Urban Natural Gas Management and Returns of Stocks

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by

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Acknowledgement

On the occasion that my paper is passed for press, my heart is full of joy and affection. I am so rejoiced and delighted that after the decades of hard work in business, I can go back to the palace of learning in my heart and realize my academic dream of youth. Despite the busy work in business and the heavy work stress, I am able to write the paper successfully. After a number of sleepless nights, I finally make a breakthrough in the ideological plight and myth in a process full of obstacles and hardships and achieve the impressive intellectual enrichment and satisfaction and the academic growth that I would never forget.

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Ultimately, I would like to dedicate this document to my most beloved family, may you always be healthy and happy!

Abstract

Historically, China's energy consumption structure has been characterized by "abundant coal, scarce oil, and limited natural gas." In 2017, coal accounted for 61% of China's energy consumption, oil for 19%, and natural gas for 7%. During the same period, coal constituted 28% and natural gas 23% of the global energy consumption mix. This comparison reveals China's significant reliance on coal resources. The excessive exploitation of coal has led to environmental degradation and pollution, a developmental approach termed "extensive development.". In the pursuit of high-quality development, China has implemented the coal-to-gas policy, mandating the replacement of high-energy-consuming and highly polluting coal-fired boilers with gas-fired ones in certain regions. This policy has significantly accelerated the development of natural gas in China. The demand for natural gas in China increased from 80 billion cubic meters in 2008 to 235.2 billion cubic meters in 2017, with an average annual compound growth rate of 12.5%.

Within the natural gas consumption structure, natural gas has become a crucial energy source for industrial manufacturing. This provides a key metric for analyzing the long-term stock price trends of publicly listed manufacturing companies. The growth rate of natural gas usage is positively correlated with the expansion and contraction cycles of manufacturing enterprises' production capacities. Thus, purchasing company stocks at the point when the growth rate of natural gas usage bottoms out and begins to rebound can lead to excess returns during the new expansion cycle of the enterprise's production capacity.

Key words: Transmission Mechanism; Industrial Gas; Consumption of Fuel Gas; Growth Rate of Profit, Stock Price, Profit Growth; Stock Price; Returns of Stocks

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Urban Natural Gas Management and Returns of Stocks

1. Introduction and Overview

1.1 Relationship between Natural Gas Energy Fluctuation and Stock Market

The research in this paper is made on the theoretical and empirical basis that the use of energy plays an important role in promotion of the real economy and thus plays a role of transmission in the capital market represented by stocks.

At present, the total energy consumption is rising continuously; in the field of real economy, the traditional energy structure dominated by coal results in the sharp increase of environmental protection pressure on Chinese government, the clean energy represented by the urban nature gas is widely recognized by the public and draws the attention from the government; based on the energy substitution strategy of "replacing coal with gas" under the leadership of the government, the demand for natural gas expands continuously from 80 billion cubic meters in 2008 to 304.79 billion cubic meters in 2019, up 8.7% on a year-on-year basis (Data issued by the National Bureau of Statistics).

In the first quarter of 2020, Chinese economy suffered from the influence of "COVID-19"; however, the "Sentiment Index Analysis Report of Chinese Natural Gas Industry in Second Quarter of 2020" [1] issued by China's Natural Gas Industry Sentiment Index Research Center of Southwest Petroleum University reveals that the sentiment index of Chinese natural gas industry in the second quarter of 2020 is 164.14, so the natural gas industry is in a booming state; the sentiment trend index of the natural gas industry in the next year as counted up in the second quarter of 2020 is 256.29, so it is expected that the natural gas industry will be in a highly booming state in the next year.

As the important research indicators in the financial field, both the energy consumption and the energy price have been attracting the attention from the scholars of the capital market; as the "weather forecast" of the national economy, the stock market fundamentally reflects the trend and the future of the national economic development, so there are undoubtedly innumerable links between the fluctuation in the stock market and the energy consumption and price fluctuation; as seen from the historical data retrospect of the American Dow Jones Index, the rise in petroleum price is accompanied by the drop in Dow Jones Index; therefore, there is a certain link between the energy price fluctuation and the stock market.

Nowadays, with regard to the urban pipeline natural gas as a terminal field of use in China, the price of the urban natural gas goes directly to the end consumption users, including various types of commercial and industrial users and residential users, the urban fuel gas enterprises are not authorized to fix the price independently, the selling price is always subject to the fluctuation in market guided price under the government regulation, and the effective market price system is not established for the use and value of the natural gas; therefore, the fluctuation in urban natural gas mainly refers to the fluctuation in gas

[1] China's Natural Gas Industry Sentiment Index Research Center of Southwest Petroleum University (2020). "Sentiment Index Analysis of Chinese Natural Gas Industry in Second Quarter of 2020" [J]. *Natural Gas Industry*, July, 40(7) [in Chinese].

consumption arising from the transmission of fluctuation in government guided price, and the fluctuation in profit of the gas-consuming enterprises as a result of the fluctuation in the gas consumption, all of which will be transmitted to the returns of stock prices; it is proved from the theoretical and the empirical perspective that the transmission effect arising therefrom shall be objective and present the positive transmission effect.

1.2 Literature Review

At present, there is a flood of literature concerning the crude oil price and the stock market fluctuation overseas, but fewer studies on coal and natural gas mainly due to the different energy structures between the countries. The foreign countries are more dependent on petroleum, and China is more dependent on coal and natural gas; second, the position of petroleum as the lifeblood of the economy is still unshakeable; for the Iran-Iraq War and the War in Afghanistan, the political and economic incentives are monopoly of the oil supply. The overseas research on this aspect is mainly divided into three categories, including the research on the integrity of the stock market, the research on the geographical characteristics of countries and regions, and the research on specific industries and typical companies.

To be specific, some foreign scholars study the crude oil price and the return of the stock market by taking the rate of return as an important indicator of stock investment; by studying the return of stocks, some scholars find that this indicator is not affected by the rate of inflation, but the crude oil price has a negative correlation effect on the return of stocks. In 1999, a scholar called Sadorsky made use of VAR models to analyze the impact of oil price on return of stocks and drew the conclusion that there was an asymmetric impact between the oil price and the economy. The more elaborate research was made on the industry; in 1993, two scholars called Al-Mudhaf and Goodwin studied the stocks of 29 oil companies listed on the NYSE at the corporate level, and found that the crude oil price had the main impact on the oil enterprises with the main base established in the USA; in addition, some scholars studies from the perspective of industry classification, and found that the impact and effect on different industries were significantly different, presenting a tendency of positive correlation with the energy industry, and negative correlation with the packing and transportation industries. In 2015, Tsai made use of the big data to analyze a variety of enterprise samples that were subject to different impacts and effects of the crude oil before, during and after the financial crisis, and found that large-sized enterprises were more likely to be affected by fluctuation in the crude oil before the financial crisis, while small and medium-sized enterprises were affected by fluctuation in crude oil price after the financial crisis.

Chinese scholars are influenced by foreign scholars' theoretical research but start the research relatively late. Two scholars called Jin Hongfei and Jin Ying (2010) draw the research conclusions that the crude oil price has impact only on the American stock market, but has no impact on the Chinese stock market; however, this research conclusion is drawn

on the basis of the capital market before the reform of non-tradable shares; in the capital market at that time, the degree of openness was lower, the speculative element was heavier, the market pricing function was abnormal, and the stock price could reflect the real market value of the enterprise, so that it was impossible to make response to the more macroscopic energy fluctuations. In his doctoral thesis[2] published in 2012, Dr. He Wenzhong[2] made use of DCC-GARCH model to research and drew the conclusion that there was a positive volatility spillover effect between the international crude oil price and the stock market, that is, the risk in one market would be significantly transmitted to another market; in the thesis, the impact of the energy price on the stock prices of different industries was also studied, but only the impact of the crude oil price on the stock prices of the industries was studies, and the coal and the natural gas as the important energies were not included in such study, and the comprehensive consideration was not given to the impact of the prices of all energies on the stock prices of the industries.

Based on the review of foreign and Chinese literature, in most research on the relationship between the energy and the fluctuation in stock price, the crude oil price is used as the energy price index variable in the current theoretical cycle, and other important energies such as natural gas are included in the research for analysis; in addition, most research is aimed at nationwide stock price index such as Shanghai Composite Index; there is no research on the stock price index of the listed companies in specific industry, in particular no targeted research on the stock price index of the manufacturing industry in which the natural gas is taken as the main energy and the consumer product, resulting in the lack of a more solid empirical basis.

[2] He, Wenzhong (2012). “Research on the "Spillover Effect" of International Crude Oil Prices on China's Stock Market and Its Transmission Mechanism.” [D] Doctoral Dissertation, Fudan University [in Chinese].

2. Analysis Method

2.1 The Theory of Transmission Mechanism Is a Powerful Analysis Tool

In the study of this paper, in combination with the theory of transmission mechanism, the theoretical deduction and the empirical research are conducted on the existence of the transmission relationship between the urban gas management and the stock price. As an important theoretical analysis tool, the theory of transmission mechanism is summarized as follows: there is a linear transmission relationship between the natural gas consumption and the profit of the gas-consuming enterprise, and there is a linear transmission relationship between the stock price of the listed company and its profitability.

On the basis of the linear transmission relationship between the consumption of the natural gas and the profit of the enterprise, the fluctuation in the consumption of the natural gas will reflect the change in the fundamentals of the enterprise; however, the industrial fuel gas users are facing a more complicated situation, and the consumption of the natural gas and the tolerance of price by such users are quite different. Overall, in the first category, the enterprises must use the fuel gas for their processes, including glass, textile, and medicine; in the second category[3], the enterprises can improve the product quality and reduce the corporate cost effectively if the fuel gas is used, including metallurgy, manufacturing, and enamel; in the third category, the enterprises are willing and able to cooperate with the government in "replacing coal with gas" so as to achieve the energy transformation after the local governments under the pressure of environmental protection make communication with the enterprises. Such three categories of gas consuming enterprises have a great demand for natural gas and a strong tolerance capacity, and there is a linear transmission relationship between the natural gas consumption by the enterprises and the benefits and profits of the enterprises, which is reflected specially in the rapid increase of natural gas consumption by such enterprises within a certain period of time, indicating that the enterprises present a good trend in production and the increase in profitability in the same period.

On the basis that there is a linear transmission relationship between stock price of listed company and the profit or profitability of the company, according to the empirical research made by the scholars, in the emerging capital market in China, the stock price is determined by profit; for the whole market, the permanent profit data and the main business profit have significant impact on the stock price, because the profitability is a main factor reflecting a company's ability to survive and the ability to enhance value; the fact that the investors pay attention to the profit data of the listed company shows that the profitability is an important information affecting the positioning of the stock price in fluctuation, and also means that the maximization of corporate value of the listed company is consistent with the maximization of shareholders' wealth to a certain extent. If the listed

[3] Zhang, Zhongxiu (2012). "Research on Development Strategy of Urban Natural Gas Users" [J]. *Economics and Management*, 2 [in Chinese].

company pays attention only to the fluctuation in the stock price and but not to the internal operating activities, the stock price without the support of profitability will not gain the recognition of the investors for a long term. [4]

2.2 Database and Other Resources

With regard to the research on the transmission relationship between urban fuel gas management and the stock price, the data on the natural gas market and the demand for natural gas referred to in the process of research in this paper is mainly sourced from the authoritative data published by the National Bureau of Statistics, and the data on the natural gas consumption is sourced from the gas consumption data published on December 31, 2017, December 31, 2018, December 31, 2019, and June 20, 2020, by Jiangsu Sanfangxiang Industry Co., Ltd. (SH: 600370) subordinate to Jiangsu Sanfangxiang Group Co., Ltd. which is one of the gas-consuming enterprises managed by Jiangyin Tianli Gas Co., Ltd. which is an urban pipeline natural gas supply enterprise located in Jiangyin City, Jiangsu Province, and the variation trend in the growth rate of the natural gas consumption is also counted up.

The data on profit and stock price of Sanfangxiang are mainly collected from the profit data of Sanfangxiang from December 31, 2017, to June 30, 2020 quoted by the information disclosure website of China Securities Regulatory Commission. All the above data have relatively reliable data sources, so it is reliable to study the above data.

[4] Qi, Xiong & Huang, Wei (2014). "Research on Relationship between Stock Price and Profitability of Listed Companies in China - A Case Study of the Financial Sector" [J]. *Economic Affairs*, 4 [in Chinese].

