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## Analysis and countermeasures of coal mine accidents based on safety economics

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**Abstract** Aiming at the severe security situation of coal mines in China in recent years, the development and research contents of safety economics are analyzed by combining the principles of economics and safety. By linking the actual production of coal mines and using the cross-discipline of safety economics, the economic reasons for coal mine accidents are summarized as follows: insufficient understanding of the law of safety investment and benefit, chaotic property rights, lack of price incentives, and heavy tax burden on coal mines. There are many cost accounting problems, low cost of mine violations, marketization of risk-taking, centralized supervision rights, and frequent transactions of power and money. Finally, starting from the economic thinking, the corresponding rectification countermeasures are proposed for the economic reasons of coal mine accidents.

**Keywords** Safety economics, Economic law, Safety investment, Cost accounting, Coal mine accidents

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### 1. Introduction

As a microcosm of the safe operation of the national economy, coal mine safety production directly reflects the basic concepts of economic and social development. In recent years, the number of disasters and deaths in coal mines in China has dropped drastically. As shown in Figure 1, the coal mine safety situation has improved significantly, but compared with the United States, Australia, South Africa and other countries, the number of coal mine disasters in China, the number of deaths, the death rate of one million tons is still far above it, and the safety of the coal industry is still serious. The safety of the coal industry is not only related to the image of the government, but also a political, economic and social issue that needs to be resolved urgently [1].

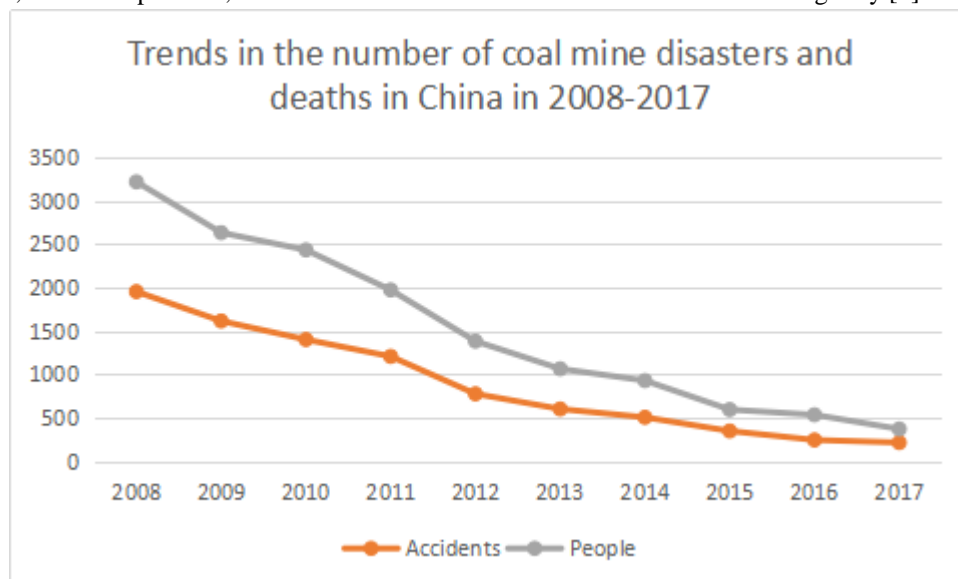


Figure 1: Trends in the number of coal mine disasters and deaths in China in 2008-2017



## **2. Overview of Safety Economics**

In the 1980s, Italian scholar D. Andreoni published the first document entitled "Safety Economics", [2] he explained the consequences of occupational diseases from the perspective of economics, the expenses incurred by workers in occupational diseases, the expenses of enterprises, the expenditures and expenses of intermediate economic groups, and the expenses of the state. Economics has gradually attracted the attention of many scholars. Ks. Son [3] and D. Petcrscn [4] conducted research on the best safety investment in the construction industry in Korea; Kenneth W [5] used the "risk map" technology to study the problem of corporate investment decision-making; The study of benefits has been carried out by Heinrich (1930)-Simonds (1956)-Andreoni (1986)-HSE (British Health and Safety Executive) (1994) for more than 70 years.

