ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ

ΤΜΗΜΑ ΝΑΥΤΙΛΙΑΚΩΝ ΣΠΟΥΔΩΝ

ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ στην ΝΑΥΤΙΛΙΑ

«Market Analysis Iron Ore & Coal and Econometric analysis on Baltic Capesize Index»

ΟΝΟΜΑΤΕΠΩΝΥΜΟ: ΜΑΤΣΟΠΟΥΛΟΣ ΘΕΟΦΑΝΗΣ ΠΑΝΑΓΙΩΤΗΣ

ΕΠΙΒΛΕΠΩΝ ΚΑΘΗΓΗΤΗΣ: ΕΥΣΤΡΑΤΙΟΣ ΠΑΠΑΔΗΜΗΤΡΙΟΥ

12ος κύκλος σπουδών

Διπλωματική εργασία που υποβλήθηκε στο Τμήμα Ναυτιλιακών Σπουδών του Πανεπιστημίου Πειραιώς ως μέρος των απαιτήσεων για την απόκτηση του Μεταπτυχιακού Διπλώματος Ειδίκευσης στη Ναυτιλία.

Πειραιάς

Σεπτέμβριος 2017

I would like to express my gratitude to the person that always thinks out of the box and supported me in pursuing a career in shipping... the professional and poet I admire most...Tomazo.

I would like to thank my tutor & professor Stratos Papadimitriou, who not only provided me with academic knowledge but also showed me how good men with integrity and values can achieve great things.

I would like to thank my parents, that are standing next to me every day in every possible way.

Table of Contents

Intoduction

The capesize vessel is considered by shipowner's,operators, charterers and shipping stakeholders as the most risky and the most volatile market of the dry bulk sector. The two many commodities that are transported with these vessels are coal and iron ore.

This project aims to describe in depth the market of these two commodities in order to understand their trade routes. These trade routes are also the trades that our examined vessel category operates.

From these trades carefully selected variables are selected and they are examined in order to attempt to give a purely quantitative model that can be used in many ways and of course the most important: the prediction of future fluctuation of the Baltic Capesize Index. It is well known that the BCI is the index that reflects the daily revenues for capesize vessels.

In the end conclusions regarding each of the variables have been presented.

Iron Ore and Its Significance

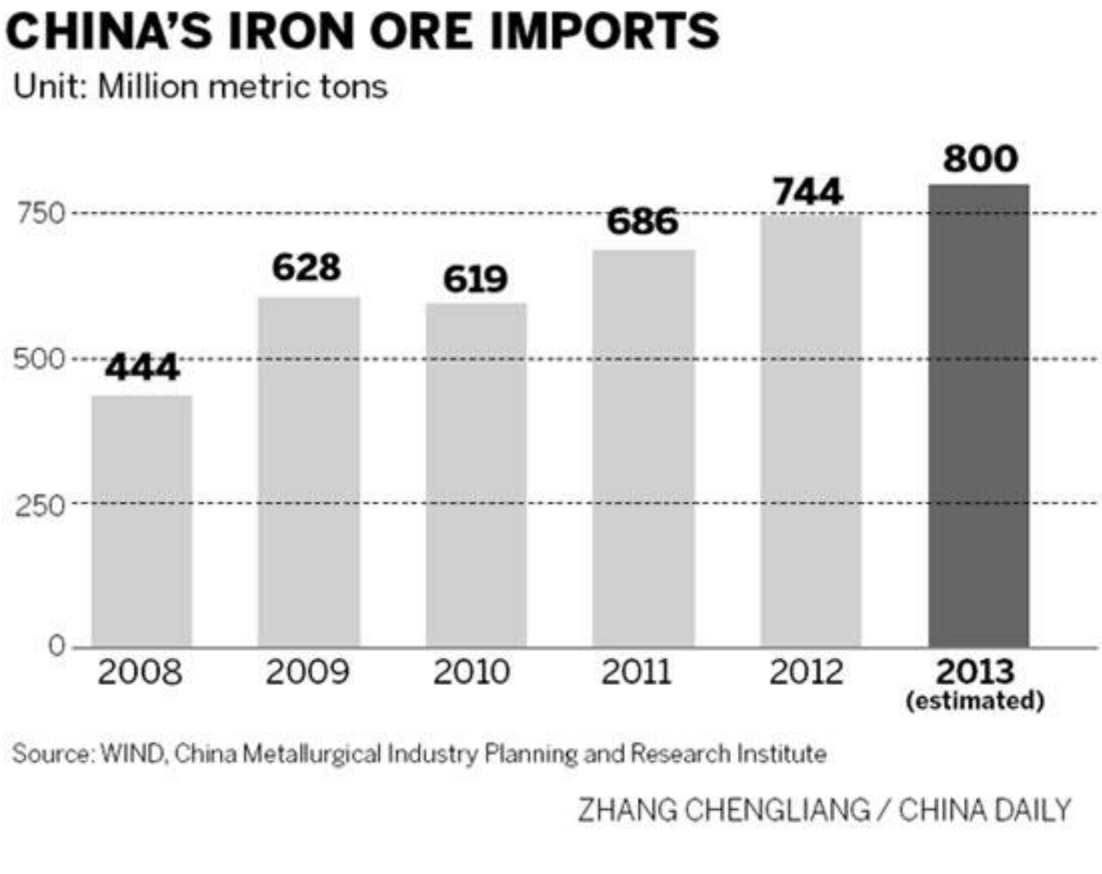
Iron is an inherent part of modern day living. Iron is required for the manufacture or building of virtually any product or infrastructure. Steel is the most widely used metal all over the world. Steel and its originator iron constitute for about 95% of metal consumption globally (Economist, 2012). The characteristics of iron such as strength, malleability have made the use of it in almost all areas of life as the common choice of metal (King, 2014). Iron, which is also synonymously used for strength is used to build bridges and dams which holds together the construction material for, may be, centuries. A few other examples where steel, a derivative of iron is used are automobile industry, infrastructure projects, buildings, aviation, household appliances to name a few (Reynolds & Dawson, 2011). Iron ore is basically a sedimentary rock upon the process of which metallic iron is extracted. The sedimentary rocks are normally formed though chemical reactions between the elemental iron and oxygen in waters over centuries. The most important iron oxides that are extracted from these rocks are haematite and magnetite (Reynolds & Dawson, 2011). The other forms of iron are limonite, siderite and goethite. Iron is quite abundant in the earth's crust but the most part of it is bound in silicates and carbonate minerals. The extraction of iron from the silicates and carbonates is very expensive and tedious. As such iron is extracted more economically from the rarer source such as haematite and magnetite.

Iron ore is extracted by mining the ore deposits below the earth's crust. Prior to industrial revolution, iron ore was extracted from laterite and goethite. Mostly haematite deposits are used for iron ore extraction in post industrial revolution era. Haematite has a high percentage of iron i.e. in the excess of 70% in it. Haematite is therefore called 'direct shipping ore' or 'natural ore' (Reynolds & Dawson, 2011). Currently, there are four types of iron ore deposits that are mined. They are magnetite, titanomagnetite, pisolitic iron store deposits, and massive haematite. Iron ore is also extracted from banded sedimentary rocks containing more than 15% of elemental iron (Reynolds & Dawson, 2011). Banded iron formations normally occur in metamorphosed Precambrian rocks. Banded ore formations contain iron in the form of silicates and carbonates and those minded contain iron as oxides. The mining results in a huge amount of iron ore as well as waste. Waste normally consists of non-ore bedrock and unwanted minerals in the ore rock. The non-ore bedrock is called 'mullock' and unwanted minerals, which are part of the ore rock are called 'gangue'. After mining, mullock is separated from the ore rock and plied as waste. And gangue is separated in what is known as 'beneficiation' process as tailings.

From the industry and economics perspective direct shipping ore or the haematite ore is the most mined ore in the world in all the human inhabited continents. The largest deposits of direct shipping iron ores are available in South America. Asia and Australia are the other two continents, where the direct shipping iron ore is found abundant in the earth's crust. Direct shipping ore deposits are still lesser compared to the magnetite ore in the world. Magnetite iron ore contains about 25% of elemental iron, which is far lesser as compared to the 70 % of elemental iron found in haematite ore. Magnetite iron ore is mined in nations such as the US, Brazil, Canada, a few Asian countries and Australia. A far lesser source of iron ore are magmatic deposits in layered intrusion, which also contain titanium and vanadium. The titanomagnetite iron ore has about 57% elemental iron (Reynolds & Dawson, 2011). But the ore is mined due to the presence of titanium in it and iron being only the bi-product of mining of this type of ore. The iron ore trade in the world is the second largest commodity by value, next only to crude oil. Considering the cheaper price of iron ore as compared to the crude oil, one can imagine the magnitude of the quantity of iron ore that is being traded across the world in order to be the second largest commodity to have been traded in the world. Steel production is about 95% of total metal production in the world (USGS, 2013). The statistics clearly indicates the significance of the trade of steel in the world. However, people who value steel as the predominant metal often ignore the significance of iron ore, from which steel is manufactured. The way there are different grades of steel quality, there are different compositions of iron ore too depending upon the type of sedimentary rocks used to extract ore. However, the composition of the rocks the percentage of iron ore available only varies marginally between different rock beds. In a similar way, the percentage of elemental iron varies in a limited range for each type of ore such as haematite or magnetite. Since steel is one of the essential commodities that govern the modern living, the trade of iron ore and steel have gained significance economically. The prices of steel or iron ore are dependent upon various factors that govern the world iron ore market (Reynolds & Dawson, 2011). The prices vary according to the demand too. Another factor that influences the prices of iron ore or steel across the world are the government policies. Limited quantity mining or controls on the export of iron ore in some Asian countries such as India affect the price equilibrium in the steel or iron ore market. The ban on iron ore extract and export in the state of Goa has resulted in the trade loss of 5 million tonnes of iron ore per month (USGS, 2013). Due to reduced supply the prices of iron ore increased in the last quarter of 2012. However, the recent lifting of ban on iron ore production in Goa, India, could boost iron ore trade and could bring down the prices in the coming quarters. The mining and export of iron ore in the nations, where it is abundantly found will have a significant contribution to the economies of those nations.

Major Iron Ore Importers and their Influence on Demand

Iron ore importers are logically thought to be the countries that do not produce iron ore indigenously and yet require large amounts of iron ore for the production of steel. However, China being the largest producer of iron ore in the world is the largest importer of iron ore too. China imported 642 million tonnes in 2012 (Reuters, 2012). The reason for highest imports of China in the world despite being the largest manufacturer is the low iron content in the ore produced in China. China as such would only produce a fraction of usable iron from the ore it produces. China thus largely depends upon imports to meet its domestic consumption needs. Due to the demand of iron ore in China, it plays a vital role in determining the price of the ore by its demand quantities. European Union is the second largest importer of iron ore in the world. EU imported 142 million tonnes in 2011 (Reuters, 2012). This is understandable due to its highly industrialized production facilities and very low iron ore deposits found in the states of EU. Japan is the third largest importer of iron ore in the world. It imported 133 million tonnes in 2011. South Korea is the fourth largest importer of iron ore in the world and Taiwan is the fifth largest importer (Reuters, 2012). South Korea imported 57 million tonnes of iron ore and Taiwan imported 16 million tonnes of iron ore in 2011. Total global imports of iron ore stood at little over 1 billion tonnes in 2011 (Reuters, 2012). Chinese market and Chinese demand for iron ore is one of the major determinants of global iron ore prices. China is also the largest manufacturer of steel in the world. As such many iron ore producing nations such as Australia, India and Brazil look up to China for exporting the iron ore produced by them. Fluctuations in the demand quantities of iron ore in the Chinese market would affect the import prices. High Chinese demand and lower supply would increase prices of iron ore and low Chinese demand in any year would force the steel prices to fall. For example, slower Chinese demand growth and increased supply of iron ore in 2H13 are bringing down the prices of iron ore in 2014 (Bourke, 2014). The price during the first half of 2013 was driven by the low stocks of iron ore at Chinese ports (Forbes, 2014). However, in the second half of 2013 stocks of iron ore rose rapidly in Chinese port and hence the prices of iron ore in the first half of 2014 fell sharply (Forbes, 2014). The prices are expected to reduce further due to fresh stocks arriving at the ports of China (Bourke, 2014). Thus lower demand in the Chinese market and higher supply are weakening the prices of iron ore currently in the global markets. The following chart shows the iron ore imports of China over the years.



(Source: China Daily, 2014)

Figure 1

Major Iron Ore Exporters

Iron ore exporter are normally those nations, which produce iron ore more than what is required for domestic consumption. Australia is the largest exporter of iron ore in the world. Australia exported 414 million metric tonnes in 2011 (Reuters, 2012). Brazil is the second largest exporter of iron ore in the world. It exported 324 million tonnes in 2011. India is the third largest exporter of iron ore in the world. It exported 87 million tonnes in 2011 (Reuters, 2012). South Africa and Canada are fourth and fifth largest exporters of iron ore on the world respectively. South Africa exported 52 million metric tonnes of iron ore in 2011 and Canada exported 35 million tonnes of iron ore in 2011 (Reuters, 2012). Since China is the largest importer of iron ore in the world, all the major iron ore exporting nations invariably export the larger chunk of their overall export quantity to China. Brazil exported a record 170 million tonnes of iron ore to China (Juan, 2014). However, Australia is still the largest exporter of iron ore to China (Juan, 2014). The top five iron ore exporting countries to China are Australia, Brazil, India, South Africa and Ukraine. These nations account for more than 90% of imports of crude ore by China (Juan, 2014). As can be clearly seen, the world iron ore market is largely dependent on Chinese demand and supply markets, since the larger volumes of overall iron ore exports go to China. Due to huge iron ore demand in China, iron ore nations do not have to compete much about exporting iron ore to China. With major exporting nations ready to ship iron ore to China, what demarcates the competition is the shipping charges due to the distance.

The iron ore from Brazil thus is slightly more expensive to China due to the increased shipping expenses (Juan, 2014). India and Australia have the advantage of reduced shipping charges due to their proximity to Chinese ports. Of the little over 1 billion metric tonnes of total iron ore exports in the world, Australia accounted for about 42% of total iron ore exports in the world in 2011 (Reuters, 2012). Brazil was the second largest exporter in 2011 contributing 32% to total iron ore exports in the world. India contributed to about 8 percent of total iron ore exports in 2011. South Africa and Canada contributed to about 5% and 3.5% of total iron ore exports in the world in 2011 (Reuters, 2012). Thus, top five iron ore exporting nations in the world contributed to over 90% of total iron ore exports in the world (Reuters, 2012). The data clearly indicate high concentration of iron ore production and exporting among only a few nations in the world. But the consumption of steel around the world has been uniformly high depending on the industrial development in those nations. The following graph shows major iron ore exporters and the export volume.

