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## Economics of Gypsum Production in Iran

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**Abstract:** The purpose of this research is to analyze the economics of gypsum production in Iran. The trend in production cost, selling price and profit are used to investigate economics of gypsum production. In addition, the multivariate time series method is used to determine factors affecting gypsum price in domestic market. The results indicated that due to increase in production and inflation, profitability of gypsum production has decreased during recent years. It is concluded that tariff and non-tariff barriers on mines machinery are among reasons for increasing production cost in Iranian gypsum mines. Decreasing such barriers could increase profitability of gypsum production in Iran.

**Key words:** Gypsum, Iran, economics, profitability, production cost

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### INTRODUCTION

Iran is located in the Middle East, between Turkey and Iraq on the West and Afghanistan and Pakistan on the East; it borders the Persian Gulf and Oman Sea in the South and Azerbaijan, Armenia, the Caspian Sea and Turkmenistan in the north. Iran has enormous reserves of natural resource. Oil reserves are estimated at about 130 billion barrels (third in the world after Saudi Arabia and Iraq) and natural gas reserves are estimated at 20 trillion cubic meters (second in the world to Russia). Minerals have been mined in Iran for several thousand years. While the focus of the mineral industry had shifted to the petroleum sector in the 1950s, the government has recently encouraged investment in the exploitation of metals and industrial minerals to diversify the nation's economic dependence on oil and natural gas (Iranian Management and Planning Organization, 2004). Continued investment in the energy and transportation sectors will enhance Iran's ability to develop and market its mineral resources.

Iran's mining industry is under-developed. Mineral production contributes only 0.6% to the country's GDP (Iranian Ministry of Industries and Mines, 2005). Add other mining-related industries and this figure increases to just 4%. Many factors have contributed to this, namely lack of suitable infrastructure, legal barriers, exploration difficulties and government control over all resources (Mobbs, 2004).

Although the petroleum industry provides the majority of economic revenues, about 75% of all mining sector employees work in mines producing

minerals other than oil and natural gas. These include coal, iron ore, copper, lead, zinc, chromium, barite, salt, strontium, silica and gypsum (Khademi and Mermut, 1998).

Gypsum accounts for 10% of the country's mining activities each year (Iranian Statistical Center, 2006). Iran's annual gypsum production is 13 million tons, which is 10% of the entire global output (Taylor *et al.*, 2006; Founie, 2007). Iran is second to the United States in production and supplies much of the world gypsum needed for construction and reconstruction in the Middle East (Fars news, 2005). Main locations of gypsum deposits are found in center, west, north and south-western of Iran. Semnan, Qom, Yazd and Khorasan are main gypsum producers' provinces. These areas are considered the most important locality for gypsum occurrences, due to the high thickness of gypsum bed.

Gypsum production in Iran increased during last three decades. Gypsum production in Iran for 2000-2006 is showed in Fig. 1. Due to increasing production cost and inflation in Iranian economy, gypsum production decreased during recent two years. In addition, internal gypsum demand and Iranian gypsum export have decreased in recent years. Gypsum output is classified as either calcined or uncalcined. Calcined gypsum produced domestically from crude gypsum to manufacture wallboard and plaster products, whereas uncalcined gypsum is used for producing cement.

There are at least 400 mines in Iran. More than 70% of mines ownership is private, 26% cooperative and only 6% is state ownership (Fig. 2).

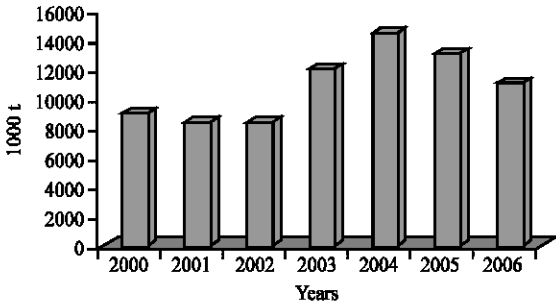


Fig. 1: Gypsum production in Iran (2000-2006), Taylor *et al.* (2006) and Founie (2007)

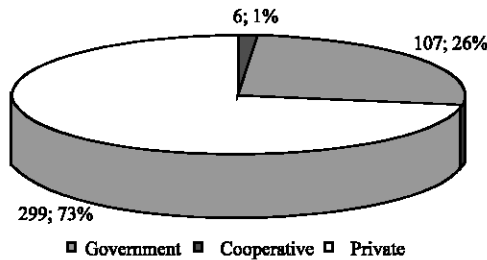


Fig. 2: Ownership of gypsum mines in Iran. Iranian Management and Planning Organization (2004)

One of the main problems for gypsum production in Iran is increasing trend of production cost. Surveying profitability of gypsum industry is important for future development of the industry. The objective of this study is to investigate economics of gypsum production in Iran.

