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## Research on the Competitiveness of Mongolian Coal Industry

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**Abstract.** This research is aimed to determine factors impacting competitiveness of Mongolian coal sector and develop possible ways to increase competitiveness of Mongolian coal on international market. Based on literature review we choose following methods of analysis: 1) Revealed Comparative Advantage for determining level of competitiveness of Mongolian coal sector; 2) panel regression for determining factors impacting competitiveness of coal sector; 3) documental analysis for developing possible opportunities of increasing competitiveness of Mongolian coal sector. Revealed comparative advantage shown that Mongolia is failing to benefit from international coal market. Mongolia ranked only at 22th place, despite having huge amounts of coal reserves. RCA analysis also shown that countries with lower economic development usually tend to have lower RCA values compared with high developed ones. Regression analysis shown that GDP supports to coal sector by transition of national income to profitable sectors. Countries with sea gateway can benefit in competition by lower transportation costs. Logistics and infrastructure support countries to achieve benefit from enhanced transportation and logistics network. We used Porter's Diamond Model to interpret and analyze each of 6 factors, that may have impact to Mongolian coal sector competitiveness. These include: firm strategy, factor conditions, demand conditions, related and supporting industries, government, chance. From these factors, we found that infrastructure has highest impact on Mongolian coal sector. Based on infrastructure, we developed possible ways of cost efficient transportation and strategical planning of coal reserves.

**Keywords.** Saemaul Undong, village development, local values, modernizing rural areas

### Introduction

#### Background

Mongolia's economic growth is driven by the rapid development of the mining sector, from which coal sector comprises most of the industry revenue. Our country's geological coal reserves are estimated at 175.3 billion, making it one of the top 10 countries in the world in terms of reserves. The country ranks fourth in terms of coal exports, after Australia, Canada and the United States [1].

The International Energy Agency and the World Coal Association predict that the demand for coal in the world market will increase in the future. The growing demand for coal has been attributed to global population and economic growth, including in China, India and other developed countries. In addition, the declining oil reserves, one of the main sources of energy, have a positive impact on coal prices, which is an advantage for our country [2].

Most of Mongolian imports and exports are carried out by rail (over 95%) both within the country and abroad [3]. In recent years, coal has surpassed exports of other commodities and has become the most important export product which supports the national financial system. In 2019, income from coal exports amounted to 3 billion USD million, which is almost three times higher than in the same period in 2016 [4].

### **Issue statement**

Many new and advanced sources of electricity and heat are emerging around the world and are being used in many countries, but coal is still one of the most demanded raw materials. Mongolia's mining sector currently accounts for 5.8 percent of total industrial output, with a very small share, indicating that Mongolia exports solely raw materials [5]. Therefore, exploring opportunities to increase export efficiency through coal processing and power generation is important to ensure Mongolia's economic security and sustainable development [6].

There is still an unanswered question for Mongolia: how to wisely utilize its natural resources while taking advantages of its geographical features. To improve our competitiveness, it is essential to study the optimal solution, one that is compatible, non-offensive, and that aligns well with the policies of our neighboring countries. Currently, there has been no comprehensive methodological study conducted to assess the competitiveness of the coal sector in Mongolia, and to identify the strengths and weaknesses of development possibilities. Therefore, we believe it is now essential and appropriate to conduct competitiveness research on the coal sector in Mongolia, and propose possible strategies for the effective management of sustainable development.

### **Research purpose**

The aim of the study is to identify the analyze competitiveness of Mongolian coal sector and suggest possible ways to increase competitiveness.

### **Innovative outcomes**

One of the main innovations of this study is analysis of Mongolian coal industry competitiveness by Porter's Diamond model, which includes following main factors: demand factors, firm structure and rivalry, demand conditions, related and supporting industries with supportive factors of change and government. Also this study introduces panel regression method, which covers main economic and infrastructural factors that can impact on revealed comparative advantage of the countries. Since statistics office of Mongolia has not long term time series data, it was decided to study whether low-income countries have lower RCA compared to high income countries. Basing on Diamond porter analysis we developed wide and complex analysis on possibility of increasing competitiveness of Mongolian coal industry. Therefore this study is one of the recent studies, which includes complex and detailed analysis of coal industry competitiveness, not only limited by Mongolia.

