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The role of artisanal and small-scale mining in China's economy

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Abstract

The last decades have seen increased international attention paid to a number of features of artisanal and small-scale mining (ASM). The beneficial roles of ASM in society and the economy in many countries, however, are often overlooked, while its negative impacts dominate official press coverage and scholarly publications of the sector. Through a review of the available literature and statistics, this paper works toward building a balanced picture of the overall role of ASM in China. First, the positive and negative impacts of ASM internationally are reviewed, followed by a short review of suggested and actual international policy responses. Then an examination of the impacts and role of ASM in China is undertaken. The authors argue that the contributions of ASM outweigh its negative impacts, but the central government needs to make more effort to regulate, guide and encourage the development of ASM and to create a sound environment for its operations.

Keywords: Role; Artisanal and small-scale mining (ASM); China; Policy

1. Introduction

Artisanal and small-scale mining (ASM) has had unprecedented growth in developing economies over the past few decades. ASM is defined as the use of rudimentary processes to extract valuable minerals from primary and secondary ore bodies, and is characterized by the lack of long-term mine planning/control. It can be illegal or legal, formal or informal and can encompass everything from individual gold panners to medium-scale operations employing thousands of people. In 1999, the International Labour Organization (ILO) estimated that there were between 11 and 13 million artisanal miners worldwide, almost 30% of whom were women [1]. ASM activities emphasize the extraction of a wide range of metals, precious stones, and industrial minerals, and accounts for a significant portion of the world's mineral and energy production.

Academics and especially journalists tend to focus on the negative impacts of ASM, generally underreporting its positive aspects. This is certainly the case in China [2], home of the world's largest ASM sector [3]. While these negative impacts should not be underestimated, overlooking ASM's positive aspects has led to policies that focus on the negative, with little consideration for the wider consequences. Through a review of the available literature and statistics, this paper works toward building a balanced picture of the overall role of ASM in China. First, the positive and negative impacts of ASM internationally are reviewed, followed by a short review of suggested and actual international policy responses. Then an examination of the impacts and role of ASM in China is undertaken.

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2. ASM internationally

ASM is an essential activity in many developing countries, as it provides an important source of employment and tax revenue, particularly in remote rural regions with few economic alternatives [4]. An estimated 80 to 100 million people are directly or indirectly dependent upon ASM for their livelihoods [5]. Hilson [6] argues that ASM plays a pivotal role in alleviating poverty in the developing world and contributes significantly to national revenues and foreign exchange earnings.

However, the employment, income and production generated from ASM often come with significant costs to miners' and nearby communities' health, safety, and environment. ASM hazards are many and varied, including: poor ground conditions leading to underground tunnel failure, methane or coal dust explosions from coal mines, flooding, machinery accidents, poor lighting and ventilation, explosives accidents, and electrocution [7]. Hydraulic monitoring of secondary deposits can also be extremely unsafe, as there is potential to undercut hill slopes and generate landslides [1]. Mercury (Hg), cyanide and other hazardous chemicals are used as reagents for recovering and purifying gold and other precious metals. Small-scale gold mining is a significant source of Hg to the environment, with as much as 800 tons/yr of metallic mercury being released into the environment worldwide [8]. Every year, about 120 to 240 tons of mercury are released into the environment in China alone due to gold amalgamation [9,10]. Fine dust from mineral processing leading to silicosis, and noise pollution, are endemic problems. ASM accidents are often underreported, due to the illegal or semi-legal status of most ASM operations; the ILO (1999) estimates that non-fatal accidents in ASM are 6–7 times greater than in the formal mining sector [5]. ASM operations can also lead to the destruction of arable and grazing land through excavation, the accelerated erosion of top soils, landslides, the collapse of old workings, unsafe tailings disposal, the lowering of water tables, soil contamination due to dust from mines and tailings, and increased levels of sediment load and flooding in nearby rivers.

In addition, ASM has been associated with a host of negative social impacts, especially in the boomtowns that arise from big mineral finds in remote locations. These include challenges such as prostitution, substance abuse, and gambling. Women are often disproportionately affected by these factors [11].

ASM is often regulated by the same legislation (i.e., for the environment, labour, mineral rights, exploration and permitting) as the formal mining industry. ASM compliance is generally low, due to the low education, lack of finance and poor levels of technology available to the miners.

