The Development of the Global Thermal Coal Market

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Declaration

I hereby certify that the work embodied in this dissertation project is the result of original research and has not been submitted for a higher degree to any other university or institution.

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16 April 2014
Acknowledgements

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List of Acronyms

API  All Publications Index
ARA  Amsterdam-Rotterdam-Antwerp
BJI  Barlow-Jonker Index
CET  Chubu Energy Trading
CHPP Coal Handling and Processing Plant
CIF  Cost, Insurance, Freight
CTCTC China Taiyuan Coal Transaction Centre
EEX  European Energy Exchange
FOB  Free on Board
GC  GlobalCOAL
HGI  Hardgrove Grindability Index
ICC  International Chamber of Commerce
ICE  Intercontinental Exchange
Incoterm ICC Terms
JSM  Japanese Steel Mills
JV  Joint venture
kcal/kg Kilocalories per kilogram
KEPCO Korean Electric Power Company
LTC Long-term contract
MCP Marginal cost of production
mmBtu Million British Thermal Units
Mt Million tonnes
Mtce Million tonnes of coal equivalent
Mtoe Million tonnes of oil equivalent
Mtpa Million tonnes per annum
MWh Megawatt hour
NEWC Newcastle coal index
NIE New Institutional Economics
NSW New South Wales
Nymex New York Mercantile Exchange
OECD Organisation for Economic Cooperation & Development
OPEC Organisation of the Petroleum Exporting Countries
OTC Over the counter
PRA Price reporting agency
RB Richards Bay
SCOITA Standard Coal Trading Agreement
SECA Standard Energy Coal Agreement
TCE Transaction Cost Economics
TEPCO Tokyo Electric Power Company
TFS Tradition Financial Services
VM Volatile Matter
Abstract

Despite their importance to the global economy, commodity markets have been the subject of limited research. In particular, the development of these markets has not been well-explored. Prior work by Roeber (1996) provides a model for how development occurred in the global oil and UK gas markets, which was applied by Li (2010) to the global thermal coal market. The recent development of the coal market, and its relative accessibility to the researcher, offers a unique opportunity to investigate market development using qualitative techniques, to generate insights into the phenomena which drive this process.

Transaction Cost Economics (TCE) is a school of economic thought that modifies neoclassical economic theory and suggests that costs to trading can be both large and meaningful; such costs include the costs of information (finding counterparties, market prices, etc), contract negotiation, monitoring and enforcement. TCE theory is used to modify the Roeber model and an alternative model is proposed which posits that transaction costs are the key drivers of commodity market development.

This model is investigated using a series of semi-structured interviews with physical coal market participants. All participants had a minimum of 20 years’ experience in physical coal marketing/trading and were well-known industry identities. Data generated by the interviews was subject to direct content analysis, which confirmed the validity of the TCE-adapted model. The model has implications for understanding the ways in which commodity markets develop and change with time, as well as the effects of policy and regulatory choices by governments.
Chapter 1: Introduction

1.0 Project Introduction

This project investigates the development of one of the world’s largest commodity markets, the global thermal coal market, in an attempt to better understand an underexplored phenomenon. By drawing on an empirical model and a well-developed body of theoretical literature (see Chapter 3), an adapted model is proposed which attempts to explain commodity market development through the lens of transaction costs. This model is subjected to testing through a series of semi-structured interviews with highly experienced coal market participants, who confirm the validity of the model for explaining the development of the coal market. The implications of this model are explored, with consequences for academic theory, industry practice and government policymaking identified and developed.

This introductory chapter provides an overview of the thesis. Section 1.1 considers some background information regarding the coal market. Section 1.2 explores the literature relevant to the project, the research questions and the project’s significance. Section 1.3 looks at the research methodology before Section 1.4 outlines the structure of the rest of this thesis.

1.1 Background

This research focusses on thermal coal, an opaque industry not well-understood by those outside of it (Kernot, 2000). Therefore a section of this chapter (and a chapter of the thesis) will focus on developing the reader’s awareness of key factors which distinguish coal from other markets and is needed to properly understand the context within which this market operates.

