

## Chapter 2

### Coal Industry

#### : Development of Small Coal Mines in Market Transition and its Externality

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### Introduction

Coal occupies dominant share in China's primary energy consumption. In 1990, the share of coal reached at 76.2%, highest percentage during open and reform period (after 1978 to present). It is often said that such a heavy dependence on coal for primary energy shows China's underdevelopment, which gives implicit assumption that coal consumption should be decreased following economic development. However, in China even during open and reform period, when China has enjoyed very rapid economic growth like 9.6% on average, the share of coal has been upward in reverse. In 1973 the percentage of coal usage in total energy consumption was 69.9% and even in 1996 the number was still 74.7%. Table 2-1 indicates contribution rates of each energy to total energy growth, and we recognize from figures that from 1960 to 1975, even in China energy switch from coal to other energies, mainly oil, was in progress. The contribution rates of oil reached at 54.8% in place of coal whose rates stayed at only 28.3% during that period. On the other hand, from 1979 to 1996 the contribution rates of coal rose again to 77.2%, which means that huge energy demand increase during open and reform period, was mostly satisfied by coal.

**Table 2-1: Contribution rates of each energy to total energy growth**

Year	Coal	Oil	Natural Gas	Hydro
1953-59	94.8	4.2	0.1	0.8
1960-75	28.3	54.8	6.5	10.7
1979-96	77.2	15.4	1.3	6.1

Source: Calculated by author based on data in *China Statistical Yearbook* each version

The success in such a huge coal production increase can be attributed to a series of deregulation to introduce market mechanism in coal industry. Oil industry, the most promising competitor before 1980s, has been stalled during open and reform period

because of lack of new resource exploration and more importantly, failure in conversion toward market economy. The most explicit effects caused by market transition in coal industry was an explosive increase in the number of small coal mines, most of which are managed by town-village governments, collectives or individuals. Section 1 describes the process of deregulation in coal industry started from 1983 and how its fruits came out. On the other hand, in oil industry there have been very few enterprises newly entering to the market even after deregulation. One of the purposes in this paper is to make clear what differences between coal industry and other energy industry led to the difference in influences on new actors' action to enter into market. The approach to this subject is to examine small coal mines' conditions of mining resource, technology, market and free riding, which is developed in Section 2. Through analysis of those factors, it is shown in Section 3 that growth of small coal mines brought about not only huge increased production but also expanded externalities like resource plundering, increased fatal accidents, and environmental pollution.

In 1998-99, Chinese government made an aggressive campaign to forcibly close unauthorized small mines in China. Statistics show that a total of 31,200 small mines have been closed during this period, representing a reduction in coal production of 268 million tons. Through the investigation in Section 4 about the background of this campaign, the goals seemed to be set to solve the externalities, especially resource degradation caused by small coal mines' operation, which should be necessarily internalized for sustainable development of coal industry in future. However, there are several difficulties, pointed out, to promote closure of small coal mines, such as local governments' slowdown, economic impacts to local communities. So lastly in Section 5, the prospect of this campaign is discussed.

## **1. Coal industry development during open and reform period**

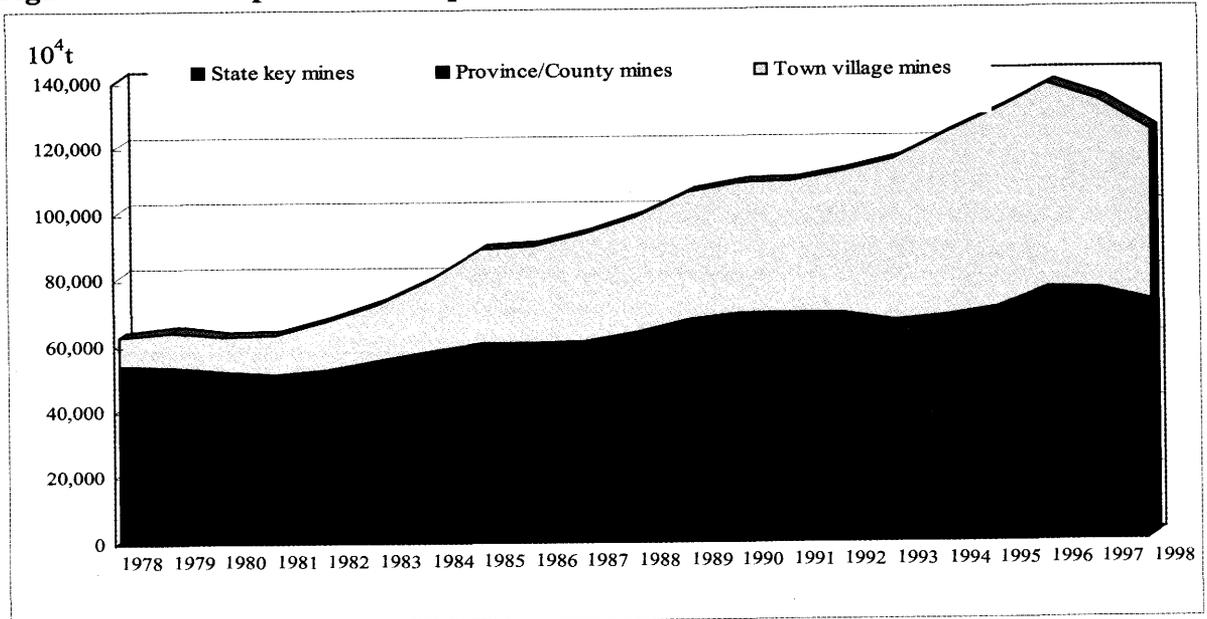
### **1.1 Present situation of coal industry**

Figure 2-1 describes the development of coal production during open and reform period. On the whole, the production was an upward trend during these twenty years. Until 1996, the total production continued to increase straightly to 1.37 billion tons, the highest point in history, although in recent years it turned to downward because of political campaign to close small coal mines, discussed in detail in Section 5. The growth of production in these twenty years reached more than 750 million tons, whose annual growth rates was very rapid, 6.8%, though slightly lower than GDP growth rates 9.6% during the same period.

We can easily recognize from figure that such a remarkable output growth was mostly

attributed to production increase from Town village mines, whose output accounted to only 14.1% in 1978 but increased to 44.7% in 1996. On the other hand, the production of State key mines, leading actors before 1980s, has been stalled, whose share occupied in total coal production declined from 55.3% in 1978 to 37.3% in 1995. It can be observed from those figures that at the process of output increase, the structural change in coal industry was also in progress, under which Town village mines came to play the leading role in producing coal.

**Figure 2-1: Development of coal production in 1978-98 by types of mines**

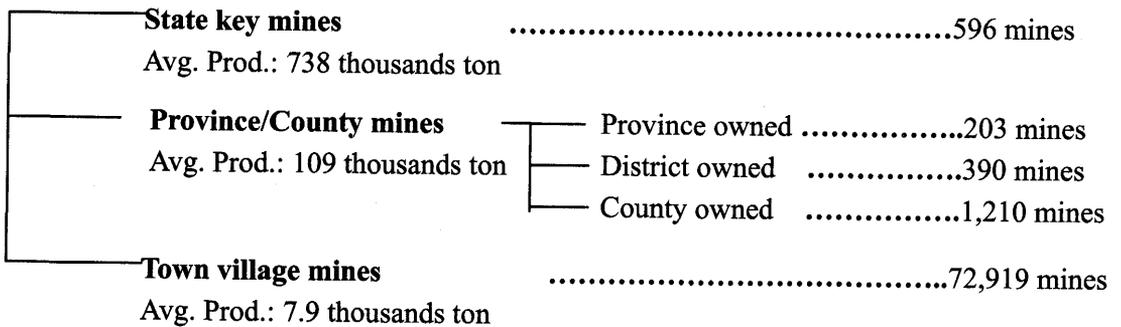


Source: prepared by author based on *China Coal Industry Yearbook* each year

Chinese coal mines can be categorized into three groups as follows. 1) State key mines, which were formerly owned and managed by the state government and whose products were mostly allocated according to the central government's planning, 2) Province/County mines, which are owned and managed by either the provincial or the county governments, and 3) Town village mines, which are owned and managed by town village governments, collectives, and/or individual. This classification of Chinese mines is originally based on the difference in a form of ownership. Besides it is also reflecting the difference in the scale of production, mining conditions, management system, and profit level. As shown in Figure 2-1, a distinct difference between State key mines and Town village mines should be in their numbers of mines and average annual production per one mine. The number of Town village mines amounted to 72,919 and their average annual production stayed at only 7.9 thousands tons, while State key mines produced an average of 738 thousands tons annually. It should be noted that in China, largest coal producing country in the world, about half share of

total coal production was produced by such a huge number of small coal mines. Due to large share of town village mines, China's index of productivity is rather unique in comparison with other coal producing countries as Table 2-2 indicates. In China, there were still so many workers working in coal industry with lower productivity and the scale of each mine was surprisingly small, which can be attributed to the large presence of Town village mines.

**Figure 2-2: Three Categories of Chinese Coal Mines**



Note: "Avg. Prod." represents average per-mine production per year.

Source: prepared by author based on *China Coal Industry Yearbook 1998*, 1995 data

**Table 2-2: Productivity data of major coal producing countries**

	Numbers of workers (10 thousands persons)	Productivity (tons/a person annual)	Average production per one mine (10 thousands tons)
USA	10.6	8872	36.8
Australia	2.6	7561	n.a.
Germany	9.3	575	279.5
South Africa	6.2	3319	332.9
Poland	27.5	492	203.3
Russia	58.6	436	53.5
India	64.1	461	23.2
China	763.8	169	1.6

Note: 1995 data, except for South Africa with 1996 and Russia with 1997.

Source: prepared by author by [17]

Additionally, we take a look at further study about the scale of Town village mines' production shown as Table 2-3. This table shows that over 90 % of Town village mines produced only less than 30 thousands tons a year, and about 60 % of coal was produced by small coal mines with below 30 thousands tons as an annual production. After 1980s, other coal producing countries, like USA, Australia, Germany has experienced the process of enlarging coal mines' scale and closing down small ones.

On the contrary to this trend, even in 1980s and 1990s, there increased considerable share of small coal mines in China's coal industry. Therefore, next question should be how those small coal mines grew up and what factors influenced their growth, which is discussed in the next part.

