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An analysis of China's coal supply and its impact on China's future economic growth

Jianliang Wang [a,*], Lianyong Feng [a], Gail E. Tverberg [b]

[a] School of Business Administration, China University of Petroleum, Beijing 102249, China
[b] The Oil Drum, 1246 Shiloh Trail East NW, Kennesaw, GA 30144, USA

HIGHLIGHTS

- We analyze an issue of prime importance for the future of China's economy.
- The decline in coal supply will present a challenge to China's economic growth.
- Rising coal price will also have an adverse impact on economic growth.

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ABSTRACT

Many people believe that China's economic growth can continue almost indefinitely. For a manufacturing-based economy such as China's to continue to grow, it needs an adequate supply of inexpensive energy. To date, this energy growth has primarily come from coal, but China's indigenous coal supplies are now falling short of the amount needed to support this growth. In this situation, the status of China's future coal supply will be very important for China's future economic development. Our analysis shows that China's ultimate recoverable coal reserves equal 223.6×10^9 MT, and its production will peak between 2025 and 2030, with peak production of approximately 3.9×10^9 MT. The extent to which China can import coal in the future is uncertain. With rising coal demand, this combination is likely to create a significant challenge to China's future economic development.

1. Introduction

As one of the dominant engines of the world's economic growth, the future of the Chinese economy is of great interest to scholars around the world. The debate as to whether China's growth can continue usually centers on issues such as the real estate bubble, the debt crisis of local governments, the high level of inflation, the low efficiency of government investment, wealth disparities, environmental pollution and destruction, and the aging population. These problems truly exist; however, they are not the fundamental factors that will decide the future course of the Chinese economy.

The hidden issue that has the power to hold back economic growth is an inadequate supply of cheap energy. China is a country that bases its economy on manufacturing (China's primary, secondary and tertiary industries accounted for 10.1%, 46.8% and 43.1% of its GDP in 2010) (National Bureau of Statistics of China (NBSC), 2011a), and manufacturing depends on an adequate supply of affordable energy, typically inexpensive and only accounting for a small amount of the total cost. The primary source of this affordable energy is currently coal; coal accounts for more than 76.5% of China's energy production and about 68.0% of its energy consumption in 2010 (National Bureau of Statistics of China (NBSC), 2011a), making it far more important than oil, gas and other energy resources. We know that coal, like any non-renewable resource, is finite, and thus, at some point the amount extracted each year will cease to grow as the resource gets depleted. Yet China's energy policy today is based on the premise that China has a virtually inexhaustible supply of coal resources (Wang, 2007a; Li et al., 2010). In fact, China became a net coal importer in 2009 (Pan and Wang, 2010), because its own production is already falling short of the amount needed to maintain economic growth. China's inability to raise supply as quickly as desired raises questions about China's long-term coal supply.

In this paper, we perform an analysis that shows that China's annual extraction of coal is likely to begin to decline in the 2025 to 2030 time period. This study is based on our analysis of China's coal resources, and how much of these resources are likely to be ultimately recoverable. The lack of future supply, together with

* Corresponding author. Tel.: +86 15810362167.
E-mail address: wangjianliang2010@yahoo.cn (J. Wang).

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the lack of suitable alternatives and the expected rise in the price of coal that is available can be expected to have adverse economic consequences.

The structure of this paper is as follows. Section 2 provides a detailed analysis of China's ultimate recoverable reserves (URR) for coal because of the importance of URR in forecasting future coal production. Section 3 analyzes future coal supply, coal demand and coal imports of China. Section 4 analyzes the availability of other energy sources that might be used as alternatives to coal. Section 5 summarizes the main findings of this paper.

2. China's coal reserves

While China's authorities report very large coal resources, the portion that can be produced under existing economic and political conditions, with existing technology, is limited. In the years since 1949, when the People's Republic of China was founded, three analyses of China's coal resources/reserves have been performed by the Ministry of Coal Industry (MCI) (Table 1). In 1998, MCI was abolished by China's central government, and since then, no further estimates of coal resources have been made. The only exception to this is a study by the Ministry of Land and Resources (MLR) that was started in 2007, covering many different resources, but is not yet complete. This project is called *The Current Situation Survey of Mineral Resource Utilization*; it is being performed to carry out the guidelines of the *Decision of the State Council on Strengthening Geological Work* (Issued by State Council in 2006).