Thermal coal is a strategic resource for many countries, providing roughly one-third of the world’s energy supply and is projected to overtake oil as the world’s largest energy source before 2030 (BP, 2012). It is also extremely important to Australia as
a major source of export earnings (BREE, 2013) in addition to being a major contributor to regional economies; for example, of Newcastle and the Hunter Valley (HVRF, 2011). This future may depend on policy responses to problems such as climate change, but such matters are beyond the scope of this thesis. Despite its importance, there has been little research into the global thermal coal market and consequently little public or academic understanding; this may be partly explained by the industry’s reputation for inaccessibility by journalists and researchers, which has also been labelled as secrecy (Kernot, 2000).

Coal is formed through a geological process of prolonged exposure of vegetable matter to heat and pressure; the heterogeneity of minerals causes the resultant coal to be highly diverse with regard to its characteristics (Speight, 2005). Key characteristics include the amount of energy content contained within the product, the amount of inherent moisture, how combustible the material is, how difficult it is to crush (or grind) the material and the volume of other entities within the material, such as sulphur or phosphorus. This diversity makes it challenging to speak of a single market for coal, as there is essentially no homogenous product. This obstacle however has not prevented the standardisation of coal prices into indices for specific product grades (such as thermal coal, semi-soft coking coal, hard coking coal, etc). Increased product acceptability has reduced the challenge of this heterogeneity (Juniper, 1997), although this has not yet completely overcome the problem of asset specificity for producers and consumers.

Although coal is distributed widely around the planet, its accessibility and the cost-effectiveness with which it can be recovered and transported to combustion facilities has meant that the global market has been naturally divided into Atlantic and Pacific basins (Schernikau, 2010). Many of the barriers between markets have now been overcome and there appears to be a large degree of integration between the two (Warell, 2005). Some differences remain, particularly with regard to commercial practice: the Atlantic basin makes greater use of spot contracts and financial markets while the Pacific market makes greater use of long-term contracts with fixed pricing. This is changing (Schernikau, 2010) but it demonstrates that
divisions remain and the market is not yet completely global; caution must therefore be used in making statements about the global market which fail to consider the impact of local exceptions.

1.2 Literature Summary

This project relies on two major contributions to the scholarly literature: a model of commodity market development and the theory of transaction cost economics (TCE). This section will provide an overview of the academic literature regarding the development of the thermal coal market before considering market development and TCE theory.

The global thermal coal market has undergone enormous change in recent decades, transforming from a highly integrated industry, dominated by equity partnerships, joint ventures, and long-term contracts, to an industry which is now dominated by spot market transactions. This vertical disintegration has not previously been the subject of academic investigation and no evidence-based explanation appears to be available. Certain factors have emerged from the literature as being significant and may have played a causal role in the market’s development. These factors include the changing structure of the market, from a concentrated bilateral monopoly to a broadly competitive market (Ekawan & Duchene, 2006; Ekawan, Duchene, & Goetz, 2006); the increasing integration of two major region markets, the Atlantic basin and the Pacific basin, into a single global market (Li, Joyeux, & Ripple, 2010; Warell, 2006); and broadening technical requirements (West, 2011).

The only major work on the development of commodity markets was published by an industry professional (Roeber, 1996) following experience in the global oil and UK domestic natural gas markets; four common stages of market development were identified: physical balancing, in which a spot market first emerges from a vertically integrated industry; price transparency, the emergence first of price reports and later of reliable spot price indices; price feedback, as indices become used for setting prices within contracts; and financialisation, as firms transfer price risk to financial markets. Roeber’s work received little attention from researchers as
it was entirely derived from experience and had no obvious connection to economic theory. Some years later, this model of commodity market development was extended to the global thermal coal market by Li (2010), where it was found to accurately represent the market; the author concluded thermal coal had reached the final stage of development and was approaching maturity. As far as can be determined, no research has yet attempted to explain why the market developed in this way or what factors trigger a shift from one stage to the next, in coal or any other commodity market. This is the objective of this thesis.