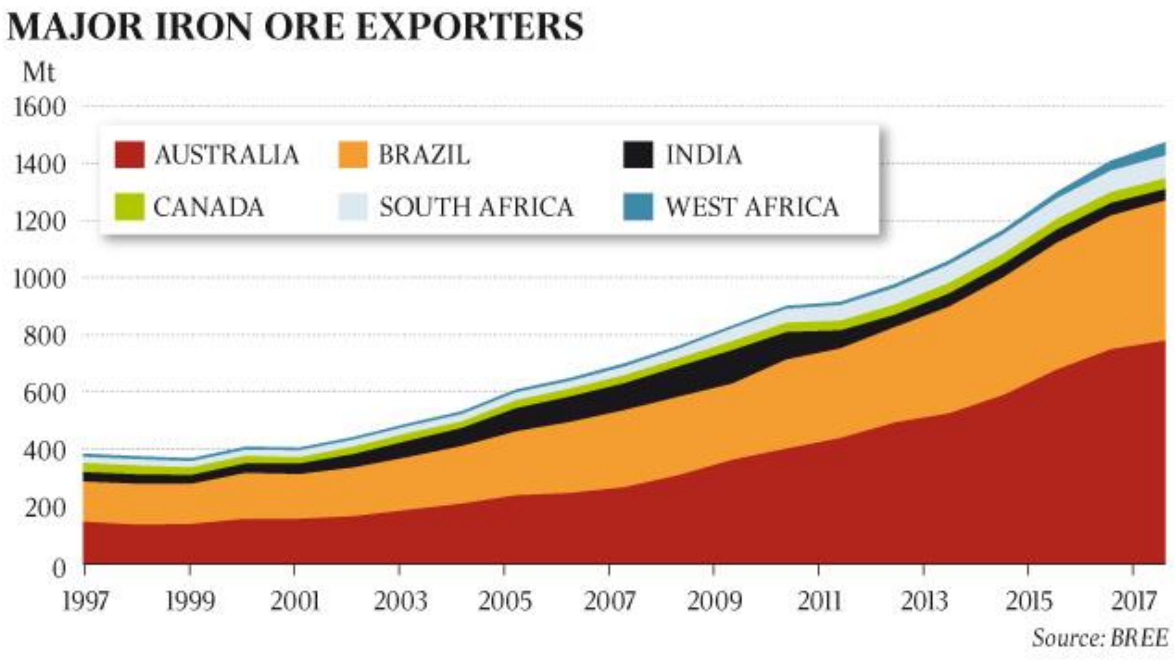


Figure 2

(Source: BREE, 2012)

Iron Ore Producers

The Republic of China has been the largest producer of iron ore and the second largest iron ore producer, Australia produces less than half of what China produces. According to the US Geological Survey data (2011), China is the largest extractor of iron ore in the world (USGS, 2014). The iron ore production of China stood at 1.3 billion metric tonnes in 2011 (Reuters, 2012). Australia is the second largest producer of iron ore in the world. Australia extracted and produced usable iron ore of 488 million metric tonnes in 2011. Brazil is the third largest producer of iron ore in the world. Brazil produced 373 million metric tonnes in 2011. India is the fourth largest iron ore producer in the world (USGS, 2014). It produced 240 million metric tonnes in 2011 (Reuters, 2012). Russia is the fifth largest producer of iron ore in the world. It produced 100 million metric tonnes in 2011. The figures of production for 2012 for the republic of China stood at 1.4 billion metric tonnes (USGS, 2014). Australia produced 525 million metric tonnes of iron ore in 2012 (USGS, 2014). Brazil produced 375 million metric tonnes and India produced 245 million metric tonnes in 2012 (USGS, 2014). Russia produced 100 million metric tonnes in 2012 (USGS, 2014). The figures clearly indicate the increase in production from 2011 to 2012 with the exception of Russia, whose production stood at the same level of 100 million metric tonnes from 2011 to 2012. Chinese mining production is largely based on crude ore being imported from the neighbouring countries such as India. Compared to crude ore there is little percentage of iron ore extraction from the usable ore. Australian mining companies continued to expand mining operations in 2012, despite the overall drop in prices of iron ore in the world. This resulted in a slightly higher production of iron ore from 2011 to 2012 by Australia. While iron ore production gives an idea of the extent of mining and ore production capacities in different nations, ore reserves in different nations provide an idea of how iron ore production and export would change in future. The following tables provides the data on iron ore production and reserves of the nations.

	Mine production		Reserves[7]	
	2012	2013[e]	Crude ore	Iron content
United States	54	52	6,900	2,100
Australia	521	530	35,000	17,000
Brazil	398	398	31,000	16,000
Canada	39	40	6,300	2,300
China	1,310	1,320	23,000	7,200
India	144	150	8,100	5,200
Iran	37	37	2,500	1,400
Kazakhstan	26	25	2,500	900
Russia	105	102	25,000	14,000
South Africa	63	67	1,000	650
Sweden	23	26	3,500	2,200
Ukraine	82	80	[8]6,500	[8]2,300
Venezuela	27	30	4,000	2,400
Other countries	96	88	14,000	7,100
World total (rounded)	2,930	2,950	170,000	81,000

Figure 3

(Source: USGS, 2014)

As of 2012, Australia has the highest crude ore reserves of 35 billion metric tonnes (USGS, 2014). Brazil has the second largest crude ore reserves in the world at 29 billion metric tonnes of crude ore. And Russia has the third largest reserves of crude ore at 25 billion metric tonnes. China, though the largest producer of crude ore in the world currently, has only 23 billion metric tonnes of crude ore reserves (USGS, 2014). The future leaders of crude ore manufacturers would be Australia, Brazil and Russia. China’s crude ore reserves would deplete faster as compared to other nations due to its higher percentage of ore extraction.

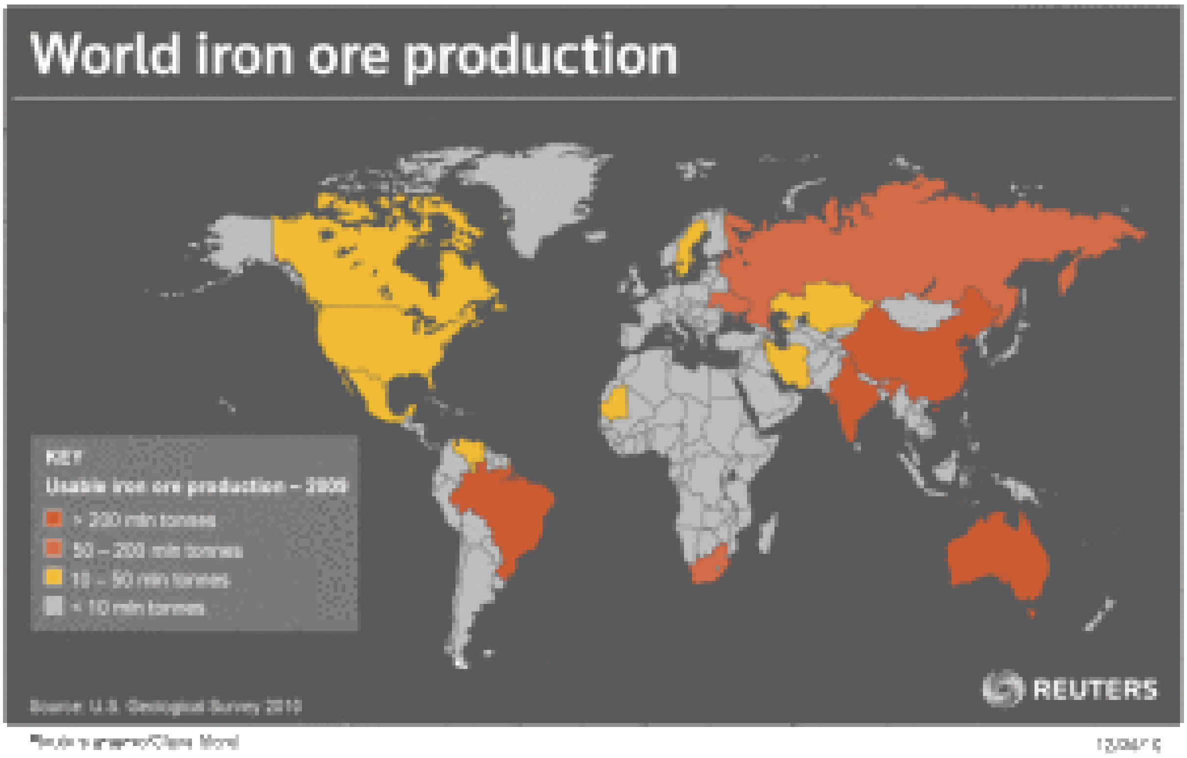


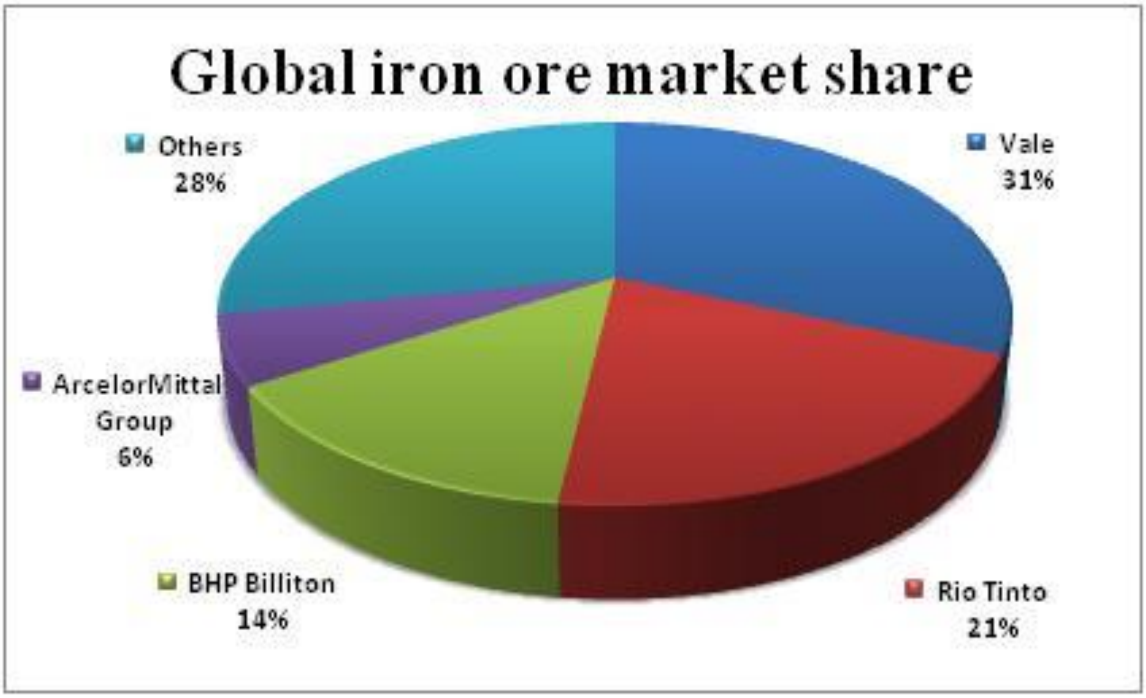
Figure 4

(Source: Reuters, 2012)

Major Trading and Producing Iron Ore Companies

The Brazilian mining corporation Vale SA, is the largest iron ore producing and trading company in the world. Vale is head quartered in Rio De Janeiro is investing USD 20 billion in the world's largest iron ore complex, in its Serra Sul mine and logistics venture of Carajas (Spinetto, 2013). Vale produced 310 million metric tonnes in 2011. The company produced 309 million tonnes in 2012 and 299.8 million tonnes in 2013 (Team, 2014). The iron ore production decreased over the last three years at Vale, and yet the company still enjoys the world leader position in iron ore production. The British company Rio Tinto is the second largest iron ore producing company in the world (King, 2014). It has mining operations in

Australia, India, Canada and Singapore. Rio Tinto produced 245 million metric tonnes in 2011. The company produced 266 million tonnes in 2013 and traded about 259 million metric tonnes in 2013 (Rio Tinto, 2014). The company is witnessing an increasing trend in the production and trade of iron ore over the years. BHP Billiton Limited is the third largest iron ore producing company in the world. It is also the world's largest mining company, which is also involved in the mining of other metals along with iron ore. The company produced 170 million tonnes of iron ore in 2013. The company is planning to increase the production to 207 million tonnes in 2014 (BHP Billton, 2013). Fortescue Metals Group is the fourth largest iron ore producing company in the world. The Australian company produced 55 million tonnes of iron ore in 2012 but produced a record 80.9 million metric tonnes in 2013 (FMGL, 2013). ArcelorMittal is the fifth largest iron ore producing company in the world. The company produced and shipped 59.7 million metric tonnes in 2013. The company plans to up the production capacity by another 15 million metric tonnes by 2015. The following chart shows global iron market share by companies in 2010.



(Source: Thomas White, 2010)

Figure 5

Major Ports of Loading & Unloading of Iron Ore

The major iron ore loading ports in the world are in Australia, South America, India and South Africa. Some of the major loading ports of iron ore in Australia are Dampier, Darwin, Esperance, Geraldton and Port Hedland. Dampier port services to West Australia's Pilbara region. The port is strategically located for iron ore exports. The port is mainly used for iron ore export by Rio Tinto through its subsidiaries. Darwin port is an upcoming port in Australia's Northern Territory. Esperance port is located in South West coast of Australia. The shipper of iron ore through this port is Portman Iron Ore Limited. Port Hedland is another port servicing to Pilbara region in the Western Australia. Iron ore is shipped out from this port by BHP Billiton. Another port used by BHP Billiton for iron ore exports is Tasmania's Port Latta. Port Walcott is another port in Western Australia, which ships out iron ore. The shipper using this port's services is Rio Tinto. The major loading ports in India are Goa, New Mangalore Port, Chennai, Kakinada and Calcutta. The major loading ports in Brazil are Ponta Da Maderia, Ponta Ubu and Guiba. Ponta Da Maderia is located near the Brazilian city of Sao Luis. He port's s services are mainly used by the world's largest iron ore producing company Vale SA. Ponta Ubu is an iron ore loading port located in the South Eastern region of Brazil. The main shipper of iron ore at this port is SamarcoMineracao. Guiba or Sepetiba is a port located in the south of port of Rio De Janeiro. The shipper that operates from this port in iron ore is FertecoMineracao. The major iron ore unloading ports in the world are in China, Japan and the EU. The Qingdao port in the Huanggang district of

China is one of the world's largest ports with links to over 130 ports in the world. The port is also the largest iron ore unloading port in China. Port of Kimitsue and Port of Oita are a couple of major unloading ports of Japan. These two ports are used by Vale for unloading its exported iron ore to Japan.

Trades Routes of Iron Ore

The major trade routes of iron ore are from Brazil to China, Australia to China, India to China, Brazil to Japan and Australia to Japan. The other trade routes are from Brazil to Europe, South Africa to Europe, Australia to Taiwan and Australia to South Korea. China being the largest importer of iron ore in the world imports most of its iron ore needs from Australia and Brazil. The Australian ports in the Western and South Western Australia and the companies mining in Pilbara region of Australia use normally ship iron ore to Chinese ports. Port Hedland in Australia is another port used by the shippers to ship iron ore to China. All of the Brazil's major east coast ports are used to ship iron ore to China by companies such as Vale SA. Vale also has quite a many hubs around the world to distribute the shipped ore to interior regions. Some of the these hubs of Vale are located in Port Sohar of Oman, Port Vizag in India and Port Oita in Japan. Another trade route of iron ore is Russia to Europe and Russia to China. Russia ships iron ore through Ukrainian ports to China. The trade of iron ore through Ukraine to China has continued despite the current political tensions between Russia and Ukraine.

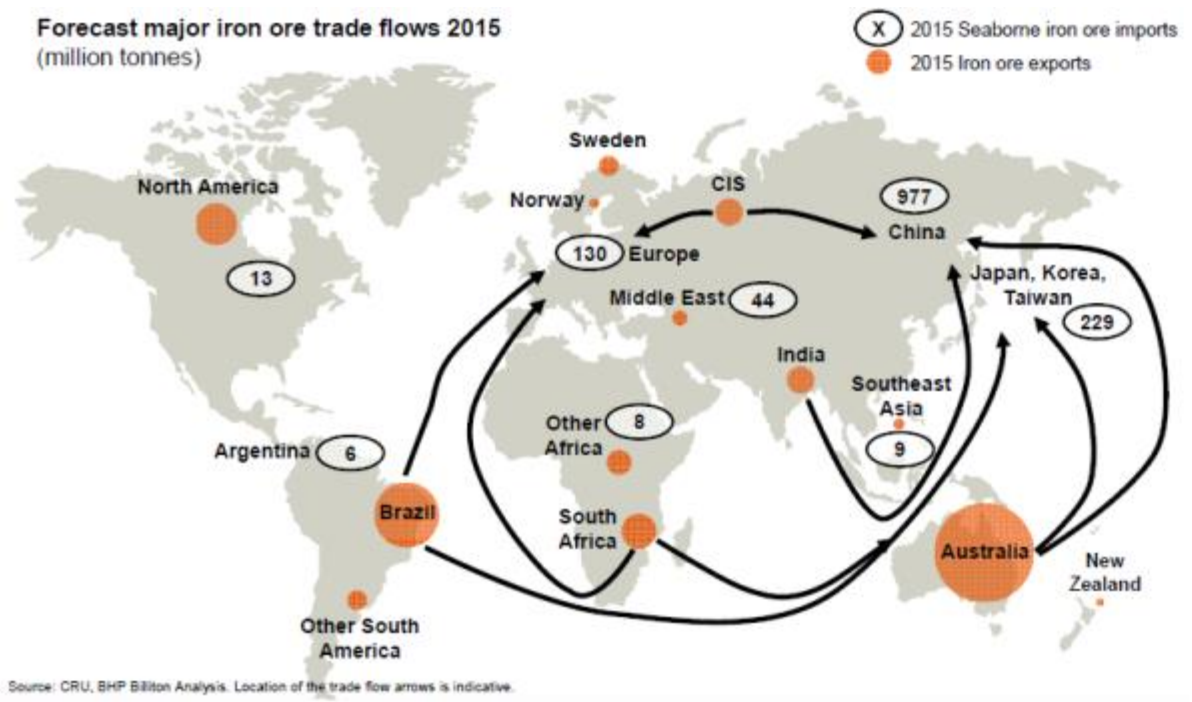


Figure6

(Source: Visser, 2012)

GDP of Countries Involved in the Trace Route

Australia

Australia, which is one of the major nations in the trade route of iron ore, is one of the richest nations in the world. Gross Domestic Product of GDP of Australia is 1.525 trillion USD as of 2014. Percentage GDP by sector of Australia is as follows; services 68.8%, agriculture 4%, manufacturing industry 27.3% as of 2012.

