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A Survey on Supply Side of Mines: a Case Study of Iran

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Abstract

The mining sector is one of the most important factors in so many countries like Iran to achieve sustainable development. Due to importance of this sector in Iran, this paper investigates the supply side of mines in Iran. Hence, the main objective of this study is to investigate the supply side of mining in Iran. In order to get this aim, first, the annual time series data are collected from the website of Central Bank and Statistics Center of Iran. This paper determines the elasticity of the production factors of labor and capital for mining sector in Iran covering data 1988 to 2010. The Cobb-Douglas function is used to estimate mining sector production function which involves the OLS method using the EVIEWS8 and SPSS software. According to the results of this study during the years of the study the coefficients of the natural logarithm of the real capital and the natural logarithm of the labor in Iran are 1.621488 and 2.962340, respectively and these coefficients are statistically significant at the 5% confidence level. Indeed, these coefficients show the amount of elasticity of production factors for the mining sector in Iran. Hence, if the capital in the mining sector increases one percentage then the production in this sector increases 1.621488 and while the labor in this sector increases one percentage, then the production in this sector increases 2.962340 percent.

Keywords: Cobb-Douglas Function, Value Added, Mining Sector, Production Function, Elasticity and Iran.

Introduction

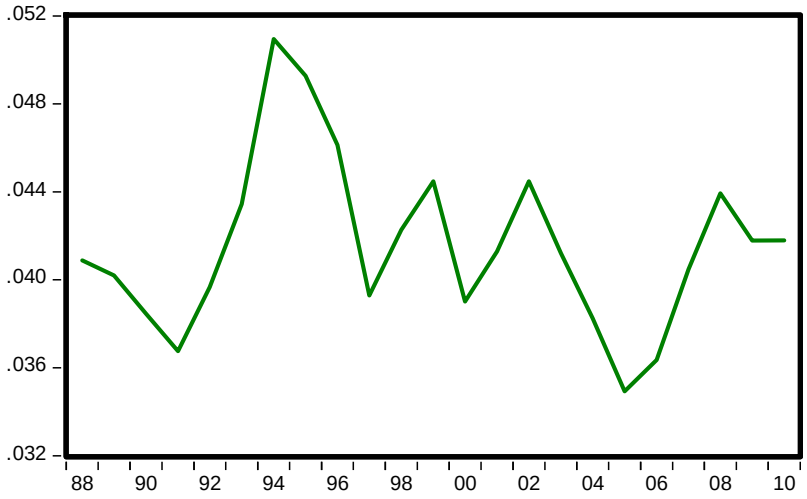
One of the most important mineral producers in the world is Iran. But unfortunately, its production is underdevelopment. More than 7% of the world's total mineral is located in Iran whereas its population is roughly 1% of the world's population. There are 68 types of minerals in Iran. Its actual and potential reserves of this country are about 37 and 57 billion tones, respectively. The most important mines in Iran are sand, metallic minerals, coal, and gravel, chemical minerals and salt. The most operating mines in Iran concerns Khorasan province. The ranking of Iran in the production of some minerals have been identified in the following table: (Connor, M. 1994; Sameni Keivani. Farshad et al, 2013a, b,c; Sharifvaqheei, Ali and Farhad Sameni Keivani, 2003; www.cbi.ir; www.amar.org.ir).

In figure 1 is shown the proportion of the mining value add respect to the value added of industrial in Iran at during of the study, (www.cbi.ir; www.amar.org.ir).

Table.1: The Ranking of the Iran Mining Sector

Name of Mineral	The Production Ranking in the World
Cement	Sixth
Iron Ore	tenth
Strontium	Sixth
Plaster	Second
Barite	Seventh
Copper	Seventh

Figure.1: the Ratio of the Mining Value Added due to Industrial Value Added in Iran



As we can see, the proportion of the mining value added has increased the period of the study in Iran. And this represents that importance of mining sector in the Iran economic. This ratio has been less than 0.5 percent in 1988 and it has gone up next to one percent in 2010. The capital stocks of the mining sector show at the following graph in the times series of the research, other papers on this subject include (Sameni Keivani. Farshad et al, 2013d,e,f,g,h,i,j; 2011k, l, m; 2012n).