**Table 2-3: Number and its production of Town village mines by scale**

Annual production	Number of mines	%	Sum of coal production (million tons)	%
Above 30 thousands tons	6,646	9.1	245.43	42.4
10 to 30 thousands tons	15,164	20.8	195.24	33.7
Below 10 thousands tons	51,109	70.1	138.51	23.9
Total	72,919	100	57,918	100

Source: *Town village coal mines in China, 1995 data*

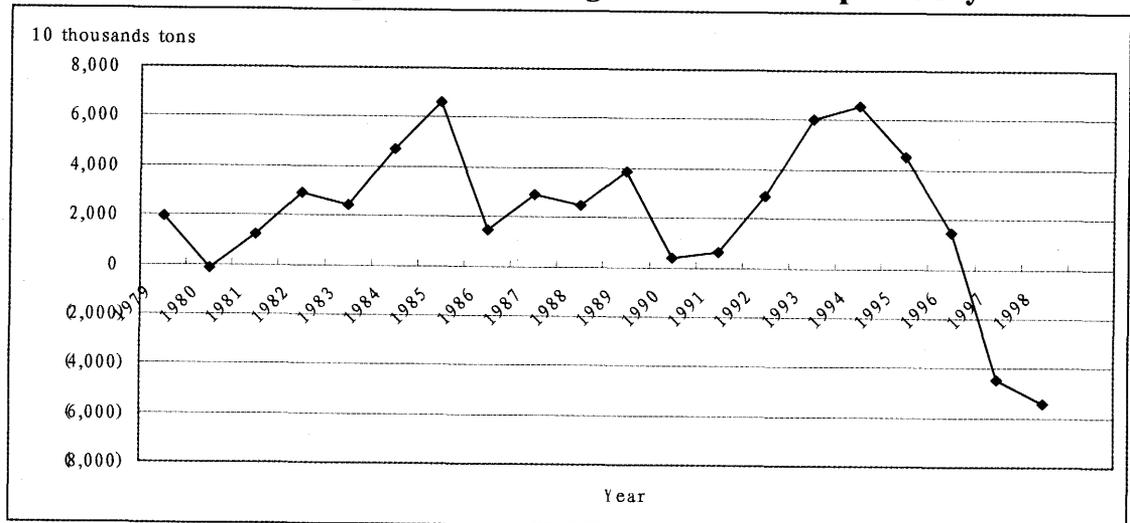
### 1.2 Deregulation in coal industry and explosive growth of small coal mines

Town village mines originate from commune- and brigade-run mines which were built during Great leap forward period started in 1958. The coal production of Town village mines made, literally, a great leap during this period from 6.79 million in 1957 to 22 million tons in 1960. However, most of mines were constructed hastily to achieve the excessive target for production increase, which was politically set without considering the needs for enough resource exploration, operational design. Consequently, their production decreased dramatically again to 9.73 million tons in 1965. At that time, the principles in the development of commune- and brigade-run mines was described as a slogan like "Should be based on small-scaled, traditional technologies, and supported by local people", which can also still be applied to describe the characteristics of present Town village mines.

In 1960s the initiatives toward centralized planned economy were rather stronger than decentralized one, and policies to strengthen State key mines' producing capacities were promoted positively. However, in the early of 1970s, the development of small coal mines were given a priority again, as a sector of "five mini industry", which included small steelworks, small chemical fertilizer plants, small cement mills, small agricultural machinery factories and small coal mines (or small power plants), and significant investment was spent for construction of those small units. Thus even under planned economy, which generally directs large-scaled and centralized producing methods, there laid the foundation of small coal mines' growth during open reform period.

Two booms of coal production by Town village mines can be found from Figure 3 during open reform period. Both of them were strongly related to the progress in conversion to market economy and deregulation in coal industry. The first one was from 1983 to 1985, when deregulation to stimulate the participation of many actors into coal market was promoted drastically. And the second one was from 1992 to 1995, when removal of restrictions on pricing and liberalization of coal prices were undertaken as the final process of market transition in coal industry.

**Figure 2-3: Increased output of Town village mines from the previous year**



Source: Calculated by author based on data in "China Coal Industry Yearbook" each version

The first attempt to introduce market mechanism into coal industry was made on November 1981, which allowed small scaled mines to sell their surplus coal with their own decision. Before that, all produced coal was allocated to users only according to the distribution plan and fixed price decided by government, but this system failed to bring out the incentives for coal mines to increase their coal production. Therefore, as for small scaled coal mines, they were assigned to attain a certain amount of production by contract and in return permitted to sell their coal surpassing planned target without any restriction on pricing. At first, this attempt was only tentative one, but on April 1983, it was formally decided by "Report about 8 measurements to accelerate the development of small coal mines" that the contracted management and double pricing system was applied to Town village mines for the purpose of supporting the investment and management by variety of actors.

Furthermore, on June and November 1984, the regulation of resource allocation and management system was loosened more considerably and the authorization for Town

village mines was transferred from central government to local one. Those deregulation certainly succeeded in increasing coal production through stimulating many actors' participation into market, resulting in about 100 million tons growth for only two years in 1984-85.

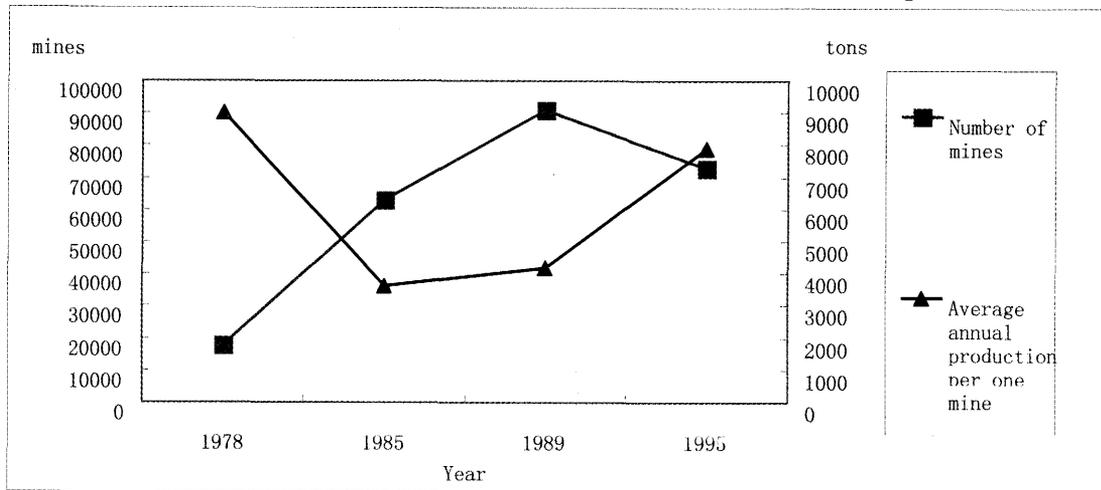
Afterwards, from the beginning of 1990s, the growth rates of Town village mines had slowed down a little due to backward to strengthening regulation in reacting against a series of rapid deregulation in 1980s. However, in 1993 when the coal prices were liberalized with the exception for those supplied to power plants, Town village mines increased their production remarkably again. More than 150 million tons of coal were added to total production produced by Town village mines in only three years, on the other hand the production of State key mines dropped by 24 million tons in 1993, which was kept lowered than the level of 1992 until 1995. The liberalization of coal pricing was originally expected to leverage the production of State key mines because fixed price set for State key mines' coal, was thought as the main reason to be lack of incentives for State key mines to increase their production. Nevertheless, it in reality resulted in the second boom of Town village mines' production, most of which was already traded with no restriction. The reason causing this unexpected outcome is as follows.

Liberalization of coal pricing in 1993 made it possible for State key mines to sell their coal with higher price. The cost to produce coal in State key mines was much higher, say about 25 % on average, than that of Town village mines. For this reason, State key mines decided to rather buy coal from Town village mines with lower price than increase their own coal production and sold it mixed with their products. Moreover, liberalization of coal pricing at the same time came to an end of the system to distribute State key mines' coal to users according to government's plan and users started to buy coal from Town village mines with much lower price than that of State key mines. As a result of that, reform in 1993 expanded the market for Town village mines and the production of State key mines decreased in reverse.

The deregulation in coal industry during open and reform period explained above, succeeded in stimulating entry of Town village mines into market considerably. The real process of development of Town village mines was to increase the number of mines through given economic inducement to collectives and individuals' action to enter into the market, caused by deregulation and market transition. The overall production increase was attributed not to scale expansion of each mine already existing in the market but to the explosive increase of the number of mines newly participating in the market. Figure 2-4 indicates the change of the number and average annual production per one mine in terms of Town village mines. From this figure, it is clearly

shown that due to the deregulation promoted in the first half of 1980s, the number of mines increased dramatically by more than 3.5 times and reached its peak in 1989. And it can also be pointed out that those mines newly starting operation were mostly very small scaled because average annual production per one mine dropped very sharply as shown in Figure 2-4. In 1990s, as the regulation on Town village mines was reinforced again, the number of mines dropped to some degree and average annual production per one mine went upward again. These data proves the fact that the growth of whole coal production by Town village mines was attained by explosive entry of new small scaled actors into market in 1980s and by the expansion of their annual production in 1990s.