In China, the study of safety economics is relatively late, and a relatively complete and systematic theoretical system of safety economics has not yet been formed [6]. However, there are many different opinions on the definition and research content of security economics. Professor Luo Yun pointed out in his article "Discussion on Security Economics" [7]: Security economics is to study security from a security perspective or from a point of view. The interrelationship with the economy is a specific area of the problem, and the main contents of the study of security economics include: safe economic input and its significance and value, social and economic benefits and the best state theory and method to achieve their matching. Professor Zhou Zhongyuan pointed out in his section "Safety Technology and Management of Chemical Safety" [8] Safety Economic Management: Safety economics is based on economic theory, and studies the laws of safety economic activities. The main contents of its research include: economy The impact of factors on safety, the impact of safety accidents on the social economy, the economic benefits of safety, and the application of economic methods in management. According to the book "Modern Security Economic Theory and Practice" edited by Professor Tian Shuicheng, [9] pointed out that security economics is to study economic relations in the security field. These relationships include: secure division of labor, security, economic interests, and security. Safety and economic benefits. Professor Cui Guofan pointed out in his chapter "Safety Management" [10] Safety Economics Overview: Safety economics is a science based on economic theory, which studies: safety theory, including: macro theory, accident The impact on the social economy, the law of the effectiveness of safety activities, the law of benefits, and the scientific management of the security economy. In his article "Research on the Core Principles of Security Economics" [11], Ma Haopeng pointed out that security economics is based on economics and combines the characteristics of security disciplines to infiltrate and apply economic research and analysis methods to safe production activities. The main content of the research is: the rules of pricing, optimization and value analysis in production activities.

The author of this paper believes that security economics is a comprehensive cross-over theory that is applied to economics and applied to safety production practices. It mainly guides the problem of solving safety investment, safety management, safety benefits and optimal allocation of safety resources.

## **3. Economic reasons for coal mine accidents**

### **3.1 Insufficient understanding of the law of safety investment and benefit**

No company in the world will not work hard to improve efficiency. It turns out that reasonable safety investment can reduce and prevent accidents, ensure safe and smooth progress, and thus improve the economic benefits of enterprises [12]. However, due to the misunderstanding of coal mine safety investment, it is considered that increasing the safety investment is equivalent to increasing the cost of coal per ton, which will lead to the reduction of coal mine efficiency, but does not consider the hidden costs, uncontrollable costs, opportunity costs, etc. of accidents. Among them, this has caused coal mine enterprises to pay less attention to safety, unable to eliminate backward production equipment and increase safety and security investment in time. Many bloody accidents are caused by coal mine safety inputs. Due to insufficient investment, the coal mine equipment is aging, the technology is backward, and the underground disaster prevention and disaster resistance is poor, which increases the possibility of accidents [13].

The safety investment and economic benefits of coal mining enterprises seem to be contradictory. In fact, as long as they are treated by dialectics, they can grasp unity in opposition. The "safety input-benefit curve"



proposed by the American scholar Votey [14], as shown in Figure 1, as long as the red benefit curve S is above the blue safety input line L, then the net benefit is  $>0$ , that is, as long as it is safe When investing in the (P1, P2) interval, safety investment can always achieve positive returns. Of course, the most ideal safety input range for safety economics research is (P1, P). If possible, we can determine P point. At this time, the maximum net income |NR| is obtained.