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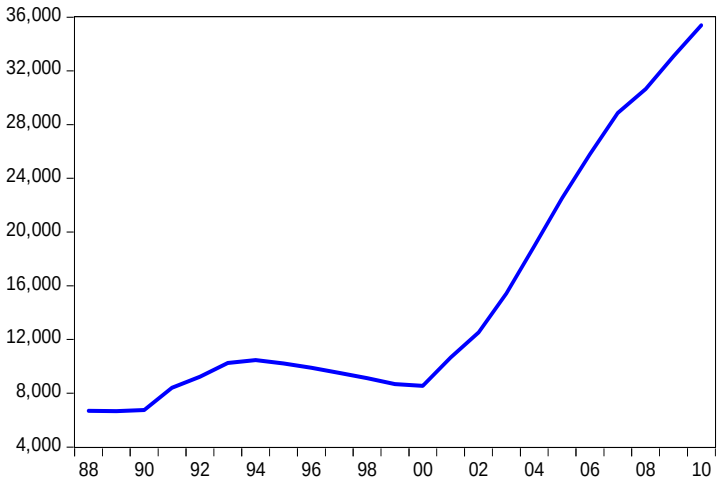
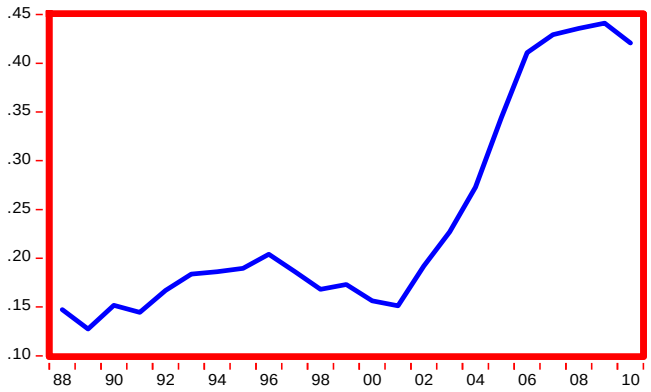
Figure.2: the Capital Stocks of the Mining Sector in Iran during 1988-2010



As we can see in figure 2, the capital stocks of the mining sector in Iran have increased period of the study years. One of the most important things in production function is the ratio of capital stock respect to labor. The paper has been calculated this ratio for the mining sector of Iran. And it has shown graphically as follows, (www.cbi.ir; www.amar.org.ir):

Figure.3: The ratio of the Capital due to the Labor in the Mining Sector in Iran



As we can see in the above figure, gradually, the production technology in the mining sector in Iran has changed from labor towards using of more than capital.

One of the most important and empirical concepts is elasticity. Generally, the ratio of percentage changing of two variables is called elasticity. If Y = f(x), then the elasticity, e_{xy}, can be illustrated by following equation:

$$e = \frac{\%\Delta Y}{\%\Delta x} \quad \text{Or} \quad e = \frac{\Delta y}{\Delta x}\frac{x}{y}$$

In fact, the elasticity shows for example if the x variable changes one percent then the y variable will change how much percentage. For example, the elasticity between x and y, e_{xy}, is 3 when a one percent increase in x causes a 3 percent increase in y.

Many papers in economics to analyze firms behaviors assumes that production functions of firms are in form of the Cobb-Douglas production function which first introduced by Charles Cobb and Paul Douglas, (Burness HS, Quirk JP. 1999; Berndt Ernst R and Wood David. 1975; Connor, M. 1994; Chakravorty U, Hochman E, ZilbermanD.1995) It is written as follow:

$$Q = F(L,K) = AL^{\alpha 1}K^{\alpha 2}$$

Where, A, α_1 and α_2 are parameters. In this function, α_1 and α_2 show the production elasticity of labor and capital, respectively. In this form, the marginal product of labor can be estimated as the following equation, (Balakrishnan P and Pushpangadan K. 1994; Banerji A. 1971; Berndt E R and Christensen L R. 1973).

$$MP_L = \propto_1 AL^{\alpha_1 - 1}K^{\alpha 2}$$

And the marginal product of capital is obtained as follow:

$$MP_L = \propto_2 AL^{\alpha_1}K^{\alpha_2 - 1}$$

Hence, the marginal rate of technical substitution between labor and capital, $MRTS_{LK}$, is:

$$\text{MRTS}_{\text{LK}} = \left(\frac{\alpha_1}{\alpha_2}\right)\left(\frac{K}{L}\right)$$

The main objective of this paper is to estimate the production function in the Iran mining sector. Determination of this function will help the Iran mining decision makers to take a good decision to reduce extra costs and increase productivity in this sector.

The main hypotheses in the study are as follow:

1. There is a positive relationship between labor and the value added in mining sector of Iran.
2. There is a positive relationship between capital and the value added in mining sector of Iran.

Materials and Methods

The paper applies the descriptive and analytical methods. Achieving the aim theoretical discussions and empirical studies was conducted using library methods. The required data, the related background information on empirical studiers and literature was collected by internet and library ways. The statistical data are taken from statistical data of Central Bank and the Statistical Center of Iran. After collecting the secondary data, it is necessary to determine to be or not to be the stationary for the data. Unit root test of Augmented Dickey-Fuller (ADF) is applied for it. Then is used the Cobb- Douglas function representing the relationship between the mining sector value add of Iran as a dependent variable and its factors of production, labor and capital, as the independents variables, other papers on this subject include, (Durlauf, S., and D. Quah. 1999; Diewert W. 1971; Engle R F and Granger C W J. 1987; Hoch, Irving. 1958; Goldar B N. 1986; Greene W H. 1980; Gupta Deepak, 1985; Garrido R. 2005; Greene WH. 2002; Jorgenson and Griliches. 1967; Little I M D, Mazumdar D and Page Jr. J M. 1987, Lynk L Edward. 1982; Matsuno Y, Hatcho N, Shindo S. 2007b; Miller KA. 1996; Mundlak, Yair. 1963; Mundlak, Y., And I. Hoch, Scott CA, Flores-Loped F, Gastelum JR. 2007).