3. New Situation of Natural Gas Market Development in China

3.1 Natural Gas Market Situation in China and Yangtze River Delta in Recent Years

In recent years, the natural gas market in China has been developing rapidly. According to the research and analysis of supply and demand the market in recent years, it is found that from 2010 to 2013, the growth rate of natural gas consumption is 17% in China with the average annual increase of 20 billion m^3, presenting an obvious momentum of rapid growth; as of 2016, the average annual increase of the natural gas consumption is 11.4 billion m^3 with the growth rate of 6%.

Meanwhile, due to the increasingly serious environmental problem, the government has to make great efforts to promote the construction of environmental protection projects, including the "replacing coal with gas" project and the clean heating project in the north of China, so as to increase the total consumption of the natural gas to a great extent. The data from 2016 to 2018 show that the average annual increase of the natural gas is 36.7 billion m^3, with a growth rate of 17%. During this period, both the increase and the growth rate have exceeded the record high in history.

From April to October in 2018, the consumption of natural gas has increased to a great extent with a growth rate of 18%, which is higher than that of the first quarter; according to the natural gas consumption in the previous years, the traditional off season of the natural gas consumption extends from April to October every year, which is different from the previous gas consumption data. Due to the further promotion of the "replacing coal with gas" project, the amount of fuel gas consumed in cities and the amount of natural gas used in the industrial production increase greatly. The survey shows that the amount of fuel gas consumed in cities in China increases by 14.8 billion m^3, the total amount of natural gas used in the industrial production increases by 16 billion m^3, and the increase of the natural gas consumed in the above two fields accounts for 80% of the total increase of the natural gas; in the other fields in which the natural gas shall be used, the total amount of the natural gas consumed maintains stable growth or remains at the same level.

In 2018, the natural gas market consumption in nine provinces and municipalities within Yangtze River Economic Belt reached 99.3 billion m^3, accounting for 36.2% of the total consumption in China. As this region covers East China, Central China, and West China, the development of natural gas has three different characteristics, including the Yangtze River Delta as a market load center, Sichuan and Chongqing as the origin of resources, and the central region with a single source of gas supply. In the future, driven by the environmental protection policy and influenced by diversified supply of resources, economic development situation, industrial transfer, and other factors, Yangtze River Economic Belt will remain the load center of national natural gas market.

In the Yangtze River Delta region covering Jiangsu, Zhejiang, and Shanghai, the natural gas market consumption in 2018 was 50.7 billion m^3, (see Figure 1), accounting for 18.5% of the total natural gas consumption in China and second only to Bohai Rim region;

Yangtze River Delta region is the load center of the natural gas market in China.

Figure 1: Natural Gas Market Consumption in Yangtze River Delta Region in 2018

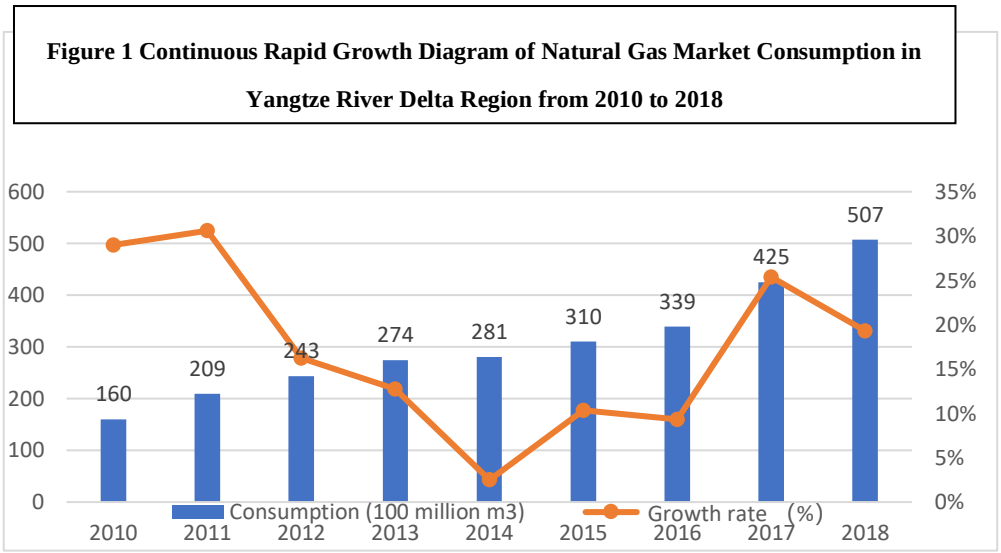


Figure 1

Among others, the natural gas consumption in Jiangsu was 27.8 billion m^3, ranking the first place in China, accounting for 10% of the total consumption in China. From the perspective of the energy consumption structure, the consumption of the natural gas accounts for 10.3% of the total energy consumption, far beyond the national average level. The Yangtze River Delta region is also the target market for the supply of air sources. The air source for supply to Yangtze River Delta includes the natural gas from the west-east gas pipeline, Sichuan-to-east gas pipeline, Ji-Ning Section pipe, Jiangsu oil field, and East China Sea, the natural gas from Rudong LNG, Ningbo LNG, Shanghai LNG, Qidong LNG, Zhoushan LNG, and other liquefied natural gas terminals, presenting the pattern of diversified supply. The types of air sources include domestic conventional gas, imported pipeline gas, imported LNG, and the natural gas from the oil and gas fields in the region[5]. Among them, the amount of supply from the long-distance pipeline and imported LNG accounts for 96% (see Figure 2).

From the perspective of natural gas market demand distribution, the Yangtze River Delta region is still an important market load center, and it is estimated that the natural gas demand will reach 80 billion m^3 by 2025, accounting for 49.6% of energy consumption in the Yangtze River Economic Belt.

[5] Pan, Wenhui & Wang, Chao (2019). "Analysis on Impact of Eastern Route of China-Russia Natural Gas Pipeline on Target Market" [J]. *International Petroleum Economy*, 27(06) [in Chinese].

Figure 2: Categories and Proportions of Natural Gas Resource Supplies in Yangtze River Delta Region in 2018

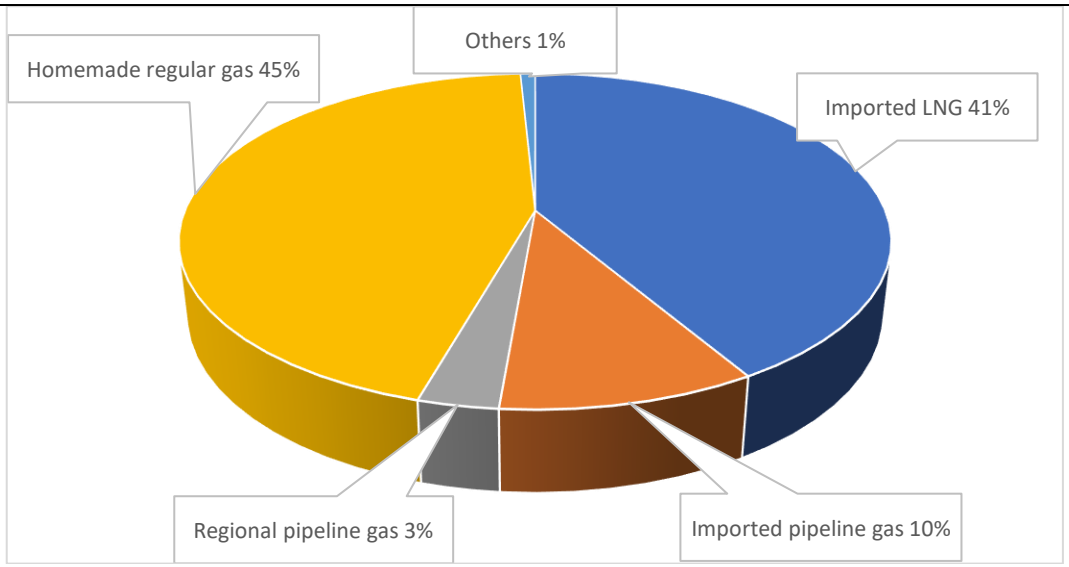


Figure 2

3.2 Impact of COVID-19 on Natural Gas Market

At the beginning of 2020, the COVID-19 epidemic ("COVID-19") broke out and the domestic economy suffered a major blow. In order to reduce the loss due to the epidemic, measures have been taken to prevent import, spread and export all over the country. Industrial enterprises have to shut down or delay the work resumption, the commercial activities are blocked, and all professions and trades almost come to a halt. The epidemic has also affected urban gas, industrial fuel and power generation in the field of natural gas utilization to different degrees.

According to the results of the collaborative prediction made by the natural gas prediction model and the industrial survey and analysis, the epidemic affected natural gas consumption in March by about 9,500 $\times 10^4$ m^3/d (among which, the urban gas was 4,000 $\times 10^4$ m^3/d, the industrial fuel was 5,500 $\times 10^4$ m^3/d) decreasing by 5,500 $\times 10^4$ m^3/d compared with that in February, and by 30×10^8 m^3 for the whole month. The heating period in five large and medium-sized cities in the North China (Beijing, Tianjin, Xi'an, Tangshan and Baoding) was extended by 7 ~ 16 days, and the gas consumption for heating was increased by about 2×10^8 m^3, and the superposed gas consumption for price-off promotion was increased by 15×10^8 m^3. It is predicted that the national natural gas market consumption in March will be 245×10^8 m^3, down 2.2% on a year-on-year basis, and the growth rate will increase by 7.3% compared with that in February. [6]

In order to support industrial and commercial enterprises to resume work and production as soon as possible, reduce the impact of the epidemic, and tide over the difficulties together, the state and local governments have introduced a series of fiscal, taxation, financial and price support policies. In terms of natural gas, the National

[6] Shen, Xin; Hao, Yingpeng, & Han, Kejiang (2020). Analysis and Suggestions on Impact of COVID-19 on Chinese Natural Gas Market [J]. *Petroleum Planning and Engineering*, 1(3) [in Chinese].

Development and Reform Commission issued the “Notice on Phased Measures to Reduce Cost of Non-residential gas”, requiring natural gas production and operation enterprises to implement the off-season sale price in advance. Seventeen provinces and municipalities, including Hubei, Hunan, Shandong, Shaanxi, Anhui and Jiangxi, have issued relevant policies to reduce the terminal sale price of non-residential natural gas and the provincial pipeline transportation fee, so as to support the resumption of work and production.

The upstream gas supply enterprises implemented the lower price to stimulate the direct supply generation users and industrial users. In early March, the gas consumption for power generation by 23 direct supply power plants in Jiangsu increased by 23.5% on a year-on-year basis. By taking various measures to support the resumption of work and production, the natural gas market demand gradually recovered in March. According to the statistics made by the National Bureau of Statistics, by the end of March, Chinese manufacturing industry resumed work at 94.7%, and the overall capacity utilization rate of all industrial enterprises exceeded 70%.

According to the up-to-date statistical data, the sentiment index of Chinese natural gas industry in the second quarter of 2020 is 164.14, so the natural gas industry is in a booming state. Compared with the first quarter of 2020, there is a certain increase in this quarter, and the coefficient of sentiment change is 1.013. Among the five indicators for evaluating the booming state of the natural gas industry, the macroeconomic indicator remains unchanged basically, the judgment indicator of industrial experts and the operation state indicator of natural gas manufacturing enterprises increase slightly, and the import state indicator of natural gas and the operation state indicator of natural gas marketing companies decrease to a certain degree. In general, the sentiment index of Chinese natural gas industry shows an upward trend in the second quarter of 2020. The changes in the main secondary indicators are shown as follows:

1. Sentiment index of natural gas manufacturing enterprises. In the second quarter of 2020, the operation conditions of domestic natural gas manufacturing enterprises improved, and the sentiment index of natural gas manufacturing enterprises is 187.56, so that the natural gas manufacturing enterprises are in a booming state. Compared with the first quarter of 2020, there is a small increase in this quarter and the seasonal coefficient of sentiment change is 1.030. Among them, capacity utilization, capacity change, enterprise output, employee income and operating conditions show a small increase compared with the previous quarter, the level of employment and the level of price remain unchanged basically, and the level of investment shows a small decrease compared with the previous quarter.

2. Sentiment index of natural gas marketing companies. In the second quarter of 2020, the sentiment index of natural gas marketing companies is 148.15, so that the natural gas marketing companies are in a relatively booming state. Compared with the first quarter of 2020, there is a small decrease in the current quarter, and the seasonal coefficient of sentiment change is 0.99. Among them, the sales volume of products shows a small

increase, and the supply and demand state, level of price, level of employment, employee income, and operating conditions show a small decrease.