**Figure 2-4: Number and average annual production of Town village mines**



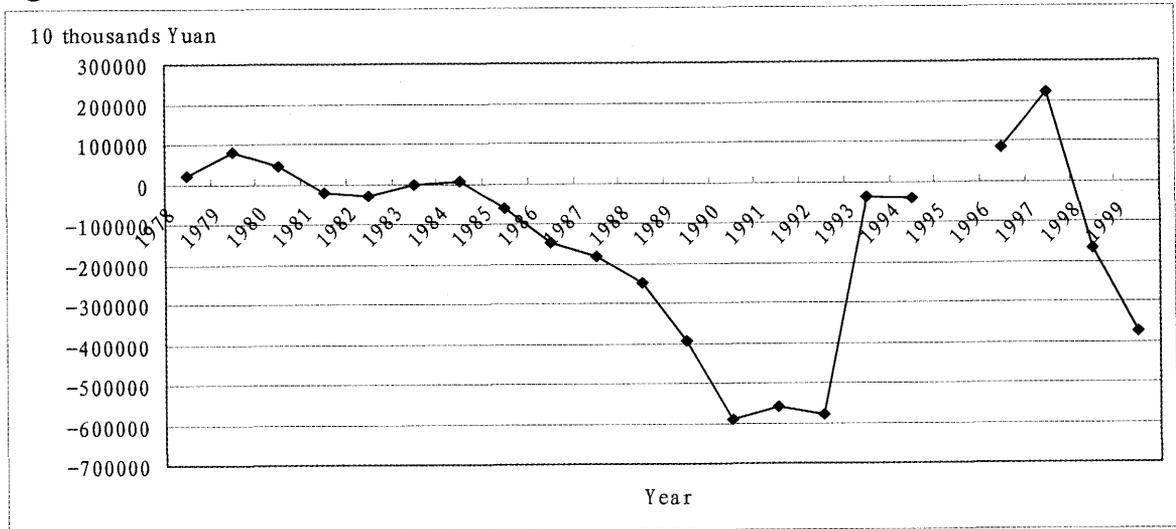
Source: Prepared by author based on data [13][15]

### 1.3 Background of deregulation: an alternative to the reform of State coal mines

The deregulation introduced into coal industry can be defined as a shortcut to increase coal production, that is, avoiding to be confronted with difficult problems to reform State key mines. From 1979 to 1995, the coal production by State key mines increased 140 million tons, occupied by only 20.7% of total increase. The annual growth rates of State key mines amounted to only 2.2%, much lower than that of Town village mines, 39.3%. Under planned economy system, State key mines had played a leading role in supplying coal to various sectors but after 1980s, suffered from serious accumulated deficits. As shown in Figure 2-5, the operation of State key mines continued to be at a loss for the most part of years before 1995. The causes to worsen State key mines' operation were mostly related to collapse of the planned economy system, in which State key mines received a huge amount of subsidies to cover their producing cost in stead of low price supplying to users and had less incentives to reduce their cost. Consequently, the deficits of coal industry put a severe strain on finance of central government, which could not afford to invest their budget in constructing new coal

mines and in filling a increasing deficit anymore. Therefore, Chinese government's leaders seemed to decide to revitalize Town village mines through deregulation, which were located outside of former planned economy, to overcome the energy shortage problems.

**Figure 2-5: Profits / deficits of State key mines**



Note: 1995 data is excluded from figure because its coverage is different from other years'.

Source: prepared by author

The major principles of development of coal industry during open and reform period can be summarized as three set phrases, “Walking by two legs”, “Going forward in parallel with large, medium and small” and “Let stagnant water stream quickly”. The first one, “Walking by two legs”, indicates development with coordination of “two legs”, that is, State key mines and Local mines (Provincial/County mines and Town village mines). And the second one, “Going forward in parallel with large, medium and small” indicates development not only by large scaled mines but also by small mines. Both of them were intended to change the former planned economy system centering State key mines in producing coal to market oriented system supported by various actors. Based on those two principles, in the first half of 1980s a series of deregulation to Town village mines on their authorization, management and taxation were promoted. Besides, the deregulation also included resource allocation, as already discussed before, and the regulation on Town village mines’ mining resource was loosened in 1984. Even if the coal resource was inside of mining area allocated to State key mines, the resource, if which had not yet been extracted, came to be mined by Town village mines. The third phrase, “Let stagnant water stream quickly”, describes this policy, by which stagnant water, that is, unutilized coal resources could be smoothly streamed to a fast flowing river, Town village mines. This deregulation contributed so much in making new actors

enter into market, although it caused a lot of serious problems spontaneously as discussed later.

With regards to liberalization on coal pricing in 1993, it was originally expected to improve the deficits problem of State key mines. Liberalization on coal pricing was introduced along with some measures to reform high cost structure of State key mines and to abolish their increasing subsidies in three years. Their deficits had been getting larger throughout open and reform period and most of them were filled by financial subsidies by government. The subsidies amounted to 5.97 billion yuan in 1995, increased considerably from 350 million yuan in 1985. Since excessively low price, controlled by government was thought as the main reason to increase the deficits of State key mines, it was expected through liberalization on coal pricing that the level of coal price should be adjusted and each mines should raise their efficiency in consequence of market competition.

However, in fact the reform of State key mines seems to obtain no outstanding results so far and the share of State key mines continued to decrease until 1995 and their deficits are still enormous. The causes of State key mines' deficits, including worsened resource conditions, huge number of surplus workers, enormous social cost, and low productivity, had tried to be solved from 1980s but without any fruits. Even at the final stage of the reform in 1993, liberalization on coal pricing, State key mines lost their leading position in the market.

As mentioned above, in most part of the years after 1980s, State key mines have been in difficulties to raise their coal production to satisfy increased demand caused by rapid economic growth. The purpose of the deregulation for the development of Town village mines can be regarded as a loophole to increase coal supply, not to be confronted with difficult problems to reform State key mines, but to take advantage of the vitality of the outsider restrained in former planned economy system. The development of Town village mines can certainly be established by transformation of coal industry into market economy.

## **2. The causes of the development of Town village mines**

In this section 2, we discuss the causes of how Town village mines made such great developments within the past 20 years. In section 1, I had pointed out that the explosive increase of the number of new mines directly contributed to the growth of the output of Town village mines. However, the loosening of the regulations does not necessarily lead to the establishment of new companies. There must be some other

reasons that have caused thousands of new Town village mines to appear almost over the night. Hereafter, I will explore the reasons of the growth of Town village mines through examining the various conditions that have led to the lowering of coal market entrance barriers.

### **2.1 Mining Resource conditions**

The production process of the coal mining industry is to extract coal resources that are buried under the ground to the surface of the ground, and then deliver to the end users. As a commodity, the value of coal is determined according to different usage. The value of steam coal is depending on its combustibility and the volume of carbon that the coal contains. While the value of the coal used as raw material is determined by such chemical characteristics as viscosity. In other words, the value of coal as a commodity is basically determined by the mining coal seam and the quality is beyond the control of the miners. Particularly for the steam coal, there is not much difference in terms of quality if it is used as fuel, even if the combustion calorie is a little bit lower. This feature helps new actors to participate in this business.

It's clear from the above description that the competitiveness of coal products is to a large degree determined by the kind of coal seam that formulated the coal. The biggest factor that affects the production cost of coal is the depth of the coal seam. Under normal conditions, the deeper the mining has to go, the more problems in relation to ground pressure, water seepage and coal gas that obstruct the production there would be<sup>1</sup>. Such investments that don't directly contribute to the growth of output as expanding the tunnels would go up accordingly. Besides, the cost to convey coal from underground to ground would also increase as the distance from the coal seam to the surface grows. In fact, the production cost would grow drastically along with the increase in depth for the extraction. On the other hand, the thickness of the coal seam determines the return on the investment. As the costs of extraction are determined by the depth the mining has to reach, the thicker the coal seam, the higher the output would be under the same cost conditions. Therefore, the production cost consideration in relation to the depth of the coal seam and the investment efficiency in relation to the thickness of the coal seam must be well balanced.

What are the resource conditions of the coal fields being extracted by the Town village mines? According to the national Town village mines survey conducted in 1996, about

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<sup>1</sup> The other natural condition that severely hampers the coal production is faults. In many cases the tunnels had to be abandoned as coal seam disappear owing to faults. The existence of faults causes great extra costs to mines and too many faults would make the costs of large-scale mechanic production unbearably high. Therefore it is more advantageous to small mines as they could move their working surfaces more flexibly. As this article mainly focuses on the extra costs caused by moving the working surface deeper down, no special attention is paid to faults. However, it does not mean the author overlooks the impacts that faults have to the scale of mines.

60%-70% of all the coal seam extracted by Town village mines is within 100 meters under the ground. Of which, 40% of the Town village mines are mining coal that are within 50 meters under the ground; around 10%-20% of the Town village mines is mining coal buried between 100 meters to 200 meters under the ground. Only 10% of the Town village mines are mining coal buried deeper than 200 meters under the ground. On the other hand, according to the same survey, 40% of the coal seam mined by Town village mines are thicker than 2 meters; 30% are between 1.3 meters to 2 meters and the rest 30% are less than 1.3 meters. It is clear that the coal bed conditions are rather advantageous to the Town village mines.

The mining resource conditions are even better in those areas that are rich in the coal resources. For instance, in Shanxi province, where the coal output is the highest in China, more than half of the output are from the Town village mines. Table 2-4 shows the mining conditions of the Town village mines, which clearly reflect the how good those conditions are.

**Table 2-4: Resource conditions extracted by Town village mines in Shanxi**

Depth	Number of mines (%)	Coal production (%)
50m>	43	32
50m-100m	31	34
100m-200m	20	26
200m-300m	4	6
300m<	2	2
Thickness	Number of mines (%)	Coal production (%)
1.3m>	6	4
1.3m-2.0m	19	15
2.0m-3.5m	15	10
3.5m<	60	71

Source: [15]

From the above analysis we could conclude that the good mining conditions contributed to the competitiveness of the Town village mines. Although the resource conditions are different to Town village mines in different locations, comparing to the national key coal mines in the same area, the Town village mines are not in an obviously disadvantageous position in terms of resource conditions. Considering the situations in other countries, for instance in Japan, where in the past the resource conditions of the small to medium sized mines were quite inferior comparing to the large ones, the situation of the Town village mines in China is particularly different. And this special situation in China has been a side effect caused by the loosening of

the restrictions during open and reform period. We will analyze this situation in greater detail in the following sections.

## **2.2 Mining technologies**

As coal industry is an industry under the ground, its production needs certain technologies to ensure ventilation, support protection and stabilize the ground pressure, etc. There are two principle methods in coal mining: room and pillar mining and longwall mining. The room and pillar mining, as it is called, means to not to mine part of the coal seam and keep them as pillars to prevent cave in. More specifically, it means to mine the coal seam through digging tunnels like a checkerboard and keep many square coal pillars arranged according to certain patterns. The longwall mining, on the other hand, means to dig tunnels around the coal bed and start the production after the coal bed is completely exposed. The working surface could be as long as several scores of meters, even longer than 200 meters. As the working surface is very big, the mining could be conducted in a line and move forward simultaneously. The coal seam after the mining collapse by themselves.

Historically, the mining of coal gradually transformed from room and pillar mining to the longwall mining. That's because the intensification of the working surface largely determines the efficiency of the coal industry. The room and pillar mining splits up the working surfaces, accordingly the production turns to be labor intensive. Mechanized production requests larger working surfaces. Therefore, since the 1960s the longwall mining gradually replaced the room and pillar mining in coal mining industry. Under the background of drastic increases of labor costs and the more work needed be done by machines, the other coal production countries represented by Japan all turned to the long cliff mining method along with the large scale mechanization of the mining industry.

