A Productivity Analysis of Mongolia's Mining and Quarrying Industry

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1. Introduction

The mining and quarrying industry plays an important role in the economy of Mongolia. The annual average growth of the value added in the mining and quarrying industry at 2005 constant prices was 4.0% in 1996-2000, 8.2% in 2006-2010, and 2.8% in 2011. In 2011, 21.7% of the country's GDP was produced in the mining and quarrying industry. In addition, 89.2% of export earnings were contributed by this industry. The share of coal and lignite mining and extraction of peat equaled 34.6% of the gross mining and quarrying industry output, which increased by 23.4 percentage points from the figure in 2000. The mining and quarrying industry is also playing an important role as a major source of Mongolia's state budget revenues (Table 1).

Productivity is measured by the value added per MNT 1,000 of expenditure on production and services. At the national level, productivity is measured by GDP and measured by the value added at a sectoral level. Thus, productivity is estimated by the ratio of the value added to the sum of intermediate consumption, labor (remunerations) and fixed capital (consumption of fixed capital) multiplied by 1,000. The basic factor productivity determines the efficiency of the labor and capital utilization in production processes. Labor productivity is one of the total factors of production and determines the efficiency of labor. Labor productivity is calculated by the ratio of value added to the annual average number of employees.

2. The Productivity of Mongolia's Mining and Quarrying Industry

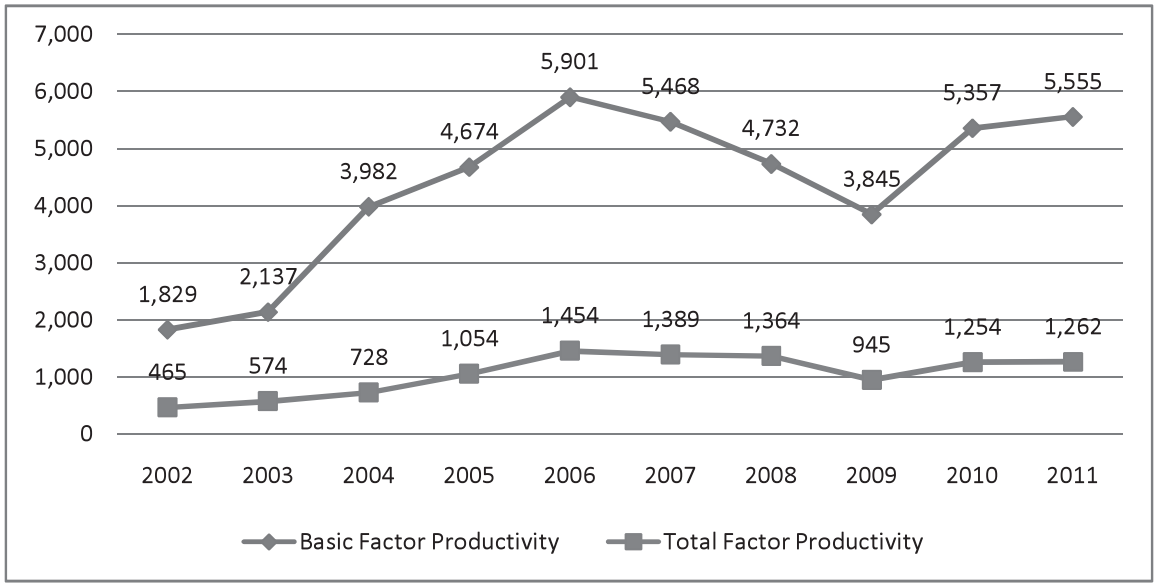
In 2011, the total factor productivity (TFP) in mining and quarrying was MNT 1,262, increasing: by MNT 797, or

Table 1: Selected Indicators for Mongolia's Mining and Quarrying Industry

	1995	2000	2005	2010	2011
Share of mining and quarrying value added of GDP, %	12.0	12.0	23.5	23.6	21.7
Share of mining and quarrying of the total industrial output, %	51.3	51.7	66.3	71.6	68.6
Share of the mining sector employees of total employment, %	2.4	2.3	4.1	3.3	4.4
Share of mineral exports of total exports, %	65.5	35.2	42.7	81.0	89.2
Composition of the mining and quarrying industry, %					
- Mining of metal ores	85.5	80.6	88.6	60.7	55.6
- Mining of coal and lignite, extraction of peat	8.2	11.2	7.5	29.9	34.6

Data source: Mongolian Statistical Yearbook, 2005-2011 editions, National Statistical Office of Mongolia

Figure 1: Total and Basic Factors of Productivity for the Mining and Quarrying Industry (current prices, MNT)