Brazil

Brazil is the largest country in South America as well as the largest country in Latin America. Brazil is the largest economy among the Latin American nations and is the second largest economy in the western hemisphere next only to the US. Brazil is among the fastest growing nations BRICS, which are Russia, India, China and South Africa apart from Brazil. Brazil has a lot of natural resources such as forests, minerals and naturally harvested agriculture. GDP of Brazil is USD 2.533 trillion as of 2013. GDP services of Brazil is 68%, GDP agriculture is 5.5% and GDP manufacturing industry is 25.5% as of 2011.

China

China is among the fastest growing economies in the world along with Indian and Brazil. China or the People's Republic of China is the most populous country in the world. China is presumed to lead the world economy in the coming decades. The sheer volume of China's markets, demand and supply quantities have a lot of bearing on the prices globally on commodities manufactured or consumed by China. Iron ore is a very good example of how the global prices vary according to the change in demand quantities in the Chinese market for iron ore. The nominal GDP of China stood at USD 9.725 trillion in 2013. GDP services of China is 44.6%, GDP agriculture of China is 10.1% and GDP manufacturing industry of China is 45.3% as of 2012.

South Africa

South Africa or the Republic of South Africa is the largest economy in the African continent. It is one of the BRICS nations with high economy growth. GDP of South Africa is USD 390.9 billion as of 2012. GDP percentage by sector of South Africa are, services 65.9%, agriculture 2.5% and industry 31.6 % as of 2011.

India

Indian is among the fastest growing economies in the world too. India is expected to become the third largest economy in the world by 2020. It is also part of BRICS nations and a member of G20 nations. Nominal GDP of India stood at USD 2.13 trillion as of 2013. Percentage GDP by sector of India are, services 66.1%, agriculture 16.9% and manufacturing industry 17% as of 2013. India's economic growth was propelled by the economic reforms it adopted in 1991 such as liberalization and free market economy.

Prospects for the Demand of Iron Ore

The global demand for iron is largely influenced by the demand quantities in the Chinese market as China is the largest importer of iron ore in the world. The immediate demand for iron ore in the second half of 2014 and even for 2015 in China may not increase due to the already existing stocks at Chinese ports (Bourke, 2014). However, Chinese overall demand for iron ore is expected to increase in the coming years due to the demand for steel used in Chinese urbanization projects (China Daily, 2014). It is estimated that China will import 850 million metric tonnes in 2014 (China Daily, 2014). The demand for iron ore in China will increase in the coming years but at a slower rate, according to Li Xinchuang, head of China Metallurgical Industry Planning and Research Institute (China Daily, 2014). Although, the demand for iron ore is expected to increase at a slower pace over the next few years, the recent lifting of ban for iron ore shipments from Goa, India and the surplus stocks at Chinese ports can neutralize the rise in demand with increased supplies. The price as such may still suffer despite rise in the demand for iron ore in Chinese markets. The price of iron ore is expected to drop by about 7 % by the end of 2014 despite slight increase in demand for iron ore in Chinese markets (CRU, 2014). This scenario indicates the rise in supplies but demand not increasing by the same rate in order to keep the price at equilibrium. The increased supplies are also due to the fact that smaller mining companies in Australia are shipping iron ore to China despite the drop in prices. The smaller companies are selling iron ore to Chinese companies with minimum profits (CRU, 2014).

Factors Affecting the Demand of Iron Ore

The demand of iron ore is directly proportional to the demand of steel in any nation of at the global level. Higher the demand for steel higher would be the demand for iron ore by the steel manufacturing companies. The demand for steel in the Chinese markets is increasing due to the planned urbanization and infrastructure projects for the coming years in China (CRU, 2014). The steel companies would be looking for more iron ore to meet the production demands of steel. However, the demand of steel can also be partially met by steel scrap by the steel producing companies, which may not solely rely on iron ore for the production of steel. Thus demand for iron ore is also driven by the fluctuations in the steel scrap market (Juan, 2014). The impact of metal scrap supply on the demand of iron ore was discussed at the 13th China International Steel and Raw Material Conference held at Qingdao, China (Juan, 2013). China's huge steel scrap pile is expected reduce the demand growth of iron ore in China in the coming years. The current weak market for steel scrap however, is not affecting the iron ore demand in China. The current weak market for steel scrap is understood to be due to tax preferences of the government of China. Another factor that drives the demand for iron ore is the collateral uses of steel metal. Many steel mills and iron ore stockists have increased purchases not due to the consumption needs but to use the stock as collateral to secure loans from the government. Commodities and metals have been used as collateral to secure loans in the Chinese markets. Thus, it is rumoured that the recent increase in demand for iron ore is not just due to urbanization projects but steel mills and traders using the stock pile as collateral to secure loans. However, the trend may not continue long enough since the use of metal stock as collateral is currently on the decline among Chinese investors. Thus, the factors that affect the demand of iron ore in any steel producing nation largely depends upon the demand for steel in that country. The demand for steel is determined by the industrial and construction activities such as infrastructure projects, housing projects and high industrial manufacturing activities of automobiles etc. that require large amounts of steel. Another driving factor of demand for iron ore is the availability and the price of substitute, which is steel scrap in the case of iron ore. The fluctuations in the steel scrap supplies and prices would drive the demand for iron ore. If the supplies of steel scrap are abundant then demand for iron ore can be expected to drop.

Coal and Its Significance

Coal is a combustible sedimentary rock black or brownish-black in color and is mostly composed of carbons and hydrocarbons (IEA, 2012). Coal is an energy source, which is non-renewable and takes millions of years to form. The coal is formed and gets the energy from energy stored in plants or other living beings that lived hundreds of years and earth was covered with swampy forests (World Energy, 2013). The plants and animals, which died millions of years ago formed a layer at the bottom of the swamps and was covered by many layers of water and sand, which helped in restoring the energy in the dead plants and animals. Due to the heat and pressure from the top layers the remains of plants and animals formed in to fossil energy, which is called as coal (IEA, 2012). There are different types of coal and are mainly classified into four main types, which are anthracite, bituminous, Sub-bituminous and lignite (World Energy, 2013). .

Anthracite: Contains 86-97% carbon and has highest heating value as compared to other types of coal (World Energy, 2013). The major reserves of this type of coal is found in China, Russia, Ukraine, Vietnam and South Korea. The most concentrated anthracite deposit in the world geologically is in Pennsylvania, United States.

Bituminous: Contains 45-86% carbon and is formed under high heat and pressure and has slightly less heating value (World Energy, 2013). The highest reserves of bituminous coal is found in South Africa and United States (IEA, 2012).

Sub-bituminous: Contains 35-45% carbon and has lower heating value as compared to Bituminous (World Energy, 2013). The biggest reserve of this type of coal is in the United States, Russia, China, Ukraine and Brazil (KPMG, 2013).

Lignite: Contains 25-25% carbon and has the lowest energy content (World Energy, 2013). This type of coal is found in many parts of the world and the biggest deposits are found in Russia, Australia, Germany, Greece, the Czech Republic, Serbia and the United States (IEA, 2012).

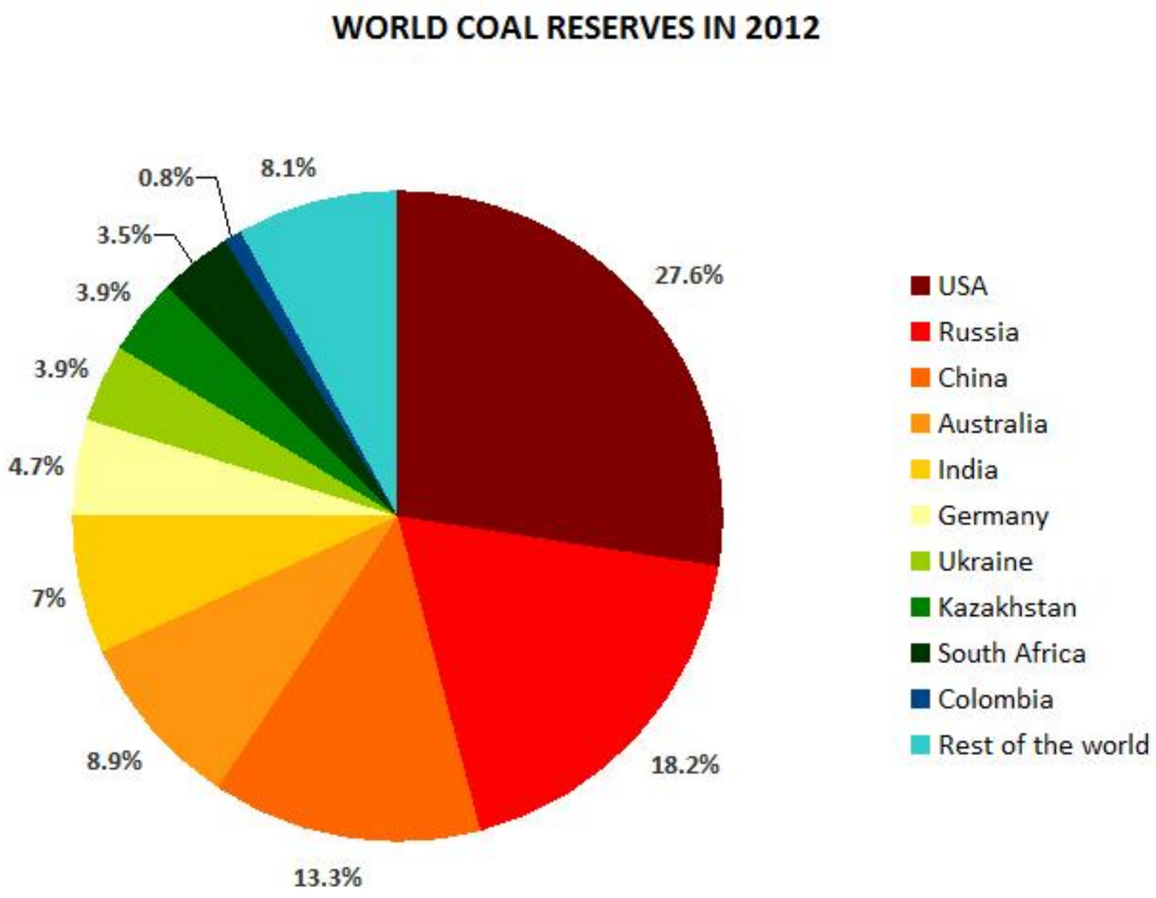


Figure 7 (Source: Accenture, 2013)

As seen in the above figure the coal reserves are found in every part of the world but the distribution is different, Though USA has the highest coal reserves but it hardly consumes it and most of it is exported to South Korea and European countries. China, which is the third highest has been consuming the available coal as well as importing since the demand for coal has been consistently increasing. China and India highly depend on coal for power generation to meet the increasing demand. The countries prefer coal over other resources since it is affordable and is available in abundance.

Coal plays an important role in addressing the increasing demand of secure energy supply. Coal is abundantly available across the different parts of the world and is widespread. Coal is available in almost every country and around 50 countries are involved in commercial mining (Accenture, 2013). Coal is found to be the most economical among the fossil fuels and is so abundant that it will be available for the next 118 years (KPMG, 2013). The coal reserves enable economic development and secure them against depending on import and price variations. Coal can be easily stored at power stations unlike the gaseous or liquid renewable energies enabling it to access the stock as per the demand. Coal-based electricity is highly reliable and well-established and around 41% global electricity supply is through coal energy (KPMG, 2013). Coal is abundant and an affordable source of energy and has continued to have low price for decades. It has been the most affordable fuel for power generation in many developed and industrializing countries for several years now.

Coal is considered as an alternative oil providing it a greater advantage since it is abundantly available and every country has easy access to the coal reserves within the home country or have an easy access to import it from other countries allowing the industries to minimize the impact of oil price fluctuation (Accenture, 2013). The other main areas where coal is used is the chemical processes, mainly in the iron and steel manufacturing industries (World Energy, 2013). Coal is also used in manufacturing cement, plastics, artificial fertilizers, pharmaceutical products and as an additive in casting of the metal alloys. The negative consequence of the use of coal include number of adverse health and environmental effects due to coal burning (KPMG, 2013). Tons of waste products is generated, which includes bottom and fly ash, containing mercury, uranium, arsenic and other heavy metals. It also contaminates land and waterways and due to release of carbon dioxide there is increased greenhouse gas leading to climate change and global warming (Accenture, 2013).

Significance of Coal to Industry and Global Economy

Coal plays a significant role in fulfilling the demand of energy for electricity globally and over the last decade the use has increased to 55% as compared to renewable energy (Accenture, 2013). Coal remains the main source of electricity generation and has been supporting the rapid industrialization of emerging economies, helping them to raise their standard of living and helping millions of people facing energy poverty. The demand growth for coal across the globe remained strong at 2011 at 5.5% (IEA, 2012). Though the power demand is increasing across the world but the use of coal for electricity generation in OECD countries has not seen much of increase since the natural gas has been taking the market share. But in non-OECD countries coal has created a major revolution in power and industry and the use of coal has been doubled. The demand for energy in the power sector has risen to 75% in the last decade (Wulandri, 2014). The use of energy by industries in the non-OECD countries has increased by two-thirds and the main source of energy is generated using coal (Tu& Johnson-Reiser, 2012).

The coal-fired power output in China and India alone increased by 2900 TWh over the past decade, which is equivalent to the total power used in whole of Germany (Tu& Johnson-Reiser, 2012). The non-OECD countries account for 70% of global use of coal, with China being the highest user of coal (Platts, 2011). The increased use of coal has enabled China and India to make significant progress in improving their needs for electricity across the country and reduced the number of people relying on biomass for cooking (Sreeja, 2013).. The use of coal for electricity has enabled China to provide electricity to millions of people in the rural areas. The access to electricity also significantly increased in the rural areas of India due to use of coal similarly in many other Asian countries the use of coal has enabled them to provide total availability of electricity (Daly, 2013). The increased availability of electricity in the developing nations enabled the economic growth since it enabled the industries to have uninterrupted power supplies and increased their productivity leading to increased revenues. It is anticipated that by 2020, non-OECD countries will consume 50% more coal-fired power (KPMG, 2013). The three-quarters of the use of coal will be outside OECD countries and would contribute significantly to industrial growth, economic expansion and prosperity to millions of people in the developing countries by providing them sufficient power to large parts of population and supply power to areas, which have limited access to electricity (Accenture, 2013). China and India, which are the emerging economies would dominate the global market of future coal use. China is the world’s biggest coal producer through the massive resources it has and its consumption is close to half of global demand (Platts, 2011). India is next to China in coal consumption and it is expected that there would be increased demand for coal in the future and the demand would double by 2035 (Sreeja, 2013). The rise in the demand for coal-fired power in India mainly comes from the power sector and it accounts for consumption of 60% of coal used in the country since the demand for electricity across the country is rapidly increasing and many rural areas still do not have effective power supplies (IEA, 2012).

India is expected to become the world’s biggest importer of coal by 2020 since the demand for coal is rapidly increasing and the domestic supply would not be sufficient to meet the demand. Coal plays an important role in energy production and accounts to 41% of world's electricity generation globally (KPMG, 2013). On every continent it is the key player of energy production both in developed and developing nations. The below graph shows the reliance of the countries on coal for the energy production as recorded by IEA Electricity Information, 2011. Thus, coal will remain an important part of the energy mix across the globe.