### **Literature review**

Mongolia has been using its mining products since the 1990s, when it began to pursue an open economic and trade policy. Industry related research has recently become more intensive. In particular, MRAM's Coal and Research Department has been conducting research in this area, and in 2012 published a booklet on the current state and prospects of the Mongolian coal sector. Recently, dozens of researchers and scholars in the mining sector have been

studying the technology, economics, planning and management of the coal industry, and strategic development policies.

Scholars and researchers including M. Porter, R.A. Fatkhudinov, A.M. Rugman, D. Cho, Kh.Ch. Moon, Ch. Woo, Sh.M. Valitov, A.R. Safullin, B.V. Fatkhudinov, B.V. Kuznetsov, L. Oyuntsetseg and Ya. Oyuntungalag conducted studies on developing methods to determine competitiveness. In addition, the Boao Forum for Asia, Asian Competitiveness Council, Council on Competitiveness, World Economic Forum, Organization for Economic Co-operation and Development conducted research studies in this context. P. Ochirbat, J. Byamba-Yu, and B. Chinzorig studied the field of mining development strategies. D. Tsedendamba, L. Erdene, D. Dorjgochoo and R. Sungui conducted studies on coal industry development, strategies and trends and covered theoretical issues as well. For example, one of the research works is entitled “Theory and Methodology to Establish National Innovation System,” a monograph research paper by L. Oyuntsetseg, 2009. Further, she conducted and assessed the methodology to improve regional competitiveness.

Ya. Oyuntungalag completed a monograph entitled “Improving competitiveness of industry”, based on an example of light industry, in 2004. Through her research work, besides proving the feasibilities to improve competitiveness of industry as a complex, she also developed a comprehensive and fundamental theoretical studies. Her research work serves a valuable reference for masters’ and doctoral students who are conducting research on competitiveness.

In the research by D. Tsedendamba, 1973, “Locations of coal industries and development research of People’s Republic of Mongolia”, he estimated coal consumption in Mongolia in 1975, 1980, 1985 and up to 1990, by using mathematical and statistical methods. For the first time, he used engineering calculation, mathematical-statistical, linear-programming and expert-assessment methods in industrial analysis to develop fundamental methodology for coal industrial development and defined technique and technology advancement in relation to their usages as well.

In the dissertation by L. Erdene, 1976, “Rational plan and development of coal industry in People’s Republic of Mongolia”, the writer used optimization methods to formulate the target programmatic policies of the industrial development in order to increase the profits, based on exploration volume, labor, salaries, costs, effectiveness and ratios. D. Dorjgochoo, 1990, in his dissertation entitled “Economic feasibilities of energy complex in the territory of People’s Republic of Mongolia”, thoroughly explained the coordination and correlations of industries and regional development plan. In another work on “Mongolian coal industry development, innovation and strategy” by R. Sungui, 2011, a mathematical module to define a process to put coal deposits into economic circulation was developed; and furthermore, coal industry development innovation and strategy was developed as well.

### **Research method and data**

#### **Research framework**

Study is based on Michael E. Porter’s book, *The Competitive Advantage of Nations*. The determinants of national advantage are divided into four categories pursuant to [7].