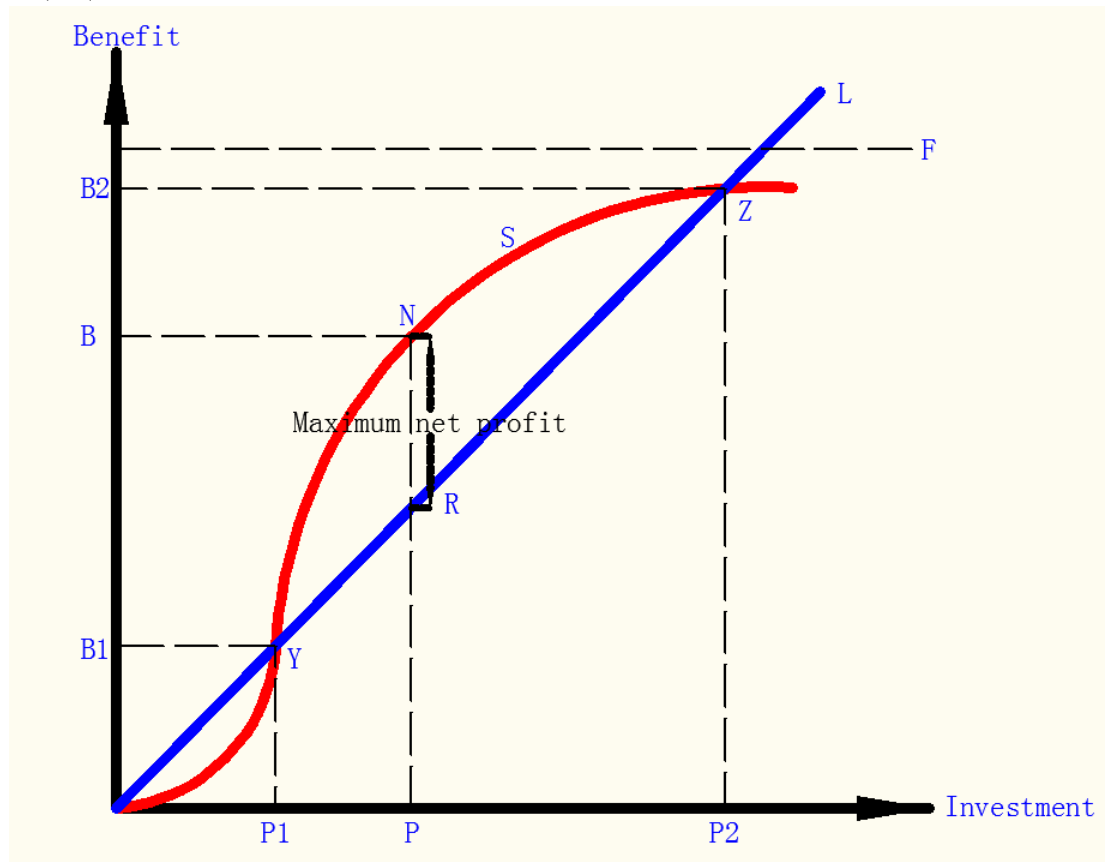


Figure 2: Safety investment-efficiency curve

It is more intuitive to apply the theory of marginal benefit to understand the law of safety input and benefit. The marginal benefit is the difference between the benefit generated after each safety investment and the benefit generated by the last safety investment. For pneumoconiosis, if no measures are taken, coal mining enterprises will face a large amount of compensation and medical treatment costs. However, as the mines adopt dust-proof measures and distribute them to miners' labor insurance supplies, not only the expenses incurred previously have been reduced, It can also reduce the loss of new employees' recruitment and training, improve the mine environment, and improve production efficiency. However, if blindly increase dust-proof and dust-proof technical equipment, it will not help the reduction of miners' pneumoconiosis, but it will increase the company's Cost of production.

### 3.2. The property rights relationship is chaotic and the price is not stimulated

Coase's theorem states that resource allocation is efficient only if the issue of property rights is clearly defined and completely resolved [15]. The development and utilization of coal resources has always been affected by the planned economic system. All localities have possession and control of mining rights without compensation. Coal resources have become an important means for local governments to achieve political achievements. In the reform of the enterprise system with separation of property rights, the property rights relationship of coal mining enterprises is not clear. As the resources of state ownership, they are allocated to local governments. Most of them adopt administrative allocation, instead of adopting market competition methods such as bidding and auction, plus the administrative approval transfer. The norm has led to barbaric mining. Not only does the mining cost not enter the price formation mechanism, but the recovery rate is very low. Especially the small coal



mines waste a lot of resources, and the mining system fundamentally violates the principle of fairness. The ambiguity of private property rights will lead producers to pursue short-term interests and reduce the investment in security fixed assets.

The scarcity of coal resources and the overheating of downstream industries will inevitably lead to a rise in demand for coal prices [16]. On the one hand, this increase led to a decline in the ability of state price regulation, and on the other hand, coal companies were driven out of control due to the surge in prices [17]. Due to the scarcity of coal resources, prices have not truly reflected the relationship between value and supply and demand. Coal mine production cannot be effectively regulated according to market rules. On the one hand, some state-owned large coal mines with overcapacity are too low. Caused the size of the contracted coal mine "coal boss" to make huge profits. It is precisely because of the current coal price plan allocation that coal prices in Shanxi Province, a province with large coal production, have been allocated by the state plan for a few decades, which will inevitably lead to chaos in the coal market order, and once the price rises, the place where coal is concentrated will A safety incident has occurred. As the basic production factor of China, if the government intervenes excessively, it is actually sacrificing the labor value of the workers in the direction of change. This will inevitably cause the coal mining enterprises to squeeze the safety investment for profit, which will have a negligible impact on the coal mine safety production accidents.