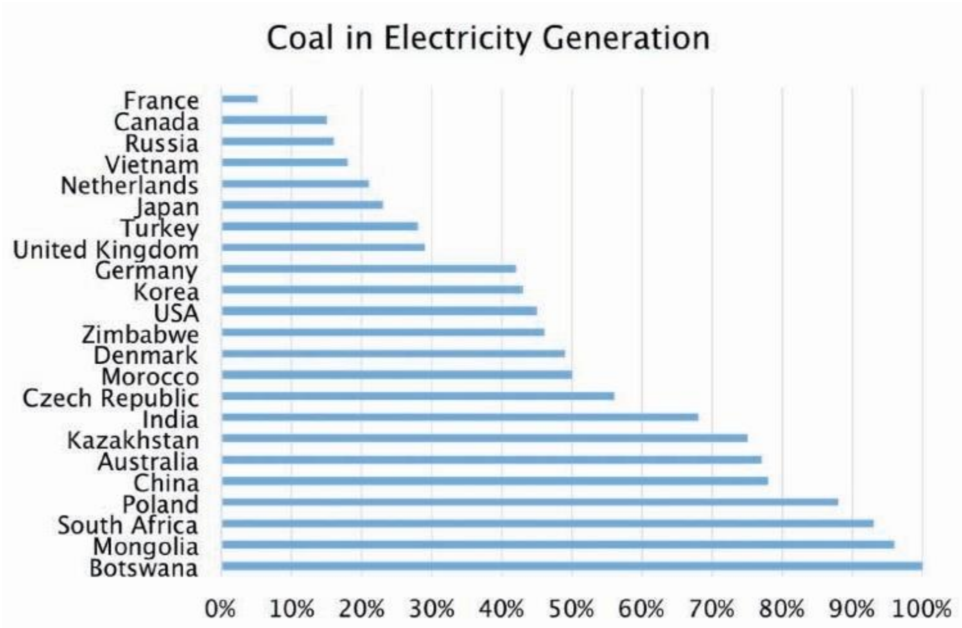


Figure 8. (Source: IEA, 2012)

From the figure it can be seen that China and India are among the highest users of coal for energy production since the population in both the countries is growing rapidly and also industrialization is increased significantly, which need effective supply of electricity. Due to the consistent increase in the population and industries the domestic supply of coal has been insufficient and expensive, which has encouraged the importers in China to get the coal from countries such as Australia and Indonesia, which are among the largest exporters of coal.

Apart from electricity, coal plays an important role in infrastructure development. The metallurgical grade coal is used to produce a material called coke, which can be used as fuel and a source of carbon to reduce iron ore to molten pig iron (World Energy, 2013). The molten pig iron is then smelted to produce steel products. Steel has wide applications and is so far the most important construction material used by various industries. The use of steel is found in skyscrapers, bridges, water systems, subways, pipelines, wind turbines, offshore oil platforms and many other modern infrastructure systems (World Energy, 2013). The production of steel other than using coke is by melting iron and steel scrap in electric arc furnaces. But countries like China and other developing nations cannot opt to produce steel by melting iron and steel scrap since they have very limited domestic supplies of iron and steel scrap (Platts, 2011). Also, the electricity required to power the electric arc furnaces comes mainly from use of coal. Thus, coal acts as cost-effective option in steel production. Coal can also be used as energy resource for producing liquid fuels, which is widely used in transportation and manufacturing. It is estimated that the world oil production is certain to reach its peak sometime during this century and will lead to increase in price of oil and petroleum products thus making way for substitutes (IEA, 2012).

Coal can act as the best substitute and can contribute to world liquid fuel production with its extensive reserves and the technologies available to produce coal based liquid fuel systems and electricity (Tan, 2013). This will support the transportation and manufacturing systems in spite of scarcity of oil reserves in future. Many countries are already building coal conversion facilities and are engaging in liquid fuel production since its value is expected to increase significantly in the future (IEA, 2012). Thus, coal provides low-cost and reliable electricity along with its contribution to production of infrastructure and option to produce liquid fuels will directly contribute to economic growth, creation of jobs and higher individual income. Coal is and would continue to be a significant contributor to the global economy due to increase in demand. Also, coal would be acting as a substitute to oil, which would further increase its demand. Coal is expected to be ahead of oil as the main fuel for the global economy by 2020 in spite of opposition from government to reduce carbon emissions (Tan, 2013). There is rising demand for coal from China and India, which is expected to consider coal as the main resource for producing electricity instead of oil since it would be cheaper and help in increasing their economies. The consumption of coal globally is expected to increase by 25% in the next ten years to 4.500 million tonnes, which is equal to oil consumption (IEA, 2012).

According to World Energy Congress, The demand for coal in China alone will increase the growth of coal as dominant global fuel since it is plentiful and affordable (Daly, 2013). Though the market has seen some fluctuations in prices in 2011 the excess supply and increasing demand growth would support the growth of coal and contribute effectively to the global economy since countries like China and India do not have much option for alternatives and they are comparatively expensive (IEA, 2012). Since coal has found increasing application in steel production through coking coal it further adds to the global economy since there is increase in demand for steel due to increase in infrastructure development in the developing nations (Myresources, 2014). Coking coal is widely used by steel manufacturers and coking coal exports from Australia, US and Canada would reach 30 million tonnes by 2015(IEA, 2012).. According to the International Energy Agency (2010), access to electricity drives economic development and it is estimated that worldwide demand for electricity would increase by 90% by 2035 and 80% of the electricity generation would be coal-fired (Myresources, 2014).

Major Importers of Coal and their Influence in the Demand of Coal

Due to increasing population and increase in demand for electricity by the industry China has changed from being the major exporter to one of the major importers of coal. According to China Electricity Council (CEC), the country has seen shortages of electricity of 25,-30,000 MW in winter and 20-40,000 MW in summer and since then the consumption has been increasing at the rate of 12.2% every year. China emerged as producers, traders and industry participants of coal in 2008 due to its production of thermal and coking coal and it exported thermal coal of 35 million mt. But since 2011 the demand in the domestic region as increased to 80 million mt and facing China to import from countries like Australia and Indonesia. According to Barclay's report, Chinese coal imports have seen an increase year-on-year by 34% and imported around 17.5 million mt in 2011 (Reuters, 2012).

	Total *of which*	**Steam**	**Coking**
PR China	289Mt	218Mt	71Mt
Japan	184Mt	132Mt	52Mt
India	160Mt	123Mt	37Mt
South Korea	125Mt	94Mt	31Mt
Chinese Tapei	64Mt	56Mt	8Mt
Germany	45Mt	36Mt	9Mt

	Total *of which*	Steam	Coking
UK	45Mt	40Mt	5Mt

Figure 9. (WorldCoal, 2013)

China overtook Japan as world's top coal importer in spite of being the world's biggest coal producer and consumer (Reuters, 2012). China's domestic production is managed by government and since the costs are rising due to competition the country has observed that foreign coal is cheaper and hence there is increase in coal import (Juan, 2013). The country imported around 200 million tonnes in 2012 (Reuters, 2012). The country's consumption of coal is considered to be robust as new coal-fired power generation is increased to meet the demand from the cement industry (Economic Times, 2013). The use of thermal coal by the cement industry is increasing to a greater extent since the government is taking steps to urbanize many parts of the country.

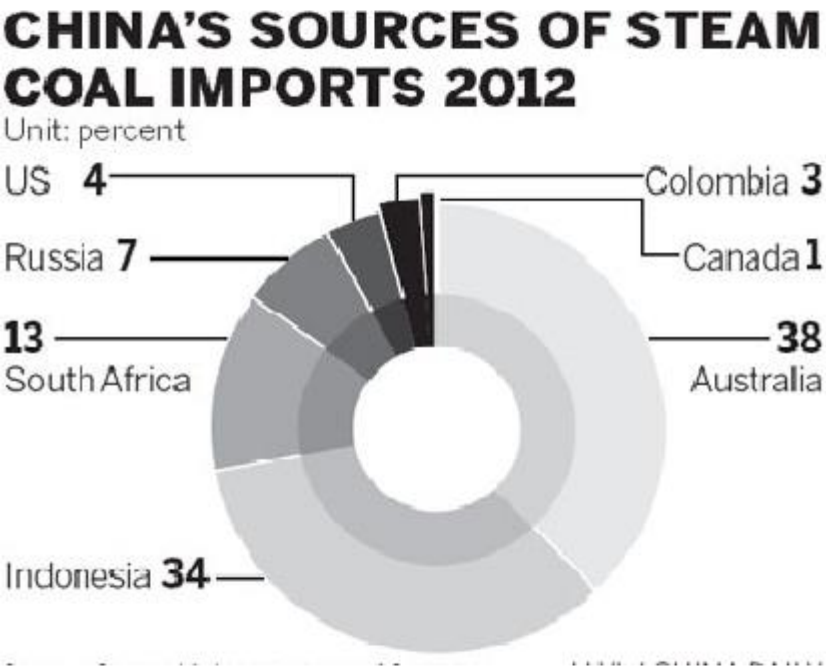


Figure 10 (Source: Juan, 2013)

From the above figure it can be seen that China imports more than 50% of the coal from Australia and Indonesia since it is available at affordable price and the trade route is very convenient and faster.According to Platts, a leading firm involved in price assessment of energy, petrochemical and metal sectors China will continue to import coal from different sources over the long term, which would have a major influence on international coal prices (Juan, 2013). According to O'Connell, China has become an important buyer in the international market from the past five years and buys the coal when the prices are low (Birol, 2013). Since the demand from Chinese coal-fired power generation companies is expected to increase every year till 2020 the company would continue to buy coal from countries such as Australia and Indonesia. According to Dai Bing the director of coal industry information department at JYD Online Corp, which is a Beijing based bulk commodity consultancy, coal imports in the country will keep increasing and the imported coal would be in demand as compared to domestic coal (Juan, 2013). The reason being the imported coal prices are lot more appealing than the prices for domestic coal. India is the second largest importer of coal next to China, which is used in the power plants, as the country is addressing the challenge of chronic power shortages, which affects the industries to a greater extent. And the domestic sources of natural gas is depleting quite rapidly. According to the report by Energy Aspect Ltd, India would soon become the world's largest importer of coal for power stations by 2014 (Economic Times, 2013). The demand for power station fuel is estimated to rise 43% to 730 million tons by 2017 and the domestic supplies are also expected to rise by 38 % by then (Economic Times, 2013). The other countries, which import coal are South Korea, Germany and UK but do not have as much demand as China and India hence have reduced influence on the pricing and demand of coal.

Major Coal Exporters and their Market Share in Exports

The world's largest exporter of thermal coal is Indonesia. Indonesia is capable of producing 425 million mt of coal as mentioned by head of Indonesia Coal Mining Association in the year 2014 (WorldCoal, 2013). Indonesia has abundant reserves in medium and low-quality coal and are competitively priced in the international market (Salva Report, 2013). Due to its strategic location it exports most of the coal to the emerging markets such as China and India which have increasing demand for low quality coal since there are new coal-fired power plants emerging in both countries to meet the domestic demand of electricity (Port Technology, 2014). The below table shows the major coal exporting countries and the quantity of exports carried out by each country.

	Total *of which*	**Steam**	**Coking**
Indonesia	383Mt	380Mt	3Mt
Australia	301Mt	159Mt	142Mt
Russia	134Mt	116Mt	18Mt
USA	114Mt	51Mt	63Mt
Colombia	82Mt	82Mt	0Mt
South Africa	74Mt	74Mt	0Mt

	Total *of which*	Steam	Coking
Canada	35Mt	4Mt	31Mt

Figure 11 (Source: WorldCoal, 2013)

The domestic coal consumption is very low hence it has an opportunity for higher international exports. The country exports three fourth of its production, which accounts for 12 % of the GDP in the largest economy in Southeast Asia (BP, 2013). The annual production of coal in Indonesia will be well above 500 million tonnes by 2020, which would be 50% increase from the current manufacturing capability The (Jakarta Globe, 2011). Indonesia has market share of over 50% in exporting steam coal whereas Australia is the largest exporter of coking coal, which accounts for 50% of world exports (WorldCoal, 2013). Russia is the next major exporter of the steam coal with 25% market share followed by countries such as USA, Colombia, South Africa and Canada, which together account for 30% of the coal exports (Coalswarm, 2010). The below figure shows the consistent increase in the export by Indonesia and Australia and hence they have the maximum market share in exporting coal.

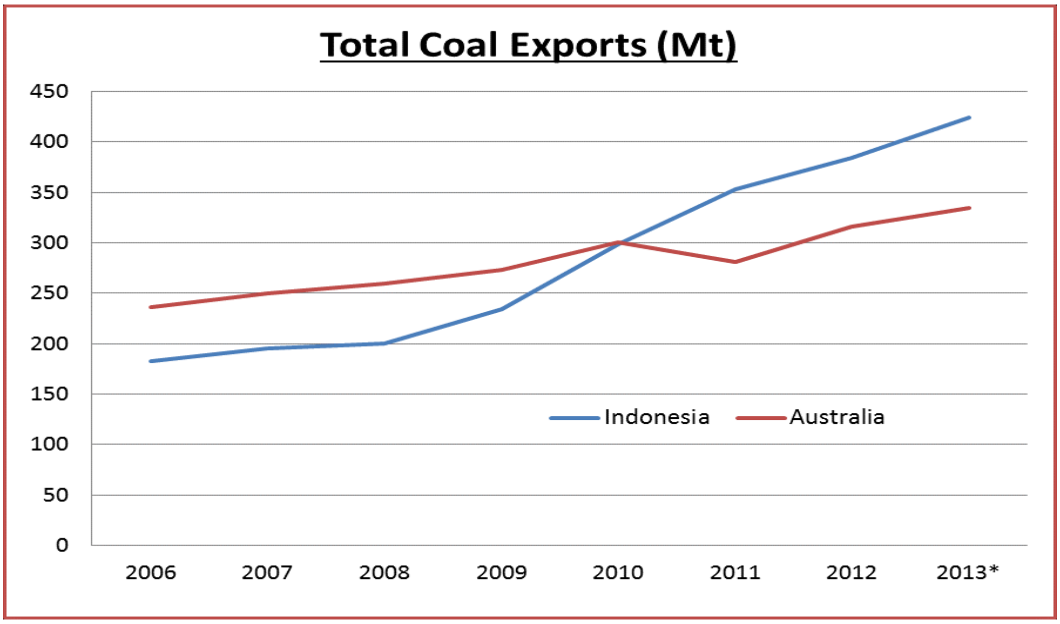


Figure 12 (Source: Salva Report, 2013)

From the above diagram it can be seen that the total coal exports from Indonesia and Australia has been consistently increasing over the years and is consistently in response to the increasing demand from China and India.There are two new exporting countries emerging in international coal scene, which are Mongolia and Mozambique (Coalswarm, 2010). These countries have reserves of coking coal, which are estimated to be more than US and hence they have significant chance to act as one of the major exporters of coke next to Indonesia and Australia (Coalswarm, 2010).

Major Producers of Coal and their Market Share in Global Production

China is the largest producer of coal and is also the largest consumer of coal. The country has coal reserves of 114,500 million tons, which is 13.3% of coal reserves of the world (Mining Technology, 2014). The annual production of coal is 3549 MT (Mining Technology, 2014). USA has the largest coal reserves in the world, which is 237,295 million tons and a total percent of 27.6% (BP, 2013). But the annual production of coal is comparatively low and is only 935Mt (BP, 2013). Russia has reserves of 157,100million tons and has world's 18.2 coal reserves in its country (BP, 2013). The annual production of coal is comparatively less and is 359Mt. In Australia coal is mined in every state and coal production plays a major role in its economy (Gandolphe, 2011). Below is the table of top ten coal producers.

PR China	3549Mt	**Russia**	359Mt
USA	935Mt	**South Africa**	259Mt
India	595Mt	**Germany**	197Mt
Indonesia	443Mt	**Poland**	144Mt
Australia	421Mt	**Kazakhstan**	126Mt

Figure 13 (Source: BP, 2013)

According to Australian Coal industry, coal is country's single largest export and the major markets are China, Japan, Korea and Taiwan. Australia's 80% of the electricity is produced by coal. India is the third largest coal producer and has coal reserves of 600,006 million tons. The country produced 595 Mt coal at the end of 2012. Coal accounts to about 68% of the country's electricity generation (BP, 2013). Indonesia is rapidly increasing its coal production and has coal reserves 500,500 million tons (Mining Technology, 2014). As of 2012 the country produced 443Mt and it uses coal to produce approximately 44% of the country's electricity (Lobello, 2013). The market share of China in global production is 47.5%, which is followed by coal production of North America, which is 13.4%. The market share of Australia is 6.3%, India is 6% and Indonesia is around 6.2% (Lobello, 2013).