Data source: Mongolian Statistical Yearbook, 2005-2011 editions, National Statistical Office of Mongolia

Table 2: Labor Productivity and Real Wage Growth in Mongolia (2000 = 100%)

ISIC	Indicators	2000	2005	2006	2007	2008	2009	2010
National	Real change of labor productivity	100.0	116.8	123.3	132.9	142.7	143.9	149.5
	Real change of the average wage	100.0	116.3	138.2	158.9	206.4	217.0	218.2
	Ratio of labor productivity and real average wage changes	***1.00***	***1.00***	***0.89***	***0.84***	***0.69***	***0.66***	***0.69***
Agriculture, hunting and forestry	Real change of labor productivity	100.0	101.1	106.4	121.8	129.8	147.2	123.5
	Real change of the average wage	100.0	78.1	101.2	107.1	153.2	162.8	141.9
	Ratio of labor productivity and real average wage changes	***1.00***	***1.29***	***1.05***	***1.14***	***0.85***	***0.90***	***0.87***
Mining and quarrying	Real change of labor productivity	100.0	76.1	71.9	69.0	64.5	88.7	93.8
	Real change of the average wage	100.0	148.3	167.9	212.2	260.0	307.9	384.3
	Ratio of labor productivity and real average wage changes	***1.00***	***0.51***	***0.43***	***0.33***	***0.25***	***0.29***	***0.24***
Manufacturing	Real change of labor productivity	100.0	168.4	210.2	261.6	267.2	184.9	189.9
	Real change of the average wage	100.0	109.0	132.2	139.0	190.4	185.3	196.8
	Ratio of labor productivity and real average wage changes	***1.00***	***1.55***	***1.59***	***1.88***	***1.40***	***1.00***	***0.96***
Wholesale and retail trade; repair of personal and household goods	Real change of labor productivity	100.0	86.7	90.3	89.3	99.9	91.2	139.3
	Real change of the average wage	100.0	102.2	110.8	137.9	177.9	188.4	180.4
	Ratio of labor productivity and real average wage changes	***1.00***	***0.85***	***0.81***	***0.65***	***0.56***	***0.48***	***0.77***

Data source: Mongolian Statistical Yearbook, 2005-2011 editions, National Statistical Office of Mongolia

2.7%, from the figure in 2002; by MNT 208, or 19.7% higher, than the figure in 2005; and by MNT 8, or 0.6%, compared to the 2010 level. The basic factor productivity in the mining and quarrying industry was MNT 5,555 in 2011, which increased by MNT 3,726, or 3 times, from its level in 2002, and was higher by MNT 881, or 18.8%, and by MNT 198, or 3.7%, compared to 2005 and 2010, respectively (Figure 1).

The annual average growth of labor productivity in the mining and quarrying industry at 2005 constant prices amounted to MNT 23.0 million in 2000, but it decreased by 4.4% annually during the period 2000-2004, and increased by 3.6% annually during the period 2005-2010.

The total change in GDP during the period 1991-2010 was MNT 1,864.7 billion estimated at 2005 constant prices, of which: MNT 805.2 billion, or 43.2%, was due to the growth of the number of employees; and MNT 1,059.5 billion, or 56.8%, was provided by the growth of an intensive factor or labor productivity.

At the national level, an adequate ratio between labor productivity and the inflation-adjusted change of average wages was lost in the period 2002-2010. In other words, inflation-adjusted wage growth was more than the labor productivity growth during the period.

The ratio of labor productivity to real average wages for the mining and quarrying industry was 1.18 in 2001, but decreased to 0.51-0.24 in the period 2005-2010.

3. Description of the Models and Results

Two methods were used in this study: (1) the growth accounting approach was used to measure the Total Factor Productivity (TFP); and (2) a productivity regression using the ordinary least-squares (OLS) method was used to identify significant factors that influence labor productivity (LP) growth.

A simple model can serve to illustrate the concept of the growth accounting approach. Suppose the time path of a nation's aggregate economic activity can be summarized by the relationship:

$$Y_t = A_t \cdot f(K_t, L_t, t), \quad t = 1, \ldots, T, \qquad (1)$$

where, Y_t is a certain measure of real aggregate economic output (for example, GDP or GNP) in year t; K_t is a measure of the capital stock or capital service in use in year t; L_t is a measure of labor in employment in year t; t is a time index intended to capture the level of technology in place in year t; A_t is an index of the efficiency with which K and L are utilized in year t; and $f(K_t,L_t,t)$ is a production function that describes how capital, labor, and technology were used to produce output.