The other reason that helped to popularize longwall mining is the increasing depth of the working surfaces. We have indicated in the previous part that the production costs of coal mines are determined by the mining depth. However, as the transportation costs increase as a direct ratio to the distance between the coal mine and the end users, the producers are facing the choices either to give up the old coal mine and to develop new coal mines that are farther away from the end users, or move the working surfaces to the deeper coal seam. Along with the increasing maturity of the long cliff mining method, the mining costs of deeper coal seam turned out to be lower comparing to the long distance transportation costs. Besides, comparing to longwall mining, room and pillar mining produces more coal gas as part of the coal seam is left un-mined. In addition, technically, the room and pillar mining is only suitable to more shallow coal seam as the ground pressure, which grows along with the mining depth, would reach

to unacceptable level when the mining depth reaches certain degree. As the depth of the coal mining increases, the conditions of ventilation and ground pressure worsens. Gradually, longwall mining was adopted by more and more coal mines. Besides, the resource recovery rate of room and pillar mining is low, as considerable parts of the coal seam are used as supporting pillars, which does not help to reduce the extra costs caused by the increased depth of the coal mines. So the higher resource recovery ratio under longwall mining was another factor that helped to promote its increasing popularity.

However, there are a few shortcomings in the longwall mining. Firstly, it needs large capital investment as it is a highly capital-intensive production method. Secondly, the production could only commence after the working surfaces are completely exposed, that means there is a long preparatory period, which does not directly contribute to the production. On the other hand, under the room and pillar mining, the production could immediately start once the coal seam is being reached. The investment costs in room and pillar mining is greatly reduced as ground pressure is used for support and protection. Comparing to the technically complicated longwall mining, it is much easier to adopt room and pillar mining in mining coal.

Then, let's see what mining method the Town village mines adopted. According to the survey, about 20% of the Town village mines in China choose the longwall mining and the rest 80% all use the room and pillar mining. By analyzing the data in different provinces, it is found that the selection of coal mining method genuinely reflected the resource conditions in different localities. The adoption rate of longwall mining amongst the Town village mines located in those areas that have superb coal resource extraction conditions like Shanxi province, Shannxi province and Inner Mongolia autonomous region is only 9% (12% in terms of output). Comparing to that, the adoption rate of longwall mining in those areas that are deficient in coal resources is much higher. It is 40% in the northeastern regions, 46% in Anhui province, 32% in Fujian province, 25% in Hunan province. The coal seam in Shanxi province are shallow in depth and coal seam themselves are thick, so technically the room and pillar mining is practical and highly efficient. It could be concluded that for the Town village mines in those areas, there is little capital and technical barriers for them to easily participate in market competition as they could employ large numbers of surplus labors in the rural areas and engage them in the labor intensive coal mining production.

### **2.3 Market structure**

In Japan and in other countries, the transformation of the market structure must not be overlooked while we examine the process during which the small mines died out. When Japan was still in Meiji period, the large coal mines mainly concentrated on

large export businesses targeted at Shanghai market, while the small mines mainly provided coal for salt making industry and for the daily use of local residents. Afterwards, as the domestic demand for coal in Japan increased along with the increasing demand for coal by waterway, railway, industries, power generation as well as the expansion of the numbers of coal users, the large mines also started to supply coal to the domestic market. Gradually the market share of small mines diminished.

How come the advantages of large mines were expanded while the number of coal users grew and the market structure became more intensified? In another word, why did the small mines survive when the market was scattered and the number of end users were limited?

Firstly, there are the impacts of transportation cost to the overall production costs. In coal industry, the transportation cost represents a large share in the price charged to the end users. It is quite normal if the transportation cost is higher than the production costs in the coal mines. Railway/waterway and truck transportation are the two common means in transporting coal. While the scale of end users were small and geologically scattered, the railway transportation costs of large mines that were located farther away would certainly be higher than the truck transportation costs of small mines located closer to the end users. Therefore, the regionally divided markets of coal often forms as a result of the geological locations.

After the establishment of the nationally integrated coal market, the large mines set up large scaled sales network through the well-planned utilization of railway and waterways based upon their control of the small end users scattered across the country. The small mines, which had targeted at satisfying the local demands for coal, lost the bases for survival. In fact, after examining the history of coal industry in Japan, we would see that large mines that performed well like Mitsui, Mitsubishi. laid a good foundation for their future transformation into comprehensive large companies by establishing highly sophisticated sales network based upon their well developed information collection functions. In Japan, the large mines strengthened their competitiveness to the small mines in the region by gradually enhancing their market information collection functions.

Besides, the other impact that the market structure had on the scale of the mines is the quality of the coal. As the scale of the end users expand, the advantages that large mines had on the coal quality were being strengthened. Take the example of coal used for power generation industry, the larger the boilers of the power plant, the more stable

they request to the quality of the coal to be<sup>2</sup>. It is the advantage of the large mines that they could supply large volumes of coal with stable quality, which reduced the competitiveness of the small mines.

It could be concluded that, the limited scale of the end users and the scattered market structure affected the scale of the mines through the transportation cost, the information collection cost and also the required coal quality, which all had been the key conditions for the survival of small mines. Then, let's discuss next what kind of roles the market structure play in the process of the rapid growth of the small Town village mines since the 1980s.

Let's first have a look at the power industry, which is the largest coal consumer. The capacity of thermal generators in China grew from 45.55 million KW in 1980 to 209.88 million KW in 1998, an increase of 4.6 times. As a result, the volume of coal consumed by power industry grew the fastest in all the industrial sectors since 1980s. The percentage of coal consumed by the power industry jumped from 20.7% in 1980 to 39.4% in 1998. (China Statistics Yearbook, 2000 edition).

Table 2-5 shows the total number of the generator units and the total volume of generation capacity by the scales. From the table we could see that although China

**Table 2-5: Number of thermal generator units and their total installed capacity by scale**

	1990		1995		1998	
	Number	Installed capacity (MW)	Number	Installed capacity (MW)	Number	Installed capacity (MW)
more than 300MW	46	15,070	123	42,075	209	71,337
200MW-300MW	120	24,160	177	35,600	192	38,610
100MW-200MW	187	20,570	250	27,844	299	33,697
50MW-100MW	224	11,361	309	16,050	362	18,704
25MW-50MW	358	9,364	475	13,531	522	14,094
12MW-25MW	502	6,401	761	9,601	843	10,585
6MW-12MW	718	4,645	1,332	9,585	1,595	11,497
less than 6MW	-	10,274	-	11,755	-	13,459

Source: prepared by author based on data in *The almanac of China power* each version

<sup>2</sup> The control to coal ash content is particularly important. The different boilers tolerate different levels of coal ash content. If the specification of coal ash content is not up to the standard, the efficiency of the boilers would be affected as melted coal ash would stick to the boilers and in some cases it might threaten the normal work of the boilers (page 68, Okamoto [1994]).

ranks 2nd in the world in terms of combined generator capacity, the majority of the generator capacity is comprised of small to medium capacity generator units. Of which, generator units with less than 100MW generation capacity accounted to 32.2% of the overall generator capacity and generator units with less than 25MW generation capacity even accounted to 16.8% of the total generation capacity. What is more noticeable is that while large scale power plants with generator capacity higher than 300MW are being constructed in the 1990s, many small to medium scale power plants with 100MW generator capacity have been constructed as well, although its percentage is lower than before.

Since more local investments were allowed in the power industry along with the open and reform policies, those town village governments that have long been troubled with power shortages encouraged the construction of the small scale power plants. Besides, as the power plants sell electricity to the power grids based upon the cost-up method, the power generation costs as well as the profits of the power plants were guaranteed to a certain degree. Therefore, being regarded as a quite profitable business, the construction of power plants attracted investments from various sources. However, under the planned economy system, coal, as a form of fuel, were supplied to the large state owned power plants as a preferential policy. Those small power plants invested by the non-state-owned entities were excluded from the coal supply system. The system works like the following. Every year there would be a coal ordering conference attended by the mines, the end users and the transportation departments (railway, waterway and ports), in which the parties negotiate on the quantities and prices of the coal to be supplied to each end users in the next year. It is said that before 1993, basically most of the coal produced by the State key mines were sold through such coal ordering conferences. Even now, considerable volumes of coal produced by State key mines were sold through the coal ordering conference, although the volume was lower than before. For instance, in the coal ordering conference held on March 2001, 390 million tons were agreed to be distributed through this channel, which amounts to about 40% of assumed coal production in 2001. The coal ordering conference still has a huge impact on the distribution of coal produced by the State key mines. However, only large state owned enterprises are allowed to participate in the allocation of coal produced by the State key mines through the coal ordering conferences and the small sized power plants have to depend on themselves for the supply of fuel coal.

Except for the power industry, there are other more scattered and smaller scale coal users. For instance, as Table 2-6 shows, there are 500,972 sets of coal-fired boilers in 1997, of which, industrial boilers account to 23,8923 sets, and household boilers account to 262,049 sets. The overall capacity of those boilers is 1,211,834t/h, and the

average installed capacity per one boiler is only 2.42t/h (by the end of 1998), each of which annually consumes only 700 tons. Those small boilers consume about 350 million tons of coal each year, which corresponds to about 29% of total coal consumption. Such small coal-fire boilers have been mostly built by the town village enterprises that came into being in large numbers along with the transition to the market economy since the open and reform. According to other data, before 1980s the number of coal fired boilers was about 200 thousands units and their installed capacity was 370 thousands t/h. It is made clear by simple calculation that for only 20 years, 300 thousands units consuming only 700 tons of coal a year, has newly entered into the coal market, in which 200 million tons of coal newly were needed to be allocated to those boilers. Like the small power plants, those town village enterprises have been excluded from the coal supply system under the old planned economy system. Such newly established enterprises urgently needed to get coal supplied out of the planned coal supply system as materials for the production. Such needs provided the favorable environment for the existence of Town village mines.

**Table 2-6: Number and installed capacity of industrial/household boilers**

	Number of Units	Installed capacity
Industrial boiler	238923	697330t/h
		57.5%
		average 2.92t/h
Household boiler	262049	514504t/h
		42.5%
		average 1.96t/h
total	500972	1211834t/h
		average 2.42t/h

Note: Data is for the end of 1997

Source: prepared by author based on [18]

**Table 2-7: Difference in coal distribution among different types of mines**

	Total production	Volume distributed beyond province	Volume distributed beyond county
State key mines	482 million tons	301 million tons (62.5%)	n.a.
Town village mines	579 million tons	112 million tons (19.4%)	249 million tons (43.0%)

Source: prepared by author based on [17]

In fact, as shown in Table 2-7, 55.7% of the coal produced by the town village mines have been consumed within the same county that the Town village mines are located

and only 19.4% of the output have been transported to the other provinces. In contrast, 62.5% of the output of State key mines are distributed to other provinces through long distance transportation. It is clearly shown that the users of the Town village mines are the local power plants and enterprises scattered around the same area.