### **3.3. The tax burden of coal mines is heavy, and the cost accounting problem is more**

In addition to the mineral resources charges, environmental protection charges, social security charges, and social function charges, the current coal mining enterprises have more funds and administrative fees, such as Sichuan, Guizhou, and Chongqing. The price adjustment fund for foreign transportation coal is levied. The standard for coal price adjustment funds in Guizhou Province is: 50 yuan/t for clean coal, 30 yuan/t for raw coal, and 70 yuan/t for coking coal. At present, the coal mining enterprises have cancelled the product tax and changed the value-added tax, the tax rate is 13%, only the deduction of the value-added tax included in the production expenses, and the actual tax on the original state-owned coal mining enterprises due to the small amount of the coal value-added tax deduction. The negative reached about 9.5%. The coal resource tax is a local tax type and is an important source of taxation for key coal-producing areas. The local governments have increased the tax amount in recent years when the coal situation has risen. Shanxi Province has raised from 1.6 yuan/t to 3.2 yuan/t, and Inner Mongolia has 0.5 yuan / t is raised to 3.2 yuan / t. Generally speaking, after the tax reform, the tax burden of the original state-owned coal mining enterprises increased to about 14%, which was 1.5 times higher than before the tax reform [18].

Although the coal cost accounting framework has been continuously deepened with the reform and opening up, it has basically adapted to the requirements of the socialist market economy management system. However, the following problems still exist: First, the coal cost is incomplete cost, and second, coal mine safety costs and maintenance fees. The extraction standards for subsidies such as subsidence and governance are too dead, and the third is the internal auxiliary business of coal mining enterprises and the unclear accounting of service organizations [19]. The ecological environment damage and compensation costs caused by coal mining should be fully reflected in the cost of coal. However, for various reasons, the cost of coal does not fully contain certain costs, resulting in a lack of environmental management fees in coal costs. . According to the basic requirements of modern accounting, coal cost accounting is a true reflection of actual expenditures in the production process. It is mandatory to stipulate some project accounting factors, which is not conducive to coal cost accounting, but coal mine safety expenditure, maintenance cost and subsidence management in coal cost accounting projects. The extraction standards such as fees have not adapted to the development of enterprises and cannot fully reflect the basic requirements of modern accounting. For non-independent legal persons and non-profit-making workers' hospitals, bathrooms, canteens, etc., they can be accounted for in the welfare fee. Actually, these institutions are still dependent on the survival of coal mining enterprises, resulting in expenses incurred due to different channels of distribution. The cost is not clear, and the cost of raw coal is squeezed, which affects the cost accounting and cost management of raw coal.



### **3.4. Low cost of coal mine violations, market risk exposure**

From the perspective of economics, the total cost of violations = illegal implementation cost + illegal opportunity cost + penalty cost  $\times$  penalty rate, but in the actual operation of coal mining enterprises, the implementation cost of violations and the opportunity cost of violations are relatively low. Levels, compensation for casualties in penalties also have a large gap with developed countries, and the penalty rate is difficult to guarantee, resulting in a low total cost of violations by coal mining companies. Too low compensation standards result in a low valuation of the economic losses of coal mine accidents, which leads to insufficient understanding of the severity of the accidents. This makes the mine owners happy and unwilling to increase their safety investment [20]. There are a large number of low-cost violations in coal mining enterprises and the profits from coal mining enterprises are obviously disproportionate. The existence of this phenomenon of “non-criminal crimes” makes coal mining enterprises finally choose to ignore safety issues for high profits. Therefore, China's relevant laws need to be revised, increase penalties, increase the opportunity cost of violations and accounting costs, and also play a deterrent role [21].

At present, the losses caused by industrial accidents and occupational diseases to the world economy are equivalent to 20 times the official aid received by developing countries, which will result in a 4% reduction in world GDP. This figure does not include some cancer patients and all contagious. Disease [22] In the face of huge economic losses, it is not the coal mine enterprises but the state that the main risk is assumed. In order to reduce the amount of tax payment, the mine owners evade fiscal and tax inspections through the “yin and yang accounts” in addition to this part. In addition to the taxes and fees paid, it is still difficult for coal mining enterprises to play a more important role in the prevention and treatment of pneumoconiosis, emergency rescue of mines, environmental remediation of surface subsidence in the goaf, compensation for serious casualties, etc. The main employer absconded and pushed the risks faced by the company to the government.