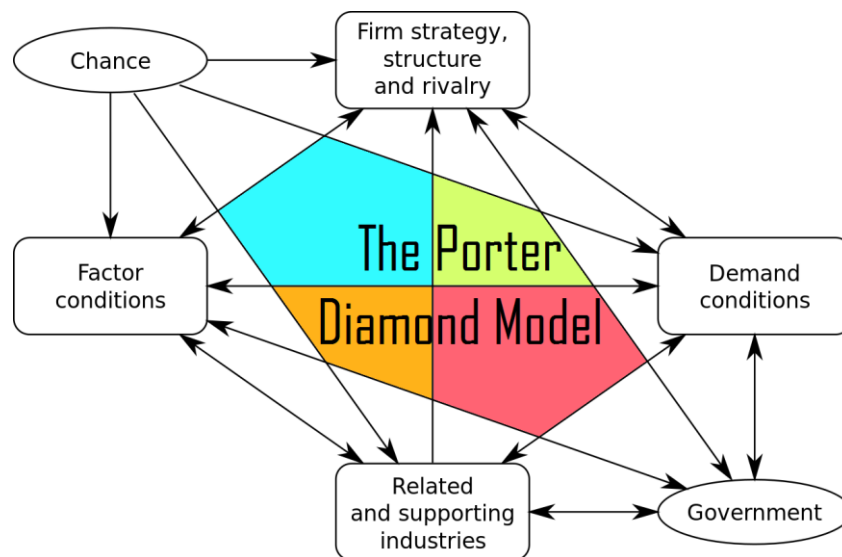


Figure 0-1. “Diamond model” Michael Porter

## Quantitative research methods

### Panel regression

In many applications, there is more than one factor that influences the response. Multiple regression models thus describe how a single response variable  $Y$  depends linearly on a number of predictor variables.

**Example:** A multiple linear regression model with  $k$  predictor variables  $X_1, X_2, \dots, X_k$  and a response  $Y$ , can be written as

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k + \epsilon$$

As before, the  $\epsilon$  are the residual terms of the model and the distribution assumption we place on the residuals will allow us later to do inference on the remaining model parameters. Interpret the meaning of the **regression coefficients**  $\beta_0, \beta_1, \beta_2, \dots, \beta_k$  in this model [8].

### Revealed Comparative Advantage

Revealed Comparative Advantage (RCA) index was developed by Balassa and Noland in 1965 [9]. Selected country's comparative advantage is estimated in terms of foreign trade flows of certain categories of goods and services, and estimated comparative advantage index is deemed as included variables that influence on trade, such as product price, quality, expenses, production factors, economic conditions, legal environment and etc. Therefore, we estimated internationally used RCA index.

For instance, the following methodology was used for estimation of RCA of  $j$  product of  $i$  country.

$$RCA_{ij} = \frac{EX_{ij} / EX_i}{EX_{nj} / EX_n}$$

- $EX_{ij}$  is  $i$  country's  $j$  product export,
- $EX_i$  is total export of  $i$  country,
- $EX_{nj}$  is total world export of  $j$  product,
- $EX_n$  is total world export.

Generally, if  $RCA > 1$ , then that product has comparative export advantage, and has not if  $RCA < 1$ . (G. Tasevska & E. Rabinowicz, 2014). In detail:

- If  $RCA < 0.8$ , then it has not comparative advantage
- If  $0.8 < RCA < 1$ , then it has weak comparative advantage
- If  $RCA = 0.8 - 1.25$ , then it has moderate comparative advantage
- If  $RCA = 1.25 - 2.5$ , then it has high comparative advantage
- If  $RCA > 2.5$ , then it has very high comparative advantage

### Research sample

In this section we used 10 annually data for period from 2007 to 2016, which is comprised from statistical data of Statistical Bulletin of Mongolian National Statistics Office, statistical indicators from World Bank. For purpose of RCA analysis data was collected for 198 World countries. Time series include: total coal exports for each country, total exports of all countries, total coal exports of the world and total exports of world countries. The data is based on annual statistical reports of Mongolia from 2000 to 2018 and Global competitiveness report from 2000 to 2018 for Mongolia.