During the epidemic outbreak, as a result of the changes in consumer demand and the fluctuations in the global market, natural gas market features have become prominent. The natural gas market has entered a period of adjustment; due to its “tenacity” and “resilience”, the natural gas also become more adaptable to market changes.

4. Industrial Gas and Price Sensitivity, Production Capacity Expansion Transmission

4.1 Industrial Gas Is the Leading Consumer in Natural Gas Terminal Market

Natural gas terminal market is divided into four parts including industrial users, urban residents and commercial users (i.e., “urban fuel gas”), power generation terminal, and chemical terminal; the industrial users and the chemical terminal (“industrial gas”) are the main users of natural gas, in which glass, ceramics, textile, metal smelting, chemical fertilizer, medicine, and other industries consume a large amount of gas. In 2018, the apparent consumption of natural gas reaches 2,803 $\times 10^8$ m^3, the consumption structure was further optimized, and the industrial fuel and the urban fuel gas remained a high level, accounting for 38.6% and 33.9% respectively, according to data statistics. The amount of gas for power generation accounted for 17.3%, and the amount of gas for chemical industry accounted for 10.2%. According to the “Report for Development of Natural Gas in China (2019)”, the structure of Chinese natural gas consumption in 2018 is shown in Figure 3. As seen from such structure, the industrial fuel accounts for the highest proportion of natural gas consumption.

Figure 3 Consumption Application and Proportion in Chinese Natural Gas Terminal Market in 2018

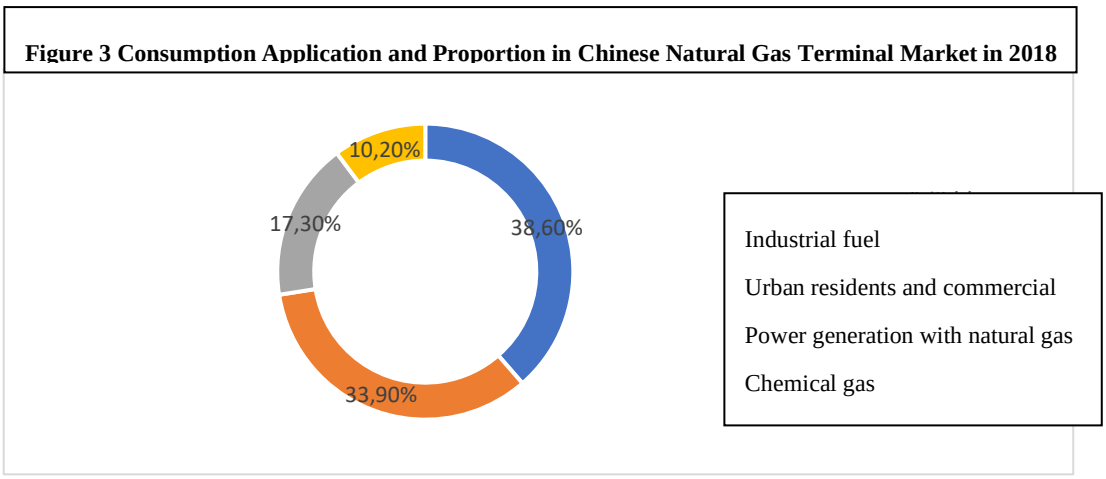


Figure 3

In addition, from the perspective of the natural gas consumption structure in Yangtze River Delta region, it is slightly different from the national average level, the natural gas consumption structure in Yangtze River Delta region presents a situation of tripartite confrontation of urban fuel gas, industrial fuel, and natural gas for power generation, the amount of natural gas for chemical industry accounts for the relatively small proportion, and that for power generation accounts for the largest proportion, as shown in Figure 4. However, if both industrial fuel gas and natural gas for power generation are deemed as the industrial users, it is still possible to draw a conclusion that the industrial users are the dominant consumption users in the natural gas terminal market.

Figure 4 Consumption Application Type and Proportion in Natural Gas Terminal Market in Yangtze River Delta Region in 2018

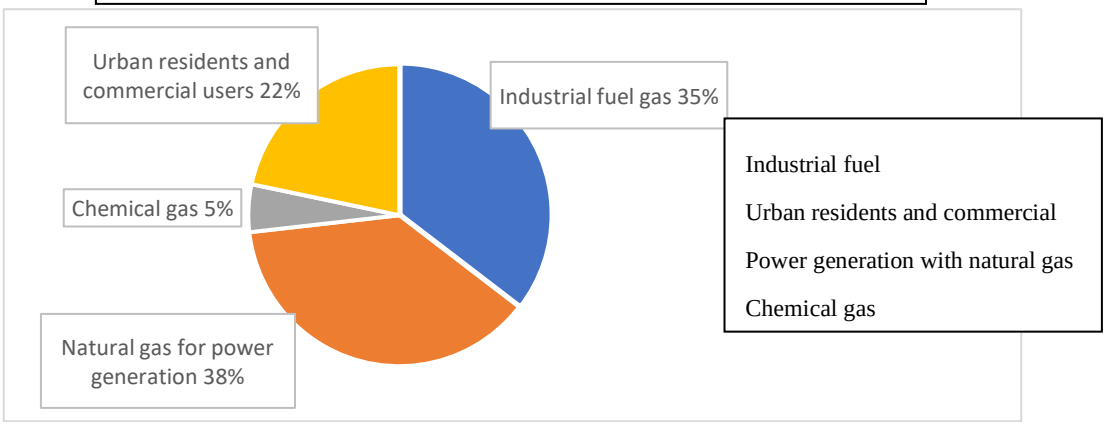


Figure 4

The operation of the domestic natural gas market in 2018 is similar to that in 2017, i.e., the ample supply of natural gas in the off season, which is mainly induced by the growth of the industrial gas consumption. There are two main reasons for the growth of industrial gas consumption in the traditional off season. On the one hand, due to the shortage of gas supply in the winter of 2017 and the intensified implementation of the policy of "lowering non-civil gas to guarantee civil gas" in the peak season, the industrial users were impelled to adjust their production and operation plans in 2018 and to accomplish orders in the off season. On the other hand, the economic situation in the first half of 2018 was relatively good, alleviating the pressure of gas consumption cost on the industrial users after replacing coal with gas. After entering the peak demand season gradually in the second half of 2018, under the regulation of a series of policies such as "lowering non-civil gas to guarantee civil gas", the industrial gas was restricted to a great extent, and the demand remained stable.

As an industrial fuel, natural gas is mainly used in steel, glass, food manufacturing, non-ferrous metals, machinery, clothing, and other industries, which are the main field of natural gas consumption. The production and consumption cost of natural gas in such fields accounts for a relatively small proportion in the sales income of specific products and is relatively insensitive to price changes, so it has high price affordability. With the support of the terminal market demand, natural gas demand is likely to keep growing.

Industrial and chemical gas consumption continued to grow in 2019, driven by the Blue-Sky Protection Campaign and the policy of "replacing coal with gas". However, affected by the economic downturn and the policy of "lowering non-civil gas to guarantee civil gas", the growth rate of industrial gas demand appears was slowed down, but the characteristic of "ample demand in the off season" might become normal. The entire market operation would show the double characteristics "amply demand in the off season" and "stable price in peak season", which is deemed as a sign that the market would keep the health development.

Industrial fuel is the largest utilization area of natural gas and also the area with the largest annual increase of natural gas utilization in China in recent years. In 2020, there are

more factors affecting the natural gas assumption in such field; in addition to the shutdown and production suspension as a result of the epidemic outbreak, the natural gas assumption is mainly related to economic development, market cycles of downstream products, international trade, and economic bearing capacity, and the reduction in natural gas consumption for industrial fuel in the first two quarters of 2020 is the main reason for the decline in the overall demand for natural gas, and the natural gas consumption for industrial fuel is most heavily affected.

4.2 Current Urban Fuel Gas Pricing Mechanism

The reform of Chinese natural gas pricing mechanism began in 2011, and the reform has been significantly accelerated in recent years. The author summarizes the reform documents for natural gas pricing mechanism published in recent years as follows:

1. In October 2015, the CPC Central Committee and the State Council issued "Several Opinions on Promoting Reform of Pricing Mechanism", proposing the general idea of "controlling the middle and liberalizing both ends" for reform of Chinese natural gas price.

2, in May 2017, the CPC Central Committee and the State Council issued "Several Opinions on Deepening System Reform of Oil and Natural Gas", assigning eight tasks for oil and natural gas system reform, including the liberation of oil and gas prospecting and exploitation, the reform of oil and gas pipeline network operation mechanism and oil product pricing mechanism, the acceleration of construction of an oil and gas trading platform, and the formation of price through market competition.

3. Centering on the above ideas and objectives of natural gas price reform, the competent national authorities have issued a series of natural gas price policies or management measures to comprehensively straighten out the prices of natural gas stations; the offshore gas, shale gas, coal-bed gas, coal gas, liquefied natural gas, and gas for direct supply to consumers have been liberated; the price mechanism for natural gas transmission and distribution and the cost monitoring and examination method have been formulated, and the policy framework of "controlling the middle" has been established; the price policy related to gas storage facilities has been defined; two national oil and gas trading centers have been established in Shanghai and Chongqing.

From the perspective of the current natural gas price system composition, natural gas price in China includes ex-factory price, pipeline transportation price (pipeline transportation fee), and urban distribution service price. The upstream gas supply companies integrating production, transportation and marketing shall sell natural gas to local distribution companies and direct pipeline supply to large users at the station wholesale prices as set by the competent pricing department under the State Council (National Development and Reform Commission) or the provincial competent pricing department. In other words, the upstream price and the pipeline transportation price of natural gas shall be managed by the central government.

At the present stage, the National Development and Reform Commission adopts the

price management mode of "benchmark price + floating range" for wholesale prices of the stations, which is actually a price management mode combining government control and market regulation. As the internal settlement price of the upstream gas supply company, the pipe transportation price is not directly related to the downstream buyer. However, the National Development and Reform Commission shall set the pipeline transportation price according to the principle of "allowable cost + reasonable income". According to a statistical data from China University of Petroleum, the transportation prices of 10 trans-provincial transportation enterprises are shown in Table 1.

Table 1: Differences in Transportation Prices of 10 Trans-provincial Pipeline Transportation Enterprises Reflecting Difference in Cost Benefit

Name of Natural Gas Pipeline Transportation Enterprise	Price of Trans-Provincial Pipeline Transportation (RMB Yuan/m^3)
CNPC Beijing Natural Gas Pipeline Co. Ltd.	0.12
CNPC Pipeline United Co., Ltd.	0.18
CNPC Northwest United Pipeline Co., Ltd.	0.12
CNPC East Pipeline Co., Ltd.	0.24
CNPC Pipeline Company	0.19
CNPC Southwest Pipeline Company	0.20
CNPC Southwest Pipeline Co., Ltd.	0.32
CNPC Southwest Oil & Gas Company	0.14
Sinopec Sichuan-East Natural Gas Pipeline Co., Ltd.	0.36
Sinopec Yuji Pipeline Co., Ltd.	0.14

Table 1

Notes: 1. The above prices include 9% VAT.

2. Calculated based on the adjustment price of trans-provincial pipeline transportation of natural gas in March 2019 and the public information of the natural gas pipeline transportation enterprises.

The terminal retail prices of local urban fuel gas companies shall be set by competent local price departments in accordance with the principle of cost plus. Natural gas has obvious natural technological and economic monopoly property of the pipeline network, and is a quasi-public utility related to national economy and people's livelihood. It has been brought into the focus range and taken as the object of government regulation at home and abroad. At present, China is promoting the deployment for the leaps and bounds of the industry, and the natural gas becomes more and more important. The timely introduction of the supporting regulatory policies is conducive to the long-term and stable development of the industry. As a reserved item for government pricing, urban fuel gas is subject to the principle of "cost plus", and cost supervision and examination is taken as an important procedure and basis for the government to formulate and adjust the price.

When fixing the price of the urban pipeline gas, such urban pipeline gas is classified into the non-residential gas and the residential gas by users; since 2013, the non-residential gas price mechanism reform has made great progress; after the reform, the price of the non-residential gas accounting for more than 80% of the total domestic consumption will be formed under the domination of the market; furthermore, research made by the Costs Survey Center of the National Development and Reform Commission reveals that the cost of gas distribution accounts for approximately 25% of the terminal price of the natural gas in China[7].

In 2017, the National Development and Reform Commission issued the "Guidance on Strengthening Supervision of Gas Distribution Price", starting the pace of market-oriented price reform in urban gas distribution link in accordance with the idea of "controlling the middle and liberalizing both ends". The document requires that all regions shall set the gas distribution price according to the principle of "allowable cost, plus reasonable income", determine the total allowable annual income by checking and approving the allowable cost of urban gas enterprises, supervising the allowable income, considering tax and other factors, and then calculate and determine the gas distribution price according to the amount of gas distributed per year.

