production capacity of 415,000 tons (DIS, 2013; DSIFA, 1987).

The import of plants from Western countries must have been a blessing for China after the heavy industry equipment and technology that introduced from the Soviet Union more than ten years ago became obsolete.

Plant imports for the "156 Projects" were financed by state loans from the Soviet Union and important commodities such as tungsten ore, copper, and rubber. However, for the implementation of the "4-3 Development Strategy," deferred payment was used, and foreign currency funds were raised by the Bank of China. To increase plant imports from Western countries, in 1975, Vice Premier Deng Xiaoping proposed the so-called "compensation trade," a method of offsetting the cost of importing coal mining machinery with the export of the coal mined. This method utilizes foreign exporters' funds. Meanwhile, Premier Zhou Enlai was also refining a more advanced method for the use of foreign capital. In 1973, when he met banker David Rockefeller, the head of the Rockefeller family, Zhou referred to the Kaohsiung Export Processing Zone in Taiwan and praised the so-called processing trade, in which foreign capital is used to import, process and assemble raw materials and parts, and then re-export the finished products (Xing & Chen, 2006; Chen, 2004).

The realization of compensation trade, processing trade, and export processing zones actually had to wait until the dawn of the Deng era. In 1978, the "Three-plus-one (*sanlai yibu*)" trading mix (custom manufacturing with materials, designs, or samples supplied and compensation trade) appeared as a form of export in China. In 1979, "Special Export Zones", equivalent to export processing zones, were approved in Shenzhen and other cities, which were designated as the famous "Special Economic Zones" in the following year.

It appears that Mao era's experimentation with the use of foreign equipment, technology, and funds contributed to the open-door policy of the Deng era.

8.4.2 Exploration of SOE Management System

As part of the institutional preparations for the Great Leap Forward, the State Council transferred a number of central enterprises (SOEs under central government management) to local governments, while encouraging the expansion of SOEs' managerial autonomy and permitting them to retain a share of the profits (State Council, "Provision of the State Council on Improving Industrial Management System," issued in November 1957). The compulsory quotas under production planning (the planning indices prohibited to be changed without the approval of the State Council) were drastically reduced, from 12 (gross output value, output of major products, trial manufacture of new products, important technical economic quota, cost reduction rate, cost reduction value, total number of staff and workers, number of workers at year-end, total wages, average wage, labor productivity, and profit) to four (output of major products, total number of staff and workers, total wages, and profit). Authority over personnel and limited changes in fixed assets were transferred to enterprises, while profits were also permitted to be partially retained by enterprises. Part of the retained profits could also be used for the welfare of staff and workers.

However, because the purpose of this system change was to enable SOEs to actively achieve the production quotas of the Great Leap Forward policy, even the basic management authority concerning production and sales was not transferred to enterprises. Worker management rights were delegated; however, personnel adjustments were required to keep the condition that the total number of staff and workers could not be increased. The investment and disposal of fixed assets were also limited to the authority set by the senior managing body.

In June 1958, the CPC Central Committee ordered that the decentralization of approximately 80% of the central enterprises should be completed within two weeks (CPC Central Committee, "Provision of the CPC Central Committee on Delegating Enterprises, Institutions, and Technical Forces," issued in June 1958). As a result, cooperation between enterprises in production activities was disrupted, and economic plans for materials, labor recruiting, financing, and transportation were severely disordered. In the midst of the Great Leap Forward, the finances of many SOEs slid into deficit, and the trial of this SOE management system failed.

Subsequently, central government ministries and agencies recovered the control of the transferred SOEs from local governments; however, after the Great Leap Forward, China renewed the search for new SOE management system.[12] The next trial was the trust (*tuolasi*) system, under which unified entities were made up of enterprises in the same industry. In 1964, following the instructions from Chinese President Liu Shaoqi, nine state trusts were established for tobacco, salt, motor vehicle, tractor & internal-combustion engine parts, textile machinery, aluminum, rubber, pharmaceuticals, and geological machinery and instruments. Several regional trusts were also established (National Economic Council, "Report of the State Economic Commission CPC Party Group on the Recommendation of the Pilot Implementation of Industrial and Transport Trusts," submitted to the CPC Central Committee and the State Council in July 1964). These establishments were expected to integrate enterprises on the basis of

industry and carry out production activities according to the state's plan. However, after the Cultural Revolution began, Liu was permanently expelled from CPC in 1968, and the trusts became the subject of criticism.

Turning to the SOE reforms of the Deng era, in October 1978, trial of the "power delegation and profit sharing" (*fangquan rangli*: expanding the SOEs' managerial autonomy and permitting the SOEs to retain a share of profits) was first executed in Sichuan Province at six SOEs, and was expanded nationwide the following year. This reform evolved into the "contracted management responsibility system for industrial enterprises (*gongye qiye jingying chengbao zerenzhi*)" later (Xu, 2014). The SOE management system enforced in the Great Leap Forward was certainly a kind of prototype for this reform.