### Research data and results analysis

#### Diamond model of Mongolian coal mining export competitiveness

Table 0-1. Diamond model analysis of Mongolian coal sector

No	Factor	Conclusion
1	Firm Strategy, Structure and Rivalry	Mongolia's coal sector is highly competitive, with 8 big players in the market, excluding small ones. But on the other side, Mongolia's coal sector challenging cost competitiveness issue. Such as coal transportation by road is insufficient at the Mongolian-Chinese border, creating long queues and reducing exports. Mongolian coal companies at the open-pit mines uses the most labor-intensive technology of stripping and transport development system. Due to the variety of mining and geological and mining technical conditions, various technological schemes for coal mining and stripping operations are used at the open pits. Drilling rigs SBSH-250 (Russian-made), SAT-6290, Sandvik D45KS, Sandvik DP1500, etc. are used in the production of mining and stripping works in the open-pit mines of Mongolia.
2	Factor conditions	The reserves of hard coal of the largest of them, the Tavan Tolgoi deposit, according to experts, exceed 6 billion tons, including 1.8 billion tons of coking coal [10]. Potentially possible volumes of coal production in Mongolia by 2035 are estimated at 125 million tons, including for export - about 75–90 million tons per year. With the intensive development of the country's economy, domestic consumption of coal during this period can grow to 12-24 million tons per year. Mongolia's infrastructure, especially its transport and water infrastructure, suffers from serious deficiencies, but the government is undertaking various large-scale infrastructure development projects in order to improve the provision of infrastructure services. Not all biggest deposits have access to the main railway line. Delivery of minerals from Tavan Tolgoi, Ovoot Tolgoi is carried





		<p>out by road. Consequently, the construction of new railways is necessary for the development of Mongolia's coal export-oriented coal industry. For the Tavan Tolgoi field, located in the south of Mongolia, two options for railway communication are being considered: to the Gashuun Sukhait border crossing on the border with China, with the adjoining Oyu-Tolgoi railway line and to Zuunbayan station, with access to the UBTZ main line.</p>
3	Demand conditions	<p>As the world's largest producer and consumer of coal, the coal sector will continue to play a key role in China's economic development.</p> <p>However, coal consumption has a significant negative impact on the environment. Therefore, first of all, it is necessary to reduce the total consumption of coal. Second, there is a need to reduce the share of coal in energy production. Coal consumption is now at its peak. As a result, small inefficient coal mines and outdated thermal power plants have been shut down in China in recent years [11].</p>
4	Government	<p>There is a risk of bureaucracy and corruption due to inconsistencies in the legal framework. Such as the lack of a unified database is a source of conflict between ministries, agencies and local governments, leading to corruption; lack of professional staff in the mining sector in Mongolia and strong political (party) influence in the selection process are some of the reasons for the discrediting of the mining sector and the risk of corruption.</p>
5	Related and Supporting Industries	<p>As of 2019, Mongolia produced 55.8 million tons of coal, from which more than half, 28.1 million tons were exported. From which it can be concluded that Mongolian coal sector highly depends from industrial sectors of other countries, especially Chinese. But on the other hand Chinese coal market is expected to grow in future.</p>
6	Chance	<p>Export of Mongolia is mainly focused on minerals and raw materials. The most promising cooperation is international cooperation in the field of the fuel and energy complex with the countries of North-East Asia (NEA). The most likely importers of Mongolian coal are China, Japan, the Republic of Korea, the DPRK and India. Opportunities to export coal products to these countries will depend on favorable energy diplomacy and energy markets, the development of export infrastructure and the availability of seaports.</p> <p>In the future, Mongolia can supply power and coking coal, oil and electricity to the markets of the NEA countries. There are reasons for this. Negotiations are underway between Mongolia and China on the feasibility of building a large power plant with a final installed capacity of 9000 MW in Mongolia, with the subsequent transfer of electricity to China.</p>

### Export competitiveness of Mongolian coal mining products

Total world coal export reached 1582588 million short tons in 2018 and have grown in all previous years. Coke export significantly fallen in 2009 and continues to grow steadily for the consequent years.

Relative Comparative Advantage calculation for all countries revealed that there are 40 countries which RCA in terms of coal export is above than 1. Following table shows estimated RCA index for countries and ranked by 10 year average value. Mongolia is ranked at 22th place from that list. Highest RCA has Australia with average RCA of 5991.54, South Africa – 495.15 and Netherlands – 321.02. Mongolia’s average RCA (9.61 points) is lower than median in below sample (RCA = 13.07).

