INDUSTRIAL DEVELOPMENT UNDER THE PRESSURE OF HIGH NATURAL GAS PRICES: A CASE OF UKRAINE

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Summary: The purpose of this study is to define the key sources of investments for the steel and chemical companies under the pressure of high gas prices, and the government’s capability to boost their development. To investigate the sources of investments and to identify the quantitative relationships between natural gas prices and company’s indicators, the author used traditional methods of structural, dynamic and statistical regression analysis including the Ordinary Least Squares (OLS) method. When natural gas prices grow the investment activity of steel and chemical companies is reduced. Under the hard pressure of gas prices these companies use only two sources of investments: long-term loans and depreciation. If the company’s unprofitability is long-term, then depreciation is not enough even to cover losses, and the company has to accumulate debts on loans or becomes a bankrupt. To ensure break-even operations of enterprises in these industries, the government should keep natural gas prices below certain limits. With the help of developed models, the author determined the critical levels of natural gas prices for metallurgical and chemical industries. The study is limited to the data on the activity of eight key manufacturing companies from one country only. In the absence of investment and renovation of production technologies the defined critical levels can be used by the government as a boundary, above which these industries will be unprofitable and their fate along with hundred thousands of workers will be questionable. This paper corrects the critical levels of natural gas prices for two manufacturing industries in Ukraine and proves that investment activity depends on the level of these prices.

1. INTRODUCTION

One of the significant factors of the last decade that have a significant impact on the development of industrial enterprises in Ukraine, along with the financial and economic crisis and political instability, was and still is the high price of natural gas. During the period 2005-2013, its level for industrial consumers increased by 10 times and in U.S. dollar terms by 6.5 times.

Let us recall that Ukraine consumes about 50-60 billion cubic meters of natural gas annually. Of these, about one-third is extracted domestically, and the rest is imported from Russia and CEE countries (Poland, Slovakia and Hungary). About a half of the total amount of gas in Ukraine is consumed mainly by metallurgical and chemical industries [10].

Hence, the most dependent on natural gas are industries such as:
- **metallurgy**, where natural gas is used as energy source for technological purposes;
- **chemical industry**, where natural gas is a key raw material for production.
The previous study [7] showed that during the financial crisis the main source of survival lies in the internal capacity of firms that are based on quality management, effective marketing and skillful investing, which enables future development of the business. However, with the rapid price growth for the basic material resources, the investment process may be deprived of its main sources that are:

- enterprise profit;
- depreciation;
- contributions of the enterprise owners;
- long-term loans.

What sources play a key role in the investment activity of the enterprises of the metallurgical and chemical industries in the period of high natural gas prices? What can the government do to boost their investment activity?

This study is devoted to find answers to these questions.

2. LITERATURE REVIEW

Natural gas is one of the most important energy sources in the world. The natural gas market is specific.

There are some general studies on the European Union (EU) natural gas market: [11] summarize the role of natural gas in EU energy imports; [3] analyze the prospects and challenges of cooperation in the field of natural gas between the EU and Arab States.

The others explore the systems or markets for natural gas distribution in some countries, such as Turkey, Italy, Ukraine [8] or in the regions.

Several studies refer to the assessment of factors determining the price of natural gas in some countries [1, 12], or the consequences of rising prices ([9]. A large number of publications evaluate the efficiency of gas distribution systems in different countries.

There are several publications that discuss the impact of high natural gas prices on the activity of manufacturers.

Huang [5] focuses on the fact that natural gas is the primary raw material used to produce ammonia.

It accounts for 85 percent of the ammonia production cost. The prices of ammonia and natural gas became strongly correlated the year 2000. Ammonia is the main input source of nitrogen
for most chemical fertilizer products used in U.S. agriculture. Therefore, since 2000 the volatile and upward trend in U.S. natural gas prices has led to a significant change in the supply of ammonia in the USA. From 2000 to 2006 U.S. ammonia production declined by 44 percent, while U.S. ammonia imports increased by 115 percent. Moreover, the number of U.S. ammonia plants dropped from 40 to 25.

Huang [6] indicates that for the period between January 1999 and June 2008 natural gas prices increased by more than 550 percent. This contributed to plant closures and resulted in a significant decline in chemical production.