The ASM academic literature frequently highlights policy alternatives intended to improve the overall situation for the miners. Hilson [6] argued that the international community could do much more to improve sustainability in the ASM industry by: (1) legalizing ASM and implementing sector-specific legislation; (2) contributing to community development and providing increased economic support; and (3) providing training and educational assistance, and playing an expanded role in the dissemination and transfer of important technologies. For India, Ghose [12] indicated that implementing educational-training related initiatives could facilitate additional environmental improvement at sites. In Brazil, Macedo et al. [13] suggested that the following could mitigate the impacts of ASM: improving coordination among public entities responsible for the control of the ASM sector; undertaking environmental management and reclamation initiatives; carrying out research and diffusing mining and environmental technology; developing and implementing appropriate licensing procedures for ASM; reviewing environmental impact evaluation and enforcement procedures; and improving regional planning. In Zambia, Kambani [14] suggested that institutions responsible for managing the environment were unable to effectively carry out regulatory and monitoring mandates due to inadequate resources, and recommended making it mandatory for all mining activities, including ASM, to submit environmental impact assessment reports before a license to mine or explore is granted. In Bolivia, Quiroga [15] outlined a preliminary strategy to move against social inequity in ASM. This strategy revolves mainly around implementing alternative sustainable livelihoods with the participation of the government (central and local), the private sector, NGOs and donors as facilitators and partners. It aims to reduce the number of families eking out a living from artisanal mining in order to enhance the viability of ASM. Hilson and Van Der Vorst [16] reviewed a series of strategies for improving environmental performance in the small-scale gold mining industry and concluded that while conditions varied regionally, few regulations and policies existed specifically for small-scale gold mining activity in developing countries. They argued that a combination of policy-, management- and technology-related initiatives was needed to facilitate environmental improvement in the industry.

In a handful of countries, legislation has been implemented in attempts to address some of the concerns mentioned above. Bugnosen et al. [17] conducted a pilot study on ASM legislations and argued that a growing number of Third World countries were introducing laws and regulations for their respective ASM sectors, but that these had not necessarily helped to promote the sectors' growth, and had not made significant improvements to the social and environmental problems associated with the sector. Since 1989, when ASM in Ghana was legalized,[1] a lot of interest had been generated in the sector because of its socio-economic benefits. However, owing to the lack of the necessary training and inadequate financial base on the part of small-scale operators, most operations are poorly managed environmentally [18]. A more positive example is the Department of Mining in Papua New Guinea (PNG), which has become a proactive source of educational activities and information gathering for ASM, leading to the creation of a comprehensive development plan for the sector [19]. This has resulted in a tripartite program with active participation from a number of donor agencies, and a private sector that promotes integrated rural development and takes into account the important economic and environmental aspects vital for effective poverty alleviation.

3. ASM in China

ASM in China is unique due to several features: foremost is the scale – China has more small-scale miners mining a larger diversity of ores than anywhere else in the world. ASM is found in all of the main administrative regions except Shanghai. The next unique characteristic of Chinese ASM is that coal is the most important commodity produced, rather than gold, as is the case in most of the world [5]. Third, unlike many countries with ASM, China's overall economy is booming, especially in the eastern coastal regions. Not only do economic migrants have a plethora of employment alternatives available in many regions, but also the booming economy has led to an increased demand for products from ASM. Finally, despite many ASM operations being illegal, the government – especially local government – has been intimately involved in the sector, actively owning, operating and/or encouraging ASM operations, although most have been privatized.

In China, mine size is divided into three categories: large-scale, medium-scale and small-scale, based on the tonnage or volume of ores or minerals extracted by the mines or oil and/or gas fields and depending on ore type.[2] A coal mine with a production capacity of less than 300,000 tons of ore per annum would be considered a small mine, whereas a gold mine with a production of 60,000 tons of ore per annum would be considered a small mine (see Table 1). Most of the small mines are collectively owned township and village mines (TVMs). TVMs are extremely widespread: for example, about 1360 of China's 2200 counties have known coal resources, of which 1257 have TVMs [21]. These TVMs encompass a variety of forms of ownership, including collective mines run at the township and the village level; privately owned mines; and all other mines excluding state mines and those run with foreign investment (Fig. 1).