### MATERIALS AND METHODS

The trend in production cost, selling price and profit are used to investigate economics of gypsum production in Iran. Profit is calculated by the following equation:

$$\pi_{(t)} = P_{(t)} + C_{(t)} \quad (1)$$

Where:

- $\pi_{(t)}$  = The profit of gypsum production in year t
- $P_{(t)}$  = The gypsum selling price in year t
- $C_{(t)}$  = Production cost in year t

Profitability is an index of competitiveness and success of a industry (Binger and Hoffman, 1988). Profitability of gypsum production is compared during recent years to indicate change in competitiveness of gypsum industry in Iran. The multivariate time series method is used to determine factors affecting gypsum price in Iranian market. The multivariate time series

method has received wide application in regression analysis (Greene, 2000). The general form of multivariate time series model is as follows:

$$GP_{(t)} = \beta_1 + \beta_2 Q_{(t)} + \beta_3 PC_{(t)} + \beta_4 INF_{(t)} + \epsilon_{(t)} \quad (2)$$

Where:

- $GP_{(t)}$  = The crude gypsum price in year t
- $Q_{(t)}$  = The gypsum production in year t
- $PC_{(t)}$  = The gypsum production cost in year t
- $INF_{(t)}$  = Inflation rate for Iranian economy in year t,
- $\epsilon_{(t)}$  = Error term
- $\beta_1, \beta_2, \beta_3$  and  $\beta_4$  = Coefficients

Annual data of gypsum price, gypsum production, gypsum production cost and inflation rate were obtained from the annual report of the Iranian Ministry of Industry and Mines, Iranian Central Bank and international data resources (Taylor *et al.*, 2006; Founie, 2007) for the period 1996-2006.

### RESULTS

Iranian gypsum industry uses relatively old technology and most plants are manual operate (Fig. 3). From 455 gypsum plant in 2005, more than 70% (330 plants) were manual, 22% (100 plants) semi-manual and only 5% (25 plants) were automatic operation. The country is in earlier stage in gypsum board industry. Only two gypsum companies are involving in gypsum board production.

The findings indicate that gypsum production cost has increased rapidly. Figure 4 shows Iranian crude production cost from 2002 to 2006. The crude production cost had increasing trend in recent years. Machinery (59%), labor (21%) and exploration (10%) are major crude production cost in Iran (Fig. 5).

Most machinery used in gypsum mines are imported to the country. Tariff and non-tariff barriers are two reasons for increasing machinery cost in Iranian mines.

In addition, Fig. 6 showed calcined production cost during recent years. Same as crude production cost, calcined production cost increased rapidly. Crude (36%), maintenance (17%), machinery (14%) and oil (13%) are important calcined production cost in Iran (Fig. 7). Although most of Iranian calcined plants are manual operated, but based on the fact that technology is old, machinery and maintenance are very important in production cost. It can be concluded that decreasing machinery cost could result in decrease calcined production cost in Iran.

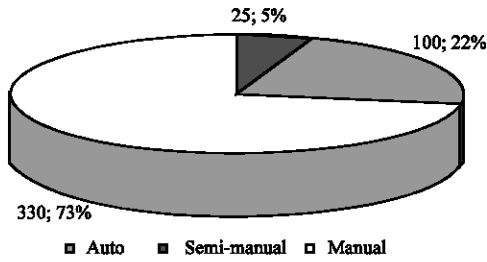


Fig. 3: Iranian calcined production line. Iranian Ministry of Industry and Mines (2007)

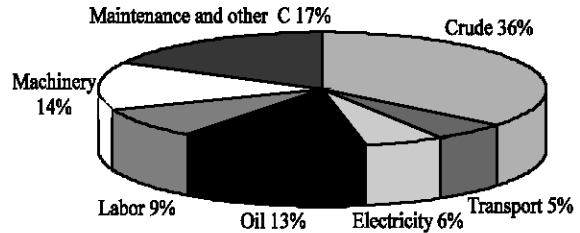


Fig. 7: Calcined production cost analysis in Iran (2006)

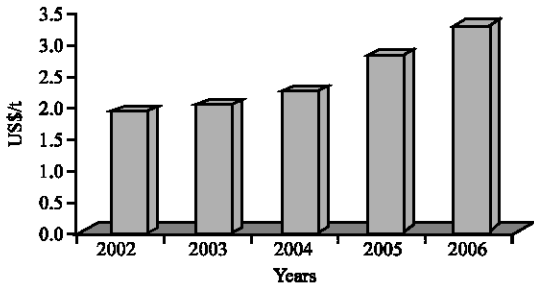


Fig. 4: Crude production cost in Iran (2000-2006), Iranian Central Bank (2006), Iranian Statistical Center (2006)