Similarly, in other countries the chemical fertilizer production highly depends on natural gas prices, e.g. in Indonesia [2], Africa [4]. The problem is, therefore, global [13].

Metallurgical products are slightly lower, but also highly dependent on the natural gas, especially produced by the open-hearth furnace [10].

As shown by [8], natural gas prices directly affect the efficiency of manufacturing enterprises: chemical and metallurgical.

Hence, the high price of natural gas leads to unprofitable production of many chemical and metallurgical products.

To reduce losses and to increase profit the production process needs to be upgraded. To do so, the investments are necessary.

Therefore, we tried to empirically establish the sources of investment that manufacturers use under the pressure of high prices for natural gas. We also addressed the question how the government can stimulate investment activity and upgrading in metallurgy and chemical industry.

3. METHODOLOGY

To identify the influence of natural gas prices on the activity of metallurgical and chemical companies, the author used traditional methods of correlation and statistical regression analysis, including Ordinary Least Squares (OLS) method.

The technology of research here is as follows:
- analyzing the structure of investments in a fixed capital of metallurgical companies by main sources,
– analyzing the structure of investments in a fixed capital of chemical companies by main sources,
– correlating the changes in investment structures of the observed companies with natural gas prices,
– analyzing the industry performance indicators for the industrial consumers of natural gas in the country,
– establishing quantitative relationships and developing predictive models by regression analysis,
– making recommendations on regulation of natural gas prices for the government of Ukraine on the basis of developed models.

Key indicators for analysis in this study include:

a) operating profitability that is a percentage ratio of operating profit to the cost of operations;

b) structure of investments in a fixed capital including the following sources: enterprise profit; depreciation; contributions of the enterprise owners; the long-term loans.

4. DATA COLLECTION

To conduct this study, the following sources of information were used:

– monthly statistics of natural gas prices for industrial consumers, installed gas distribution companies in Ukraine for the period 2006-2013,

– annual reports of the large metallurgical and chemical companies in Ukraine for the period 2006-2013,

– data from previous studies of the author.

The accuracy of the information used is confirmed by audit reports and state service.

5. RESULTS

Natural Gas Prices

Over the last decade the dynamics of natural gas prices for Ukrainian industrial consumers was heterogeneous (Figure 1).

Except for the 2013-2014 period, the gas price increased. The highest growth rates were recorded in 2009, as well as in 2011-2012. Average annual growth rate for the whole period
was 21.5 per cent. In general, within a decade, the price of natural gas in dollar terms increased by 5.8 times, and in the national currency - by 9 times.

![Graph showing the dynamics of average annual prices for natural gas for Ukrainian industrial consumers](image)

**Fig.1.** Dynamics of average annual prices for natural gas for Ukrainian industrial consumers, USD per thousand cubic meters * - This data is for 1st Quarter of 2014

**Metallurgy**

On the example of key metallurgical companies in Ukraine, we investigated how to change the structure of investment in fixed assets by main sources.

The group of metallurgic companies includes: Azovstal, Zaporozhstal, Arcelor Mittal Kryvyi Rih, Dneprovsky metallurgical combine named Dzerzhinsky, Mariupol metallurgical combine named Ilyich.

Total production of these companies accounts for about 60 per cent of the total steel production in Ukraine.

Figure 2 shows that up to 2009 the profit was the main source of investment in fixed capital for the five largest steel companies.

Growth rates for natural gas in the period 2006-2008 were relatively high (30-36% per year). In 2009, there was a jump in the price of natural gas by 2.2 times, which against the background of the unfavorable situation in the world market of metals led to a loss in domestic metallurgy [8]. As a result, the volume of investment in the observed companies fell by more than 2 times.
Fortunately, the crisis forced many owners to think about shifting production to less energy-consuming technologies, and in 2010-2011 the investment process in the industry was quickened by the contributions of the owners, and at the expense of long-term loans.

However, further increase in gas prices has led the industry to a situation of permanent losses. A large part of depreciation deductions and credits were spent to cover losses and only the rest was directed to the investment in fixed capital. In this situation, under the hard pressure of high natural gas prices, borrowing becomes difficult and sinking fund (depreciation) becomes the main source of investment.

**Chemical Industry**

The group of observed chemical companies includes: Concern Stirol, Odessa Port Plant, Severodonetsk Azot.

Total production of these companies accounts for more than 30 per cent of all chemical production in Ukraine.