Coal Traders and Companies that produce Coal in Global Basis

The major traders and companies in China are state-owned Shenhua Group, China Coal, Shanxi Coal (Xinhua, 2012). These are the top 3 coal producing companies in the world and China Minimetals Corp along with the above firms are the only companies, which have been granted license by government to export coal (Datamonitor, 2013). Sinosteel is another company, which started off as iron ore and steel trading company supporting China's steel industry has started importing different types of coal since the quality coal has become scarce in the country (Xinhua, 2012). The private enterprises in the country include Qinfa Group, which is the largest privately owned company in China and trades around 10 million tonnes of coal each year of which 70% are imported (Xinhua, 2012). Quinfa gets the coal from domestic and overseas market such as Indonesia, Australia and Vietnam (Xinhua, 2012). Guangdong Fuels Co.Ltd is an energy and commodities trader supplying thermal coal to large and mid-size firms in China's southern Guangdon province. It sells 3 million tonnes of thermal coal to cement manufacturers and local power plants each year and in that 2 million tonnes are imported from Indonesia and Australia (Datamonitor, 2013). Tata International is another big trader, which operates from six locations including India and China (Rao, 2013). The company carried out business-to-business coal trades of about 1million ton coal in 2012-2013 and expects to reach 10 million tonnes by 2015-2016, which sells the commodity in different parts of Asia (Rao, 2013). Vitol is one of the largest coal trading companies in the world having its own mines in US, Indonesia, South Africa, Russia, Columbia and Canada and supply coal to all major European power utilities and the Asia Pacific regions (Vitol, 2014),. The company has traded 34 million tonnes in 2013 (Vitol, 2014).

Xstrata Coal is world's largest trader of seaborne thermal coal headquartered in Sydney. The company produced 106 million tonnes of coal in 2012 and the amount of coal exported was 85% (Xstrata, 2014). The company has underground coal mine sin Australia, Colombia and South Africa (Xstrata, 2014). Peabody Energy is the largest private sector American company and supplies coal to the emerging regions for steel and electricity (Peabody Energy, 2014). The company sells the coal to customers in United States, Australia, China, Europe, South Africa, South America and Indonesia (Peabody Energy, 2014). It sells coal produced by company itself as well as trades coal from other coal producers in addition to its coal production. The company has sold around 251.7 million tons of coal through trade, sales and brokerage in 2013 (Peabody Energy, 2014).

Major Ports of Loading and Unloading Coal in Worldwide Basis

The major ports for loading and unloading coals in China are Quinhuangdao, Tangshan and Huanghua. The total coal supplies among these three ports was about 18.3 million tonnes in 2012 (Xinhua, 2012). Quinhuangdao port is the world's largest coal loading port and handles half of the needs of China and is located in Hebei province, North China. The coal inventory stored in this port in 2012 was 9.08 million tons, which has a capacity of storing 10.18 million tons (Xinhua, 2012). Tangshan is strategically located in Hebei to transport coal from north to south China and the port had an inventory of around 8.1 million tons (Xinhua, 2012). The loading of coal in Australia is carried out by nine major coal-loading ports, which are located in New South Wales and Queensland. Port Waratah Coal services is the world's largest coal handling operators and carries out loading of coal through two of its ports, which are Carrington and Koorangang (Minerals, 2014). The Port of Gladstone in Queensland is the fifth largest coal export terminal and is the largest multi-commodity port. The are two coal terminals, which are Barney Point Coal Terminal and RG Tanna Coal Terminal and between them it has the capacity to stock 78 million tonnes of coal per year.

India's major port for loading and unloading coal is Krishnapatnam Port Company Ltd. (KPCL), which is situated in east coast of India (Port Technology, 2014). The port has massive storage area of 6,500 acres, which is purely meant for coal storage (Port Technology, 2014). The coal loading port in Indonesia is Apar bay, which provides loading facility for coal obtained in East Kalimantan mines in Indonesia (CIBT, 2014). The loading rate of coal every day is around 8,000 to 10,000 (CIBT, 2014). Another major port in Indonesia, which loads and unloads coal is Cigading International Bulk Terminal (CIBT) and has state-of-the-art operational facilities to handle bulk coal materials within the port (CIBT, 2014). The port is strategically located along Sundastriat which is known as the safest port in the country. The company loads up 12, 000 dwt from different mine sites (CIBT, 2014).

Trade Routes of Coal

One of the most important trade routes in the world is the South China Sea, which stretches from Singapore and Strait of Malacca in southwest to the northeast to Strait of Taiwan (EIA, 2013). Large quantities of coal is supplied through this route, the coal from Australia and Indonesia is exported through the South China Sea to countries such as China and India. The map below shows the South China Sea trade route

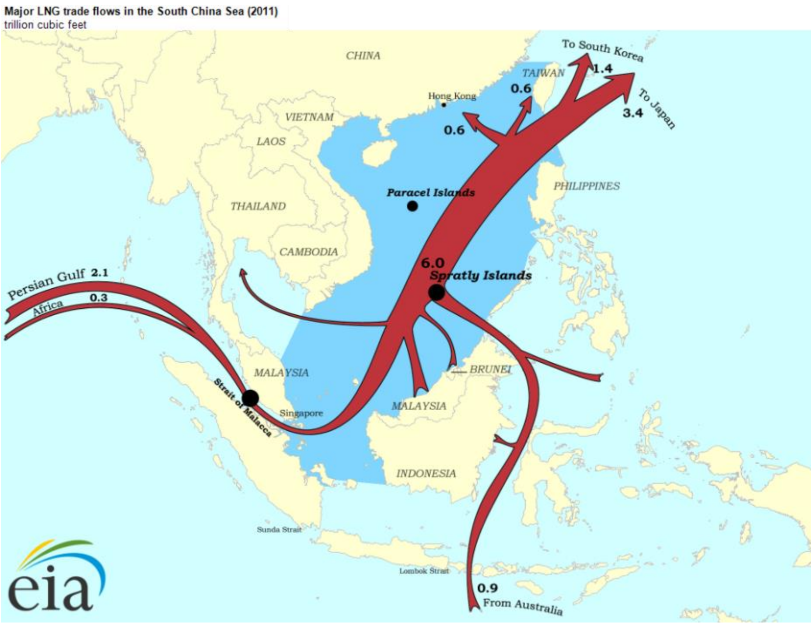


Figure 14. (Source: EIA, 2013)

The Strait of Malacca is the shortest sea route, which connects Africa and Asian consumers (EIA, 2013). The route connects the ports of Australia in Queensland and New South Wales to the three major ports in China, which enables China to get continuous and effective supplies of coal (Datamonitor, 2013). The south China route also connects Australia and Indian ports.

Gross Domestic Product of the Countries involved in the Trade Route

China

China is locates in East Asia and I s a sovereign state. It is a single-party state and is run by Communist Party. The country is world's second largest country by land and is the most populated country in the world with population of 1, 35 billion (Datamonitor, 2013). China has been the fastest growing nations in the world from the past 10 years and the economy depends on the investment and growth due to increasing exports in various products and services. The growth of China is also due to low labor costs, high productivity and its good infrastructure, which has enabled the manufacturing industries to grow significantly. Due to increasing manufacturing industries the country's power consumption is extensive and it is the world's largest consumer of energy and relies on coal for 70 % for the energy needs (Datamonitor, 2013). The overall GDP growth of the country in the first quarter of 2014 is 7.14% (International Energy Agency, 2013).The GDP growth in the agriculture sector is 10.1% and the country has seen a significant GDP growth in the industry and service sector of 45.3 and 45 % respectively (IEA, 2012). The country is world's second largest economy by GDP and is also the world's fastest growing major economy with consistent growth rates of 10% from the past few decades (Datamonitor, 2013)

India

India is the seventh-largest country by land and is located in South Asia. The country is the second most populous country in the world. According to International Monetary Fund, Indian economy is one of the fastest growing economies in the world and as of 2013 has the nominal worth of USD 1.842 trillion. The country has the second largest labor force of around 486 million (Datamonitor, 2013). The average annual growth rate of GDP is 5.8% from past few years (KPMG, 2013). Among which the service sector has seen a significant growth in GDP and it makes up 55.6% of entire GDP (Datamonitor, 2013). The next contributor to the GDP is the industry sector and it accounts for 26.3% and the agricultural sector accounts for 10.1% (KPMG, 2013).

Australia

Australia officially addressed as Commonwealth of Australia is the country, which is made up of mainland, the island of Tasmania and numerous smaller islands. The country is sixth largest by land area and is world's 12th largest economy. Australia is a developed country and is one of the wealthiest country in the world. Australia ranks the highest in national performance, quality of life, education, health and freedom of economy (KPMG, 2013). Australia is the major exporter of agricultural products such as wheat, mineral such as iron ore and energy in forms of coal and liquefied natural gas (International Energy Agency, 2013). The main markets for its export business are China, Japan, the US, South Korea and New Zealand. Australia is the 12th largest economy in terms of nominal GDP (Datamonitor, 2013). The mining sector accounts for 9% of the total GDP and the economic growth is highly dependent on mining sector and agricultural sector (International Energy Agency, 2013). As of 2012 the GDP in the service sector has been the highest at 68.8% followed by industry sector at 27% and the service sector contributes 4% of the entire GDP of the country (Datamonitor, 2013).

Indonesia

Indonesia is a sovereign state located in Southeast Asia and land is comprised of 13,466 islands (KPMG, 2013). The country is world's fourth most populous in the world. The economy of the country is world's 16th largest by nominal GDP. Indonesia's economy is mixed wherein the private and government sectors both play an important role (Datamonitor, 2013). The country has rich natural resources, which include natural gas, crude oil, copper, gold and coal (KPMG, 2013).. The country is one of the world's largest exporter of coal, which is a significant contributor to its economy. Also, Tourism sector is the other major contributor to tis economy. The GDP is highest in industry sector, which is 47% followed by the GDP in service sector, which is 38.6% and the agricultural sector has the GDP of 14.4% (Datamonitor, 2013).

Prospects of the Demand of Coal

The demand for coal will be highly driven by China and India in the future due to increase I population and industries, which require electricity supplies. This has stimulated the mining activities in countries such as Australia, Indonesia and many other countries. The prediction made by international Energy Agency (IEA) shows that coal would exceed the oil consumption and become the world's major source of energy by 2017 (Pfeifer, 2013). Currently coal is at the top of global energy mix having 36 % share of electricity generation. China would continue to be the world's largest importer since the demand for thermal coal in power generation will increase significantly by 2020 (Kemp, 2013).But with increasing impact of using coal on the environment the country is looking at alternative energy sources. But for the next few years China and India would continue to use more coal unless any strict laws are established for reducing the carbon emission caused due to coal consumption (Pfeifer, 2013). In the long term the magnitude of coal demand highly depends on the government policies on providing energy security, affordability with less environmental damage to be caused by the source of the energy (Kemp, 2013).

Factors that affect the demand of coal

The demand for coal would continue to rise in countries like China and India due to the increased required of power generation to supply electricity to the local people and the industries. However, the demand can be affected by environmental factors and might lead to government policies to reduce the use of coal (Queensland Government, 2010). The environmental challenges such as climate change, water constraints, falling costs of clean technology such as solar PV and onshore wind, changes in the laws to reduce the carbon emission due to use of coal can have a significant impact on the demand of coal (Caldecott et al., 2012). The increased pressure on the government to reduce air pollution can indirectly impact coal prices and its consumption and might also lead to closing down of the coal plants to reduce environmental pollution (Caldecott et al., 2012). To discourage the use of coal for power generation the government might impose a tax increasing the price of coal significantly and force the consumers to opt for other sources of energy (Kemp, 2013). The coal-fired power generation is still expected to grow absolute terms over next few decades but the share in the electricity mix will gradually reduce in the longer period due to environmental concerns, which will influence the pricing and force the consumers to switch to other resources for power (Kemp, 2013).

Capesize Ships

Capesize ships are very large ships used to transport ore and other minerals (Gilly&Drunen, 2012). The bulk carriers are so large that they cannot travel through either Suez or Panama canals. Capesize ships are normally above 150,000 long deadweight tons or DWTs (ClassNK, 2009). These ships are normally used to transport ore, coal and raw materials. Capesize ships are also used as tankers to transport crude oil and other liquid petroleum products (Gilly&Drunen, 2012). Some of the largest Capesize ships are of the size 400.000 DWTs (ClassNK, 2009). The deep drafts of Capesize ships make them not fit to dock into smaller ports. Only large ports with deep waters can dock Capesize ships. Since Capesize vessels cannot travel through Panama canal, they have to sail via Port Horn to move between Atlantic and Pacific oceans. Those Capesize vessels, which have to pass through Suez take a longer route via the Cape of Good Hope since their size and deep draft does not allow them to pass through Suez canal. Though deepening of Suez canals from 18m to 20 m in 2009 allows some smaller Capesize ships, larger Capesize ships still cannot pass through the Suez canal (ClassNK, 2009). Capesize ships can dock only large port terminals with deep waters in the world (Gilly&Drunen, 2012). Smaller ports or ports with relatively shallow waters are not suitable for docking of Capesize ships. Capesize ships of sizes more than 200 DWTs are used for the transportation of iron ore. About 93% of Capesize transportation in the world involves the shipping of iron ore and coal. The demand for huge Capesize ships is growing by the day. The Capesize ships of the size 40,000 DWTs are common these days. The big Capesize ships, also called bulkers or bulk carriers are used to transport iron ore from Brazil to China and Australia to China.

History

Capesize ships or bulk carriers probably first appeared in 1850s. Bulk carriers were built with the advent of steam powered ships back then. Bulk carriers became a reality with the invention and adoption of steam engines in the shipping. The first known bulk carrier is probably the British vessel SS John Bowes in 1952 (ClassNK, 2009). The ship was built and used for the transportation of coal. The ship was built using a steam engine, metal hull and a sea water ballasting system. The first self-unloader using conveyer belt to unload the cargo was built in 1902. Diesel powered bulk carriers started appearing in 1911 (ClassNK, 2009). Though bulk carriers started operating much earlier, it was only after World War II that the need of bulk carriers started to emerge. Till that time even iron ore and coal were moved in smaller containers. Till that time even dry cargos were moved in boxes and bags. It was in the 1950s that the need for unpacked dry cargo carrier started to emerge (Cullinance, 2005). This is due to the increased trade needs between the nations. The trade of dry cargo till that time was not as much between nations as within a nation. The transportation of dry cargo within a nation used lake routes and inland waterways to ferry dry materials such as mined ore and coal (Cullinance, 2005). When international trade increased the need for bulk carriers that could carry loose, unpacked dry material arose. The first bulk carrier of the modern times, which ran on diesel was built in Japan in 1954. The bulk carrier named NichiryuMaru was built with twin shafts and twin engines (ClassNK, 2009). The vessel had a length of 153 metres and breadth of 21 metres. The bulk carrier had a depth of 11.5 metres and had the deadweight of 15,368 tons (ClassNK, 2009). The vessel was designed to carry iron ore. After NichiryuMaru, the construction of bulk carriers continued in Japan and building of bulk carries became prominent marine activity in Japan in the 1960s (ClassNK, 2009).

Historically i.e. in the mid of 1900s bulk carriers were classified based on their design and use. Bulk carriers were classified as Ore carriers, Open Hatch bulk carriers, Wooden chip carriers and Double Side Shell bulk carriers (ClassNK, 2009). Ore carriers were built with small cargo holds and large side tanks. This type of design was done to handle high specific gravity of iron ore. The side tanks were often used as oil tanks (Cullinance, 2005). Open Hatch bulk carriers had wide opening in the front to enable loading and unloading of dry cargo. They were built to hold large size cargos, due to the wide opening (Cullinance, 2005). The bulk carriers were built such that along with bulk cargo, other cargo such as containers and pulp products could be carried. Double Side Shell bulk carriers did not have frames inside the hull. The design enabled strength members to be protected from corrosion due to the exposure to corrosive environment of the hold. Both single sided and double sided bulk carriers needed to comply with structural rule till 2004. But in 2004 the compliance was made non-mandatory (ClassNK, 2009).