Table 0-2. RCA calculation for coal export

Country Name	Code	Income	Region	Average
<b>Australia</b>	AUS	High income	East Asia & Pacific	5,991.54
<b>South Africa</b>	ZAF	Upper middle income	Sub-Saharan Africa	495.15
<b>Netherlands</b>	NLD	High income	Europe & Central Asia	321.02
<b>Canada</b>	CAN	High income	North America	294.83
<b>United States</b>	USA	High income	North America	202.65
<b>Venezuela</b>	VEN	Upper middle income	Latin America & Caribbean	202.17
<b>Montenegro</b>	MNE	Upper middle income	Europe & Central Asia	187.04
<b>Bosnia and Herzegovina</b>	BIH	Upper middle income	Europe & Central Asia	180.56
<b>New Zealand</b>	NZL	High income	East Asia & Pacific	162.94
<b>Poland</b>	POL	High income	Europe & Central Asia	127.37
<b>Zimbabwe</b>	ZWE	Lower middle income	Sub-Saharan Africa	102.18
<b>Mozambique</b>	MOZ	Low income	Sub-Saharan Africa	96.81
<b>Kosovo</b>	XKX	Upper middle income	Europe & Central Asia	55.87
<b>Ukraine</b>	UKR	Lower middle income	Europe & Central Asia	50.16
<b>Russia</b>	RUS	Upper middle income	Europe & Central Asia	44.48
<b>China</b>	CHN	Upper middle income	East Asia & Pacific	26.78
<b>Eswatini</b>	SWZ	Lower middle income	Sub-Saharan Africa	24.55
<b>Kazakhstan</b>	KAZ	Upper middle income	Europe & Central Asia	15.86
<b>Belgium</b>	BEL	High income	Europe & Central Asia	14.02
<b>Spain</b>	ESP	High income	Europe & Central Asia	13.35
<b>Czech Republic</b>	CZE	High income	Europe & Central Asia	12.80
<b>Mongolia</b>	MN G	Lower middle income	East Asia & Pacific	9.61
<b>Norway</b>	NOR	High income	Europe & Central Asia	8.12
<b>Botswana</b>	BWA	Upper middle income	Sub-Saharan Africa	7.69
<b>Kyrgyzstan</b>	KGZ	Lower middle income	Europe & Central Asia	6.53
<b>Lithuania</b>	LTU	High income	Europe & Central Asia	6.44
<b>United Kingdom</b>	GBR	High income	Europe & Central Asia	6.18
<b>Bulgaria</b>	BGR	Upper middle income	Europe & Central Asia	5.43



<b>Philippines</b>	PHL	Lower middle income	East Asia & Pacific	4.67
<b>Peru</b>	PER	Upper middle income	Latin America & Caribbean	4.23
<b>Bhutan</b>	BTN	Lower middle income	South Asia	4.17
<b>Colombia</b>	COL	Upper middle income	Latin America & Caribbean	3.83
<b>Slovenia</b>	SVN	High income	Europe & Central Asia	2.93
<b>Belarus</b>	BLR	Upper middle income	Europe & Central Asia	2.87
<b>Latvia</b>	LVA	High income	Europe & Central Asia	2.24
<b>Malaysia</b>	MYS	Upper middle income	East Asia & Pacific	2.12
<b>Zambia</b>	ZMB	Lower middle income	Sub-Saharan Africa	2.04
<b>Greece</b>	GRC	High income	Europe & Central Asia	1.95
<b>Romania</b>	ROU	High income	Europe & Central Asia	1.08
<b>Egypt</b>	EGY	Lower middle income	Middle East & North Africa	1.08

There are 35 countries with RCA higher than 1 point. Median RCA in below sample is 35.5309 points.