Table 1
Classification of mining scales for selected minerals (unit: tons)

Mineral	Unit (ores)	Large-scale	Medium-scale	Small-scale
Coal	×100,000	>9	3–9	<3
Iron ores	×100,000	>20	6–20	<6
Copper	×100,000	>10	3–10	<3
Lead	×100,000	>10	3–10	<3
Zinc	×100,000	>10	3–10	<3
Bauxite	×100,000	>10	3–10	<3
Tungsten	×100,000	>10	3–10	<3
Tin	×100,000	>10	3–10	<3
Gold	×100,000	>15	6–15	<6
Phosphate	×100,000	>10	5–10	<5
Pyrite	×100,000	>5	2–5	<2

Source: Extracted partly from Ref. [35].

ASM plays both positive and negative roles in China. On the positive side, it is an important source of mineral and fuel supply both locally and nationally, and can lead to the full utilization of resources by exploiting deposits not favourable to large-scale mining [23]. As ASM is now largely privately owned and market-driven, it can encourage large state-owned mines to be more rational and efficient through competition. It can improve the national industrial layout by producing commodities closer to customers, and can contribute to prosperity in remote rural areas by providing employment and improving rural ecology by decreasing deforestation. On the negative side, ASM operations are often illegal, can encroach onto the concessions of the formal mining sector, leading to safety hazards by undermining existing

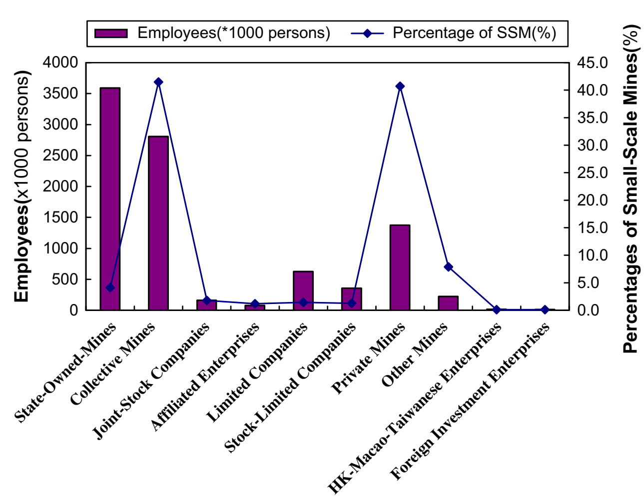

Fig. 1. The ownership structure of small-scale mines in China, 2001. Data source: Ref. [22].

[1] ASM in Ghana was legalized by the PNDC Law 218, 1989.
[2] For details, refer to the Notification of the Ministry of Geology and Mineral Resources on the Classification of Scales of the Mines Construction issued on 17 March 1998. Also, see Zhong [20].

workings while high-grading the deposit; moreover, they often have extremely poor safety records, evade taxes and can cause a host of environmental problems. The negative aspects are comprehensively covered both in the international literature and China-specific articles such as Wright [2], who reviewed a number of Chinese press reports on ASM. The positive aspects of the industry are elaborated upon below.

3.1. ASM: an important source of resources

China has the largest ASM industry in the world in terms of production, as indicated in Table 2, and employment [5]. Table 3 shows the percentages of the number of enterprises, output, gross production values and employment from ASM (excluding oil and natural gas ASM) in their totals relative to the entire mining industry nationwide. In 2001, ASM in China accounted for 95.3% of all mining enterprises and contributed 72.2% of total ore output, 48.6% of gross production value and 54.2% of employment. The small coal mines (SCM) produced more than one-third of coal for the whole coal industry in 1998. During the period 1981–1998, aggregate output of the SCM exceeded 7.5 billion tons, accounting for about 40% of the whole coal mining industry and 25% of national primary energy production.[3]

In China, ASM has greatly mitigated the shortage of energy and minerals caused by the booming economy and has saved large amounts of capital investment in the formal state-owned mining industry. Since Chinese leaders first stressed the ASM industry during the Great Leap Forward, the output of ASM has risen rapidly.[4] Fig. 2 illustrates the growth of SCMs in China since its liberation in 1949. Total output has grown rapidly and almost continuously from around 80,000 tons in 1967 (in the early stages of the Cultural Revolution) to just over 600 million tons in 1996, increasing at an average rate of 14% per year [2]. Almost 60% of coal output, and more than 90% of the mines, were SCMs producing below 30,000 tons per annum (see Table 4).