Transaction Cost Economics (TCE) was a major theoretical development in economics which rejected the key assumptions of the dominant neoclassical school, with its idealised concept of almost frictionless exchange and symmetric information between buyers and sellers. In contrast, TCE has been able to make broad conclusions about the behaviour of economic agents and the structure of transactions (Macher, 2008). Neoclassical economics relies on three assumptions: the perfect rationality of economic agents (sometimes termed ‘hyperrationality’), perfect information of economic agents, and zero transaction costs. TCE, often nestled into the broader school of New Institutional Economics (NIE), rejects each of these and claims that economic agents are boundedly rational, that they lack perfect information and that transaction costs are both positive and meaningful to the development of markets (Williamson, 2009). These costs can occur at one of two levels: the level at which contractual relationships are structured (e.g. the costs of an integrated structure compared with a spot market structure) and the level at which resources are allocated (e.g. the cost of identifying counterparties and negotiating sales contracts).

At the structural level, TCE assumes that economic agents are boundedly rational, which leads to the conclusion that contracts for complex transactions are necessarily incomplete and prone to maladaptation or opportunism in unanticipated future circumstances. Such maladaptation presents the greatest risks when the transaction (or relationship) involves highly specific assets which cannot be easily redeployed should the relationship break down. Specific assets in the
context of the coal market may include coal mines which producing a particular quality coal or a power station designed to burn a particular quality coal. Agents are said to therefore select the governance structure which minimises the potential costs of maladaptation (‘transaction costs’). These structures may include a simple spot market contract, where the asset specificity is very low; hybrid structures, such as joint ventures or long-term contracts, where the asset specificity is somewhat greater; and vertical integration, where the risk of maladaptation is largest. In certain scenarios, transaction costs may be sufficiently high to deter any transaction from occurring or may lead to complete vertical integration (Williamson, 1981).

At the resource allocation level, transaction costs refer to the broad categories of information, negotiation and enforcement costs. These are the incurred costs of engaging in a transaction and can include costs such as identifying who is active in the market, learning the current market price, creating a contract and potentially going to the courts to ensure performance (Dahlman, 1979). Where these costs are greater than the benefits of a transaction, they may also prevent trade from occurring.

The literature on transaction costs broadly complements the Roeber model of commodity market development. The model notes the chronology of development without claiming any theoretical foundations. The TCE literature is able to account for individual changes in the market but no effort has previously been made to bring explanations for individual changes into a cohesive body of work. This is the literature gap at the heart of this thesis, which investigates whether a combination of both TCE with the Roeber model can account for the development of commodity markets.

1.2.1 Research Questions

The goal of this research is to fill the gap in the literature and determine whether a synthesis of the Roeber model with TCE might offer a fuller account of commodity market development than either is able to provide alone. Therefore, the research question is:
What factors were causally responsible for the development of the global thermal coal market?

Sub-questions have also been identified which were expected to provide valuable insights:

1. Do current theories, such as the Roeber model and TCE, adequately explain what has been observed?
2. If current theories are limited, how can they be improved?

These questions form the basis of the research project for this thesis.

1.2.2 Significance

The significance of this research for economic theory is that it linked microeconomic theory (transaction cost economics, or TCE) with an empirically derived model for the development of commodity markets (the Roeber model). By linking these two, the understanding of commodity market development has been improved and the tools of TCE can now be brought to bear on improving the understanding of specific phenomena in the commodities sector. Although more work needs to be done to ensure that this finding is robust and can account for all commodities, the groundwork has now been laid for these investigations to proceed. This work is also significant in that it appears to be the first time that research into coal markets has been conducted with direct access to coal market participants, instead of relying purely on statistical data.

The significance of this research for policymakers is that the development of commodity markets, and the role of participants within those markets, can now be better understood. This has the potential to lead to improved policy and regulatory outcomes.

The significance of this research for practitioners is that the development of similar markets (such as metallurgical coal) can now be better predicted and the role of market participants can now be accurately defined and modelled. The model offers an account of intermediary firms – particularly marketers, traders, brokers,
originators, financial exchanges and news reporting agencies – as transaction cost economisers, which appears to be novel. This also accounts for the existence of informal market practices, such as trust and relationships. Improved understanding of transaction costs and their applicability to commodity markets may lead to cooperative efforts to reduce such costs and improve the efficiency of commodity markets.