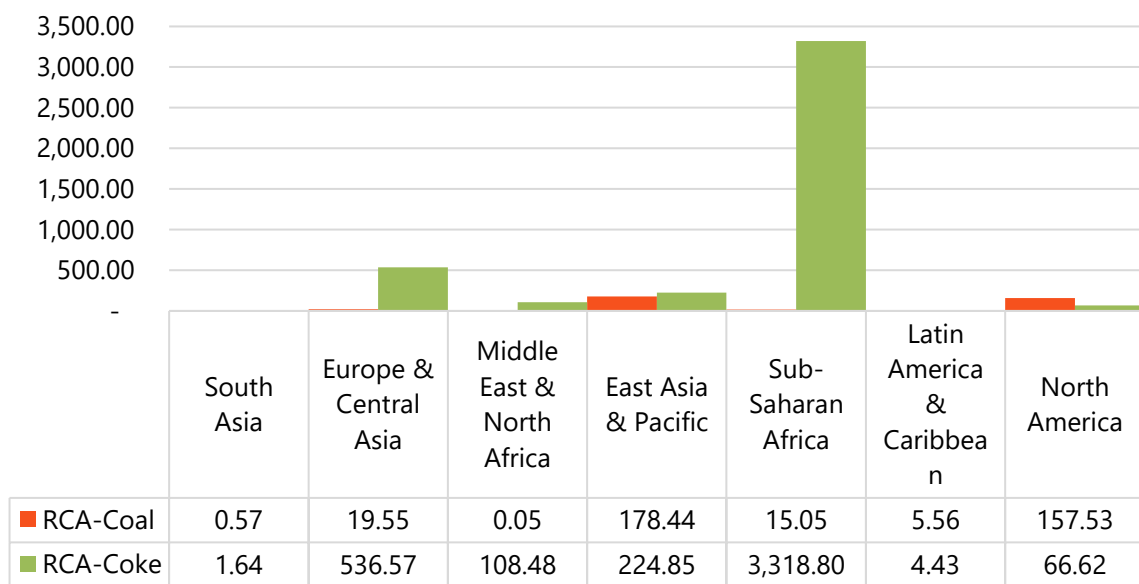


Figure 0-1. RCA by regions

RCA evaluation among countries shown that countries of Europe and Central Asia, East Asia and Pacific, North America has higher values compared with other regions. Sub-Saharan Africa has highest RCA values in terms of metallurgical coal.