To representing the model is used the Cobb Douglas function as the following:

$$Q = F(L,K) = AK_{-1}^{\alpha 1}L^{\alpha 2}$$

Now, the paper takes the natural logarithm from two sides of above equation, so we can easily the following liner function:

$$\text{Ln}(Q) = \ln(A) + \alpha_1 \ln(K_{-1}) + \alpha_2 \ln(L)$$

Where

A = as a constant amount

ln(Q) = the natural logarithm of the mining sector value added of Iran

$\ln(K_{-1})$ = the natural logarithm of the capital stock in the mining sector in Iran with one lag period.

ln(L) = the natural logarithm of the number of employees in the mining sector in Iran.

Hence, the linear regression model can be used to estimate the production function in this research. The statistical population limits to Iran economy. The studied variables in this study are annual time series data mainly from 1988 to 2010. The study applies EIEWS8 and SPSS Software. Then significant of the model and coefficients investigates using appropriate statistical analyzes.

Results and Discussion

Due to the results of the ADF test, at 5% confidence level, all of the data are not stationary at the level but only the natural logarithm of the mining sector value added of is stationary at the first difference level and the other variables in the natural logarithm of the variables are stationary at the second difference. In other words, however the variables have unit root test at the level but have not unit root test at the first difference for the Q and the L and second difference for the K_{-1}, while the natural logarithm of the variables are used in the Cobb Douglas function, (Cox, D., and H. Miller. 1965; Dickey D A and Fuller W A. 1981).

The ADF test results are as come at the following table:

Table 2. The results of ADF test

The names of variables	ADF statistics	The Critical Value at 5%	The Stationary at	Prob.
Ln(Q)	-5.523267	-3.644963	1st difference	0.0012
$\ln(K_{-1})$	-5.147565	-3.658446	2st difference	0.0028
Ln(L)	-8.588226	-3.673616	2st difference	0.0000

In order to estimate the relationship among the mining sector value added of Iran and the effective's variables, the L and K, are applied the linear regression model. The function coefficients can be found from the below table, (Sameni Keivani. Farshad et al, 2012; Sharifvaqheei, Ali and Farhad Sameni Keivani, 2003):

Table 3. Coefficients of Model

Dependent Variable: LNQ
Method: Least Squares
Sample (adjusted): 1990 2010
Included observations: 21 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-24.84971	4.918796	-5.051991	0.0001
LN K_{-1}	1.621488	0.590941	2.743910	0.0129
LNL	2.962340	0.450918	6.569568	0.0000

R-squared	0.755483	Mean dependent var	7.626202
Adjusted R-squared	0.729745	S.D. dependent var	0.493012
S.E. of regression	0.256298	Akaike info criterion	0.241170
Sum squared resid	1.248083	Schwarz criterion	0.389949
Log likelihood	0.347127	Hannan-Quinn criter.	0.276218
F-statistic	29.35214	Durbin-Watson stat	1.204337
Prob(F-statistic)	0.000002		

And for this model we can write as follow:
Substituted Coefficients:
==========
LNQ = -24.84971+ 1.621488* LN K_{-1} + 2.962340*LNL

The results of the study show, in the model, the coefficients of the natural logarithm of the capital stock in the mining sector with one lag period and the natural logarithm of the number of employees in the mining sector in Iran are 1.621488 and 2.962340, respectively. Due to the information of above table, all of coefficients are significant at %5 confidence level. In fact, these coefficients show the amount of elasticity of production factors for the mining sector in Iran. Hence, if the capital in the mining sector increases one percentage then the production in this sector

increases 1.621488 and while the labor in this sector increases one percentage, then the production in this sector increases 2.962340 percent.

The coefficients of the variables are also statistically significant due to ANOVA test (see the ANOVA table as the follow):

Table 4. ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.856	2	1.928	29.352	.000[b]
	Residual	1.248	19	.066		
	Total	5.104	21			
a. Dependent Variable: lnQ						
b. Predictors: (Constant), ln(L), ln(K)						

Due to the ANOVA data in table 3, the Sig is near to zero so the correlations are significant among the mining sector value added and the independent variables also the t-test statistic confirms it and also the value of R-Square is enough big which indicates the contribution of ln(L) and $\ln(K_{-1})$ on the natural logarithm of the mining sector value added of Iran is 0.755483%. The closeness of R2 and Adj-R2, 0.729745%, shows the Goodness of fit of data. Generally, the hypotheses are accepted means that:

1. There is a positive relationship between labor and the value added in mining sector of Iran.
2. There is a positive relationship between capital and the value added in mining sector of Iran.

The results of the paper show that one percent change in capital causes to change 1.621488 percent in the production of the mining sector and one percent change in the labor causes to change 2.962340 percent in the production. In other words, the elasticity of capital and labor are 1.621488 and 2.962340, respectively.

Conclusions

This survey investigates the supply side of mines in Iran. Hence, the main objective of this study is to investigate the supply side of mining in Iran. It indicates the production function for mining sector in Iran covering data 1988 to 2010. The findings of the research would be useful for the government of Iran to take best decision in order invest into this sector.

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