4.3 Sensitivity Analysis of Industrial Users to Fuel Gas Price

Natural gas is widely used in the industrial field as the chemical raw material, industrial fuel, and power generation fuel. According to the statistics made by some institutions, the application of natural gas in the industrial field involves 42 sub-categories under 17 categories. The demand intensity of natural gas varies with the fields, resulting in the different cost proportions of natural gas as production raw material or fuel in the end products in these fields. Therefore, the operation in each field has different sensitivities to natural gas price.

Furthermore, natural gas, as the best industrial fuel, together with electricity, constitutes the energy source in rigid demand. With the higher requirement for environmental quality in China, environmental protection promotes the adjustment of energy structure. Natural gas, as a clean and efficient industrial fuel, is the inevitable choice for fuel upgrading in the industrial field. The industrial users have different sensitivities to the gas price. Therefore, we believe that in terms of price sensitivity, there must be certain transmission with the operating profit of industrial users and the stock price of relevant listed companies.

Of course, it is undeniable that due to the different purposes of the natural gas, the natural gas is used in some fields at the downstream in a more flexible manner. Either the chemical users or the power generation users and some industrial users show great

[7] Zhang, Jia'an (2019). Research on Difference between Distribution Pricing Cost and Accounting Cost of Urban Gas Enterprises [J]. *Price: Theory and Practice*, 2 [in Chinese].

flexibility when using the natural gas. On the one hand, these users have surplus production capacity resulting in the high regulation of natural gas utilization; for example, the natural gas chemical industry plays the role in interruption of users. On the other hand, these users are more sensitive to the gas price. Scholars generally believe that different users have different gas price affordability, and there is a big difference in the influence of the price of the alternative energy and their own product markets on the industrial fuel users, and both the natural gas chemical users and the natural gas power generation users have weaker gas price affordability.

4.4 Gas Consumption Dependence of Typical Industrial Users and Industry Growth

According to a research report for typical industrial customers prepared by Petrochina Kunlun Gas Company in 2015, the dependence of the industrial users on the gas consumption is closely related to the industrial growth and the profitability. The area under the research covers Beijing, Hebei, East China, Shandong, Anhui, Northwest China, Gansu, Hubei and Hunan in which Petrochina Kunlun Gas Company makes the operation layout, and the research was made on 78 customers in 18 industries[8].

The research reveals that the profitability and the expansion of industrial users under the new normal are slowed down generally, but 22% of the industrial users plan to build and expand plants and production lines in two years, and 13% of industrial users intend to transform and upgrade their products, which shall be included in the enterprise strategic development plan, and the overall gas consumption by the industrial users increased by almost 8% on a year-on-year basis.

The gas consumption and gas consumption behavior of various industries show an increasingly obvious regularity. In general, the star enterprises and the dark-horse enterprises are highly dependent on gas companies, fully indicating that the demand for gas consumption can reflect the relatively high correlation between the industry growth and profitability of manufacturing enterprises. Such 78 industrial customers under research are divided into 18 classes, including petrochemical industry, chemical industry, ceramics, glass, steel, non-ferrous metals, non-metal, machinery, electronic equipment, textile and clothing, tobacco products, food manufacturing, beverage manufacturing, paper making and paper products, medicine, waste material recycling, gas power generation, and distributed energy. According to the Boston matrix method, in accordance with the two dimensions including gas consumption and price affordability/growth potential, they are classified into star type, cash cow type, dark horse type, and restricted type in the matrix (See Illustration 1).

[8] For this part of the research, please refer to Zhou, Lan (2016). Gas Use Behavior Analysis of Industrial Customers and Development of Customer Management [J]. *China Petrolum Economy*, 24(2) [in Chinese].

Illustration 1: Positive Effect Relation between Gas Consumption and Industry Growth of Industrial Users Shown in Boston Matrix

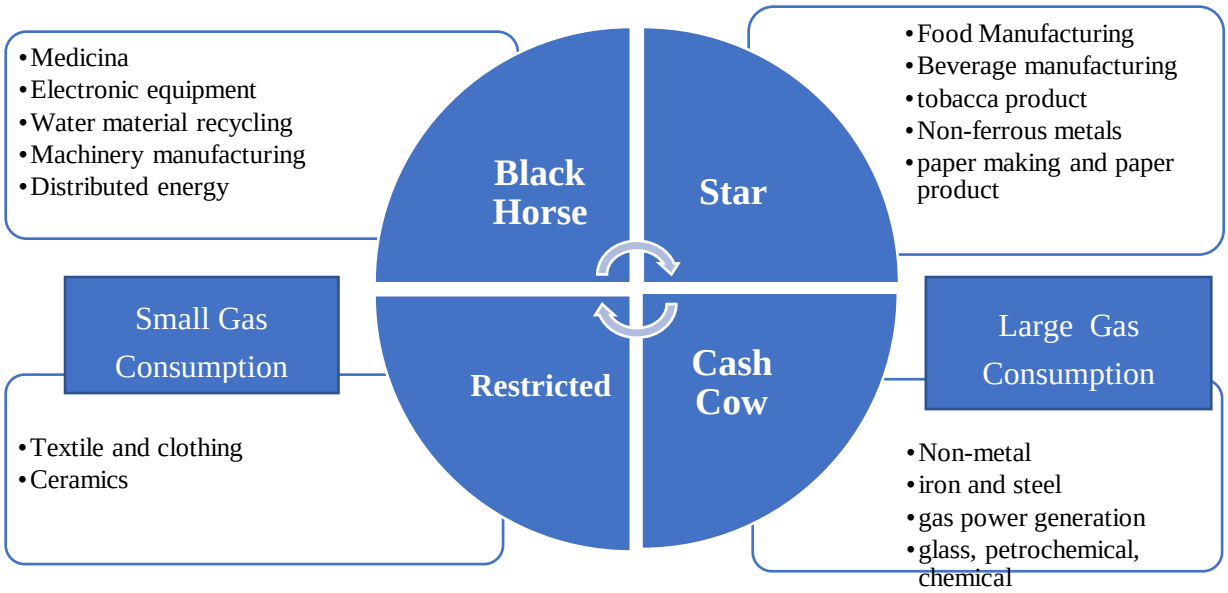


Illustration 1

First of all, let's take a look at the first-class star users with large gas consumption and good growth, including tobacco products, food manufacturing, beverage manufacturing, nonferrous metals, paper making and paper products, which are characterized by large gas consumption and good growth.

The first subclass is the tobacco product industry; in the long term, the consumer group base of the tobacco is large, the sustainable purchase power is high, the demand for tobacco will still remain at a relatively high level, the proportion of natural gas cost in the production cost is generally lower than 10%, the enterprises have a very high gas price affordability and great development potential, so the attention paid to the gas consumption by such enterprises can reflect the growth and profitability of such enterprises.

The second subclass is the food manufacturing industry with the large rigid market demand and subject to less influence of the overall economic environment. The sales volume of enterprises generally presents an upward trend, and the profit margin of their main products is relatively high. For example, Hubei W Group and Z Food Factory achieve the profit margin of 30% and 10% respectively, so they have higher gas price affordability. Regardless of the small scale of gas consumption, the gas consumption by the enterprises presents a steady growth trend compared to the same period of last year. Meanwhile, as most enterprises intend to expand the factories, it is expected that the gas consumption of this industry will continue to increase. In addition, the products of the food industry are taken orally, so the users generally attach importance to environmental protection and cleaning.

The third subclass is the beverage manufacturing industry which is similar to the food manufacturing industry in property and characterized by optimal overall development and high product profit margins. Among them, the gas consumption of Hubei H Company increases by 14% on a year-on-year basis, and that of Hebei Z Beverage Factory increases by 1% on a year-on-year basis, showing a steady development. In the beverage manufacturing industry, the proportion of natural gas cost in the production cost is generally very low. For example, it is 2% in beer enterprises, 5% in general beverages, and 1% in dairy products. Therefore, the enterprises have very high gas price affordability.

The fourth subclass is the non-ferrous metal industry falling within the basic material industry in the national economy, which is closely related to the development of local economy. The non-ferrous metal industry has a complex structure, which can be subdivided into heavy metal manufacturing such as copper, lead and zinc, light metal manufacturing such as aluminum and magnesium, precious metal manufacturing such as gold and silver, and rare metal manufacturing such as tungsten, molybdenum and lithium. The market demand and gas consumption of the segmental industry vary greatly. For example, among the research subjects, the gas consumption of a smelter in Hubei (producing of anode copper) decreases by 15% on a year-on-year basis, that of a company in East China (producing of aluminum products) decreases by 12% on a year-on-year basis, that of a company in Northwest China (producing manganese metal) and that of a company in Ningxia (deep processing of aluminum strip) increase by 39% and 30% respectively. In general, the natural gas cost of this industry accounts for a small proportion in the production cost, and the enterprises have relatively high gas price affordability and certain development potential.

Two companies in paper making and paper product industry are involved in the research. A company in East China produces wallpaper with the gas consumption decreased by 25% compared with that in the previous year; a paper company in Hunan produces high-grade household paper with the gas consumption decreased by 25% on a year-on-year basis. Under the influence of economic environment, the production benefit and the gas consumption of gas consuming customers decrease to a certain extent, but the natural gas cost accounts for only approximately 1% of the production cost of the enterprises, so the sensitivity of the enterprises to natural gas price is very low. Therefore, there is still a great potential for expansion and increase of the natural gas in the future.

Secondly, we look at the second-class cash cow users with large gas consumption and small future development potential. Such industrial enterprises, which use a lot of gas but have little potential for future development, are called cash cow. The industries include gas-fired power generation, steel, glass, non-metal, petrochemical and chemical industries.

In the first subclass, the production of gas-fired power generation has its particularity. Its power generation is dependent on the power generation task assigned by the provincial power grid and subject to the indirect influence of natural gas price. However, the decrease of natural gas price will not directly drive the increase of gas consumption of the gas-fired

power generation enterprises. The research reveals that the gas consumption of a power plant in Jiangsu increases by 19% on a year-on-year basis, and that of a power plant in Beijing decreases by 11% on a year-on-year basis. Both power plants say that the increase and decrease of gas consumption are subject to policy restrictions, and they have no idea of production expansion. The gas-fired power generation industry consumes a large amount of gas. The annual gas consumption of the power plant in Jiangsu and the power plant in Beijing is 300 million m^3 and 170 million m^3 respectively, making a great contribution to the sales volume of gas and the cash flow, and playing a role of peak regulation. Furthermore, such enterprises are the key objects encouraged by the state for development and play a role of a mainstay in the cash cow industry.

In the second subclass, the iron and steel industry are one of the sectors which are influenced significantly by the slowdown in the domestic economy. The research reveals that 50% of the iron and steel enterprises are suffering serious loss, and it is expected that the winter period will last two to three years. Except for Q Company in Hebei, the gas consumption of the other six enterprises under the research decreases by 7% on average compared with the same period last year. The gas consumption of Q Company in Hebei increases by 59%, because the coke oven gas is replaced by the natural gas for the hot rolling under the pressure imposed by the Environmental Protection Bureau. Thus, it can be seen that the local government's efforts in implementation of environmental protection policies play a direct role in promoting the development of natural gas.

In the third subclass, the glass industry is subject to the most significant drop of gas consumption, the gas consumption of the five enterprises under the research decreases by 45% on a year-on-year basis on average, among which the gas consumption of Y Glass Company in Hebei, C Glass Company in Hubei, and N Glass Company in Hebei decreases by 88%, 60% and 52%, respectively, mainly due to the overcapacity of the glass industry and the recession of the real estate market. In this industry, the cost of natural gas accounts for 30% ~ 60% of the production cost. Under the pressure of survival, the glass enterprises, on the one hand, replace the natural gas with heavy oil, petroleum coke, and coal, and on the other hand, they are forced to consider product transformation and upgrading.

In the fourth subclass, the non-metal industry is subject to the large gas consumption and the great fluctuation in the market demand, and the cost of natural gas accounts for a high proportion of the production cost. Among the three enterprises under research, the gas consumption of J Carbon Company in Shandong and T Glass Fiber Company in East China decreases by 3% and 32% respectively compared with the same period of last year. The enterprises say that the cost of natural gas accounts for 30% to 40%, and the current gas price is unbearable, so they have to replace natural gas with heavy oil and coal. On the contrary, the gas consumption of T Glass Fiber Company in Shandong increases by 10% on a year-on-year basis, mainly because this company manufacturers high value-added products such as computer motherboards and electronic cloth raw materials and achieves the large profit margin. The cost of natural gas accounts for only 12%. The user plans to

add another production line to meet the demand of orders.