3.2. ASM: an essential competitor in resource markets

The success and rapid development of ASM directly led to fierce competition with large and medium-scale state-owned mines, most obviously in the domestic coal market since the early-1990s. By the late-1990s, SCMs became the outcasts of China's coal industry, first due to their poor safety and environmental record and second because of the oversupply of coal that threatened the viability of the large state-owned coal mines (SOCMs). As a result, the SCMs have been subject to one of the most vigorous and sustained programs of mine closure ever seen [28]. Due to its advantages in terms of low production costs, flexible operation and sales mechanisms, ASM had gradually increased its share of China's coal market (Fig. 3), especially in the areas where SCMs were located. This competition repressed the rise of coal prices and forced SOCMs to take all possible measures to develop their access to capital, mine development and operation models, production management, employment structure, and distribution of profits, so as to improve their competitiveness. The reasons why ASM has the low costs could be attributed to many aspects but the following factors could not be ignored: their low technology, poor safety and environment, unskilled workforce, and tax avoidance. In addition, the rise of ASM also encouraged the development of new mining legislation and a new mineral resources management system, introduced in 1986.

By 1997, the combination of pressure from the Asian Financial Crisis and hugely competitive ASM coal industry forced China to turn to macro-economic and political policies in order to provide some protection for the SOCMs. Fig. 4 provides a clear picture of how SCM production growth fell sharply against the state mines during the major changes of economic policies in the mid-1980s and the late-1990s, and political movements in the late-1960s and the late-1970s.[5] As seen in Fig. 4, the last closure campaign undertaken from 1997 to 2001 led to a significant reduction in both production and the number of SCMs, though only during the two political events was there any actual fall in output. The number of SCMs was reduced from 82,000 in 1997 to only 23,000 with an annual output of 245.94 million tons, in 2001 [29]. Almost 60,000 SCMs (including 1028 state-owned small mines) were closed, leading to a three-fifths reduction of coal output from SCMs. While many of the smallest SCMs closed, the remaining operations often expanded their production to make up the difference. However, since 2002, a surge in demand for coal has led to the expansion of existing SCMs and the reopening of some closed mines [30].

There are three types of competition between ASM and state-owned mines: rights to exploit resources, access to capital, and access to mineral markets. As explained in the next part of discussion, ASM in China

[3] The data are based on Ye and Zhang's publication [26, p. 2–3] and the Statistical Bulletin on the Development of Mineral Resources 1996, 1997, 1998, issued by the former Ministry of Geology and Mineral Resources in 1997 and in 1998, and Ministry of Land and Resources in 1999.

[4] The Great Leap Forward was instituted in early 1958 as a means of greatly accelerating economic growth and advancing socialist construction according to China's specific economic conditions.

[5] Both the Great Leap Forward and the Cultural Revolution happened in these two periods.

Table 2
Chinese productions of several major minerals

Mineral product	China's production in 1997 ('000 tons)	China's world ranking by production	% Produced by Chinese ASM	Number of ASM workers
Aluminium	8000	10	75.6	23,625
Antimony	101	1	46.4	54,599
Coal	1,360,000	1	42.5	2,696,056
Copper, mined	440	8	9.0	54,865
Gold[a]	0.185	5	33.3	463,000
Iron ore	249,000	1	32.1	259,704
Lead, mined	650	1	31.1	83,827
Manganese	2300	1	65.7	74,170
Mercury	0.614	3	8.5	738
Molybdenum	30	2	15.4	11,364
Phosphate rock	30,400	2	51.0	45,145
Salt	29,300	2	10.3	3188
Tin, mined	56	1	44.4	31,906
Tungsten, mined	24	1	35.3	25,599
Zinc, mine	1210	1	31.1	83,827

Source: After Billiton [24] and DFAIT [25].
[a] The gold figures are based on the discussion in section 2.4.2.2 of Ref. [24].