The above mentioned market structure is one of the key factors that contributed to the growth of the Town village mines. In another word, as the growing demand for coal caused by the open and reform policy is scattered and small in scale, it is more beneficial to the development of small Town village mines and it provided a bigger market space for the Town village mines to compete in.

#### **2.4 Free riding**

In the 1980s the Chinese government issued a lot of policies to encourage the Town village mines to participate in the market competition. In the previous section, we had described the regulation policy that encouraged the free market competition. The most distinctive feature of that policy was to allow the operation of Town village mines even in the mining area possessed by State key mines, described as “Let stagnant water stream quickly”. As a result, the total number of Town village mines inside of State key mines’ mining area reached 14,432 in 1995.

The fact that up to 20% of the Town village mines are engaged in the production activities within the key state owned coal fields worth certain attention. It had tremendously contributed to the development of the Town village mines as they utilized various operational resources of the key state owned coal fields and avoided lots of costs otherwise needed to be paid for. This will be explained by the following examples.

Firstly, the Town village mines established on the key state owned coal fields did not have to invest on the various infrastructures. Simply by paying royalties, the Town village mines were able to utilize the railways, roads and power resources that have been constructed by the key state owned collieries through heavy investments. Under normal situations, coal production could only commence after the above mentioned large-scale infrastructure constructions are completed. Not burdened by those investments has been a key factor that helped most Town village mines to participate in the market competition within such a short period. Besides, because they are mining inside the State key mines’ mining area, the Town village mines saved the investment on conducting geological resource surveys.

On the other hand, the southern China traditionally is deficient in coal resources. Large-scale coal developments were conducted in those regions in the past because of

political reasons. However, as little consideration was given to the geological distribution of the coal resources in the past, those coal mining programs suffered setbacks. New evaluations were conducted to those coal mining programs at the end of 1970s and many large coal mines in southern China were closed. In those areas where there are many abandoned large coal mines, it is quite easy for the Town village mines to find the coal seam by redeveloping those abandoned large coal mines. Consequently, the initial investments were greatly reduced.

### **3. The evaluation of the development of the Town village mines**

How should the development of Town village mines brought by the deregulation be evaluated? Below we would first look at their positive sides.

From the point of view of increasing the coal output, the development of Town village mines has been undoubtedly successful. As described in section one, the total volume of coal output increased by leaps and bounds as a result of the participation of the production of many Town village mines. For the town village enterprises, which came into being as a result of the economic reforms and as they were not included in the planned economic system, their success to a large degree is attributable to the Town village mines that have provided them with the important production material – coal. Besides, the functions that the Town village mines played in easing the pressures on railway transportation, which has been the bottleneck that had constrained the economic development, should be fully recognized. As there are certain distances between the coal production areas to that of the coal consumption areas, in many places the gap between coal demand and coal supply has been a long time problem. Under normal situations, coal are transported from the coal resource rich northern areas to the coaster areas where the economy is developing rapidly through railway or waterways. As the output of local mines has been increased owing to the contributions of the Town village mines in the eastern and southern China, to a certain degree, those local Town village mines helped to satisfy the local demand for coal.

The Town village mines also played an important role in developing the rural economy. The benefits of the economic reforms had been first shown in the rural areas and the agriculture productivity had been greatly improved in the early 1980s. Consequently, there appeared large numbers of surplus labors in the rural areas. Many of them went to look for jobs in the cities and caused many social problems. Under such a situation, the Town village mines with 3.01 million employees helped to absorb the surplus labors in the rural areas where there are few other industries.

However, during the mean time, the growth in the output volume of Town village mines also caused serious problems. As indicated in the previous sections, the majority of the Town village mines mushroomed to participate in the market as a result of the loosening of the regulation. The production of those Town village mines has been a kind of extensive coal production. Externally, such extensive productions were reflected in the plundering of the coal resources, increased injury and fatal accidents and the environmental pollution. In this section, hereafter let's look at the negative sides of the Town village mines more specifically.

### **3.1 Lower resource recovery rate**

The resource recovery rate of the Town village mines is extremely low. It is more clearly reflected in the areas that are rich in the coal resources. According to a rough survey, normally the resource recovery rate of the Town village mines is only 10%-15%, which is too low comparing to the 60%-70% resource recovery rate of the State key mines. The main cause of the low resource recovery rate is the backward technologies used by the Town village mines in the production. It has been indicated in the previous discussion that more than 80% of all the Town village mines adopted room and pillar mining in mining coal. Under this method, large volumes of coal resources that had been used as supporting pillars in the coal mines were abandoned under the ground later on. The resource recovery rate of that method would certainly be low comparing to the longwall mining method.

The problems do not stop there. Next, let's have a look at the equipment in the Town village mines. There are some data that reflected the popularity of basic production equipment in the Town village mines (mine winch, ventilation fans, water pumps, mine lumps, gas inspection instruments). According to the data, up until 1995, about 33,486 Town village mines had those basic production equipment, which represented only 45.9% of the total number of the Town village mines. It is difficult to talk about such problems as seepage and gas that also affect the coal production in simple words as those problems are different in different coal mines, however, those problems would occur when the mining reaches 10s of meters under the ground and gradually become more serious. For those Town village mines without the basic production equipment, they only exploit the coal seam close to the surface of the ground and they abandon the coal fields once the mining conditions deteriorate. Those Town village mines develop the coal fields in a destructive manner and once the mining costs go up, they immediately transfer the working surface to the new coal seam. All these contributed to the 10%-15% low resource recovery rate in the Town village mines.

In the section 2, we analyzed data related to the depth and thickness of the coal seam developed by the Town village mines. It shows that the Town village mines basically

concentrate on mining the thick coal seam that are close to the ground surface. That means they either exploit the thick coal seam, or they abandon the thin coal seam that would otherwise increase the mining costs. To the Town village mines, the costs of mining new coal fields are often lower than the costs of deepening the working surface to extract coal buried deeper under the ground. That's because the new coal seam are located close to the ground surface and the costs of digging tunnels are very low. Besides, comparing to mining the thin coal seam, finding thick coal seam brought higher mining efficiency. Therefore, that kind of practice is widely spread in the coal resource rich Shanxi province and the northwestern provinces where coal resource conditions are quite favorable.

What made the matters worse was the deregulation policy that had greatly helped to alleviate the restrictions on the coal industry in the beginning of open and reform drive. As this policy allowed Town village mines to engage in production activities in the key state owned coal fields, the output volume of coal had grown drastically within a very short period of time as Town village mines benefited from many costs savings. Now the drawbacks caused by that policy start to constrain the further development of the coal industry in the future.

When the liberalization policy was formulated, it only allowed the Town village mines to work on the neighboring areas of the key state owned coal fields. Its objective was to let the Town village mines to utilize the infrastructures that have been invested and constructed by the key state owned coal mines. However, along with the constant moving of the working surfaces, gradually the Town village mines started to mine the coal seam that belonged to the key state owned coal mines for the hope of finding new coal.

For the Town village mines, in stead of keeping a distance from the key state owned coal fields, they tend to be as close to the center of the key state owned coal fields as possible in order to fully utilize the various production equipment and infrastructure facilities. However, serious problems would occur once the Town village mines start to mine the coal seam that have been targeted by the key state owned coal mines. That's because the coal production schedule of the State key mines had been made in advance according to the cost calculations while taking into account of the lifecycle of the coal fields.

As currently the Town village mines only exploit the shallowly buried coal seam and abandon the coal seam buried deeper under the ground, in the future, even if the abandoned coal seam were to be redeveloped, such redevelopment costs would not be recovered. Even for those shallowly buried coal seam that have only been partially

exploited, it would be difficult to recover the costs of digging new tunnels and mining the remaining coal seam because the coal that were easy to be mined with low cost had already been exploited. In fact, when the State key mines expanded the tunnels and tried to develop new coal fields, it is quite common for them to find that the actual life cycle of the new coal fields were much shorter than the designed life cycle. That's because the Town village mines had already exploited the targeted coal seam without any long term view or planning and thus ruined the coal fields.

For instance, there are 275 Town village mines working on the coal field managed by the Datong Mineral Bureau, the number one coal field in China in terms of output. As much as 278 million tons of the coal resources could not be recovered as a result of the disordered mining by the Town village mines. The losses of Yanzishan Coal Mine reached 129 million tons and Sitaigou Coal Mine lost 49 million tons and its life cycle was shortened by 12 years. The annual output of Sitaigou coal mine dropped from the designed output volume of 5 millions to only 2 million tons. There is another example. Kangcheng Coal Mine, which is under the Handan Mineral Bureau of Hebei province, has become famous for its law suits against the Town village mines that had caused severe losses to the Kangcheng Coal Mine. There are 254 Town village mines mining on the coal fields belonged to the Kangcheng Coal Mine. Those Town village mines caused losses up to 8.37 million tons of coal resources that could not be recovered as a result of their plundering. Consequently, the output of Kangcheng Coal Mine dropped from 430,000 tons in 1991 to 250,000 tons in 1993.

### **3.2 Increase of fatal accidents**

Of all the industrial productions, coal production is one of the most dangerous as such dangers as cave in, coal ash explosion, gas leakage and seepage might occur at any time. As coal mining progresses deeper under the ground, coal gradually die out, so the working surface needs to be constantly moved to mine new coal resources. Therefore, extra investments on safety measures are needed along with the moving of the working surfaces. We could see by looking at the details of the production costs of the key state owned coal mines that normally safety and protection investment account to 15%-20% of the total cost, although the percentage varies according to different mining conditions in different coal fields. However, such investments on safety and protection measures often were sacrificed as targets for cost reduction.

The following data shows the dangerous operation environment of the Town village mines. In 1995, there were 17,066 Town village mines worked in single tunnel, using natural ventilation, applying lighting, explosives and switches that had not been treated for explosion prevention. The figure represented 64.5% of the total number of the Town village mines. In 1998, 6304 fatal accidents were caused by coal production.

Of which, 4575 were employees of the Town village mines, which accounted to 72.6% of the total deaths. If we compare the fatal accidents per one million tons of coal output, for the key state owned coal mines it was 1.04, and for the Town village mines it was 8.86. The latter is eight times more than the former. Such drastic differences are really shocking.

Comparing to the past, it needs to be admitted that the security situation of the Town village mines has been improved. The fatal accidents per one million tons coal output in 1978 in the Town village mines reached 13.81. However, calculated by the actual output volume of that year, the death toll was only 1316. That means the annual absolute death toll increased 3.5 times along with the growth of the output volume. It could hardly be denied that Town village mines increase their output at the costs of the increasing number of work-related injuries and deaths in those Town village mines.