In the fifth subclass, the petrochemical industry is sensitive to natural gas price because the natural gas is used as the raw material. In recent years, the rising price of natural gas has brought great pressure to the petrochemical industry, and Z Company in Hubei and other large and medium-sized customers can only maintain the basic break even. The natural gas cost of X Chemical Industry in Shandong accounts for 80% of the production cost. This Y user has changed the production process to use the self-produced dry gas to produce hydrogen. It is also worth noting that the petrochemical industry is sensitive not only to price but also to gas quality.

In the sixth subclass, the customers of the chemical industry mainly produce chemical fertilizer, soda ash, carbon disulfide, and methanol. As a cyclical industry, such customers are subject to the large fluctuation in market demand, and the cost of natural gas accounts for a high proportion of the production cost, and the gas price affordability of chemical enterprises is relatively low. In the Decree No.15 "Natural Gas Utilization Policy" issued by the National Development and Reform Commission in 2012, it is clearly defined that the chemical industry belongs to the restricted class of natural gas development. Therefore, such customers have small future development space but consume a lot of gas, so it is possible to reflect the operating conditions of the enterprises by paying attention to the gas consumption of such enterprises.

Then, we will analyze the third-class black-horse industrial users, which are not large in gas consumption but have a good prospect of industrial development. Such industries include medicine, electronic equipment, machinery, distributed energy, and waste material recycling.

As the first subclass, the medicine industry mainly uses natural gas to produce steam for disinfection and sterilization. Characterized by the relatively small gas consumption and very high price affordability, the enterprises are the high-quality dark horse customers. For example, the gas consumption of B Pharmaceutical Company in Hubei and T Biotechnology Company in Beijing in the first three quarters of 2015 is 560,000 m^3 and 2,610,000 m^3, respectively, increasing by 17% and 23% on a year-on-year basis respectively, showing a great development potential.

As the second subclass, the electronic equipment industry seizes the golden opportunity of growth while Internet+ is booming currently. These kinds of users mainly use natural gas to produce steam, which is used to heat the production equipment and dry the circuit boards, and to heat and humidity the central air conditioner and keep the constant temperature and humidity in the workshop. J Electronic Company in Hubei mainly produces printed circuit boards and memory banks and takes a leading position in the world. This user says that the enterprise gains good benefits and has large development space and plans to build a new processing base to produce the circuit boards with more layers and higher profits.

In the machinery industry as the third subclass, the users are widely distributed and diverse, and the research objects include 7 automobiles and auto parts enterprises, 2 small household machinery enterprises and 1 large machinery enterprise. Among others, the automobile enterprises consume only about 1 million m^3 of natural gas per year but have the great industry development vitality and potential. For example, the gas consumption of L Automobile in East China, J Automobile in Anhui and F Automobile in Hubei increases by 1076%, 37% and 33% on a year-on-year basis. Thus, it can be seen that the automobile industry has the large rigid demand and the stable growth of gas consumption, so this industry takes the leadership in the machinery industry.

The distributed energy industry is an exception. For example, T New Energy Company is not yet profitable but has good prospects for development and consumes the amount of natural gas increasing by 280% on a year-on-year basis. The waste material recycling industry mainly includes the waste battery recycling, the regeneration of waste mineral oil, and the disposal of copper-containing waste, and belongs to the environmental protection industry. With the support of the national policy, this industry has good prospects of development and high gas price affordability, but the small scale of gas consumption.

The last class of industrial users is the restricted users with small gas consumption and insufficient development power. For example, in the ceramic industry as a whole, natural gas is mainly used for furnace heating, and the proportion of natural gas cost in the production cost is about 15% on average. However, there is a big difference within the industry, and it is sensitive to gas price and has a high requirement for gas quality.

In the restricted class, the gas consumption of the textile and clothing industry is very small, and the annual gas consumption of the four enterprises under the research is basically less than 500,000 m^3. Although the cost of natural gas accounts for less than 10% of the production cost, a large number of small and medium-sized enterprises and low-end homogenized enterprises in the industry compete fiercely, resulting in the diluted profit space and the lower middle gas price affordability. Of course, the high-end customers in the industry still have potential for development. For example, N Textile Company in Shandong with an annual turnover of RMB 100 million yuan, mainly produces and exports carpets with a profit margin of 30% and a natural gas cost ratio of only 0.2%, so this enterprise gives no consideration to alternative energy for the time being.

5. Empirical Analysis: Natural Gas Consumption by Listed Companies and Changes in Stock Price

5.1 Analysis of Natural Gas Consumption and Changes in Stock Price for Huaxi Holding (000936)

5.1.1 Main Business Characteristics of Chemical Fiber Subordinate to Huaxi Holding

Huaxi Holding (000936), a company founded in Jiangyin, Jiangsu Province and listed on the Shenzhen Stock Exchange, is mainly engaged in the research, development, production and sales of polyester chemical fiber, petrochemical logistics and warehousing services, merger and acquisition investment, and asset management during the reporting period, and has no significant changes within the reporting period.

The subsidiary of Huaxi Holding, which is mainly engaged in polyester chemical fiber business, is Huaxi Chemical Fiber. The chemical fiber industry in which Huaxi chemical fiber is located is a basic industry and occupies an important position in the national economy. It is a mid-end industry in the petrochemical industry chain, with petrochemical products at the upstream, and yarn, fabric, and other textile products at the downstream. Because the upstream and downstream of chemical fiber industry – petrochemical industry and textile are cyclical industries and export-oriented industries respectively, there are obvious cyclical fluctuations in the overall development of chemical fiber industry.

The main products manufactured by Huaxi Chemical fiber are polyester staple fibers, including polyester staple fiber for spun lace, semi-dull polyester staple fiber, bright polyester staple fiber, fluorescent whitening polyester staple fiber, etc. Among them, the polyester staple fiber for spun lace is mainly used in spun lace and acupuncture equipment, and the final products are widely used in the fields of medical materials, medical treatment and wiping, automobile, filtration, leather, and engineering infrastructure. The semi-dull polyester staple fiber, bright polyester staple fiber, fluorescent whitening polyester staple fiber is mainly used in the textile industry for spinning alone or blending with cotton, viscose fiber, hemp, wool, vinylon fiber, etc., and the yarns so produced are used in clothing, textile, home decoration fabric, etc.

The polyester industry has obvious regional characteristics. Globally speaking, the production capacity is mainly distributed in Chinese mainland, India, Taiwan Region, ASEAN, South Korea, and Western Europe. In China, the polyester staple fiber manufacturers are mainly concentrated in Jiangsu, Zhejiang and Fujian in the southeast coast, accounting for about 80%[9] of the total production capacity in China. The industry has the relatively obvious regional characteristics. In addition, the seasonal polyester industry has no obvious seasonal characteristics.

[9] Zhang, Youliang (2020). Current Situation and Market Analysis of Polyester Staple Fiber Industry in China [J] *Synthetic Fiber Industry*, 3 [in Chinese]

Table 2: Top 10 Direct-Spinning Polyester Staple Fiber Manufacturers Distributed in Southeast Coastal Area and Their Production Capacities

Manufacturer	Production Capacity/(kt.a^{-1})
Sinopec Yizheng Chemical Fiber Co., Ltd.	900
Jiangsu Sanfangxiang Group Co., Ltd.	800
Jiangyin Huahong Chemical Fiber Co., Ltd.	580
Fujian Jinlun Fiber Shareholding Co., Ltd.	450
Jiangsu Yida New Materials Co., Ltd.	410
Jiangsu Huaxicun Co., Ltd. Special Chemical Fiber Factory	400
Xiamen Xianglu Chemical Fiber Co., Ltd.	360
Jiangsu Jiangnan Fiber Co., Ltd.	300
Zhejiang Hengming Chemical Fiber Co., Ltd.	300
Jiangsu Tex-Sino Chemical Fiber Co., Ltd.	300

Table 2

As a typical cash cow industrial enterprise, Huaxi Chemical Fiber is located in the traditional cross industry of petrochemical industry and textile industry. The enterprise uses a large amount of pipeline natural gas in its production process and consumes a relatively large and stable amount of natural gas. There is a close-linear relationship between the growth rate of gas consumption and profit, and the change of stock price.

5.1.2 Huaxi Holding's Financial Indicators and Changes in Profit Growth Rate

Within the reporting period of Huaxi from 2016 to June 30, 2020, the author has sorted out the financial data disclosed publicly by Huaxi Holding, mainly including the profit data and the profit growth rate, as shown in the following table:

Table 3: Huaxi Holding's (000936) Values and Growth Rates of Net Profits from 2016 to 2020

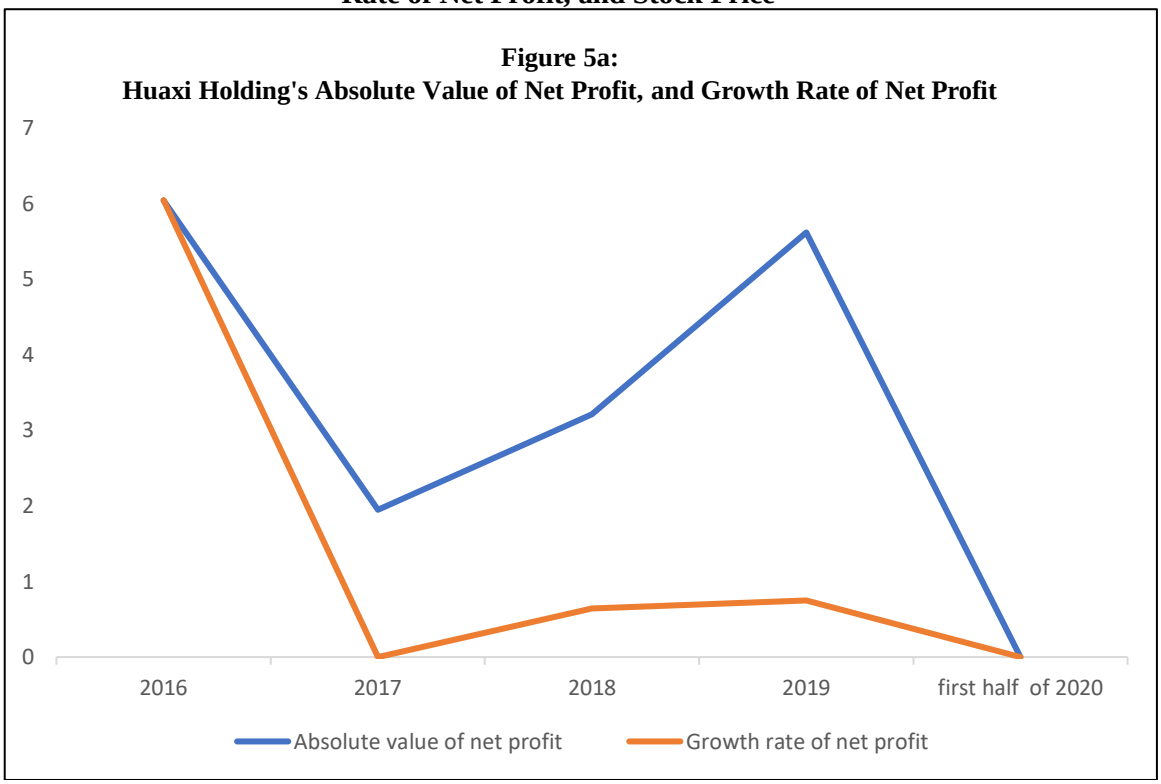
Unit: RMB 100 million Yuan

	2020.6.30	2019.12.31	2018.12.31	2017.12.31	2016.12.31
Reporting period	Semi-annual report	Annual report	Annual report	Annual report	Annual report
Net profit attributable to shareholders	- 1.32	5.62	3.21	1.95	6.04
Year-on-year growth rate of net profit	- 139.25%	75.04%	64.27%	- 67.67%	604.46%

Table 3

As can be seen from the above data, Huaxi Holding's net profit dropped from RMB 601 million Yuan in 2016 to RMB 195 million Yuan in 2017, then rebounded to RMB 321 million Yuan in 2018, RMB 562 million Yuan in 2019; in the first half of 2020, Huaxi Holding suffered a loss of RMB 132 million Yuan. We can see Huaxi Holding's absolute value of net profit, growth rate, and stock price trend as shown in the following figure:

Figure 5: Line Graph of Trends in Huaxi Holding's Absolute Value of Net Profit, Growth Rate of Net Profit, and Stock Price



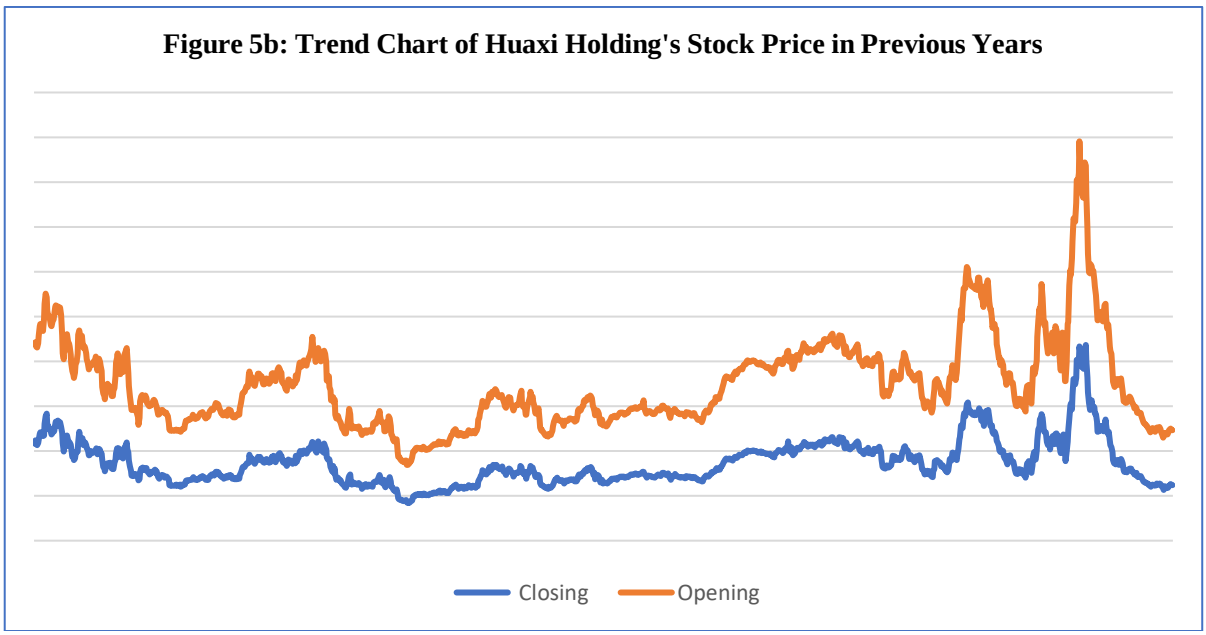


Figure 5

It can be seen from the above trends that from 2017 to the first half of 2020, there is a weak correlation between the overall trend of Huaxi Holding's stock price and the net profit; from 2017 to 2019, Huaxi Chemical Fiber's net profit maintains a steady growth trend as a whole, indicating that the stock prices of chemical fiber industrial enterprises are subject to the factors such as chemical fiber raw materials, and international and domestic import and export, and maintain a weak correlation with the net profit index and the net profit growth rate of the enterprises; therefore, whether there is such a weak

correlation between the stock price and the gas consumption. The author further studies and compares Huaxi Chemical Fiber's gas consumption data.

5.1.3 Trend in Natural Gas Consumption by Huaxi Chemical Fiber

The author visited the Marketing Department of Jiangyin Tianli Gas Co., Ltd. and acquired the data on natural gas consumption by Huaxi Chemical Fiber from 2016 to the first half of 2020, as shown in Table 4:

Table 4: Natural Gas Consumption by Huaxi Chemical Fiber from 2016 to 2020

Huaxi Chemical Fiber	2020.1-6	2019	2018	2017	2016
Consumption ($10,000m^3$)	692	620	454	52	72

Table 4

It can be seen from the data on gas consumption that in 2016, Huaxi Chemical Fiber did not use the natural gas boilers in a large scale, so the gas consumption was not significant; however, from 2017 to the first half of 2020, the natural gas consumption increased to a great extent. According to the data on gas consumption in the first half of 2020, it is estimated that the gas consumption in 2020 will reach 13 million m^3; based on the data on gas consumption by Huaxi Chemical Fiber over the past four years, we find that the consumption of the natural gas has been rising rapidly, indicating that the enterprise has a better production situation, which is consistent with the fact that there is a weak correlation with the trend of stock price and the growth rate of net profit as described above.

Figure 6: Line Graph of Positive Growth of Natural Gas Consumption by Huaxi Chemical Fiber from 2016 to 2020

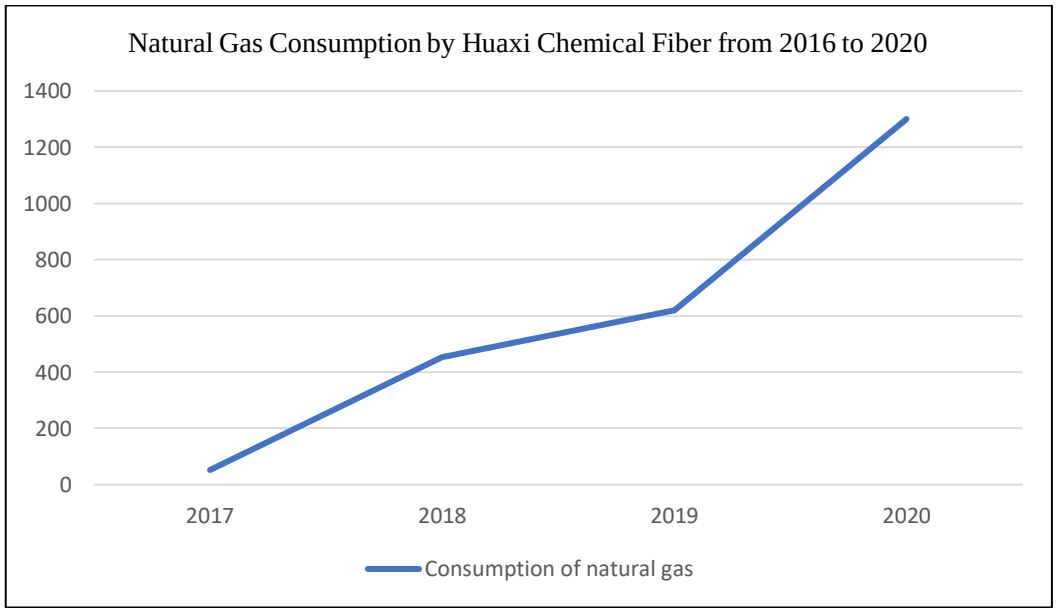


Figure 6

5.2 Analysis of Natural Gas Consumption and Changes in Stock Price for Sanfangxiang (600370)

5.2.1 Main Business Characteristics of Sanfangxiang's (600370) Textile

Sanfangxiang (600370) is a company founded Jiangyin, Jiangsu Province and listed in Shanghai Stock Exchange. During the reporting period, Sanfangxiang is mainly engaged in textile business, chemical business, and thermal power business. The main products of the textile business include the production and sales of all kinds of printed and dyed cloth, polyester-mixed cotton cloth, yarn-dyed cloth, as well as the dyeing and finishing of cloth and printing processing.

The main business closely related to the consumption of natural gas is textile printing and dyeing. Textile industry is the traditional pillar industry of Chinese national economy and an important livelihood industry, as well as one of the industries with traditional international competitive advantages. In 2019, the domestic and international risks and challenges to the development of Chinese textile industry increased significantly. The whole industry continued to accelerate its transformation and upgrading, strived to overcome downward risk pressure, and maintained a stable overall sentiment degree and production situation. However, under the multiple pressures such as the slowdown in demand in domestic and foreign markets, the more complex trading environment, and the continual increase of comprehensive costs, the enterprises are faced with the weak growth momentum of investment, the declined efficiency level, and the slowdown in the main economic operation indicators. In 2020, Chinese textile industry will face a more complex and severe external situation. The complex situation of increasing risks in the global economy is intertwined with domestic structural and cyclical problems, and there are still normal pressures such as rising costs and intensifying competition.

According to the "Guidelines on Industry Classification of Listed Companies" (Revised in 2012) published by China Securities Regulatory Commission, Sanfangxiang belongs to "C17 textile industry". Since 2020, faced with the severe test brought by COVID-19 epidemic and the complex and volatile domestic and international environment, China has overcome the adverse impact of COVID-19 and achieved steady macroeconomic recovery. When fighting against the epidemic, the textile industry has gradually promoted the resumption of work and production of enterprises, and made the due contributions to guarantee the production and supply of epidemic prevention materials at home and to meet the needs of international epidemic prevention and control .However, because the loss caused by the epidemic has not been completely recovered, the textile enterprises still suffer from the prominent production and operation pressure and lack of confidence in investment and development, and the negative growth trend of the industry has not been reversed, so the stable operation in the whole year is facing a severe test.

5.2.2 Sanfangxiang's Financial Indicators and Changes in Profit Growth Rate

Within the reporting period of Sanfangxiang from 2016 to June 30, 2020, the author has sorted out the financial data disclosed publicly by Sanfangxiang, mainly including the profit data and the profit growth rate, as shown in the following table:

Table 5: Sanfangxiang's (600370) Values and Growth Rates of Net Profits from 2016 to 2020

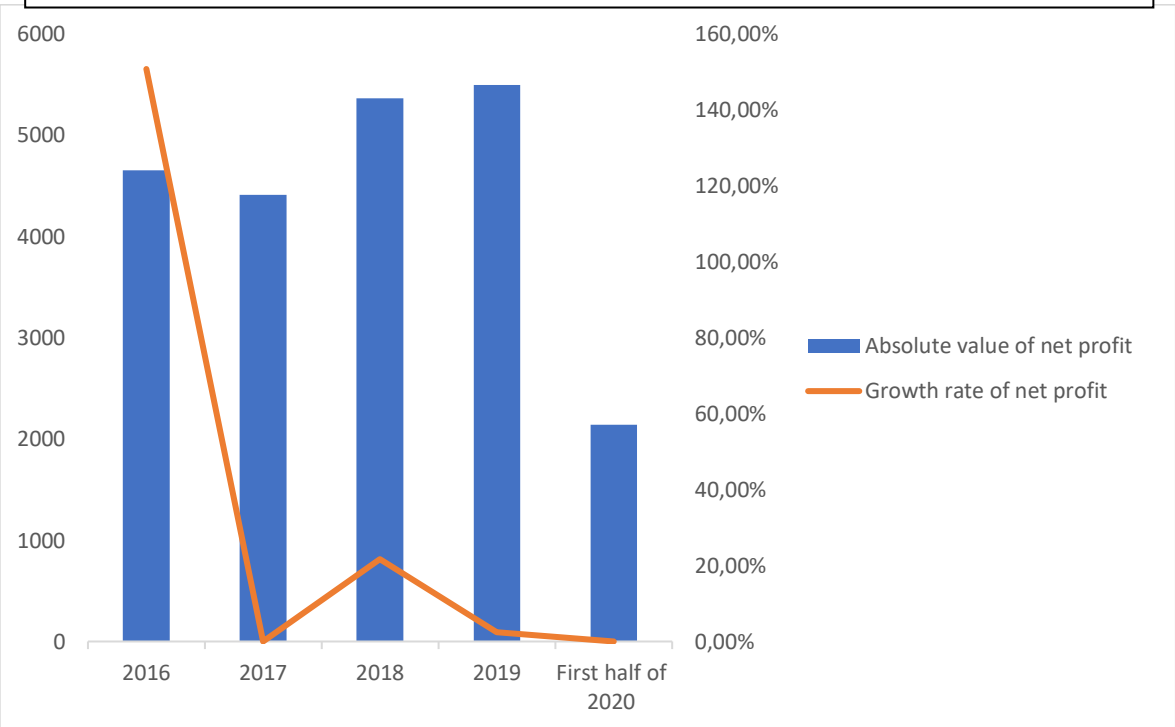
Unit: RMB 100 million Yuan

	2020.6.30	2019.12.31	2018.12.31	2017.12.31	2016.12.31
Reporting period	Semi-annual report	Annual report	Annual report	Annual report	Annual report
Net profit attributable to shareholders	2139	5493	5363	4409	4654
Year-on-year growth rate of net profit	- 25.49%	2.44%	21.63%	- 5.26%	150.76%

Table 5

As seen from the above data, Sanfangxiang's net profit presents an overall stable growth trend from 2016 to 2020. We make the further analysis of Sanfangxiang's absolute value and growth rate of the net profit and the trend of the stock price, as shown in Figure 7:

Figure 7a: Line Graph and Histogram of Trends in Sanfangxiang's Absolute Value of Net Profit, Growth



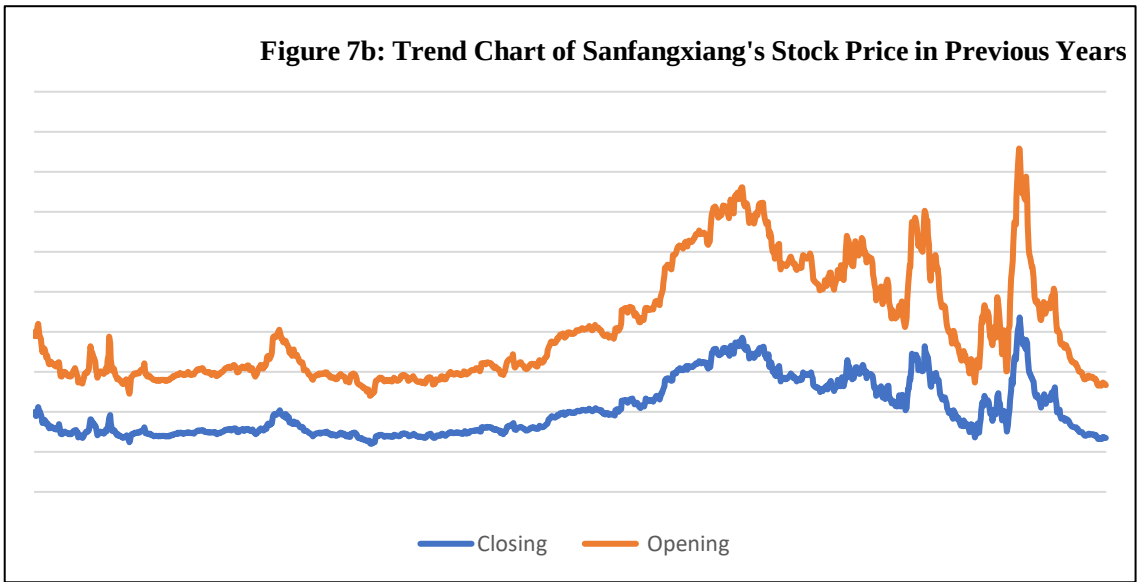


Figure 7

It can be seen from the above trends that Sanfangxiang achieved a high growth rate of net profit in 2016, resulting in the higher stock price in 2016. In 2018, Sanfangxiang's growth rate of net profit presents a rising trend, but its stock price was still lower, indicating that the stock price formation mechanism for the textile industry enterprises is complicated; it is worthy to discuss whether there is a certain association with the growth rate of the gas consumption. The author makes the further research and discussion based on the data on gas consumption.

5.2.3 Trend in Natural Gas Consumption by Sanfangxiang

The author visited the Marketing Department of Jiangyin Tianli Gas Co., Ltd. and acquired the data on natural gas consumption by Sanfangxiang from 2016 to the first half of 2020, as shown in Table 6:

Table 6: Fluctuations in Natural Gas Consumption by Sanfangxiang from 2016 to First Half of 2020

Sanfangxiang	2020.1-6	2019	2018	2017	2016
Consumption (10000 m^3)	2154	694	647	1061	666

Table 6

It can be seen from the data on gas consumption by Sanfangxiang, the gas consumption by Sanfangxiang reached 6.66 million m^3 in 2016, far more than that by Huaxi Chemical Fiber in the same period; in 2017, the gas consumption by Sanfangxiang reached the maximum level of 10.61 million m^3, and dropped to 6.47 million m^3 and 6.94 million m^3 in 2018 and 2019 respectively; in 2020, Sanfangxiang expands production capacity and add the gas-fired thermal power project, the consumption of the natural gas rises sharply, so we observe the trend of gas consumption by Sanfangxiang in textile

industry as shown in Figure 8: Natural Gas Consumption by Sanfangxiang from 2016 to 2019

Figure 8 Trend Chart of Natural Gas Consumption by Sanfangxiang from 2016 to 2019

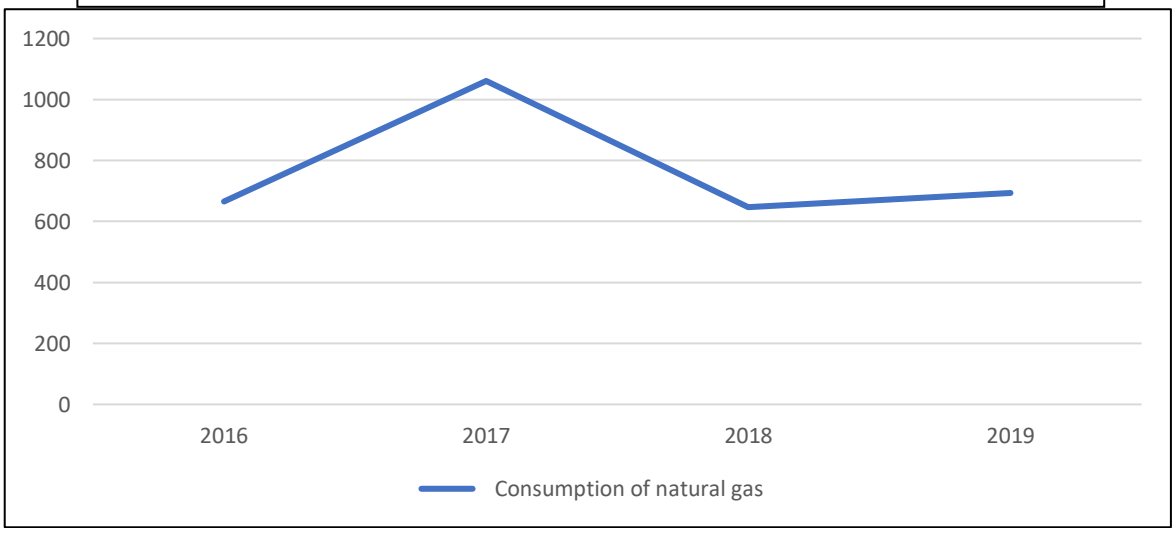


Figure 8

Based on comparison between the above trend and the stock price trend, we can find that within the period of time that the consumption of natural gas was larger in 2017, Sanfangxiang's stock price presented a rising trend; from 2018 to 2019, the stock price was relatively lower, the consumption of the natural gas by Sanfangxiang increased to a certain extent in 2019, and Sanfangxiang's stock price was higher than that in 2018, indicating that the enhancement of market and investor confidence due to the improved production situation should not be ignored, and there was a positive correlation between the stock price and the consumption of the natural gas; however, the profit formation mechanism was relatively complicated, the positive correlation between the stock price and the growth rate of profit in the same period was relatively insignificant. At the same time, the author acquired data on cost publicly disclosed by Sanfangxiang as follows:

Table 7: Cost of Natural Gas in Sanfangxiang's Items by Product Accounting for Less than 10% in 2019

Unit: RMB Yuan

Products			
Product	Composition of Cost	Proportion in Total Cost in Current Period	Proportion in Total Cost in Previous Period
Dyeing, finished fabric	Fuel power	9.98%	8.67%
Cotton yarn	Fuel power	8.40%	8.62%

Table 7

As seen from the aforesaid cost analysis table, in Sanfangxiang's main business such as dyeing, finished fabric, and cotton yarn, the cost of the natural gas accounts for less than 10%; therefore, in general, the influence of natural gas consumption on the industrial profit

is relatively small, and main raw material, market factors, policy factors, and political factors are the main influences as determined. However, the increase in the consumption of natural gas can reflect the normal production operation and the expansion of production capacity of the enterprise, as well as the sustainable operation ability of the enterprise. Therefore, when the consumption of natural gas increases significantly, it is allowed to purchase the stocks of such enterprise, and the resulting returns of stock price are positively correlated.

5.3 Analysis of Natural Gas Consumption and Changes in Stock Price for Fasten (000890)

5.3.1 Main Business Characteristics of Fasten's Metal Products

Fasten Company is mainly engaged in metal products business. The metal products business means the production and marketing of steel wire and wire rope products for various purposes and in different specification. Among them, the wire rope products mainly include the wire rope for PU synchronous belt used for transmission of materials and power in aviation, computers, and high-grade equipment, the flexible wire rope used for auto parts such as automobile door and window lifters and brake devices. The steel wire products mainly include all kinds of steel wire and its products with specifications ranging from 0.5mm to 12mm. According to their purposes, the products are classified into spring steel wire, packaging steel wire, car seat skeleton steel wire, and flexible axle hose steel wire, and rope-making steel wire.

The supply of some raw materials for Fasten's metal products business is controlled by others, resulting in low bargaining power, limited access to high-performance raw materials, and higher procurement costs. The fluctuation in price of raw materials affects the supply and quality level of raw material in the market, which may cause uncertain influence on the Company's operating results. Furthermore, there are many small and medium-sized enterprises in the metal products industry where Fasten Company is located. For most products, the price competition is an important factor affecting the customers' procurement decisions, and it also has an important influence on the gross profit margin of the Company's products.

5.3.2 Fasten's Financial Indicators and Changes in Profit Growth Rate

Within the reporting period of Fasten from 2016 to June 30, 2020, the author has sorted out the financial data disclosed publicly by Sanfangxiang, mainly including the profit data and the profit growth rate, as shown in the following table:

Table 8: Fasten's (000890) Values and Growth Rates of Net Profits from 2016 to 2020

Unit: RMB 100 million Yuan

	2020.6.30	2019.12.31	2018.12.31	2017.12.31	2016.12.31
Reporting period	Semi-annual report	Annual report	Annual report	Annual report	Annual report
Net profit attributable to shareholders	1060	-77756	-145228	14314	14135
Year-on-year growth rate of net profit	112.24%	- 435.41%	- 201.46%	1.27%	27.12%

Table 8

It can be seen from the above data that from 2016 to 2020, Fasten's net profit underwent the huge losses in 2018 and 2019, and began to gain profit gradually in the first half of 2020. We further analyze Fasten's absolute value and growth rate of the net profit, and the trend of stock price as shown in Figure 9:

Figure 9a: Line Graph and Histogram of Trends in Fasten's Absolute Value of Net Profit, Growth Rate of Net Profit, and Stock Price

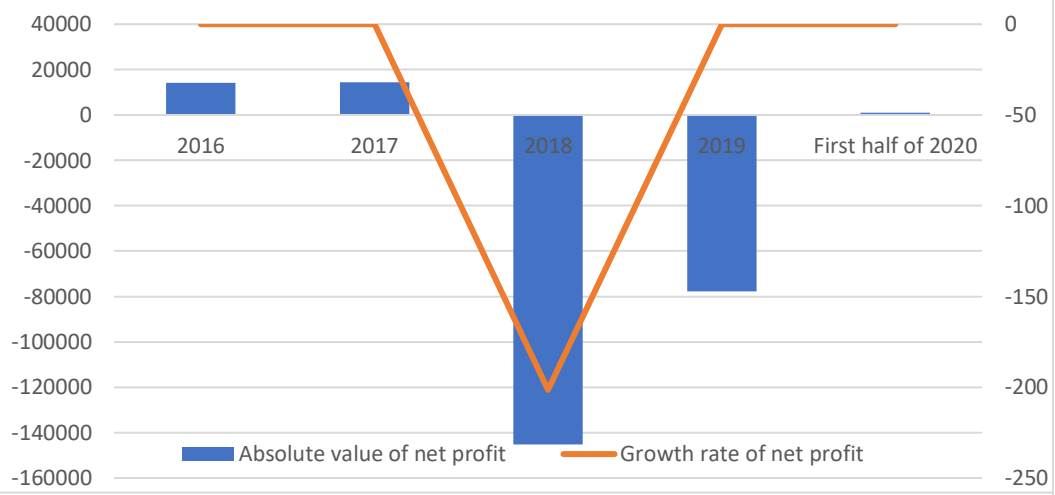


Figure 9b: Trend Chart of Fasten's Stock Price over Years

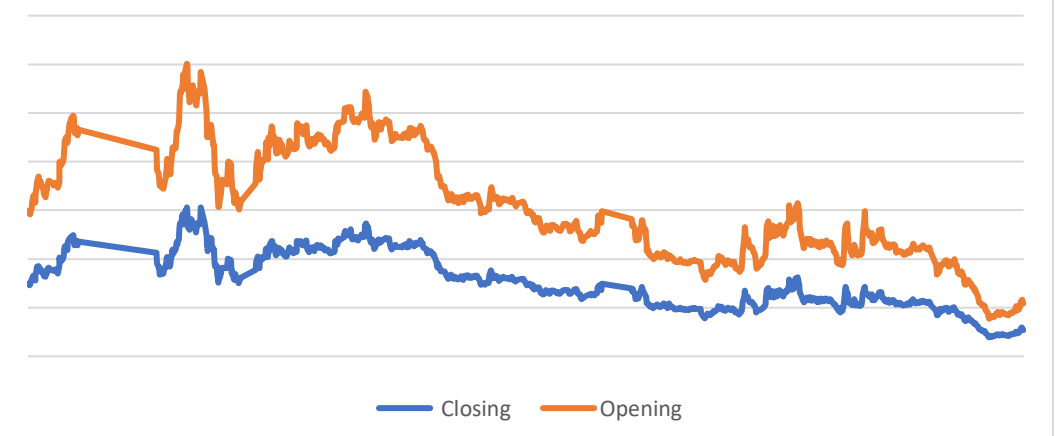


Figure 9

Based on the above trend, we can roughly see that Fasten's absolute value of net profit, and the growth rate of net profit reached a high level in 2016 and 2017. The positive trend of profit promoted the overall increase of Fasten's stock price in 2016 and 2017; when fasten suffered from the huge losses in 2018 and 2019, Fasten's stock price declined, indicating there is a positive correlation between the profit and the stock price of the iron and steel industry. It is worthy to study that whether there is certain correlation between the stock price and the growth rate of gas consumption. The author makes the further research and discussion based on the data on gas consumption.