has access to very few proven reserves. This partly explains the reason why most ASM operators in China scramble for resources and profits against the state-owned mines. The state rarely invests in ASM development. According to statistics by the survey of China Mining Association [36], in the period 1985–1995, the average ratio of investment to output for medium-scale SOCMs was RMB213 (US$25.72) per ton. In contrast, the total investment for SCMs producing 300 million tons of coal was RMB64.4 billion (US$7.8 billion), leading to an average ratio of RMB231 (US$ 27.90) per ton. Most ASM mines are largely self-financed and do not require large investments in geological exploration, infrastructure, and production and living facilities. As a result, they have a clear competition advantage in mineral markets because of low production costs. ASM has thus been able to provide inexpensive minerals to aid in the bottom up industrialization of China's countryside while encouraging the formal mining industry to increase competitiveness both domestically and internationally. In contrast to the state-owned large mines, most ASM mines are largely self-financed, although ASM operations do not require large investments in geological reconnaissance, infrastructure, and production and living facilities. As a result, they have a clear competition advantage in mineral markets because of low production costs.

3.3. ASM: an implement for full recovery of resources

A considerable number of ASM operations exploit mineral resources in ore bodies abandoned by large- and medium-scale miners. These deposits are categorized as sub-marginal by the formal mining sector, but are considered exploitable by ASM techniques. ASM, with its more flexible production methods, cheaper labour, smaller equipment and overall lower costs can successfully mine small or almost exhausted deposits that larger operations would never consider. For example, in 1995, SCM produced 156 million tons of coal from about 260,000 coal mining units abandoned by the SOCMs, representing some 27% of total production and 34% of SCM production [26].

Proven reserves legally accessible to ASM are very small. According to our estimates, in 1995, the percentages of proven reserves available for ASM in China were 9.2% of coal, 3.3% of iron ore, 5% of non-ferrous metals and 10% of gold reserves. The annual

Table 3
Position of the ASM in the whole mining industry in 2001

Categories		Number of enterprises		Total output		Gross production value		Employment	
		Number	%	100 million tons	%	RMB billion	%	Million persons	%
Total (excluding oil and natural gas)		153,723	100.0	45.22	100.0	458.35	100.0	7.84	100.0
State-owned mines		7299	4.7	12.56	27.8	235.77	51.4	3.59	45.8
ASM	Collective ASM	125,153	81.4	23.92	52.9	58.44	12.7	2.95	37.6
	Other ASM	21,271	13.8	8.74	19.3	164.15	35.8	1.30	16.6

Source: Ref. [36].

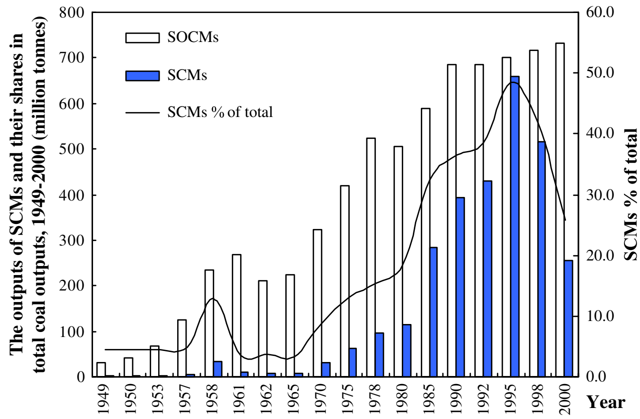

Fig. 2. The variation curve of the SCMs in China's coal industry, 1949–2000. Source: Modified from figure 1 of Ref. [4].

increase of new ASM operations in China from 1984 to 1995, however, was over 10,000. ASM contributed a large proportion of China's production with limited capital investment and relatively limited mineral resources.

3.4. ASM: improving the mining industrial layout of China

Great distances between sources of supply and locations of demand for minerals in China often lead to long distance transportation of resource products. A modern Chinese saying is "coal in the north areas is transported to the south areas, electricity in the west areas is transmitted to the east areas." For both historical and geological reasons, most of the high energy-consuming enterprises are located in the coastal developed areas of eastern China. For instance, coal consumption in the east accounts for about 70% of the total nationwide. On the other hand, most minerals used in the energy industry, especially coal deposits, are located in more remote northwestern areas of China. Only 17% of coal reserves are located in eastern China, most of which are small and exist in complicated geological conditions difficult for large-scale mechanized operations to exploit. They are, however, quite suitable for SCM. Coal resources in the eastern coastal areas, especially in the nine provinces south of the Yangtze River, are exploited by disperse ASM operations. Coal production in the eastern coastal areas was about 52 million tons in 1980, yet amounted to over 240 million tons in 1998, increasing at a rate of 10% per year during the period.[6] Transportation bottlenecks would have made it extremely difficult for northwestern China to supply all of the coal needed for China's massive industrial growth; thus, the ASM sector greatly mitigated the pressure placed on the transportation infrastructure.