1.3 Method

This project has been undertaken with the paradigm of scientific realism, which accepts an external reality and affirms the view that research should strive to achieve true explanations of phenomena. A series of semi-structured interviews of coal marketers and traders were used to gather views regarding the development of the market. The data gathered in these interviews was then subjected to direct content analysis to deliver insights. This approach was limited by the number of participants and potentially by the motivations for their participation. The ethical implications of this project are believed to be minimal.

Scientific realism relies on ontological and methodological realism. Ontological realism affirms the view that there is an objective, external reality which has the potential to be known. It asserts that entities are both real and irreducible, and that causation is similar real and knowable. Methodological realism asserts that truth is the fundamental aim of science. The paradigm of scientific realism accepts that there is both an external, objective reality and that the goal of research is to discover and explain the truth of this reality (Maki, 2008).

Given the extensive range of private quantitative data required to answer the research question, much of which would be commercial-in-confidence or otherwise inaccessible to outside researchers, a qualitative approach was instead chosen, with primary data gathered directly from coal market participants. Market participants were identified through a public list of clients for a major coal-trading exchange (globalCOAL, 2013) and approached to participate individually in semi-structured interviews. Those without sufficient experience of physical coal markets were
excluded. Interviews were consensually recorded in the participant’s own office or a neutral location, and transcriptions were generated for data analysis.

The data was analysed using direct content analysis. Transcripts were reviewed and coded for factors identified from the literature and also for factors which emerged from the data. Coded data was extracted and re-coded to reflect the status of the factor (e.g. causal, consequential, etc). Data were then grouped to identify which factors appeared idiosyncratic and which reflected common experiences or views. Once the analysis was complete, data was shared with some participants for feedback on its validity.

The limitations of this approach to research primarily relate to participant selection and motivation. Participants had decades of experience in coal markets and many continued to occupy important positions in the industry; participatory self-selection may have introduced a bias. Those with limited experience – those who no longer participate in coal markets, or those who joined more recently – were excluded, which may also have introduced bias. This may have led to important insights being omitted from the data. The motivation of market participants may also limit the project as they were mostly active in the market and may have had commercial reasons for providing or not providing particular insights. The risks of either outcome are believed to be low, as the data used for this project reflected general views; idiosyncratic views were excluded or labelled appropriately.

The ethical implications of this project are minimal. All interviewees consented in advance to participation and were offered advance copies of the research instrument. Participants were provided with pseudonyms (e.g. ‘Coal Trader 1’) and transcriptions were de-identified prior to verification. Original recordings and other identifying material was destroyed as soon as was practical. Interviewees were able to veto the inclusion of any data which made it possible to identify participants or which may have compromised commercial confidentiality. Retained data will be retained on an encrypted hard drive in a secure facility at the University of Newcastle.
1.4 Outline of Dissertation

This dissertation proceeds in the following way. Chapter 2 provides background information on the coal market. Chapter 3 reviews the literature on commodity market development, coal markets, Transaction Cost Economics and related topics. Elements of the Roeber model and TCE are synthesised to create a model of commodity market development. Chapter 4 discusses the methodology and the chosen method for this research. Chapter 5 reviews the fieldwork data and investigates if the data validates the TCE-adapted model. Chapter 6 discusses the implications of the new model with regard to existing theory and industry practice before concluding.
Chapter 2: Background

2.0 Overview

This chapter will provide important background information on the global coal market which relate specifically to this project. The matters which are identified here are generally not well known outside of the industry and may be useful in understanding some topics which are covered later in this thesis. Crucially, the discussion will reveal a complex industry and indicate the historical and geographical conditions that have created the modern thermal coal market. Section 2.1 covers product factors, including the formation, mining and usage of coal. Section 2.2 covers coal geography and transportation. Section 2.3 covers market factors, including pricing, market participants and financial coal markets.

Although this section is referenced as thoroughly as possible, the limited amount of research which has been conducted into coal markets means that some claims are made without supporting evidence. They are supported by the author’s own experience and are included simply to improve understanding of the market.

2.1 Product Factors

Coal is an extremely heterogeneous product with complex quality characteristics, which influence its suitability for different end uses. This heterogeneity has traditionally made it difficult to speak of a single coal market and impeded the development of standardised grades and prices. This section will look at its formation, production and use, before reflecting on the environment impact that can result when coal is combusted for power generation. These issues are important background knowledge for understanding issues of asset specificity (the importance of which is discussed in Section 3.4) and how the market can be highly concentrated.