The trust system, although criticized during the Cultural Revolution, continued to be utilized by some local SOEs in a similar manner, for instance, by the Tianjin Paper Manufacturing. On entering the Deng era, many such enterprises were established as "enterprise companies (*qiyexing gongsi*)", rather than "administrative companies (*xingzhengxing gongsi*)" (Yu et al., 1981). In the 1990s, the proposal that the trust system should be used to reform SOEs was brought up (Ju, 1996). In 1991, China started a pilot project with 55 state-level large enterprise groups for the reform of the state-owned asset management system. Subsequently, a system known as authorized operation (*shouquan jingying*) of state-owned assets, under which the state-owned assets administration gives the core enterprise of an enterprise group, i.e. the "group company", the authority to manage and control the state-owned assets of its key related companies in the group, was adopted in reforming large SOEs (Xu, 2019). It appears that large-scale trusts have been revived under this system.

Conclusion

This chapter has inspected the heavy industrialization during the Mao era and examined its legacy to the Deng era. Heavy-industry-oriented development strategy during the Mao era aimed at strengthening national defense, and as a result, investment efficiency was viewed as secondary, and was not improved. In contrast, heavy industrialization in the Mao era laid the foundations of heavy industry, trained a large number of engineers, thus providing favorable conditions for economic development in the reform and opening-up era. The presence of heavy industry, particularly the electric power, metallurgy, organic and synthetic chemicals, and machinery industries, was maintained during the Deng era. The challenge of improving investment efficiency was also a difficult issue during the Deng era. Moreover, the embryonic forms of some of the reform and opening-up policies could be found in the policies related to heavy industrialization during the Mao era, such as the utilization of foreign plants, technology, and funds, and the exploration for a better SOE management system.

Heavy industrialization during the Mao era resulted in the institution of state ownership and the planned resource allocation system in China's economy. China's SOEs still dominate many heavy industries. These industries have become the "commanding heights" for state capital to control the Chinese economy, which has led to

criticism of China's economic system as a form of "state capitalism." Furthermore, in October 2020, China set forth a policy of strengthening the national security system and ensuring national economic security at the Fifth Plenary Session of the 19th CPC Central Committee. Will China strengthen the dominant power of state capital over key industries further on the grounds of national security? It has become more important to look back to the Mao era, and study the issue of today's China in historical perspective.

Notes

1. "Heavy industry" in China's industrial statistics is similar to that of the "heavy-chemical industry" in Japanese statistics, but there are some differences. For instance, in Japan, metals, machinery, and chemicals are classified as heavy-chemical industries. In China, some of these industries, such as bicycles and home appliances, are classified as light industries. Therefore, the term heavy industry as it is used in this chapter is quite close to the heavy-chemical industry in Japan, but there are some differences. In addition, in this chapter, the term industry means mining, manufacturing, and production and supply of electricity, gas and water.
2. The economic theory also influenced the radical implementation of heavy-industry-oriented development strategy. See Chap. 1.
3. The Fifth FYP does not exist, including in the form of an "opinion", "report syllabus" or "outline." Not until March 1978, after Mao's death, did the National People's Congress pass the "1976–1985 Ten-Year Plan Outline of Developing National Economy (Draft)".
4. Nakagane (2002) termed China's planning system as "slack centralization," judging from the weakness of the bureaucracy and the absence of law and order, setting the number of controlled products and directive planning indicators aside. In fact, the three FYPs, from the second to the fourth, were not formally "plans" but rather "opinions" and "outlines", and the policy often shifted significantly. The First FYP was finally decided in the middle of the five-year period. The plan and actual results always greatly deviated from one another.
5. The First FYP pointed out that "our country's industry has been unevenly concentrated in one location or along the coast, and this state of affairs is irrational for economy and national defense," whereas the Second FYP proposed that "in order to adapt to national defense and security requirements, the layout of enterprises should be dispersed accordingly"; therefore, the dispersal of industrial areas for national defense purposes has been paid heed since the country's founding.
6. The Fourth FYP also emphasized the construction of the Third Front in the southwest and northwest. The plan also positioned the development of agriculture as an important part of war preparedness and called for the strengthening of light industry construction at the strategic rear, in addition to heavy industries, such as iron and steel, petroleum, and machinery.
7. The manufacture of synthetic fiber polymers is classified under heavy industry as manufacture of organic and synthetic basic chemicals, while spinning and other processes are classified as a light industry under manufacture of synthetic fibers.
8. From the second half of 2013, the National Bureau of Statistics abolished the "light industry" and "heavy industry" classification in its statistical reports (Gu, 2013).
9. Nakagane (2012) argued that China's high rate of heavy industrialization was a "deliberately and consciously created industrial structure" in the Mao era, but manifested itself as a "result of the formation of a market economy" and "an inevitable effect of income growth" after the reform and opening-up.
10. Between 1963 and 1965, "Others", namely other industries n.e.c., also showed negative ICOR. However, in this case, gross output expanded despite the decrease in capital.
11. In 1982, all major projects of the "4-3 Development Strategy" were put into operation. Plant imports for heavy industries, such as chemical fertilizers and synthetic fibers, exerted a significant impact on the expansion of grain crops production in the 1980s and the abolition of the

"clothing coupons" (cotton clothing ration ticket) after 1984 (Xing and Chen, 2006). These efforts during the Mao era prepared for the expansion of supplies of agricultural products, clothing, and detergents on entering the reform and opening-up era.

12. In 1970, the majority of central enterprises were again transferred to local governments to build complete industrial systems in each region.

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