Table 4
Production of ASM coal mining shaft in 1995 (unit: tons, %)

	Number	Percentage in total	Production (million)	Percentage in total
Total	72,919	100	579	100
Over 30,000	6646	9.1	245	42.4
10,000–30,000	15,164	20.8	195	33.7
Below 10,000	51,109	70.1	139	23.9

Source: Ref. [27].

Since ASM is found in large areas of most of China's 32 provinces, regions and municipalities, it often bears the responsibility of supplying cheap minerals to economically less developed and remote rural areas. Fig. 5 shows the geographical distribution of ASM enterprises in 31 provinces of China in 2001. Provinces such as Hebei, Shandong, Henan, Hunan and Shanxi have even more output from ASM than those from the State-owned mines.

3.5. ASM: contributing to the prosperity and promotion of local economic development

ASM plays a pivotal role in alleviating poverty and promoting local economic development in mining areas. In 1998, ASM in China earned RMB4.36 billion (US$0.5 billion) in profits and contributed RMB44.07 billion (US$5.3 billion) in tax revenues [32]. Coal ASM has been a pillar to local economies in counties with energy shortages off the main transportation routes and in coal-producing counties. Metal ASM operations bring income into local counties through sales of their products, and industrial ASM operations contribute to the local and regional agriculture and construction industries. In addition, ASM directly leads to the development of other industries, such as transportation, construction (often supplied by other ASM operations), metallurgical and processing industries, chemical industries, the electrical power industry and commercial service industries, in addition to improving local infrastructure.

The case of our ASM field survey on 12 April 2004 in Shahe city of Hebei province provides a good example for the role of ASM in local economic development. Shahe is located in southern Hebei province, in northern China in an area with a highly advanced mining economy. By the end of 2003, there were 290 mines in Shahe, 286 of which were classified as small-scale operations, and only four of which were middle-scale mines. ASM operations produced 48% of the total raw coal and 100% of the iron ore and China clay (kaolinite) in 2003. ASM operations in Shahe provided employment for 15,000 peasants since 2000, greatly mitigating poverty in Shahe's rural areas. According to our survey,

[6] The data are based on Ye and Zhang's publication [26, p. 44] and the Statistical Bulletin on the Development of Mineral Resources 1996, 1997, 1998, issued by the former Ministry of Geology and Mineral Resources in 1997 and in 1998, and Ministry of Land and Resources in 1999.

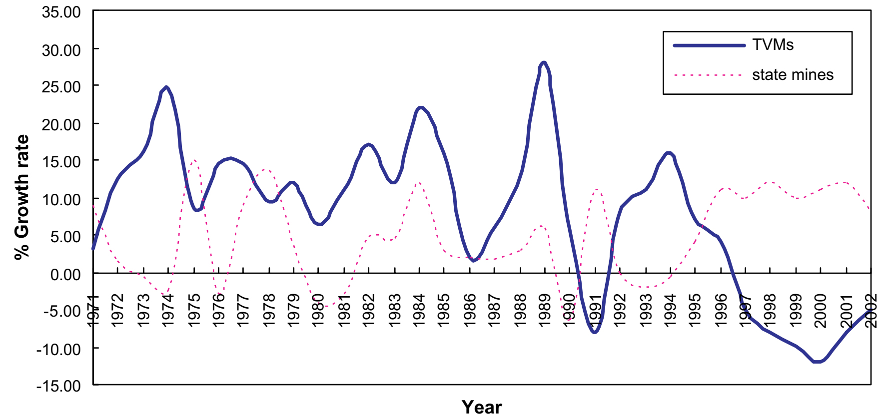

Fig. 3. The growth rate change curve of ASM (mainly TVMs) and state mines in China, 1971–2002. Data source: 1) data in 1971–1996 from Ref. [2]; 2) data in 1997–2000 from Ref. [22]; 3) data in 2001–2002 from author's estimates.