The situation in the chemical industry is even more deplorable (Figure 3).
The jump in gas prices in 2009 caused this industry to incur a loss, from which it could not recover for more than 5 years. The volume of investments into this sector, unlike metallurgy, decreases every year. Depreciation is not enough even to cover losses. Hence, the chemical industry accumulates debts on loans.

Establishing the Quantitative Relationships

Regression analysis confirmed the key role of natural gas prices in the formation of profitability of the enterprises in metallurgical and chemical industries. There are significant and adequate linear models that can be used to predict the average level of profitability of the major industrial consumers of natural gas in Ukraine:

\[
P_m = 39.47 - 0.099g, \tag{1}
\]

\[
P_{ch} = 45.61 - 0.136g, \tag{2}
\]

where \( P_m \) is operating profitability of metallurgical industry in Ukraine, %;

\( P_{ch} \) is operating profitability of chemical industry in Ukraine, %;

\( g \) is a price for natural gas for industrial consumers, USD per thousand cubic meters.

Models (1) and (2) are significant (greater than 0.95) and adequate (determination coefficient is higher than 0.86, the Fischer ratio is above 36, p-values are less than 0.01). This gives us the right to use developed models to predict an average level of profitability of the major industrial consumers of natural gas in Ukraine.

As can be seen, the profitability of chemical companies is more sensitive to changes in natural gas prices:

– at zero price for gas an average profitability of chemical companies will be more than 45%,

– if the gas price grows to $100, the average profitability of chemical companies will reduce by 13.6%.

Developed models enable us to establish the critical gas price for both industries, i.e. the price, at which an industry has zero margin and above which the industry becomes unprofitable.

In the early 2014 the critical price of natural gas for metallurgy was 400 USD, for the chemical industry – 336 USD. Comparing these levels with the existing dynamics of gas prices for industrial consumers (Figure 4), we can see why the majority of companies in the metallurgical and chemical industries suffer losses.

In comparison with previously obtained critical levels for the period till 2013 (Goncharuk,
2015), the levels above in Figure 4 are lower. This indicates that year by year the problem continues to deepen. Urgent action is needed to update the production technologies in order to reduce dependence on natural gas. But in view of the difficult economic situation in Ukraine, where neither foreign nor domestic investment during the war are possible, in my opinion, the current solution may be in price differentiation and government support for these industries.

Fig. 4. Annual dynamics and critical gas price levels for industrial consumers, USD per thousand cubic meters
* - This data is for 1st Quarter of 2014

To ensure break-even operations of enterprises in these industries the government should keep natural gas prices below these limits. Otherwise the production in these industries will lose economic sense, which will cause serious losses for the economy.

Thus, it is appropriate to differentiate natural gas prices for different industrial consumers.

6. CONCLUSIONS

When natural gas prices grow, the investment activity of steel and chemical companies is reduced. Under the hard pressure of gas prices these companies use only two sources of investments: long-term loans and depreciation.

If the company’s unprofitability is long-term like in Ukrainian chemical companies, then depreciation is not enough even to cover losses, hence, the company has to accumulate debts on loans or becomes bankrupt.
This is not only the problem of Ukrainian companies, this is a global problem.

To solve it, an urgent action is needed to update production technologies in order to reduce dependence on natural gas. But for certain manufacturers, such as ammonia producers, it is impossible to reduce gas consumption significantly.

To ensure break-even operations of enterprises in these industries the government should keep natural gas prices below certain limits. Otherwise the production in these industries will lose economic sense, which will cause serious losses for the economy.

Using the OLS method, the author developed two linear models for predicting operating profitability of both metallurgical and chemical industries subject to pricing for natural gas, for corresponding industrial consumers. These models enable us to determine the critical levels of natural gas prices for these two industries.

The critical gas price levels defined for Ukrainian metallurgy and chemical industry can be used by a state regulatory authority as a boundary, above which these industries will become unprofitable and their fate, along with hundred thousands of workers, will be questioned.

Thus, when investments are impossible or may not result in the reduction of gas consumption in the industry, it is advisable to reduce the price of gas for such consumers, i.e. by using the tool of differentiation for natural gas prices.

Therefore, we propose to set natural gas prices for various industries differentially. Such prices cannot exceed the defined critical levels.

REFERENCES


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