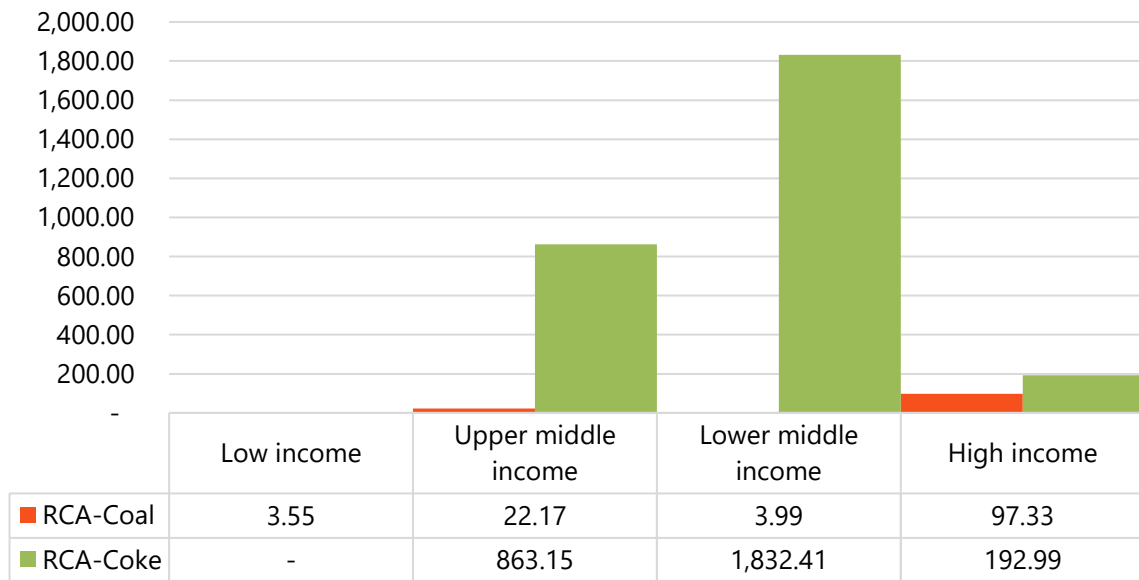


Figure 0-2. RCA by country income groups

RCA evaluation by income groups shown that Upper middle and High income countries usually have higher RCA compared with low income countries. For metallurgical coke, low income countries don't have any comparative advantage, but on other side upper middle and lower middle income countries have greater RCA compared with high income countries. Mongolia's revealed comparative advantage of coal sector have grown in 2010-2012, but declined in 2014 and 2015. Since 2015, RCA reached to its peak in 2017 with 20.01 points.

#### Determinants of coal mining export competitiveness

This part of study aimed to determine main determinants of coal mining export competitiveness. Variables are included as follows:

- Foreign direct investment (FDI)
- Gross domestic product (GDP)
- Whether country is landlocked (LANDLOCK)
- Logistic performance index (LPI)
- Quality of infrastructure (QPI)

Table 0-3. Panel regression for Coal RCA determinants

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI	2.15E-09	3.76E-10	-5.733360	0.0000
GDP	1.99E-11	6.01E-12	3.312920	0.0009
LANDLOCK	-58.25440	19.40968	-3.001306	0.0027
LPI	19.35100	5.124146	3.776435	0.0002
QPI	21.41142	11.22021	1.908290	0.0564
C	2.052958	12.15005	0.168967	0.8658
R-squared	0.072179	Mean dependent var		43.99731
Adjusted R-squared	0.019518	S.D. dependent var		460.8044
S.E. of regression	456.2852	Akaike info criterion		15.13656
Sum squared resid	7.41E+08	Schwarz criterion		15.47288
Log likelihood	-28268.88	Hannan-Quinn criter.		15.25615
F-statistic	1.370642	Durbin-Watson stat		2.086975
Prob(F-statistic)	0.000554			

From above we can conclude that main determinants of coal sector competitiveness are FDI, GDP, LANDLOCK, LPI, which have significant impact in 5% confidence level. And QPI has impact in 10% confidence level. Increased foreign direct investment helps countries that have developing economies to obtain competition in world market. GDP supports to coal sector by transition of national income to profitable sectors. Countries with sea gateway can benefit in competition by lower transportation costs. Logistics and infrastructure support countries to achieve benefit from enhanced transportation and logistics network.

**Possibilities to increase the competitiveness of the coal sector**

There are two options for transporting coal to the Chinese border: by rail or by road. As can be seen from the figure below, rail transport is more efficient and can transport 2-4 million tons more coal per year than road transport.