5.3.3 Trend in Natural Gas Consumption by Fasten

The author visited the Marketing Department of Jiangyin Tianli Gas Co., Ltd. and acquired the data on natural gas consumption by Fasten from 2016 to the first half of 2020, as shown in Table 9:

Table 9: Fluctuation in Natural Gas Consumption by Faste from 2016 to 2020

Fasten	2020.1-6	2019	2018	2017	2016
Consumption (10000 m^3)	355	767	900	928	854

Table 9

It can be seen from the data on gas consumption by Fasten that in 2016, the gas consumption by Fasten reached 8.54 million m^3, far more than that by Huaxi Chemical Fiber and Sanfangxiang in the textile industry in the same period. In 2017, the gas consumption by Fasten reached the maximum level of 9.28 million m^3, and dropped to 9.00 million m^3 and 7.67 million m^3 in 2018 and 2018 respectively; it is estimated that the gas consumption in 2020 will reach 7.80 million m^3. Among others, the gas consumption of 7.67 million m^3 in 2019 reached the minimum level within the reporting period, and the net value and the growth rate of the net profit also reaches the minimum level within the reporting period. From the charts, we can see the trend of gas consumption by Fasten clearly:

Figure 10: Line Graph of Natural Gas Consumption by Fasten from 2016 to 2019 Reflecting Upward and Downward Trend

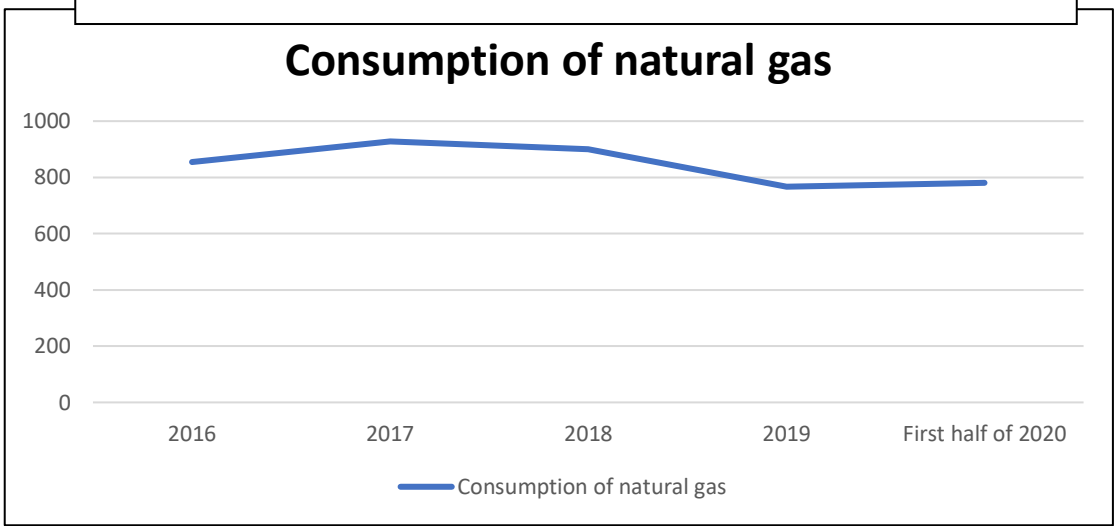


Figure 10

Based on comparison between the above trend and the stock price trend, for Fasten's metal products business, the gas consumption thereby is positively correlated to the absolute value of net profit, the growth rate of net profit, and the trend of stock price; whenever Fasten's stock price is lower, its profit and benefit are also lower; whenever Fasten's stock price is higher, its profit increases. The consumption of the natural gas is also closed related to it. The increase in the gas consumption reflects that the enterprise's production capacity is expanded, and the benefit is increasing.

Therefore, based on the analysis and judgment of the metal industry where Fasten is located, the increase in consumption of the natural gas can still reflect the normal production operation and expansion of production capacity of the enterprise, as well as the sustainable operation ability of the enterprise. Therefore, when the consumption of natural gas increases significantly, it is allowed to purchase the stocks of such enterprise, and the resulting returns of stock price are positively correlated.

5.4 Design and Verification of Regression Models for Stock Price Fluctuation and Natural Gas Increment

The natural gas consumption of the three industrial enterprises is taken as a typical case and the basis of inductive scientific research. The conclusion that there is a positive correlation between the natural gas increase and the returns of stock can also be demonstrated through the data modeling method of deductive demonstration.

5.4 .1 Selection of Variables and Data

In this paper, Shanghai Securities Exchange's industrial board indexes such as mechanical smelting, iron and steel, chemical industry, and textiles, and Shanghai securities composite index are selected as the dependent variables, and the price and

demand for crude oil, as well as the price, consumption, and demand for natural gas are selected as the independent variables.

Since this paper studies the correlation between the returns of stock and the natural gas consumption factors, the stock market index is selected as the stock market price in this paper because the stock price index can well reflect the trend of stock prices in China due to the availability and scalability of data. Energy is represented by crude oil and natural gas, and the price and demand for crude oil are important aspects of energy factors. Natural gas, as an important force in the energy field in recent years as discussed above, is because Chinese machinery, smelting and other industries are all dependent on natural gas, and their factors have an important impact on the returns of stock in the stock market.

5.4.2 Design of Regression Models

(1) Establish a regression model for the impact of energy factors on the energy sector based on the data. The design model is:

$$Y = a0 + aX_1 + bX_2 + cX_3 + dX_4$$

Let Y be the stock index of the industrial sector, X1 be the monthly average price of crude oil, X2 be the demand for crude oil, X3 be the price of natural gas, and X4 be the demand for natural gas. The linear regression is conducted to obtain the equation:

$$Y = -13935.39 + 36.04x_1 + 50.40x_2 - 8.51x_3 - 44.21x_4 \quad (1)$$

(2) Establish the impact of energy factors on the index of the whole Shanghai securities market, and obtain the model by regression:

$$Y = 15535.53 + 27.16x_1 + 61.14x_2 - 21.42x_3 - 28.77x_4 \quad (2)$$

5.4.3 Checking and Correction of Regression Models

D-W test of the models (1) and (2) shows that there is the autocorrelation between such two models. Use the generalized difference method to eliminate the autocorrelation of the models, so as to obtain a new model (1):

$$Y = 17932.95 - 0.48x_1 + 54.79x_2 - 4.05x_3 + 333.85x_4$$
$$R^2 = 0.9065 \quad DW = 2.0200$$
[AR (1) = 1.0442 AR(2) =-0.4488]

And to obtain a new model (2):

$$Y = 16801.59 - 0.0071x_1 + 51.51x_2 - 3.136x_3 + 298.76x_4$$
$$R^2 = 0.8993 \quad DW = 2.005$$
[AR(1) = 1.0547 AR(2) =-0.4660]

According to the correlation analysis, it can be found that both models reflect that energy price has little influence on Chinese stock market, while the consumption and the demand have the strong impact on Chinese stock market.

Based on the above empirical analysis, the conclusion is drawn that there is the weak correlation between the energy factor and the stock price, and there is the weak negative correlation between the stock price and the energy price; however, different from the energy price, there is the weak positive correlation between the demand and consumption of the energy (including natural gas) and the stock price; the stock market index or the returns of stock in China are subject to multiple factors, but based on the regression equations as a whole, the positive correlation with the increase of natural gas is an objective existence.

6. Conclusions

What studied in this paper is that the consumption of important emerging energy in the field of energy, namely the urban natural gas, plays an important role in promotion of the real economy. In the natural gas consumption structure, the natural gas has become an important energy for industrial manufacturing, creating a critical tracking indicator for us to study and analyze the long-term changing trend in the stocks of the listed companies in the manufacturing industry, because the growth rate of the natural gas consumption is positively related to the production capacity expansion and contraction period of the manufacturing enterprises. If the corporate stocks are purchased when the growth rate of the nature gas consumption by the listed enterprises is bottoming out, we will gain the excess returns of stocks in the new expansion period of corporate production capacity.

Based on the theory of transmission mechanism, starting from the features of the natural gas industry itself, this paper first analyzes the industrial characteristics, and based on the analysis of the dependency of the subdivided sectors in industry on the natural gas, this paper makes the empirical and reliable quantitative analysis of the gas consumption by the industrial listed companies, which are the customer units of Jiangyin Tianli Gas Co., Ltd. as a urban gas supply enterprise as well as the absolute value of profit and the growth rate of profit of the listed companies in the same period. Therefore, we draw the conclusion that the consumption management of the natural gas is synchronized with the company's profit expansion cycle and consistent with the variation trend in the stock price, so it is used as one of the decision-making indicators for investment in the stocks. However, it should be pointed out that, urban natural gas, profit, and stock price linkage transmission mechanism does not apply to any industry, nor apply to the industry which is less dependent on natural gas but extremely sensitive to price of natural gas; when making investment in stocks, we shall still apply this theory practice to the industry in which the natural gas is used as the main heating fuel and the industry in which the cost of natural gas accounts for a high proportion of the production cost, so as to achieve the goal of rational investment.

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About the Author

Huang Laitai, born in March 1958 in Jiangyin, Jiangsu Province, China, holds a Master of Business Administration from Tongji University. She is a Senior Economist, Member of China Democratic National Construction Association, and currently serves as the Chairwoman of Jiangsu Lianda Group.

Born in the late 1950s, the author has abundant life experiences: She spent her school years during the Cultural Revolution, worked as a sent-down youth in a production team, as a textile worker, and a doctor, and is now a successful entrepreneur. She also served as President of the Kjiangyin Federation of Industry and Commerce (General Chamber of Commerce).

In the early 1990s, the exciting years of reform and opening up, Huang Litai abandoned medicine and transitioned into business. She founded Jiangsu Lianda Group in 1994, headquartered in the beautiful and prosperous riverside city of Jiangyin, Jiangsu Province.

Over the past 20+ years, the enterprise she founded has grown from the garment industry to become a diversified group company, with major industries including textile and garment, urban energy, hotel real estate, and financial investment.

Huang's evolution from an ordinary woman to a successful entrepreneur can be attributed to her ability to learn, accumulate knowledge, innovate continuously, and embrace challenges. To realize her dream of creating a century-old enterprise, she furthered her education by enrolling in the professional doctorate joint program of the University of Geneva and Tsinghua University's PBC School of Finance.. This commitment underscores the pivotal role of knowledge in her path to success.

Huang has received numerous accolades, including "China's Outstanding Entrepreneurial Woman," "Top 100 Outstanding Chinese Female Entrepreneurs," "Top 10 Innovative Private Female Entrepreneurs in China," "National Model for Women's Contributions," "National Ambassador of Love for Supporting Western China," "Top 10 Excellent Private Entrepreneurs in Jiangsu Province," "Hope Project Outstanding Contribution Award," "Jiangsu Province's Leading Female Entrepreneur," "Top 10 Integrity Models in Jiangsu Province," "Wuxi Businessperson of the Year.", and both National and Jiangsu Provincial "March 8th Red-Banner Holder."