on average, every ASM operation in Shahe could create RMB3 million (US$360,000) of industrial product value annually with an annual profit of RMB0.6 million (US$72,000). The local ASM industry, led to the creation of a series of related industrial developments in Shahe, including ore concentrating and processing, transportation, machinery manufacturing, construction, living and commercial services. In 2003, there were 100 ASM concentrators in Shahe, annually processing more than 4 million tons of ore. The annual income of transportation services due to ASM, involving about 2000 cars and 6000 trucks, amounted to more than RMB30 million (US$3.6 million).

3.6. ASM: contributing to rural employment, mitigating deforestation and improving the social environment

ASM contributes to the improvement of China's environment through supplying cheap mineral fuels to replace traditional firewood. This has resulted in a great reduction in logging, benefited water quality, aided flood control, and helped mitigate soil erosion. Coal consumption in rural China was 274 million tons in 1996, an increase of 91 million from 1987; the consumption of firewood in rural areas was reduced by 60 million tons over the same time period, from 279 million tons to 219 million tons in 1996 [26].

The employment provided by ASM has helped lower crime and suicide rates in rural areas, assisted in raising living standards, and minimized rural–urban migration in ASM areas [26]. ASM has greatly contributed to the provision of financial support to local agriculture, the construction of bridges and roads, education, and rural collective welfare projects, among many others [20].

In the same case of Shahe mentioned above, in recent years, the capital accumulated from ASM has been used to develop the industries of farmland water conservancy, pharmacy, livestock breeding, machine fabrication and various other public undertakings. The Xurui Industrial Company in Shahe, for example, which was established in 1999 as a result of ASM coal mine, has since evolved into a diversified company involved in planting, breeding and milk processing. In 2003, the company reclaimed an area of deserted and sandy land, creating about 667 ha of arable land. Many similar successful experiences can be easily found in Shahe and other ASM areas.

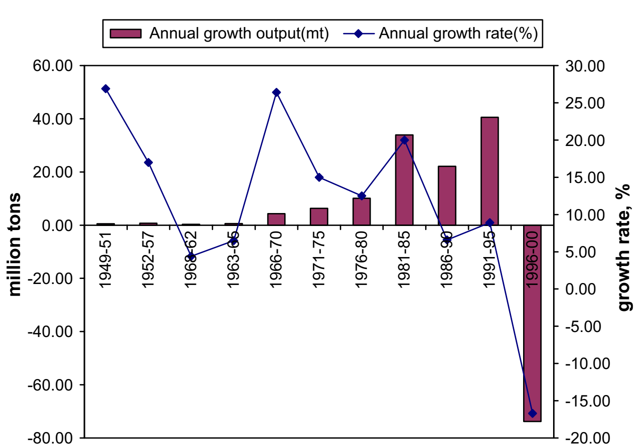

Fig. 4. The growth output and growth rate of ASM (mainly TVMs) in China, during different planned periods. Data source: Ref. [22].

4. Conclusion

Mining is an indispensable economic activity and has been the driver of much of the economic development of many countries. Andrews-Speed et al. [28] argued that ASM might bring tangible, short-term benefits to the communities involved that are outweighed by the costs