The basic model for GDP growth decomposes output growth into: labor growth, capital growth, and TFP growth.

$$\Delta \ln Y = S_l^* \Delta \ln L + S_k^* \Delta \ln K + \Delta \ln TFP \qquad (2)$$

Output = Labor + Capital + TFP

In terms of growth, it can be expressed as: TFP growth = Output growth - Capital growth - Labor growth

The basic model for labor productivity growth decomposes the labor productivity growth into: capital deepening and TFP growth. Capital deepening means an increase of the capital intensity, i.e., the capital service used by a worker or per work-hour.

$$\Delta \ln\left(Y/L\right) = S_k^* \Delta \ln\left(K/L\right) + \Delta \ln TFP \qquad (3)$$

As illustrated in Table 3, the contributions of labor and capital for output growth of the mining and quarrying industry were positive, but the contribution of Total Factor Productivity was negative.

Results of the Regression Analysis

LOG_Y = 0.2746*LOG_CAP - 0.0822*LOG_FDI + 3.0711

Y = Labor productivity of the mining and quarrying industry at 2005 constant prices, billion MNT;

CAP = Capital deepening of the mining and quarrying industry at constant prices, million MNT (X1)

FDI = FDI in the mining and quarrying industry (FDI, TOTAL*100) (X2)

Due to the lack of long-term dynamic data, labor was substituted by total employment and total capital by the consumption of fixed capital by industries. A GDP deflator at 2005 prices was used to estimate the amount of fixed capital consumption at 2005 constant prices.

The above regression equation suggests that a raising of the capital deepening in the mining and quarrying industry will result in labor productivity growth. On the other hand, it also indicates that an increased share of foreign direct investment (FDI) in the mining and quarrying sector of the total FDI would result in a labor productivity decline in this sector. The regression results were statistically significant (Table 4).

Table 3: Results of the Growth Accounting Model for Mongolia's Mining and Quarrying Industry (%)

	GDP	Labor	Capital (Consumption of fixed capital)	TFP
1996-2000	4.0	0.43	10.9	-7.33
2001-2005	8.2	16.4	-1.0	-7.2
2006-2010	2.8	-3.1	7.9	-2.0
2011	8.7	32.3	15.3	-38.9
Contributions:				
1996-2000	100.0	10.8	272.5	-183.3
2001-2005	100.0	200.0	-12.2	-87.8
2006-2010	100.0	-110.7	282.1	-71.4
2011	100.0	371.3	175.9	-447.2

Data source: Mongolian Statistical Yearbook, 2005-2011 editions, National Statistical Office of Mongolia

4. Conclusion

The Mongolian economy is still dependent on the primary sectors of mining and agriculture, and the share of manufacturing of final products remains low. Nevertheless, the labor productivity increase was an important factor in Mongolia's economic growth during the period 1991-2010.

The results of the productivity analysis of the mining and quarrying industry suggested that in order to adhere to a proper ratio between the labor productivity and average wages, it is essential to focus on certain issues of the country's development policy. They include, but are not limited to:

- Implement and adhere to the principle of consistent increase of wages on the basis of improved productivity and skills;
- Take measures to raise the contribution of the manufacturing sector to GDP along with enhancing the effectiveness of labor productivity and investment, while steadily developing the mining and quarrying sectors as a top priority in general.

Productivity improvement should not be limited to labor productivity alone. Similar to other countries, it is necessary to give importance to the productivity of all areas because it affects the development of all economic sectors. Total factor productivity estimations need to be extensively used in the country's development policy and planning.

A continuous and intensive economic growth should be attained by increased labor productivity and investment efficiency in the mining industry at first, and be followed by an intensive development of the processing industries. The country needs to make its economy a multifaceted one that is private-sector-led, high-technology-based and expert-oriented. Dynamic processing industries will help the economy to become less dependent on mineral resources.

Table 4: The Regression Results

Method: Least Squares				
Sample: 1995-2011				
Included observations: 17				
Variable	Coefficient	Standard error	*t*-statistic	Probability
LOG_CAP	0.2746	0.0551	4.9793	0.0002
LOG_FDI	-0.0822	0.0267	-3.0751	0.0082
C	3.0711	0.1080	28.4313	0.0000
R-squared	0.7056	Mean dependent variable		2.9574
Adjusted *R*-squared	0.6636	S.D. dependent variable		0.1469
S.E. of regression	0.0852	Aikake's information criterion		-1.9293
Sum squared residual	0.1016	Schwarz criterion		-1.7822
Log likelihood	19.3987	*F*-statistic		16.7781
Durbin-Watson statistic	1.7094	Probability (*F*-statistic)		0.0002

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