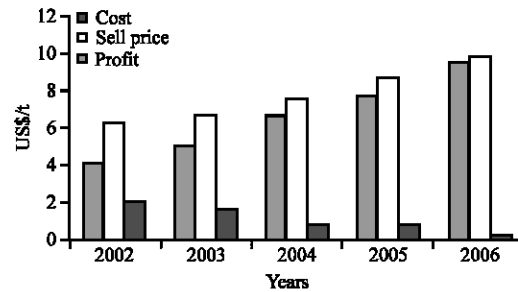


Fig. 8: Calcined cost, sell price and gypsum production profit in Iran (2006). Iranian Central Bank (2006), Iranian Statistical Center (2006) and research findings

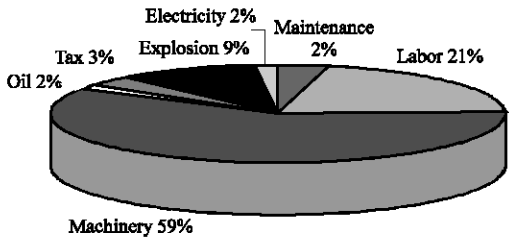


Fig. 5: Crude production cost analysis in Iran (2006)

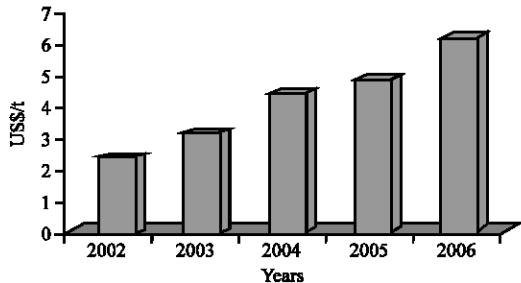


Fig. 6: Calcined production cost in Iran. Iranian Central Bank (2006), Iranian Statistical Center (2006)

Accurate statistics on productions and consumption of Iranian gypsum for plaster of Paris, cement and wallboard production are not available. The available data

indicate that manufactured gypsum is very inmodest relative to raw material quantities consumed in cement industry (Iranian Ministry of Industries and Mines, 2005). It could be related to industry specification and market demand.

Although calcined selling price is increased in recent years, but due to speedier trend in calcined production cost, profitability of calcined production has decreased during recent years (Fig. 8).

The result of multivariate time series regression is reported in Eq. 3.

$$\begin{aligned}
 GP_{(t)} &= 13836.4 - 0.00237 Q_{(t)} + 16546.4 PC_{(t)} + 70.12 INF_{(t)} \\
 &\quad + \varepsilon_{(t)} \\
 \text{t-value} &= (20.04) \quad (-0.24) \quad (4.41) \quad (10.3) \\
 \bar{R}^2 &= 0.998 \quad \quad \quad F = 1654.7^{***} \quad (3)
 \end{aligned}$$

Gypsum production (demand) coefficient sign is according to the expectation. Gypsum production is considered a variable to explain the demand law (the effects of quantity on price is negative). But, due to low mobility resources in mining industry and low elasticity of demand for gypsum, gypsum production (demand) quantity did not significantly responded to the gypsum price and the coefficient is not statistically significant. The gypsum production cost plays a major role in the

gypsum price in the Iranian market. Due to the major share of machinery cost in gypsum production cost, the expansion of mining machinery or tariff reduction is considered a major strategy to decrease gypsum price and develop gypsum industry in Iran. The sign of inflation rate coefficient is significant and according to that expectation. A higher inflation rate increases the country over all products and services prices, promote gypsum price in the Iranian market.

### **DISCUSSION**

This study analyzes the economics of gypsum production in Iran. The results indicate that due to high inflation rate and gypsum production cost, profitability of gypsum production in Iran has decreased during recent years.

Most of Iranian calcined plants are manual operated, but machinery is very important in production cost. It can be concluded that decreasing machinery cost could result in decrease calcined production cost in Iran. Most machinery used in gypsum mines are imported. Tariff and non-tariff barriers are two reasons for increasing machinery cost in Iranian gypsum mines. Decreasing such barriers could decrease production cost and increase profitability of gypsum production in Iran.

In addition, the result of multivariate time series regression showed that the gypsum production cost and inflation rate plays major role in the gypsum price. Furthermore, due to low mobility of resources in mining industry and low elasticity of demand for gypsum, the gypsum quantity do not significantly influence on gypsum price.

Although Iranian government, like many countries support small industries, but the subsidy provided could

not be available in long run. Finally, both private and government sectors should emphasis on research to decrease production cost and increase profitability of gypsum industry.

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