Current Capesize Ship Design

Bulk carriers have been given several trade names due to their use and size. Some of the current popular trade names are Handisize bulk carrier, Lakesize bulk carrier, Panamax bulk carrier, Post-Panamax bulk carrier and Capesize ships (Gilly&Drunen, 2012). Bulk carriers with deadweight range between 1000 and 5000 tons fall in this category of carriers. Lakesize bulkers are those with deadweight between 20,000 to 27,000 tons and with shorter drought of about 7.925 meters (Cullinance, 2005). Panamax bulk carriers are the largest bulk carriers that can pass through Panama canal (Cullinance, 2005). These vessels have a breath of around 32 metres and a deadweight of 80,000 tons (Gilly&Drunen, 2012). Post-Panamax bulk carriers are those, which cannot pass through Panama canal and which have a breadth of more than 32 metres and of deadweight in the range between 80,000 to 120,000 tons

(Cullinance, 2005). Capesize ships have a deadweight of more than 100,000 tons and are capable of entering deep water ports. Bulk carriers are also classified by the utilities and functions. They are Geared bulk carriers, Gearless carriers, Combined carriers, Lakers, Self-dischargers and BIBO or bags in bags out. Geared bulk carriers are normally of Handsize but with cranes, conveyers and derricks on the deck to facilitate loading and discharging of cargos without the use of shore equipment. Gearless carriers do not have cranes or conveyers (Cullinance, 2005). These vessels require shore based equipment such as conveyers, cranes etc. to charge and discharge the cargo (Gilly&Drunen, 2012). Combined carriers carry both liquid and dry bulk cargos. These vessels will have separate compartments for dry cargo and liquid cargos. They are expensive of the lot due to the design of the ship to accommodate both liquid and dry cargo. Self-dischargers are bulk carriers with conveyer belts. They are used to charge and discharge the carrier with the cargo. The conveyer belts or kind of excavators move both across the length of the carrier as well as sideways to enable charging and discharging of the carrier. Lakers are carriers of about 10,000 deadweight capacity and are used in the Great Lakes. BIBO or 'bags in bags out' carriers contain cargo in bags. These carriers are used to transport food grains and sugar in bags.

Economics of Capesize Ships

Capesize ships are preferred for transcontinental destinations due to the distance as well as the capacity to carry bulk load of dry cargo such as iron ore and coal. The production of coal and iron ore forecasts indicate that the production is going to increase in the coming years (Cullinance, 2005). Since Capesize ships mainly find their use in the transportation of coal and ore, the future market for Capesize ships appear bright. The following chart shows the forecast of coal consumption in the world.

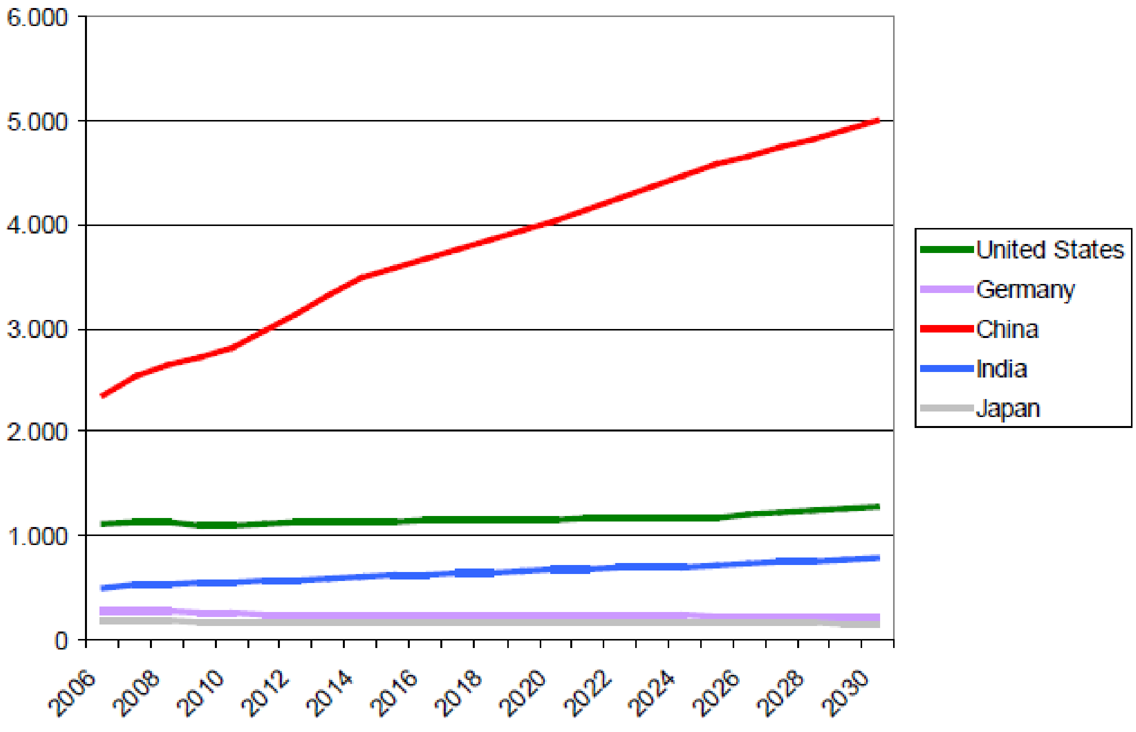


Figure 15

(Source: Gille&Drunen, 2012)

The following chart shows the forecast of iron ore in the world in the coming years.

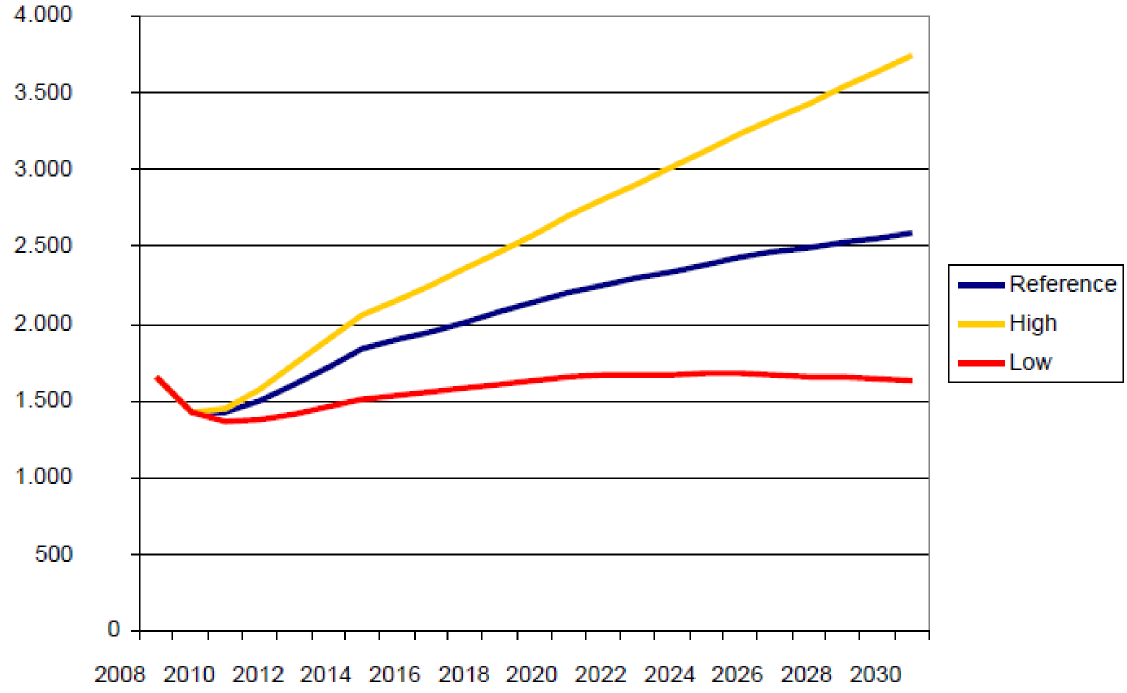


Figure 16

(Source: Gille&Drunen, 2012)

Though the market for the usage of Capesize ships appears attractive, the economics of operating Capesize ships need to be viewed from the perspectives of profitability, operating costs as well as the ship construction costs. The construction costs of a Capesize ship is directly dependent on its deadweight, type and size (Cullinance, 2005). The construction cost of the ships are also rising to labour and other input material costs. Also, since the construction of Capesize ships might run into years, the actual costs of the ship would even go up due to the stalled investment in the construction of the ship. All these contribute to major risks to the Capesize ship builder. The fluctuating shipping prices across the globe would also pose a threat to the cost effectiveness of opting for Capesize ships even for coal and iron ore. All the factors such as coal and iron ore demand and supply, the prices and the shipping price market need to be conducive in order for the Capesize ship companies to recover their costs. During the 2008 economic recession, the Capesize fleet had to face the toughest challenge since the trading companies opted for smaller and cheaper vessels to transport dry cargo. The price trend of bulk carriers including Capesize ships is shows in the chart below.

	Newbuilding							Second hand prices mid 2009		
	1998	2000	2002	2004	2006	2007	2009	5 yr	10 yr	15 yr[11]
Handymax	20	21	23	27	30	38	35	27	18	12
Panamax	25	25	26	28	30	45	50	35	22	14
Suezmax	33	35	38	40	45	60	60	45	25	18
Cape size	43	41	35	55	63	85	83	60	45	30

Figure 17

(Source: Gille&Drunen, 2012)

As can be seen the prices of bulk carriers as well as Capesize ships have grown over the years. Capesize ships face more difficulties in producing return on investments as compared to tankers. The value of dry cargo commodities are far lesser than crude oil transported by tankers (Kassambe& Gang, 2013). As such the transportation costs contribute substantially to the price of the landed goods as compared to tankers. In case of crude oil tankers the transportation costs is only a small percentage or even fraction of crude oil price and as such little flexibility in transportation pricing does not really matter to the traders. What matters more to the traders in case of tankers is the safety and speed of transportation and charging and discharging facilities. However, bulk dry cargo carriers need to provide value to customers in lieu of transportation charges since sea freight is substantial portion of landed dry cargo materials. The bulk carriers as such would be faced with difficult challenge of operating with very minimum profit margins as compared to the costs (Kassambe& Gang, 2013). Also, as compared to the costs of building Capesize ships and the profit margins they operate in, the breakeven of the costs of owning and operating Capesize ships takes longer as compared to other smaller vessels or tankers. Probably due to the same reason Capesize ships are owned and operated by mining companies themselves such as Vale SA in order to facilitate shipping of huge quantities across the continents (Bloomberg, 2012). Since they are owned and operated by the mining companies there would be some room for cost benefits of carrying bulk loads. Commercially owned and operated Capesize ships on the other hand, will be faced with the task of proving additional costs of transportation by Capesize ships (Bloomberg, 2012). It would be interesting to explore as to whether economies of scale would help the business of commercial operations of Capesize vessels.

Economies of Scale of Capesize Ships

Economies of scale refers to cost reduction due to bulk volume operations, whether it is production or transportation. Capesize ships are known to carry huge dry bulk cargos of iron ore and coal (Lloyd's, 2007). As such the freight per unit volume of cargo should reduce due to the sheer capacity of the ships and due to reduction in handling costs as well as the reduction in loading and unloading costs (Kassambe& Gang, 2013). The spot rates of bulk carriers are definitely higher than handysize and panamax vessels. In 2007, the spot rates of capesize ships stood at USD 1 million per day as against USD 38,000 for smaller handysize vessels (Lloyd's, 2007). But considering the building costs of the capesize ships and the maintenance costs that goes with it, the difference in earnings per day can barely help capsize ships to compete with smaller ships (Bloomberg, 2012). The capesize ships can achieve economies of scale only in longer voyages (Lloyd's, 2007). In shorter voyages though other costs involved in the operation of capesize ships nullify the advantage of huge transportation (Kassambe& Gang, 2013). An example of nullification of the advantage of economy of scale is that of Vale SA (Bloomberg, 2012). According to Alphabulk, Vale SA paid USD 158 million more in shipping dry cargo through capesize ships as compared to the costs associated with handymax or panamax ships (Bloomberg, 2012). The costs of the bigger ships were also higher due to decreased capsize shipping rates (Bloomberg, 2012).

Thus, capesize ships and big bulk carriers have definite use in long haul trips with dry cargo load. Big bulk carriers are suited for long voyages due to the build of the ship as well as focused maintenance and navigation that can be achieved by the use of a single bulk carrier instead of many smaller vessels (Lloyd’s, 2007). The use of smaller vessels though may still be economically viable even for longer routes (Bloomberg, 2012). But the advantage of monitoring and control of a single large carrier cannot be achieved by the sue of several smaller carriers. As cited above large iron ore companies such as Vale SA therefore prefer the use of big bulk carriers to smaller vessels even though they have to spend more on the freight charges (Lloyd’s, 2007). The shipment though a single large carrier will also ease logistical operations and can ensure timely (Cullinance, 2005) delivery of the shipment in longer routes. As such even though there is no real economy of scale achieved by the use of capesize ships, they are still preferred dry bulk carriers especially in the longer routes (Bloomberg, 2012). The companies tend to ignore the price advantage of transporting through smaller carriers in long haul voyages for the sheer benefits associated with logistics, time, and safety and needless to mention the delivery of bulk volume in a single trip.

QUANTITATIVE PART

In the previous part of the project, an in depth descriptive analysis was conducted regarding the iron ore and coal global trading patterns. These two commodities which are considered of extreme importance and they are directly correlated with the global energy sufficiency are the main commodities that capesize bulkers transport.

The quantitative analysis has been based on the following variable categories and their further breakdown as follows:

Shipping Variables

Baltic Exchange Capesize Index (X1): it is part of the Baltic Dry Index(BDI)and it represents the basic index of the capesize vessels' market. In our model it is set as the Dependent variable.

Capesize Bulkcarrier Fleet Development(X2)

It shows in absolute numbers the available capesize tonnage in terms of dwt.

Commodity Variables

CO1 Commodity BRENDT BLOOMBERG(X3)

It is the price of the crude oil. The price is expressed in USD/barrel and it is the basic commodity which acts as a predictor/reflection of the global growth. It acts like a substitute of coal for thermal/heating appliances. The data is obtained by Bloomberg Database (https://www.bloomberg.com/quote/CO1:COM)

South african export price coal (X4)

This variable is chosen since South Africa is considered as one of the top exporters of thermal coal which means that price fluctuations of this commodity can influence the demand for coal from South Africa. The commodity coal is one of the two commodities that can adjust the demand for capesize vessels. It is expressed as usd/pmt. The data is obtained by Index Mundi Database (https://www.quandl.com/INDEXMUNDI/COMMODITY_COALSOUTHAFRICANEXPORTPRICE-Coal-South-African-export-price-Monthly-Price)

Australian Thermal Coal (X5)

This variable is chosen since Australia is considered as one of the top exporters of thermal coal which means that price fluctuations of this commodity can influence the demand for coal from South Africa. The commodity coal is one of the two commodities that can adjust the demand for capesize vessels. It is expressed as usd/pmt. The data is obtained by Quandl database (https://www.quandl.com/ODA/PCOALAU_USD-Coal-Price).

Iron Ore (X6)

This variable is chosen since iron ore’s price fluctuation reflects changes in demand for capesize vessles to conduct its transport. It is expressed as usd/pmt. The data is obtained by Clarkson's Report(Shipping Intelligence Network Timeseries, 20 January 2015)

Dummy variable(X7)

This variable takes two values 0 or 1. I set her as 1 for prices small or equal to 5000 that the BCI has. When the start of the analysis took place, if dependent's values of higher than 5000 were included the data was distorted and no normal distribution was marked.

Currency Variables

The importance of currency exchange rate, is very important since it alters in a very smooth way the imbalances of trade between two countries (https://www.ft.com/content/a3b9e74c-ba6f-11e3-aeb0-00144feabdc0). The following currencies cover the most important trade routes between countries regarding the iron ore and coal trade.