### **3.3 Environmental pollution**

The negative effects caused by coal production to the environment include the accumulation of human refuses, ground subsides, pollution to the underground water, etc. Here we cannot analyze the environmental pollution caused by the Town village mines as there isn't sufficient data in this area. However, from the quality of coal provided by the Town village mines, it could be said that the environmental pollution caused by Town village mines is more severe than what is caused by the state owned coal mines. Although there is no national data on the quality of Town village mines, the following could show that the quality of coal provided by Town village mines is inferior to the quality of coal provided by the state owned coal mines.

Firstly, the coal ash content and the sulfur content of coal provided by the Town village mines is high because most of the coal produced by the Town village mines were supplied to the market without going through the coal preparation process. As stated in the previous sections, normally Town village mines only exploit the shallowly buried coal seam. The carbonization degree of the shallow coal seam is low as those coal seam were only formed at a later stage. Therefore, the coal ash content of those coal seam is quite high. Coal with high coal ash content normally discharge more coal dusts as the combustion efficiency is low. However, the coal preparation process could effectively reduce coal ash content. On the other hand, coal preparation process could eliminate 50% of the pyrite sulfur content in coal. The overall sulfur elimination could also reach 20% by the coal preparation process. Generally speaking, most of the sulfur content in coal produced in China belongs to pyrite organic sulfur, so the coal preparation process could effectively reduce the sulfur content in the coal in China. In reality, the coal preparation rate of the Town village mines is only 7%, which is much less than 46.8% coal preparation rate of the State key mines (Table 2-8). Therefore, from the popularity of the coal preparation process in the Town village mines,

it could be understood that the quality of coal provided by the Town village mines is most likely inferior to the quality of coal provided by the key state owned coal mines.

**Table 2-8: Diffusion of coal preparation by types of mines (1997)**

Type of coal mine	Coal production (million tons)	Prepared coal (million tons)	percentage of prepared coal (%)
State key mine	526.11	246.19	46.8
Province/County mine	225.67	52	23.0
Town village mine	573.22	40	7.0
Total	1325	338.19	25.6

Source: *China Coal*, Vol. 26 No. 1, Jan. 2000.

In addition, looking at the development process of the Town village mines, many of them are mining in areas where no state owned coal mines existed before. The reason that no state owned coal mines in those areas was the quality of the coal seam were not good enough as quality of the coal seam had been one of the important factors that determined whether to make the investment or not. For those Town village mines that came into being and quickly started production as a result of the loosening of restrictions, basically no consideration was given to the quality issue. Consequently, many Town village mines are mining coal seam with high coal ash and sulfur contents.

In the section 2 and 3, we analyzed and evaluated the reasons that caused the development of Town village mines in the beginning of the open and reform period and pointed out problems it had brought about. The key points could be summarized as the following:

Although the degradation of the coal industry contributed to the sharp increase of the number of companies in this field, at the same time, the rapid development of Town village mines also benefited from the excellent coal resource conditions in China, which had made the industry entrance barriers in terms of capital and technical investments very low. The main reasons of the vigorous development of Town village mines are that they took advantage of the plentiful surplus labors in the rural areas and engaged in labor intensive production that does not require much capital and technical investments. However, such extensive coal production was conducted at the costs of plundering the resources, the increasing fatal accidents and severe environmental pollution. Therefore, such production could not be continued. In such countries as Japan, the United States, Australia, the coal industry has been transforming to a new coal industry that needs considerable investments. Next we would discuss the issue of

how to evaluate the capital and the technical levels of the Town village mines in China.

In the next section, I will examine the ideal combination of capital, technology and labor in the coal industry, starting from the viewpoint of the production scale that clearly reflects the combination of various essential production factors. Based upon that, we will discuss the necessity of implementing industrial policies in the coal industry and further discuss the advantages and disadvantages of the forced closure of coal mines in China.

#### **4. Background of the policy to close the small mines**

##### **4.1 Justifications for the industrial policy in coal industry**

First let's redefine the market positioning of the small mines. Even in Japan small mines also hold certain market shares before. Does this fact show that the existence of small mines economically makes sense?

In manufacturing industry, it is quite common for small sized companies to take certain market shares. Under normal situations, small sized companies could exist in the market either because the product is produced in small volumes but in a great number of varieties, or because the particular company specializes in a certain field and perform better than the large companies in terms of technology. However, in coal industry, the situation is completely different. Coal, as the production target, its quality could not be changed by the producers through investing in the essential production factors. This is especially true for steam coal that are used as fuel. The quality of the coal could mostly be determined by the resource conditions of the coal seam.

In such a case, the scale of the coal mine in the coal industry should also be determined by the coal seam that the company decides to exploit. In other words, if the coal resource reserves that could be exploited is very big, even huge investments could be recovered later on, then investors would make huge investments to expand the production scale. On the other hand, if the coal resource reserves is limited and the coal seam are thin, or there are a lot of faults in the coal seam, the investors would turn to labor intensive small scale production. Under such situations, economically it makes sense for the existence of small mines as they could effectively recover the coal resources that otherwise could not be recovered by the large coal mines. Most likely, such small mines would start production when there is a great demand for coal and when the prices are high. Once the coal market is stagnating and prices fall down, the small mines would suspend production. Therefore, the existence of small mines is marginal.

The investors would expand the scale of the coal mine if the coal resource reserves to be exploited were plentiful. This could also be explained from the perspective of the technologies used for coal mining. It has been indicated in the previous sections that appropriate equipment and technologies are needed in order to exploit the coal resources buried deeper under the ground. The deeper the mining goes, the more sophisticated production equipment would be needed as such problems as gas, ground pressure, seepage, that hamper the coal production would be more serious. Besides, the extra costs of extending the tunnels would also increase. As such fixed costs that increase along with the increasing depth of the coal seam to be mined represent a large share of the overall costs, so unless the output would be huge, the costs of moving the working surface deeper under the ground would not be recovered. Therefore, the production scale of the coal mines in the coal resource rich coal fields normally is quite large.

Some people might notice there is an inherent precondition in the above discussion. If the relationship between the scale of resource reserves and the scale of the coal mines that have been stated above could be established, from the perspective of effectively recover the resources, the social benefits could be maximized under such a relationship. However, such an ideal situation could not be reached under *laissez-faire*, without any restriction. An effective system must be adopted in order to guarantee such an ideal situation is reached. Such system means the allocation of coal mining area that represent the rights to exploit the coal resources have to be managed strictly. The objective of the system is to ensure effective recovery of the coal resources under the ground and minimize abandonment of the coal resources. Therefore, while allocating the coal mining area, it is very important to allow companies with superior capital and technical capabilities to exploit the coal resources that have good mining conditions. Small mines could be allowed to exploit those lean coal resources where no large scale capital and technical investment is needed and those shallow coal seam could be exploited at relatively lower costs.

From the perspective of effectively recovering the limited resources, it is critical to allocate coal mines with superior capital and technical capabilities to coal fields with more resources in reserves. That's because the characteristic of the coal industry determines that the deeper the working surface goes, the higher the mining costs would be. Therefore, for those coal mines trying to maximize profits within a short period of time, the best way is to concentrate on the shallow coal seam that need little investment and remove the working surface to the other shallow coal seam once the costs start to increase. Strict management for allocation of coal resources must be implemented in order to completely put an end to such practices. The rights to exploit the coal fields

rich in resource reserves should only be allocated to those coal mines able to make appropriate capital and technical investments in order to exploit the deeply buried coal seam.

It could be concluded from the above analysis that it is necessary for the government to be involved in the market resource allocation in order to effectively utilize the resources. Of course, in principle, the involvement of the government should be restricted to the management of coal mining area only. Once the government has allocated the coal resources as the rights for coal mining should be freely traded in the market so that the social resources could be best allocated. Besides, the government should limit the number of coal fields supplied to the market so that the trading prices of the mining rights in the market would not be too low and let the trading prices reflect the overall resource reserves in the coal fields. Thus, coal mines would also be motivated to exploit the thin coal seam buried deeper under the ground that require higher production costs.

In the previous section, it had been indicated that the coal industry in China as represented by the Town village mines developed in leaps and bounds during the process of open to the outside world. However, as those Town village mines adopted the extensive production method, the problem of resource plundering is becoming more and more serious in China. Then, did the Chinese government apply its coal resource management functions in the coal industry? In the next part, let's review the problems brought by the Town village mines that had developed along with the loosening of restrictions during the open and reform drive.

#### **4.2 China's case: closure of small mines to solve externalities**

Did the Town village mines in China remain in small scale because the coal resource reserves are limited and only suitable to small-scale production?

In China, the status of the exploitable coal resources could be classified based upon the following indicators: the economically exploitable reserves; the un-economical exploitable reserves and the recoverable reserves (re-exploiting the abandoned mine fields). The so-called economically exploitable reserves refers to the coal resources that are regarded exploitable under the current mining technologies and at the same time economically worthwhile after conducting resource survey. The un-economical exploitable reserves refers the coal resources that are not targeted for exploitation after conducting resources survey, because the coal seam are too thin and economically is not worthwhile for exploitation, or because the coal ash content is too high (combustion calorie is low), or because the mining conditions are unworkable owing to faults, gas or seepage. The recoverable reserves refers to the redevelopment of the

remaining coal seam that the large coal mine had mined before. For instance, using labor intensive mining method to recover the remaining supporting coal pillars that could not be recovered by using machines.

According to the above classification, in 1995, 64.3% of the Town village mines focused on the economically exploitable coal reserves (65.7% in terms of output). 14.7% of the Town village mines focused on the recoverable coal reserves (15.5% in terms of output). Geologically, the Town village mines focused on recoverable coal reserves in the 3 provinces in the northeastern region accounted to 30.8%, the eastern coaster areas accounted to 35%, the middle and southern areas accounted to 22%. Historically, large scale coal mines used to develop in those areas, particularly in the eastern and southern areas. Later on those large coal mines gave up because economically it was not worthwhile for them to continue. So the Town village mines redeveloped those coal fields that had been abandoned by the large coal mines. The remaining 21% Town village mines focused on the un-economical exploitable reserves (11.4% in terms of output).