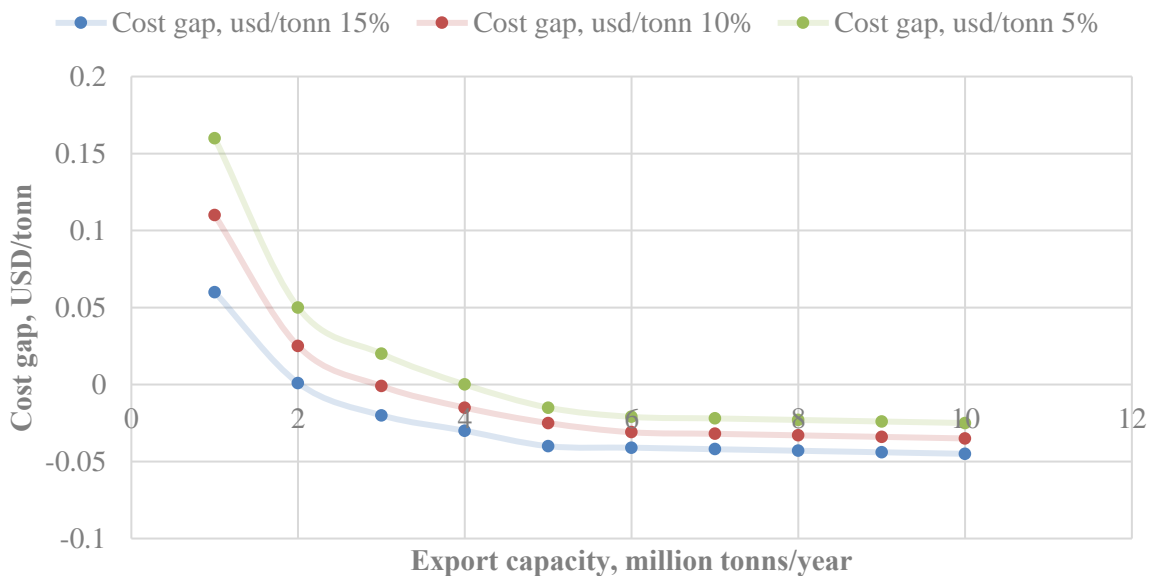


Figure 0-3. Differences between coal and road transport options

Prerequisites:

- The construction cost of the railway will be 2 million USD per 1 km, and the cost of the road will be 500 thousand USD per 1 km.
- Operating costs will be 3 cents per ton / km for rail and 8.5 cents for roads.
- 5, 10 and 15 percent discount options are considered.

**Conclusion**

**Summary**

Mongolia's economy mainly focused on raw mining materials. The mining industry is crucial part of the economy and further development of Mongolia. Today, in Mongolia, mining enterprises perform primary processing of raw materials. Enterprises usually do not create added value products, due to a limited of funds for capital investments, a lack of necessary equipment, incomplete development of technologies and methods for producing high-quality final products. Therefore, it is necessary to take measures aimed at increasing the level of processing of exported raw materials for the production of finished products, as a result of which the equipment and technologies of existing enterprises will be updated.

At present, the rating of Mongolia's national competitiveness is not high, as evidenced by the data of leading analytical agencies - the World Economic Forum and the World Bank. The country has a very low level of infrastructure development, low indicators of the state of

health of the nation and the quality of primary education, many negative characteristics of the quality of the macroeconomic environment: very high interest rates, high government debt rate, low credit rating of the country. In Mongolia, the quality of institutions, both public and private, is low: the issues of protecting property rights, combating corruption, the independence of the judiciary, the effectiveness of government decisions, guarantees of the safety of life and business are at a low level.

The solution by the government of these issues will be able to change the nature of Mongolia's modern advantage in the world coal market and transfer it from the category of comparative to the category of competitive, thereby increasing the level of its competitiveness not only in the corresponding product market, but also on a national scale.

### **Policy recommendations**

A systematic analysis of the obtained research results allows us to conclude that the development of exports is very important for the further improvement of the Mongolian economy. Based on the possibilities of developing coal in Mongolia's deposits, forecasts of demand for coal in the domestic and world markets, an assessment was made of the prospective volumes of coal production and it was concluded that its efficient transportation is impossible without developed railways. For the foreseeable future, coal will continue to be one of the main fuels and energy resources in the fuel and energy balance of Mongolia. The further development of Mongolia's coal energy depends on the possibilities of increasing the volume of geological exploration, the development of transport and industrial infrastructures, and the development of domestic and foreign markets.

In this regard, the activities of the railways should be aimed at transport services to the largest industrial enterprises, among which a significant place is taken by enterprises of the coal industry. The increase in the volume of coal transported seriously increases the load on transport infrastructure. If the existing tendencies of growth in the volume of rail transport continue, the length of bottlenecks will grow. Solving this problem requires investment in infrastructure.

The modernization of the UBTZ will significantly increase its throughput and increase the volume of freight traffic from East Asia. Taking into account the current state of the Mongolian economy, the implementation of projects for the development of transport infrastructure is possible only with the financial and technical support of international companies.

The following strategic objectives have been set within the framework of the general strategy for the development of the mining and industrial sectors:

- *Strategic Objective 1. Improve coal management policy*
- *Strategic Objective 2. Improve infrastructure policy*
- *Strategic objective 3. Introduce a sustainable development policy for the coal sector*
- *Strategic Objective 4. Increase the capacity of coal mines*

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