### **3.5. Concentration of regulatory rights, multiple transactions of power and money**

The main body of safety supervision of coal enterprises in China is the National Emergency Management Department, and the provincial and local safety supervision bureaus under it, and the Safety Supervision Bureau receives the leadership of higher authorities and local governments, and under the current government management mode. Most of the leading bodies of the Safety Supervision Bureau are elected by the local government's people's congress, which leads to the safety management of coal mining enterprises by the safety supervision bureau, and the exercise of power by the safety supervision bureau reflects the will of the local government. It is impossible for the central government to implement all-weather monitoring of coal enterprises across the country. When the local government's economic interests and social interests are impacted, the local government's game decision-making is often to seek economic benefits and social benefits [23]. This kind of internal supervision is strong and the external weak situation is very likely to lead to the concentration of regulatory rights, forming a self-inspection of "hiding theft", and the people's supervision can only be reduced to a slogan.

In China's coal economy, government regulation will inevitably lead to rent-seeking problems in relevant departments or some officials within the government. In the process of rent-seeking, the collusion between government and business also provides institutional incentives for private coal mines that do not meet the conditions for safe production and should have been suspended for rectification. In some government departments, the illicit production activities of the government provide incentives for illegal production and operation. Coal mines have a negative attitude toward strengthening safety equipment investment and improving workers' working conditions, and government officials who have benefited from it have actually acted as "protective umbrellas" for some illegal mine owners. The issue of safe production has been repeatedly banned. In the final analysis, officials and mine owners have formed a community of interests [24]. As a pillar industry of China's energy industry, coal mining industry plays an important role in national economic production, but the corruption problem is also the hardest hit area of the economic industry. If the government and coal mining enterprises can not cure the power and money, the safety of coal mining enterprises. It is difficult to get a fundamental turnaround in the situation.



#### **4. Economic Countermeasures for Coal Mine Safety Production**

In order to achieve safe production of mines, it is necessary to cover all aspects of safety involved in the production of coal mines. When rationally deploying safety inputs, it is necessary to conduct a comprehensive analysis of the current state of safe production of mines, focusing on the assessment of weak links. It is also necessary to refer to the experience of advanced countries, abide by the law of economic value, and fully think and demonstrate with the thinking of economics. Change the examination and approval system under the traditional planned economy, with the clear approval of the property rights as the threshold for coal mine access, and find ways to make the legal person of the coal mine obtain the property rights of the mine to form a real property right incentive for the mine owner. By adjusting the economic development mode of the downstream industry, on the basis of government regulation, the market order is continuously improved, administrative intervention is reduced, and price increases are boosted by demand. Further revision and improvement of safety cost extraction standards and management methods, scientific assessment and rational formulation of safety cost accrual standards, and regulations for the extraction of standard floating ranges [25]. Continuously improve the accounting system, especially in terms of cost accounting, it should implement full-caliber accounting. It is recommended that in the accounting system, Article 9 of the accounting system includes "environmental governance guarantee" and "conversion development fund". The compensation standard for coal mine safety production accidents has been greatly improved, so that enterprises can not afford accidents in the economy, and they can't afford to die, so that mine management personnel can take the initiative to increase their active investment beforehand. Increase the responsibility of coal mining enterprises in the social insurance of miners, and distribute the mines to disperse the economic losses of accidents and improve the ability of coal mine enterprises to resist accident risks. Adjust the coal mine supervision policy, adopt the current national tax policy to vertically supervise the mine safety, block the non-safety supervision of government personnel from excessively interfering with the mine economy, implement more stringent financial review and punishment methods, and give full play to public opinion and public supervision.

As D. Andreoni said by the "safety economics" proponent: the most high return value of all corporate capital is the security investment. How to rationally allocate security investments to use the limited resources to obtain the maximum security effect and achieve the best security benefits is the focus of attention in this field. Many scholars have made fruitful research in the field of security and economics. I believe that as long as we follow the laws of economics and theories are linked to reality, the security situation of coal mines will be fundamentally reversed.

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