From the above data, we could see that economically it is reasonable for part of the small Town village mines to exist. To the 35.7% Town village mines that focused on recoverable coal reserves or un-economical exploitable coal reserves, their existence reflected the resource conditions, although they may be small in scale<sup>3</sup>. Such Town village mines more often are located in the areas that are poor in coal resource reserves. For instance, about half of the Town village mines in Sichuan province are engaged in mining coal seam that are thinner than 1.3 meters. One third of the Town village mines in the province work on coal seam range from 1.3 to 2 meters. Only a very small percentage of Town village mines are engaged in mining coal seam that is thicker than 2 meters. Sichuan province ranks third in terms of the coal output in China, however, its resource reserves is only 1% of the national total. The high output of Sichuan province shows how much coal resources have been recovered under such difficult resource conditions. In fact, the resource recovery rate in some of the Town village mines in Sichuan province reached 70%-85%.

Even so, the fact that the remaining large numbers of Town village mines engaged in mining the economically exploitable reserves shows that there are still mismatches between the resources and the capital and technologies. In other words, the Town

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<sup>3</sup> It must be pointed out that it does not mean that there is no problem with those Town village mines that exploit the un-economical exploitable coal reserves. As more often the products of those Town village mines contain high coal ash or sulfur content, they cause great negative impacts to the environment. Therefore, it is necessary to put those Town village mines under control. This article mainly discusses resource-plundering issue and the environmental issues would be discussed in another article.

village mines have plundered considerable resources that could have been exploited in large scale through heavy investments in capital and technologies. As stated in the previous section, such Town village mines are mainly located in coal resource rich areas such as Shanxi province and other northwestern provinces.

A close look at the resource development situation of the Town village mines in China shows that there is no balance between the mines' capital and technical capabilities and the resource conditions of the coal fields that the mines are engaged in mining. The ever more serious plundering of the coal resources in China reflects that apparently the government did not fully apply its intervention functions such as managing the coal fields. Here, let's first check why the market measures could not solve the problem externally. As stated before, the market should be able to effectively allocate the resources through the minimum government intervention in managing the allocation of coal resources. As long as the ownership is clarified, such external problems as wasting the resources could be efficiently resolved by the market itself (Coase rule). However, in reality, the plundering of resources caused by the Town village mines that came into being under the market oriented reform drive since the 1980s have been growing to be more and more serious. The cause of the problem lies in the division of the coal fields. In another word, the fundamental cause of the worsening situation is that the ownership of the coal fields have not been clarified while dividing the coal fields.

In the past, the allocation of coal resources as the coal mining area in the coal industry in China is extremely ambiguous. For instance, coal mining area with more than 100 million tons of coal in reserves, which could be exploited for over 100 years has been set as the standard for dividing the key state owned coal fields. Because the size of the coal mining area is so big and there are huge volumes of exploitable coal seam, the government issued the policy that allowed the Town village mines to work on State key mines' mining area. The policy did not clarify the ownership of the coal mining area at all. Under such a situation, the Town village mines would certainly not pay the royalties that should have been collected for the exploitation of under ground resources. Besides, the resource recovery rate makes no sense to the Town village mines under that policy. Naturally, the Town village mines simply abandoned the thin coal seam buried deep under the ground. The extremely low resource recovery rate in the Town village mines could be explained by the above stated economic incentives.

In the above we reviewed the problems caused by the loosening restrictions in the coal industry in China since the 1980s. It is necessary to manage the coal resources strictly in order to stop plundering of the coal resources. At any rate, government must not let the numerous Town village mines that are active in the market place to develop freely.

In stead, necessary intervention from the government is needed in order to keep the balance between the resource conditions and the scale of the mines. The participation of the mines in the market should be restricted through policies formulated based upon the standard that could keep the balance between the scale of the mines to that of the coal resources to be exploited. Thus selective elimination of the mines could be implemented.

## **5. Recent policies and their prospects**

### **5.1 Progress of the policies in 1990s**

Since the 1990s, the plundering of resources caused by the Town village mines aroused much attention from the Chinese government. During period of time, the energy shortage lasted throughout the 1980s were finally put to an end. Therefore, it is now possible to review the system that had encouraged the development of the Town village mines in order to boost up the coal output. In the Working Conference on the National Town village mines held in March 1994, the subject of re-examining the development format that had focused on the Town village mines was clearly raised for the first time. During the meeting, the vice-premier Zou Jia Hua at the time, expressed great concerns to the many problems existed in the Town village mines in his speech. Those problems included the following. Many Town village mines started production without the basic production equipment. Fatal accidents occurred frequently. The resource recovery rate was low and many resources had been plundered. Mr. Zou mentioned that the state would not let go of the plundering that threatened the coal seam in the key state owned coal fields and he made it clear that Town village mines would be rectified and straightened out.

Various laws and regulations were issued after the Working Conference on the National Town village mines. In Dec. 1994, "The Management Methods of Coal Production Licenses and Management Regulations on Town village mines" were promulgated. In Aug. 1996 "The Coal Law" was passed and "The Mineral Resources Law" was amended. All those laws and regulations included clauses that forbade the Town village mines to plunder the resources.

It is clearly stipulated in the Management Methods of Coal Production Licenses that mines engaged in coal production must be re-inspected and they must apply for production licenses. The inspection standards are that the mines must have basic production and safety equipment, the coal seam to be exploited need to be confirmed and the certain resource recovery rate should be reached under certain resource conditions. The Management Regulation on Town village mines was fully targeted at

the Town village mines. It had reiterated the basic policy that all coal resources are owned by the state. It also clearly stated that although the state would continue to support the development of Town village mines, the state would strictly manage all the coal resources. According to “The Management Regulation”, Town village mines working on the State key mines’ coal mining area must observe the following rules. Firstly, the Town village mine must obtain approvals from the State key mines and the Ministry of Coal Industry (at that time). Mining could only be conducted in the designated coal seam and the Town village mines are not allowed to seize resources and exploit coal seam belong to other coal mines. Also the Town village mines must have the necessary production, safety and environmental protection equipment. What particularly attracts attention is the requirement to the Town village mines that they must have the necessary capital, technologies, production equipment and talents that are inline with the designed production scale before the Town village mines are allowed to start production. It shows that the government had realized the basis for the intervention in the coal industry, which is the balance between the resource conditions and that of the capital and technical capabilities of the coal mines. Since then, the laws and regulation on governing the coal industry have been more comprehensive and complete after the promulgation of The Coal Law and the amendments to The Mineral Resources Law.

According to the above laws and regulations, Town village mines must reapply for the production licenses and the mining permits. Without such licenses and permits, any mining activities would be deemed illegal. “The Mineral Resources Law” in particular strictly stipulated the division of coal fields and basically no Town village mines are allowed to exploit coal resources in the key state owned coal fields. That means the deregulation policy that had supported the development of Town village mines from the beginning of the open and reform drive has been fundamentally changed.

## **5.2 Enforcement of closure of small mines**

The industrial policy of closing the small mines and reducing the output was implemented in 1998 after the relevant laws and regulations had been put into place. The mainly targeted mines were those without the production licenses and mining permits. In another word, the small mines that plundered the coal resources with good conditions by extensive coal production, most of them were Town village mines were closed down and the overall output volume was reduced. According to the program, a total number of 25,800 small mines would be forced to close from Nov. 1998 to the end of 1999 and the overall output volume would be reduced by 250 million tons. In reality, there were 61,000 small mines in 1998, so 42% of the small mines were to be forced to close. Then, let’s see what kind of small mines were included in the closure list.

The characteristics of the small mines to be closed and the detailed rules were announced in the “National Policy Conference on Closing Illegal and Geologically Unsuitable Mines” held on Nov. 11 and 12 1998. Three types of mines were included in the closure list (Table 2-9). (1) 10,600 mines exploiting coal seam within coal mining area possessed by State key mines (the output of those mines were 143 million tons). (2) 14,600 illegal mines that did not obtain the production licenses and mining permits, even though those mines were not located in the key state owned coal fields (output volume 104 million tons). (3) 600 mines producing high sulfur content coal and did not have coal preparation facilities (output volume 5 million tons)<sup>4</sup>. Of all the small mines that did not obtain the production licenses and the mining permits, 51,200 of the small mines were engaged in illegal production (output volume 430 million tons). Of which, 13,000 small mines were exploiting coal resources in the key state owned coal fields (output volume 114 million tons). That means more than 20,000 illegal mines were not included in the closure list<sup>5</sup>. However, most of the illegal mines that survived were mining coal resources outside the territory of key state owned coal fields, and the majority of the small mines within the territory of the State key mines were to be forced to close. Apparently, the objective of the adjustment was those small mines within the territories of the State key mines.

**Table 2-9: List of closed small mines in the campaign**

	Number of Mines	Reduced production
Mines within State key mines' mining area	10,600	143 million tons
Mines without the production licenses and mining permits	14,600	104 million tons
Mines mining high sulfur coal without coal preparation	600	5 million tons
Total	25,800	About 250 million tons

Source: [9]

<sup>4</sup> Here some attention should be paid to the fact that the percentage of mines producing high sulfur content coal (sulfur content is higher than 3%) is very low. While talking about the implementation of the closure policy to the small Town village mines, the common view is that the targets should be the small mines that cause environmental pollution. In fact, as analyzed in this article, the biggest objective of the closure policy has been to prevent plundering resources. The controlling to the mines producing high sulfur content coal was quite superficial. Through a survey on mines in Hunan province conducted by the author (conducted in 2001), it is confirmed that the Town village mines producing coal with more than 3% sulfur content were not even included in the closure list and the production has been continuing.

<sup>5</sup> By the way, of the 10,600 Town village mines working on the coal fields of the key state owed mines, 3300 of them are the legal mines that have obtained the production licenses and the mining permits (annual output 60 million tons). The reason that those legal Town village mines were also included in the closure list is that they fight with the State key mines for market share and hampered the production of the State key mines, while the resource recovery rate is much higher in the State key mines, even though those Town village mines did not plunder the resources.

Geologically, the small mines that had been targeted for closure mainly located in the coal resource rich areas including Shanxi, Henan, Inner Mongolia, Heilongjiang, Guizhou. 10,100 mines in those 5 provinces were the targeted to be closed (output volume 161 million tons), which accounted to 39.3% of the total number of mines to be closed. In terms of output volume, those mines represented 64.2% of the total. As stated in the previous section, the output volume of those Town village mines has been quite considerable. That shows in those areas the resource recovery rate in the Town village mines were extremely low. The problem of plundering the coal resources with favorable resource conditions has been particularly serious in those areas. In sharp contrast, the Town village mines in Sichuan and Hunan provinces, where the output volume of the Town village mines was also very high, were not listed as key targets for closure. The reason might be the high resource recovery rate reached by those Town village mines exploiting resources with unfavorable conditions, or because the existence of the Town village mines in those two provinces would help to alleviate the shortage of coal supply in the local markets.