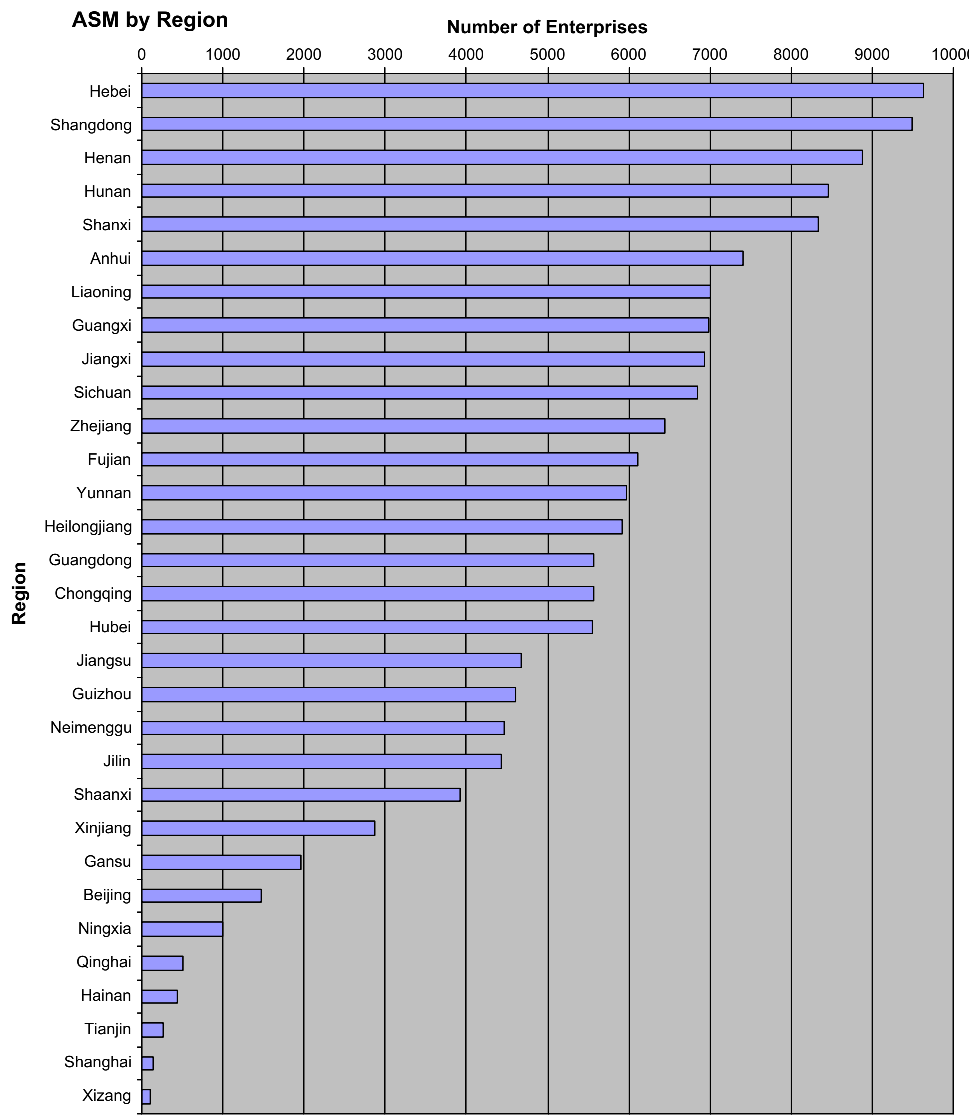

Fig. 5. Geographical distributions of ASM enterprise numbers in China, 2001. Data source: Ref. [31].

incurred in terms of illness, injury, pollution, waste of natural resources and market distortions.

This paper, however, has argued that in the case of China, the contributions of ASM may outweigh its negative impacts, especially if the central government makes more effort to regulate, guide and encourage the development of the industry and create a sound environment for its operators. For proponents of ASM, see a well-regulated industry as the cornerstone of future rural economic development, particularly for disadvantaged communities in poor regions [33]. An appropriate system of laws and regulations and a suitable institutional structure for administration are important requirements for the effective management of small-scale mines [34]. Governments, regional and international bodies must play an expanded role in bridging critical information, technological and economic gaps.

In China, ASM contributes significantly to the supply and full utilization of resources; market competition in the resource sector; reducing transportation bottlenecks; and rural socio-economic and, in some cases, ecological improvement. Legal small-scale mines continue to be an important supplementary source of coal and minerals to China's economy. ASM in China has had great and rapid development in the past and contributed significantly to the development of the economy. For the medium term at least, it is certain that ASM will continue to play a crucial role in China's mining industry.

As with the international experience, the ASM industry in China cannot be expected to effectively regulate itself and mitigate its own negative impacts. However, regulating ASM does not mean destroying it. Governments and international agencies need to build a sound and sustainable small-scale mining environment. With particular respect to China, an appropriate system of laws and regulations, and a suitable institutional structure for administration, are of key importance to the effective management of ASM [34]. A policy for ASM can only be implemented effectively if the interests of most or all relevant parties are adequately met [28].

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