EUR/USD(X8)

Euro to United States Dollar.(https://www.bloomberg.com/quote/EURUSD:CUR)

USD/AUD (X9)

United States Dollar to Australian Dollar(https://www.bloomberg.com/quote/USDAUD:CUR)

AUD/CNY(X10)

Australian Dollar to Chinese Yuan(https://www.bloomberg.com/quote/AUDCNY:CUR)

USD/CNY(X11)

United States Dollar to Chinese Yuan(https://www.bloomberg.com/quote/USDCNY:CUR)

Global Marco-Economic Variables

The following set of variables, practically reflects the economic growth of countries/regions that are considered as the top importers of the two commodities. Their overall economic performance measured by different indices, presents the potential and the expectations that can arise regarding the demand for the mentioned above commodities.

China Industrial Output CRUDE STEEL (X12)

This indicator expresses in absolute numbers the million tons of crude steel production within China. The data is obtained from National Bureau of statistics of China (http://data.stats.gov.cn/english/easyquery.htm?cn=B01)

China Industrial Output (X13)

In China, industrial production measures the output of businesses integrated in industrial sector of the economy such as manufacturing, mining, and utilities. This indicator shows the annual difference on a percentage base development of the industrial production.(http://www.tradingeconomics.com/china/industrial-production)

China Leading economic Index (X14)

In China, the Leading Index is used to forecast the future economic trend. The index is based on a group of eight indicators reflecting different aspects of economic activity including: Hang Seng China Mainland circulation index, investment in newly started project, ratio of industrial production, real estate development leading index, money supply M2, national debt interest rate spread, consumer expectations index, logistics Index. The index has a base value of 100 as of 1996.(http://www.tradingeconomics.com/china/leading-economic-index)

EU changes in inventories (X15)

Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and work in progress. Data are in current local currency.(http://www.tradingeconomics.com/euro-area/changes-in-inventories)

EU Government Spending(X16)

Government Spending refers to public expenditure on goods and services and is a major component of the GDP. Government spending policies like setting up budget targets, adjusting taxation, increasing public expenditure and public works are very effective tools in influencing economic growth. The numbers are absolute and are expressed as billion Euros. (http://www.tradingeconomics.com/euro-area/government-spending)

European union Construction Output (X17)

The production index in construction measures the evolution of output within the construction sector, including building construction and civil engineering. The numbers show a year to year change in the construction output and are expressed in percentage basis. (http://www.tradingeconomics.com/euro-area/construction-output)

European Industrial Production (X18)

In Euro Area, industrial production measures the output of businesses integrated in industrial sector of the economy such as manufacturing, mining, and utilities. The numbers show a year to year change in the european industrial output and are expressed in percentage basis. (http://www.tradingeconomics.com/euro-area/industrial-production).

Euro Area Z economic(X19)

In the Euro Area, the ZEW Economic Sentiment Index measures the level of optimism that analysts have about current economic situation and expected economic developments for the next 6 months. The date covers up to 350 financial and economic analysts. The index is constructed as the difference between the percentage share of analysts that are optimistic and the percentage of analysts that are pessimistic about the development of the economy. Therefore, the ZEW indicator measures the confidence on a scale of -100 (all analysts are unhappy with the current developments and expect the conditions to deteriorate) up to 100. A 0 value indicates neutrality. (http://www.tradingeconomics.com/euro-area/zew-economic-sentiment-index)

Dummy variable(X20)

Takes two prices 0 or 1. There was an attempt to break even more the model. Set it as 1 for everything. No change. No effect.

India Industrial Production(X21)

In India, industrial production measures the output of businesses integrated in industrial sector of the economy such as manufacturing, mining, and utilities. It is expressed in percentage basis and expresses a year to year change(http://www.tradingeconomics.com/india/industrial-production)

South Korean Construction Order(X22)

In South Korea, construction order show the budget reported from construction companies of any kind of construction such us residential, business and utilities constructions. It is an absolute number expressed in million KRW. (http://www.tradingeconomics.com/south-korea/housing-index)

South Korean Industrial Production(X23)

In South Korea, industrial production measures the output of businesses integrated in industrial sector of the economy such as manufacturing, mining, and utilities. . It is expressed in percentage basis and expresses a year to year change (http://www.tradingeconomics.com/south-korea/industrial-production)

South Korean Manufacturing Production(X24)

In South Korea, industrial production measures the output of businesses l sector of the economy such as manufacturing. It is expressed in percentage basis and expresses a year to year change. (https://tradingeconomics.com/south-korea/manufacturing-production)

South Korean New Orders (X25)

In South Korea, because new orders heavily affect business confidence they are a leading indicator for growth in gross domestic product. This indicator is expressed in absolute numbers and in million KRW cureency.(http://www.tradingeconomics.com/south-korea/new-orders)

South Korean Changes in Inventories(X26)

In South Korea, changes in inventories are often a leading indicator for the overall performance of the economy. It is expressed in absolute numbers either positive or negative and is expressed in KRW currency(http://www.tradingeconomics.com/south-korea/changes-in-inventories)

Taiwan Changes in Inventories(X27)

In Taiwan, changes in inventories are often a leading indicator for the overall performance of the economy. It is expressed in absolute numbers either positive or negative and is expressed in TWD currency.(http://www.tradingeconomics.com/taiwan/changes-in-inventories)

Methodology

After the collection of the data from the sources that have been metioned below the table, I highlighted the fact the when all of the prices of the dependent variable are included, the data do not follow normal distribution. When prices above 5000 are excluded - by using a dummy variable of 0 - 1 form then the normal distribution is observed, basis the K-S test.

One-Sample Kolmogorov-Smirnov Test

		VAR00001
N		46
Normal Parameters[a,,b]	Mean	2447.1739
	Std. Deviation	1152.85561
Most Extreme Differences	Absolute	.127
	Positive	.127
	Negative	-.092
Kolmogorov-Smirnov Z		.860
Asymp. Sig. (2-tailed)		.450

a. Test distribution is Normal.

b. Calculated from data.

(The Ho of normality is not rejected)

The final model as it is concluded based on the Stepwise regression is the following

Coefficients[a]

Model		Unstandardized Coefficients		StandardizedCoefficients	t	Sig.
		B	Std. Error	Beta		
6	(Constant)	-11814.638	3133.348		-3.771	.001
	VAR00013	165.029	36.489	.482	4.523	.000
	VAR00008	2477.310	1317.983	.393	1.880	.068
	VAR00006	-12.865	3.961	-.674	-3.248	.002
	VAR00017	101.104	27.576	.434	3.666	.001
	VAR00026	-.149	.061	-.262	-2.444	.019
	VAR00016	21.805	8.925	.702	2.443	.019

a. Dependent Variable: VAR00001

The model has a very smooth adjustment, conclusion that is based on following checks:

R Square

R square is equal to 0,7. This means that the model explains 70 per cent of the changes that occur in the dependent variable.

Standardized Residuals Test

If the residual is less than -2, the residual's observed frequency is less than the expected frequency.

Greater than 2 and the observed frequency is greater than the expected frequency.

If your residuals are +/-3, then it means that something extremely unusual is happening. If you get +/-4, it’s something unexpected that cannot easily interpreted.

DATES	RESIDUALS	DATES	RESIDUALS
1999-Q1	-0.98010	2006 - Q3	-0.50762
1999-Q2	-0.86814	2006-Q4	-0.37750
1999-Q3	-118.672	2007-Q1	0.01230
1999-Q4	-0.37464	2007-Q2	0.30383
2000-Q1	0.02046	2007-Q3	143.192
2000-Q2	0.45173	2007-Q4	376.770

2000-Q3	0.83234	2008-Q1	-0.74567
2000-Q4	0.72241	2008-Q2	0.88694
2001-Q1	0.78484	2008-Q3	-116.424
2001-Q2	0.71184	2008-Q4	-215.347
2001-Q3	0.06659	2009-Q1	0.00764
2001-Q4	0.18546	2009-Q2	0.47356
2002-Q1	0.28716	2009-Q3	0.28873
2002-Q2	-0.35472	2009-Q4	0.42855
2002-Q3	-0.39696	2010-Q1	-0.17990
2002-Q4	-0.31262	2010-Q2	151.514
2003-Q1	-0.13705	2010-Q3	0.14335
2003-Q2	-0.17432	2010-Q4	0.48765
2003-Q3	-0.23150	2011-Q1	-198.464
2003-Q4	121.502	2011-Q2	-169.801
2004-Q1	110.798	2011-Q3	0.34430
2004-Q2	-120.928	2011-Q4	0.18257
2004-Q3	-0.61365	2012-Q1	-0.13666
2004-Q4	0.14356	2012-Q2	0.68514

2005-Q1	0.27508	2012-Q3	-123.131
2005-Q2	-0.53446	2012-Q4	0.15444
2005-Q3	-0.72041	2013-Q1	-0.03105
2005-Q4	0.62343	2013-Q2	-0.10118
2006 - Q1	-0.90077	2013-Q3	0.99620
2006 - Q2	-165.870		

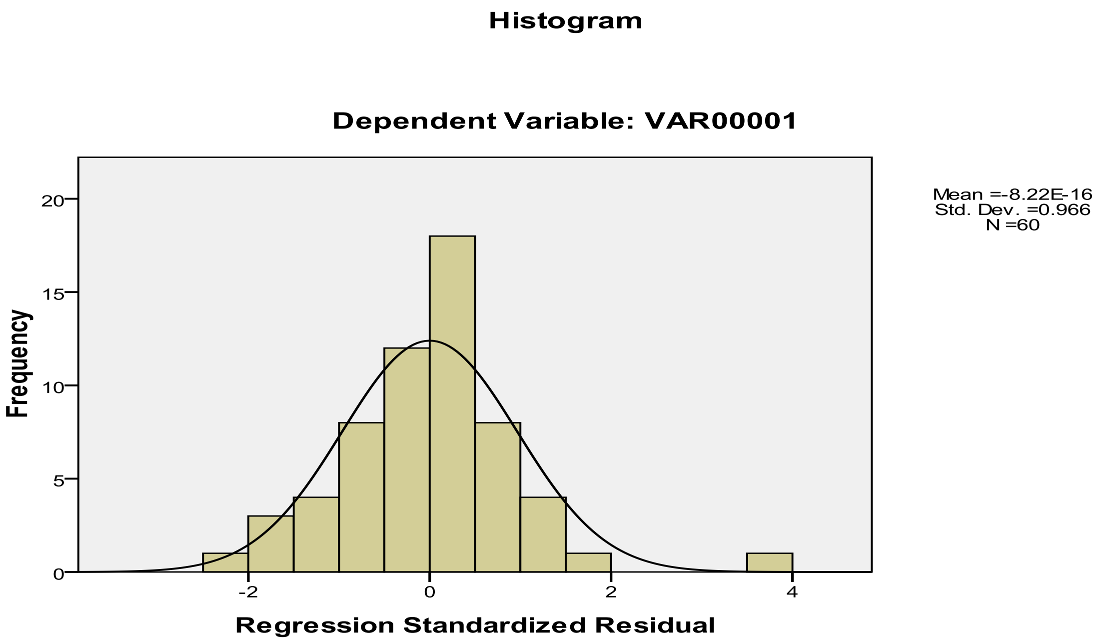
(based on calculations)

The table shows the residuals of the model that occurred based on the timeseries data.

The main rule that applies to that test is that we need 100% of the prices of the residuals to be between -3 and 3.

In order to be more specific we need 95% of the prices of the residuals to be between to be between -2 and 2.

Both of the mentioned above criteria are fully satisfied. The residuals that have prices outside of the mentioned above limits are referred to the years that basis our initial dummy variable use are excluded from our model in order for the dependent variable to follow a normal distribution patter.

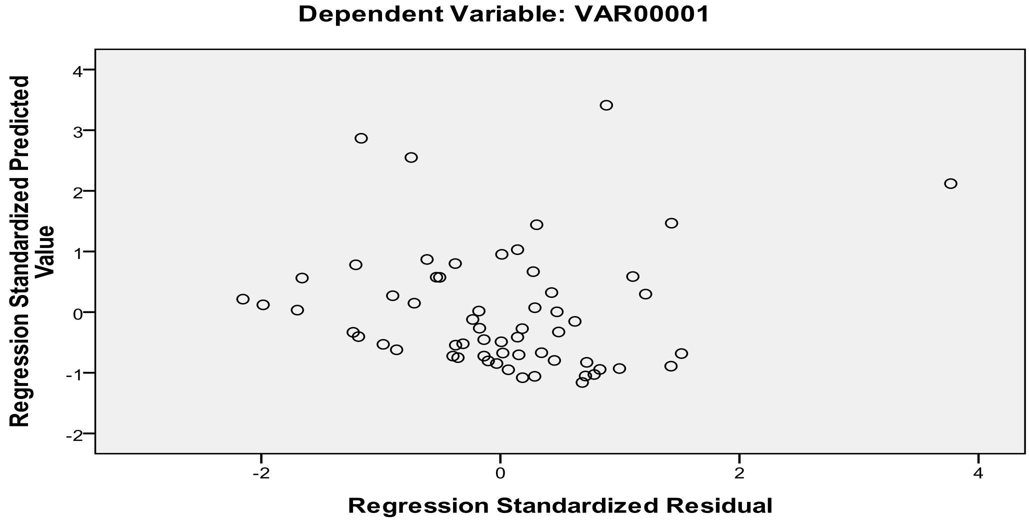


Autocorrelation test

Autocorrelation is a characteristic of data in which the correlation between the values of the same variables is based on related objects. It violates the assumption of instance independence, which underlies most of the conventional models. It generally exists in those types of data-sets in which the data, instead of being randomly selected, is from the same source.(http://www.statisticssolutions.com/autocorrelation)

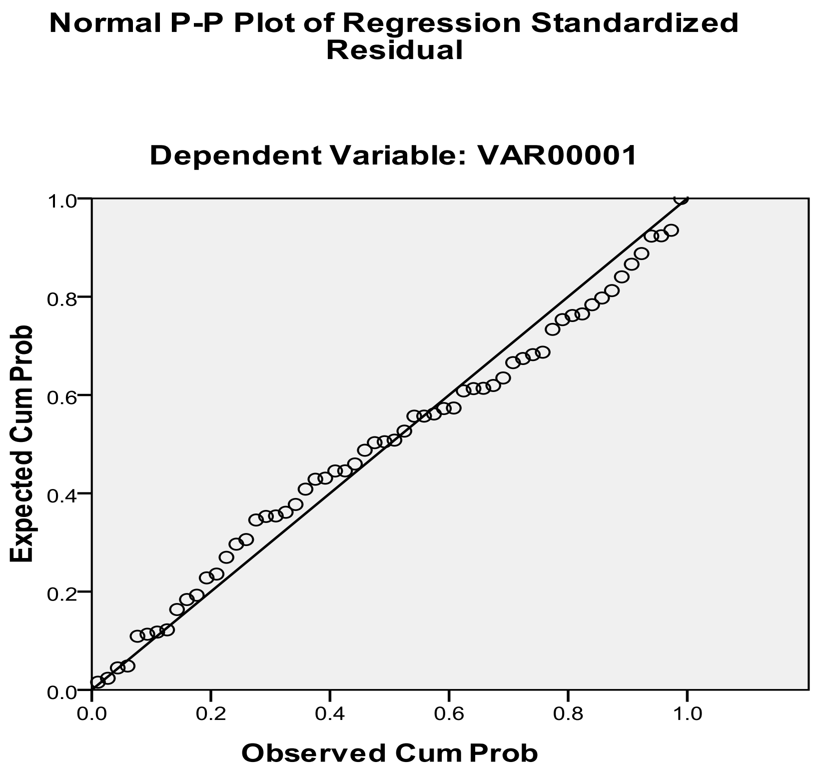
When the data of a research have the characteristic of autocorrelation, then there should be a linear or any other purely identifiable pattern between the variable(s). In our case the residuals and the dependent variable do not have any kind of relationship. This can be concluded by the following scatter plot, which is produced by the examination of our data.

Scatterplot



<u>Homoscedasticity Test</u>

Homoscedasticity describes a situation in which the error term (that is, the "noise" or random disturbance in the relationship between the independent variables and the dependent variable) is the same across all values of the independent variables. Heteroscedasticity (the violation of homoscedasticity) is present when the size of the error term differs across values of an independent variable. The impact of violating the assumption of homoscedasticity is a matter of degree, increasing as heteroscedasticity increases.(http://www.statisticssolutions.com/homoscedasticity)



In case we do have a breach of the Homoscedasticity we are facing the opposite statistical phenomenon, that of heteroscedasticity. We need all of the residuals to be "as close as possible to the central line" which means that there will be fewer std errors, and this will mean better predictability for our model.