No new mines were allowed to be established while small mines were being closed and coal output volume was being reduced. In order to implement the closure policy and force those small mines to stop coal production, railways, power plants and banks were not allowed to do business with those small mines that were on the closure list. The actors to enforce the closure policy were led by the State Economic and Trade Commission in the central government and the State Administration of Coal Industry was responsible for the implementation of the policy. Special horizontal committees were to be established locally in order to monitor the implementation on the provincial, city and town village levels.

### **5.3 Difficulties in the closure of small mines and the prospects**

Let's have a look at the progress made by the end of 1999 on closing the small mines and reducing the output volume. The overall national coal output volume in 1999 was 1.023 billion tons. Comparing to 1996, when the coal output volume reached the highest point in China, within 3 years more than 350 million tons had been reduced, which accounted to 25.6% of the total output volume. During the period of time, 31,200 small mines were forced to close but 37,900 small mines were allowed to continue. Looking at the output structure, in 1996, the output volume of State key mines accounted to 39.1% of the total volume, Province/County mines 16.2% and Town village mines 44.7%. By the end of 1999, the output volume of State key mines reached 49% of the total volume, state owned local mines 20% and Town village mines only accounted to 31%. The percentage of the Town village mines' output volume had been greatly reduced. From the statistics, without a doubt, the closure

policy had been quite successful. According to certain data, the coal output volume in 2000 was further reduced to around 950 million tons.

The question is whether the policy on closing the Town village mines would be continued in the future. Could the coal industry structure that heavily depends on Town village mines be reformed? The following difficulties need to be overcome if the closure policy targeted at the small Town village mines is to be continued.

The first one is whether the reforms in the State key mines would progress smoothly. As analyzed in section 1, the growth in coal output in the beginning stage of the open and reform drive was to a large extent depended upon the development of the Town village mines. Although many problems exist in the Town village mines, comparing to the State key mines that maintained high production costs, the Town village mines successfully provided large volumes of cheap coal to the market. While there is over supply, the objective of reducing the coal supply could be reached by rectifying the Town village mines. However, it is doubtful whether the State key mines could supply the extra coal that used to be provided by the Town village mines when the demand for energy recovers. The fact that the reforming measures to the State key mines initiated in 1992 did not progress smoothly shows how difficult it is to establish a coal supply structure centered on the State key mines under the market economy. It is certainly reasonable to say that, the State key mines were put in a difficult position in the market competition when the Town village mines applied low pricing strategy through extending the production and consequently reduced the market share held by the State key mines. However, the State key mines could not blame the unfair competition of the Town village mines as the only reason that had caused the decline in the State key mines. The fundamental cause of the decline in State key mines has been their low efficiency.

From this perspective, the development road taken by the Town village mines during open and reform period could be the direction for the reforms in the State key mines. The Town village mines only took a step ahead. As at the time, the policy of “walking by two legs” were implemented, the reforming to the State key mines were suspended, which resulted in the fact that now the issue needs to be re-addressed. Some people hold the opinion that the government had actually intended to have the local governments trim down the State key mines by handing over management of State key mines to the local governments before the policy of closing small mines and reducing the output volume was implemented. Anyway, the fundamental problem of the State key mines could only be resolved by making progresses in reforming the State key mines. The future of this task is unpredictable because it is extremely difficult to carry out the reforming policies in the State key mines.

Besides, as long as the entrance cost of the coal industry remains to be low and there are still large spaces in the market allow the existence of small Town village mines, later the small Town village mines would re-enter the market and start production once the situations permit, even though the forced closure policy is successfully implemented in certain period of time. On the other hand, it is undeniable that the Town village mines, as the engine of the economic prosperity in the rural areas, had greatly contributed to the development of rural economy. Many rural areas in China are extremely poor. In some areas, the coal production industry offered lots of employment opportunities to the local labor and tax revenues from the coal industry accounted more than half of the total local tax revenues. Below, the author would examine the situation of Henan province, which ranked 2nd in terms of coal output volume in China, a province the author had visited.

According to certain sources, since 1998, according to the “Basic Standards of Town village mines in Henan Province”, 2175 small Town village mines in the province were forced to close and the annual output volume was reduced by 20.26 million tons. The targets for the closures were those illegal mines without the mining permits and those mines within the territories of the key state owned coal mines. After the rectification, around 1800-1900 Town village mines were allowed to continue coal production. However, even the provincial coal management bureau admitted that part of the Town village mines that had been closed down started illegal production later on after the rectification. That shows the closure policy has not been successfully enforced. The background of the slowdown by the local government against the closure policy is the importance of the Town village mines to the local economy.

In order to prove the difficulties in closure of mines, firstly let’s have a look at the impacts of the closure policy to the local economy. In many areas in Henan province, the Town village mines played the role of pushing forward the local economy. Here we would take the example of Pingdingshan city, where the production volume accounted to 36% of the overall output volume of the Henan province, which ranks second to Shanxi province.

The output volume of Province/County mines and Town village mines accounted almost 50% of the total output volume of the Pingdingshan city, which also represented 33% of the total production volume of the local mines in Henan province. The number of Town village mines jumped from 45 in 1976 to 522 in 1985 in the city. The combined output volume of the Town village mines and the 18 local state owned mines was 9.93 million tons, and the combined number of employees reached 68,483. By the end of 1990, there were 567 local mines in the city, of which, 17 were local

state owned mines, annual output 4.43 million tons. 550 were Town village mines, annual output 8.99 million tons. By the end of 1998, there were altogether 1237 local mines in the city, of which, 15 were Province/County mines and 1222 were Town village mines (the designed annual production volume was 17.83 million tons). The production volume of the Town village mines accounted to 80% of the total production volume of the local mines. From 1949 to 1998, the city altogether produced 260 million tons of coal, of which, 170 million tons of coal was produced by the Town village mines. Apparently the Town village mines had become the main coal producers in the city.

Not only important to the local economy, the Town village mines also have huge impacts on the local finance situation. In Lushan county, Baofeng county, and Shilong district of Pingdingshan city, 50%-90% of the annual local tax revenues are contributed by the coal industry. Such phenomenon is not limited to Pingdingshan city alone. The tax revenue contributed by the local coal industry often represents a big share of the total local financial income in all the places where the coal output reach a certain degree. The more rural area the place is, the more important the coal industry is to the local financial income. There are lots of places where 80% of the financial income comes from the local coal industry.

Pingdingshan city plans to reduce the number of Town village mines to 800 by the end of 1999 and finally reduce the number to 600 in three years. The final coal output is planned to be reduced to around 6 million tons. To compensate the reductions, the city would promote diversified business operations in other industries in order to obtain RMB 150 million increased sales income and absorb 10,000 employees from the coal industry. The success of this plan is depending on whether the diversification operation in other industries could be smoothly carried out. Considering how much the local economy depends on the coal industry, it is doubtful whether the closure policy to the Town village mines could be implemented according to the schedule. On the other hand, since the 1990s, the number of Town village mines had been increasing rapidly. Although most of the new Town village mines are small mines, most likely their initial investments have not been recovered yet. There is no compensation clause to such investments in the closure policy and from that perspective, people could also understand how difficult it is to enforce the closure policy to the Town village mines.

Finally I would like to point out the other major difficulty in pushing forward the closure policy, that is how to solve the problem of energy supply within the region. It has been indicated in the previous sections that 57% of the coal produced by the Town village mines are consumed within the region and only 17% are transported to the other provinces. The figure clearly shows much impacts it would have on the local energy market to enforce the closure policy to Town village mines. Those areas that

used to get coal supply from the Town village mines that have been closed are facing the problems of finding new energy supply channels. However, many places don't want to do that. This attitude had also been indicated during the interview to the managers of the provincial coal industry management bureau.

## **Conclusion**

In this chapter, we have explored the background of striking growth of coal production caused by introduction of market mechanism after 1980s. Also the background and the prospects of aggressive campaign to close small coal mines promoted in recent years have been examined. Major findings can be summarized as following points.

Firstly, the most part of the increased output has been satisfied by Town village mines, most of which are very small scaled and scattered on whole country. Secondly, the most influencing cause for development of those Town village mines was deregulation to introduce market mechanism into coal industry and low entrance barriers to enter into market, in terms of mining resource, mining technology, small scaled and scattered market structure and free riding also helped them participate in coal market within very short period. Thirdly, although their contribution to coal supply increase was very large, they worsened externalities such as resource plundering, increased fatal accidents and environmental pollution at the same time. Fourthly, especially from the perspective of resource protection, the campaign promoted by central government to close down small coal mines can be evaluated as necessary and justified for sustainable development of coal industry. However, lastly, the campaign seems to be difficult to implement because of big impacts to local economy, tax revenue, and energy supply.

Two implications could be brought out from above findings.

The first one is that the difference in performance between coal and oil industry could be caused by the difference in technology introduced to each industry. More concretely, coal industry is more labor intensive than oil industry and therefore, the deregulation of coal industry resulted in stimulating a wide range of actors to participate in market, while that of oil industry obtained no remarkable outcome. State companies are still playing dominant role in oil industry for the reason that it is needed to invest large amount of capital to enter into oil producing market.

The second one is that the energy statistics in these two years seems to have some overestimation in terms of energy consumption decreasing. The energy consumption of China in 1999 was sharply decreased from the level in 1996, cut by 12.2% in only three years, even though annual GDP growth rates in the same period was still kept

high about 7.9% on an average. Consequently, the elasticity of energy consumption to GDP growth turned to negative from 1997. It seems to happen very uncommonly, especially such a short time, because energy prices itself, which is the main cause to lower the elasticity, kept falling. The decrease of energy consumption mostly came from the sharp declining of coal consumption, which had been obtained by political campaign to close small coal mines as discussed in this chapter. However, it is concluded in this chapter that small coal mines targeted to be closed down, has been playing major role in increasing coal production during open and reform period, also more competitive than State key mines, and contributing to local economy, tax revenue and energy supply. Therefore, it seems quite difficult to enforce the campaign according to the plan set by central government. In spite of those difficulties, the target for closure of mines was politically set in advance, and so it can be thought reasonably that statistics are not reflecting real consumption but the political target.

Throughout the course of this chapter, transformation of coal industry in market transition is discussed especially from the perspective of production level. Nevertheless, the coal market structure, such as coal distribution and pricing has also played critical role in the development of Town village mines. I will examine this topic in greater details in the next paper coming soon.

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