Table 1 shows the results of the three national forecasts of coal resources/reserves in China. *Coal reserve*, which is also called *discovered resource*, is the quantity of coal estimated to be contained in known accumulations; *prognostic resource*, which is also called *undiscovered resource*, is the estimated quantity of coal in accumulations yet to be discovered; *total coal resource* is the sum of *coal reserve* and *prognostic resource* (Wang, 2007).

From Table 1, we can see that all of these forecasts were prepared prior to 1999 and used the old classification systems of mineral resources/reserves. These old systems were very similar to the classification system of the Former Soviet Union (FSU), under its system of central economic control, but modified by China to reflect its own conditions. The main purpose of exploration activities under these old systems was to know the quantities of mineral resources for use by the central government rather than to exploit them directly by businesses. Therefore, these systems reflect primarily the existence of coal based on geological conditions, with little consideration to whether it would be economically feasible to extract these resources in the future. This means that part of reserves assessed in these systems may never be extracted (Chen et al., 2002). Moreover, *The Chinese Mineral Resources/Reserves Classification System and its Application*, which was submitted by the Chinese government to theUnited Nations (UN) (2001), indicates that the classification system was problematic:

> *The above edition* (i.e. old classification system)*, which was different from the international well known normal practices, had made it very difficult for mining industry of China to communicate in common language with that of other countries, and hence, it has impeded the progress of China in developing market economy and opening its door to the world for investments in the mining industry*.

To make its system more similar to those of market economies, in June 1999, China's government issued a new edition of its classification system named *Classification for Resources/Reserves of Solid Fuels and Mineral Commodities* (*GB/T* 17766-1999) as a national standard (General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ), 1999). This new system was established based on the classification systems of the United Nations (UN) (1997) and U.S. Geological Survey (USGS) (1980) and was the first one which evaluated resources based on likely economics of extraction, in additional to geology and feasibility of extraction.

The new classification system provides three major categories: *reserves*, *basic reserves* and *resources* (General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ), 1999). Resources consist of a part of total identified mineral resources (the same as *coal reserves* in Table 1) and undiscovered resources (the same as *prognostic resources* in Table 1); basic reserves are a part of total identified mineral resources; reserves are that minable part of basic reserves based on all relevant considerations, including economic (General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ) 1999). Thus, reserves are the real item of interest because only they can be produced under existing economic and political conditions, with existing technology. More information and detailed definition of these items on the 1999 change in classification systems can be found in Appendix A.

The question then becomes how resource/reserve data, prepared prior to 1999 should be modified, to be consistent with the new definitions, since no new analyses have been issued since 1999. On March 8, 2001, the circular of *Modifying Technology Requirement of Solid Mineral Resources/Reserves*, which was used to convert forecast results of resources/reserves under old classification systems into ones under the new classification system, was issued by MLR (2001a). In the same year, MLR (2001b) published the modified results of basic reserves and reserves under new

Table 1
Results of three national forecasts of coal resources/reserves in China (10^9 MT).

	First (1958–1959)	Second (1973–1980)	Third (1992–1997)
Total coal resources	9377.9	5059.2	5569.7
Coal reserves	–	566.5	1017.6
Prognostic resources	–	4492.7	4552.1

Note: The results of the second forecast of coal resources are at the end of 1975; the results of the third one are at the end of 1992. *Source*: Department of Geology in Beijing Institute of Mining (DGBIM) (1961), Yang and Han (1979), Han and Yang (1980), China Coal Geology Bureau (CCGB) (1999), Hu and Jiang (2000).

Table 2
Statistics of China's basic reserves, reserves and URR (10^9 MT).

Year	Production	Cumulative production	Basic reserves	Reserves	Recovery rate	URR
2001	1.38	32.82	334.09	189.12	56.61%	221.94
2002	1.45	34.27	331.76	188.64	56.86%	222.91
2003	1.72	35.99	334.20	189.27	56.63%	225.26
2004	1.99	37.98	337.34	188.03*	–	226.02
2005	2.21	40.19	332.64	184.24	55.39%	224.43
2006	2.37	42.56	333.48	182.54	54.74%	225.10
2007	2.53	45.09	326.13	176.80	54.21%	221.89
2008	2.80	47.89	326.14	181.79*	–	229.69
2009	3.05	50.94	318.96	177.79*	–	228.73
2010	3.24	54.18	279.39	155.73*	–	209.91
Average	–	–	–	–	55.74%	223.59

Note: Recovery rate=reserves/basic reserves; URR (ultimate recoverable reserves)=cumulative production+reserves. Reserves with *=basic reserves × average recovery rate.