Variables Selection

Through the step wise regression process, our final model will have the following format

Y= B +A(a)Variable(a)+ A(b)Variable(b)+.......A(z)Variable(z)

Y is the dependent variable in our case. Basis our table is the X1 variable and it represents the Baltic Capesize index.

B is the constant of the model. The value of this constant is -11814.638

Independent Variables that have been selected by the stepwise regression and have formed the model with the highest R square are the following and next to them there are their coefficients.

VAR(13) China Industrial Output year to year change(pc) with coefficient 165.029

VAR(08) The exchange rate of Euro/US dollar with coefficient 2477.310

VAR(06) price of Iron Ore with coefficient -12.865

VAR(17) European union Construction Output year to year change (pc) with coefficient 101.104

VAR(26) South Korean Changes in Inventories with coefficient -0.149

VAR(16) EU Government Spending (absolute number) with coefficient 21.805

The model stands as follows:

BCI = -11814.638+ VAR(13)*165,029+VAR(08)*2477,310+VAR(06)*(-12,865)+VAR(17)*101,104 +VAR(26)*(0,149)+VAR(16)*21,805

Conclusions basis data analysis

The coefficient of China Industrial Output Variable is positive. It is absolutely logical basis the whole project, that when the industrial production increases, the demand for coal and iron ore increases (under ceteris paribus norm) and so the demand for capesize vessels increases. This gives to BCI an upward push. More specifically an increase of 1 point of this variable (1%), will cause an increase of 165,029 points of BCI (dependent variable).

The coefficient of the exchange rate euro to us dollar is positive. It is absolutely logical since the following chain regarding currencies is followed. The higher the euro as a currency the more competitive and more cheap the iron and coal becomes (since the international trading is conducted in us dollars) and the demand gets higher for iron ore and coal. Under ceteris paribus norm and so the demand for capesize vessels increases. This gives to BCI an upward push. The prices that this variable takes has 4 decimals. The most extreme change can take place only after the first decimal point, but for academic reasons we assume that if there is a pure 1 unit increase, then the BCI will increase by 2477,310.

The coefficient of the price of iron ore is negative. It is absolutely logical since the higher the price of iron ore the less the demand for it in the global markets. Under the ceteris paribus norm the less demand for capesize vessels will give a negative/downward push to BCI. More specifically in case there is a one point increase (one usd increase in the price) of the iron ore price, there will be a 12,8 point reduction of the BCI.

The coefficient of the European Union Construction Output is positive. It is absolutely logical basis the whole project, that when the construction increases, the demand for coal and iron ore increases (under ceteris paribus norm) and so the demand for capesize vessels increases. This gives to BCI an upward push. More specifically in case there is an increase of 1 point in this variable, there will be 101,104 points increase in the BCI.

The coefficient of South Korean Change in inventories is negative. Even if this variable has the slightest impact on the dependent variable the program that we analyzed the data when was programmed through step wise procedure to give us the optimum model, included this variable. When the inventories are reduced then under the ceteris paribus norm the demand for coal and iron ore increase due to the perspective that they will be replenished. This consequently leads to the increase of BCI. Exactly the opposite happens when we have an increase, which due to the minus in front of the coefficient the perspective of replenishment are fewer. In case there is an increase of 1 billion KRW, there is will be a reduction of the BCI of 0.149 points.

The coefficient of EU Government Spending is positive. It is absolutely logical. The more the EU spends, more income is available within the economy. This consequently leads to higher and stronger economic activity. This can trigger the demand for electronics, cars, constructions, and any area that can be directly related with the our two examined raw materials. It has a positive push to BCI always under the ceteris paribus norm. More specifically in case there is a 1 billion increase in EU government spending, there will be a 21,8 points increase in the BCI.

References

Accenture (2013), From Thermal Coal Production to Marketing and Trading, viewed 22 April, 2014

http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-Thermal-Coal-Production-Growth-Opportunity-Coal-Mining-Industry-Asia.pdf

ArcelorMittal (2013), ArcelorMittal Liberia ships 3 million tonnes of ore in 2013, on track for 4.5 million tonnes this year, viewed 27 April, 2014, http://corporate.arcelormittal.com/news-and-media/news/2013/aug/15-08-2013

Birol, F (2013), Coal's Role in the Global Energy Mix: Treading Water or Full Steam Ahead?, viewed 27 April, 2014

http://cornerstonemag.net/coals-role-in-the-global-energy-mix-treading-water-or-full-steam-ahead/

Bloomberg (2012), Economy of Scale? Not So Much for Vale SA's 400,000 DWT Super Ore Carrier, viewed 23 April, 2014 http://gcaptain.com/economy-scale-vale-sas-400000/

Bourke, G (2014), Slower demand growth, rising supply to drive base metals prices in 2014, viewed 27 April, 2014 http://www.bnamericas.com/news/metals/slower-demand-growth-rising-supply-to-drive-base-metals-prices-in-2014

BP (2013), BP Statistical Review of World Energy, viewed 27 April, 2014 http://www.bp.com/content/dam/bp/pdf/statistical-review/statistical_review_of_world_energy_2013.pdf

Caldecott, B, TIlbury, J & Ma, Y (2012), Stranded Down Under? Smith School of Enterprise and Environment, ISBN 978-0-9927618-0-6

China Daily (2014), Demand for iron ore and steel to rise in 2014, viewed 30 April, 2014 http://www.chinadaily.com.cn/business/Urbanization/2014-01/14/content_17237855.htm

CIBT (2014), viewed 30 April, 2014

http://www.cibt.co.id/operation

ClassNK (2009), Bulk Carrier, viewed 30 April, 2014 http://www.classnk.com/hp/pdf/publications/Publications_image/bulk_carrier_pamphlet.pdf

Coalswarm (2010), Exports and Imports, viewed 29 April, 2014

http://coalswarm.org/find-information/search-by-topic/exports-and-imports/

CRU (2014), Iron Ore Market Outlook, viewed 1 May, 2014 http://www.crugroup.com/market-analysis/products/IronOreMarketOutlook

Cullinance, K (2005), Shipping Economics, Elsevier Limited, UK

Daly, J (2013), China to Dominate the 2013 Coal Market http://oilprice.com/Energy/Coal/China-to-Dominate-the-2013-Coal-Market.html

Datamonitor (2013), Coal: Global Industry Guide, viewed 4 May, 2014

EIA (2013), The South China Sea is an important world energy trade route, viewed 5 May, 2014 http://www.eia.gov/todayinenergy/detail.cfm?id=10671

Economic Times (2013), India likely to be the largest coal importer in 3-5 years: Platts, viewed 28 April, 2014
http://articles.economictimes.indiatimes.com/2013-09-02/news/41689034_1_largest-importer-coal-rupee-volatility

Forbes (2014), The Latest Iron Ore Price Slump: Causes And Effects, viewed 27 April, 2014

http://www.forbes.com/sites/greatspeculations/2014/03/14/the-latest-iron-ore-price-slump-causes-and-effects/

Gandolphe, S (2011), Global Coal Trade: From Tightness to Oversupply, IFRI

Juan, D (2013), Steel scrap supply expected to ease iron ore consumption, viewed 28 April, 2014
http://www.chinadaily.com.cn/bizchina/2013-09/27/content_16998266.htm

Gilly, J &Drunen, E (2012), New Dry Bulk Shipping Services in an uncertain Economic Climate, viewed 2 May, 2014
http://www.ecorys.nl/contents/uploads/publicaties/11_1.pdf

International Energy Agency (2013), Medium-Term Coal Market Report 2013, viewed 1 May, 2014

IEA (2012), The Global Value of Coal, viewed 20 April, 2014
http://www.iea.org/publications/insights/insightpublications/global_value_of_coal.pdf

Juan, D (2013), China coal imports to continue affecting global prices: Platts, viewed 28 April, 2014
http://www.chinadaily.com.cn/business/2013-05/22/content_16518558.htm

Juan, D (2014), Brazilian iron ore imports at record, viewed 29 April, 2014
http://usa.chinadaily.com.cn/world/2014-01/27/content_17259987.htm

Kassembe, E & Gang, Z (2013), The Bulk Carrier Maximum Optimal Ship Size, International Journal of Business and Management, Vol. 8, No. 4

Kemp, J (2013), Is there any future for coal?, viewed 3 May, 2014 http://business.financialpost.com/2013/11/19/is-there-any-future-for-coal/?__lsa=7d36-92b0

King, H (2014), Iron Ore, viewed 25 April, 2014 http://geology.com/rocks/iron-ore.shtml

King, J (2014), Steel Plant Information, viewed 26 April, 2014 http://www.steelonthenet.com/plant.html

KPMG (2013), 2013 Energy Industry Outlook Survey, viewed 22 April, 2014 http://www.kpmg.com/ES/es/ActualidadyNovedades/ArticulosyPublicaciones/Documents/2013-Energy-Industry-Outlook-Survey.pdf

Lloyd's (2007), Bulk Carrier Focus, viewed 26 April, 2014, http://www.lr.org/Images/BulkCarrierFocus4_tcm155-175169.pdf

Livemint (2013), India's coal imports increase 48% in June, 28 April, 2014

http://www.livemint.com/Industry/Vgjj8qwwcALndjzgKaoLrL/Indias-coal-imports-increase-48-in-June.html

Lobello, C (2013), The world's top 7 coal countries: By the numbers, viewed 27 April, 2014

https://theweek.com/article/index/243765/the-worlds-top-7-coal-countries-by-the-numbers

Mining Technology (2014), Coal giants: the world's biggest coal producing countries, viewed 28 April, 2014 http://www.mining-technology.com/features/featurecoal-giants-the-worlds-biggest-coal-producing-countries-4186363/

Minerals (2014), Ports and Transport, viewed 30 April, 2014

http://www.minerals.org.au/resources/coal/exports/ports_and_transport

Myresources (2014), Coking coal: Key driver of the global economy

http://www.myresources.com.au/news/project-monitor/36-project-monitor/5773-coking-coal-key-driver-of-the-global-economy

Pfeifer, S (2013), Demand for coal will be driven by China and India, viewed 4 May, 2014

http://www.ft.com/intl/cms/s/0/a2325138-252e-11e3-b349-00144feab7de.html#axzz30wanxei4

Peabody Energy (2014), Sales and Trading, viewed 2 May, 2014

http://www.peabodyenergy.com/content/103/Sales-and-Trading

Platts (2011), China's Coal Market: Global Impact, viewed 24 April, 2014

http://www.platts.com/news-feature/2011/chinacoalimpact/importer

Port Technology (2014), Leading facilities for the Indonesian coal market, viewed 23 April, 2014

http://www.porttechnology.org/technical_papers/leading_facilities_for_the_indonesian_coal_market/#.U2WRVPmSxIE

Port Technology (2014), Krishnapatnam Port, the coal hub of India, viewed 3 May, 2014 http://www.porttechnology.org/images/uploads/technical_papers/Krishnapatnam_Port_-_the_coal_hub_of_India.pdf

Queensland Government (2010), Coal Plan 2030, viewed 2 May 2014

http://www.dlg.qld.gov.au/resources/plan/cg/coal-plan-2030.pdf

Rao, N (2013), A bright side to coal, 28 April, 2014

http://www.tata.co.in/article/inside/xF9G0HfZOK4=/TLYVr3YPkMU=

Reynolds, T & Dawson, V (2011),Iron Will: Cleveland-Cliffs and the Mining of Iron Ore, 1847-2006, Wayne State University Press

Reuters (2012), China overtakes Japan as world's top coal importer, viewed 26 April, 2014

http://www.reuters.com/article/2012/01/26/coal-china-japan-idUSL4E8CQ3GS20120126

Reuters (2012), FACTBOX-Top iron ore exporters, importers, viewed 26 April, 2014 http://in.reuters.com/article/2012/01/27/ironore-exporters-idINL3E8CK1WK20120127

Salva Report (2013), Indonesian Coal Exports – Half Year Summary https://salvareport.com/indonesian-coal-exports-half-year-summary/

Sreeja, V (2013), India Set to Surpass China as World's Largest Coal Importer For Use In Power Plants, viewed 25 April, 2014 http://www.ibtimes.com/india-set-surpass-china-worlds-largest-coal-importer-use-power-plants-1327117

Spinetto, J (2013), Vale Sees Iron-Ore Market Oversupplied From 2015 on New Capacity, viewed 25 April, 2014 http://www.bloomberg.com/news/2013-10-07/vale-sees-iron-ore-market-oversupplied-from-2015-on-new-capacity.html

Tan, F (2013), Coal to surpass oil as top global fuel by 2020: report, viewed 25 April, 2014

http://business.financialpost.com/2013/10/15/coal-to-surpass-oil-as-top-global-fuel-by-2020-report/?__lsa=d690-59dc

Team, T (2014), Vale Reports Heavy Net Loss On Tax Dispute Settlement, Iron Ore Production To Rise, viewed 30 April, 2014
http://www.forbes.com/sites/greatspeculations/2014/03/03/vale-reports-heavy-net-loss-on-tax-dispute-settlement-iron-ore-production-to-rise/

The Australian (2012), Iron ore's rocky ride set to continue, viewed 25 April, 2014
http://www.theaustralian.com.au/business/in-depth/iron-ores-rocky-ride-set-to-continue/story-fnfwwgy3-1226501651294#

The Jakarta Globe (2011), Indonesia to Lead Coal Export Growth Through 2020, viewed 22 April, 2014

http://www.thejakartaglobe.com/archive/indonesia-to-lead-coal-export-growth-through-2020/

Trading Economics Data-Time series viewed, 25 April 2014

http://www.tradingeconomics.com/china/industrial-production

http://www.tradingeconomics.com/china/leading-economic-index

http://www.tradingeconomics.com/euro-area/changes-in-inventories

http://www.tradingeconomics.com/euro-area/government-spending

http://www.tradingeconomics.com/euro-area/construction-output

http://www.tradingeconomics.com/euro-area/industrial-production

http://www.tradingeconomics.com/euro-area/zew-economic-sentiment-index http://www.tradingeconomics.com/india/industrial-production

http://www.tradingeconomics.com/south-korea/housing-index

http://www.tradingeconomics.com/south-korea/industrial-production

http://www.tradingeconomics.com/south-korea/manufacturing-production

http://www.tradingeconomics.com/south-korea/new-orders

http://www.tradingeconomics.com/south-korea/changes-in-inventories

http://www.tradingeconomics.com/taiwan/changes-in-inventories

Tu, K & Johnson-Reiser, S (2012), Understanding China's Rising Coal Imports, viewed 22 April, 2014

http://carnegieendowment.org/files/china_coal.pdf

USGS (2014), Iron Ore, viewed 26 April, 2014
http://minerals.usgs.gov/minerals/pubs/commodity/iron_ore/mcs-2014-feore.pdf

Visser, W (2012), Mining Week 12/'12: Australian tax passed, but BHP warns for demand, viewed 30 April, 2014
http://thebusinessofmining.com/2012/03/24/mining-week-1212-australian-tax-passed-but-bhp-warns-for-demand/

Vitol (2014), Trading Coal, viewed 3 May, 2014

http://www.vitol.com/coal.html

WorldCoal (2013), Coal Market and Transportaion, viewed 29 April, 2014

http://www.worldcoal.org/coal/market-amp-transportation/

Wulandri, F (2014), Indonesia Coal Output May Rise Even as Prices Decline, ICMA Says, viewed 23 April, 2014

http://www.bloomberg.com/news/2014-03-31/indonesia-coal-output-may-rise-even-as-prices-decline-icma-says.html

World Energy (2013), World Energy Resources, viewed 21 April, 2014

http://www.worldenergy.org/wp-content/uploads/2013/09/Complete_WER_2013_Survey.pdf

Xstrata (2014), viewed 4 May, 2014

http://www.xstratacoal.com/EN/AboutUs/Pages/default.aspx

Xinhua (2012), China major ports face coal oversupply, viewed 1 May, 2014

http://www.china.org.cn/business/2012-07/03/content_25792118.htm

Xinhua (2014), Imported iron ore stockpiles up in China, viewed 1 May, 2014
http://www.chinadaily.com.cn/business/2014-01/07/content_17221259.htm

Appendix

Please check following pages regarding the data.

Due to the lack of space please find in electronic form the data.