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1 The author has three years’ experience as an economist in the coal industry, performing commercial, logistical and market analysis. He has developed a training course and co-authored a book on the industry.
2.1.1 Coal Formation

Coal is the result of vegetable matter which has been buried – often in swampy conditions – and exposed to heat and pressure for millions of years. Over time, these two forces work to reduce the amount of moisture and leave a firm, rock-like product which can be combusted to create energy, and harnessed for a variety of uses (such as steel production and electricity generation). Depending on the power of these forces and the duration of exposure, coal can range from a soft, moist brown substance called peat to a harder, blacker product which we know as coal. Further pressure will refine the product into pure carbon – a diamond (Thomas, 2012).

Different qualities of coal have different uses and this affects their commercial value. Low-ranked coal – such as peat and brown coal (also known as lignite) – can be used for power generation but generates less energy per unit of weight than higher-ranked coals (that is to say, it is less efficient – more of the product must be combusted to generate the same amount of energy per unit of weight as other products). This limits its commercial value. Low rank coal also exhibits a tendency towards spontaneous combustion, which limits its transportability. While peat and lignite are commonly used by local communities for power generation, these factors mean that trade is limited.

Higher ranks of coal exhibit greater carbon levels per tonne, which mean the coal is able to generate greater energy in combustion and therefore has more value. Sub-bituminous and bituminous coals are black in colour and widely used for generating electricity and in the production of steel. There are no formal rules about which coal is used for each process – coal used for steel-making (‘coking’ or ‘metallurgical’ coal) can be used for power generation but higher prices mean it is generally uneconomic to do so; coal used for power generation (‘thermal’ or ‘steaming’ coal) can be used for steel production as long as it exhibits characteristics appropriate to a steel mill (Speight, 2005).
There are also products which rank higher than bituminous coal, such as anthracite (a lustrous black product which is commonly used as a domestic fuel, due to its very high energy content and lack of smoke in combustion) and graphite (such as that used in a pencil). These products have a wider range of uses than other ranks of coal and therefore comprise a separate market (Osbourne, 2012).

The geology of coalfields is such that layers of coal are interspersed with layers of rock and shale. A layer of coal is called a ‘coal seam’ and may be anywhere from several millimetres to several metres in thickness. Seams (or ‘bands’) may be hundreds of kilometres in length and vary in thickness, quality and depth. A surface mining operation may encounter more than a dozen separate layers of coal in a single location.

This demonstrates the significant heterogeneity which characterises coal and many other commodity products; this makes it difficult to create standardised grades or prices for the product, which itself impedes efficient trade. Technological progress is making this less of an issue, as modern combustion facilities are able to accommodate a broader range of product qualities (West, 2011).

Heterogeneity creates issues of asset specificity when particular qualities of coal can only be sourced from particular mine sites or can only be consumed by particular users; asset specificity is discussed further in Section 3.4.

2.1.2 Coal Mining

Although coal mining traditionally involved underground shafts and pick-axes, modern mining operations involve a greater amount of technology and are conducted on a far larger scale. Surface production operations (also called open-cut or strip mining) generally involve the removal of vegetation, dirt and layers of rock (broadly referred to as ‘overburden’) before the coal is simply dug up. Many operations use high explosives to relocate overburden or to partially fracture the coal seam, easing the recovery process. A high degree of precision is required for these operations to avoid relocating coal with the overburden and to prevent coal from fracturing to a size which is not economic to transport and sell.
Modern underground mining operations are conducted with continuous miners or longwall miners. Continuous miners are machines designed to dig in a narrow forwards direction; a large rotating drum on the front of the machine with a number of protrusions which resemble teeth or claws. These dig into the wall of coal, breaking it apart and feeding the product onto a conveyor belt, which carries it to the surface. Longwall miners are machines designed to dig in a broad horizontal direction; large drums shear back and forth along the coalface, pulling coal from the face onto conveyor systems, and the machine incrementally moves forwards. Longwall panels may be as much as a quarter-kilometre in width and several kilometres in length. The longwall approach is able to recover greater volumes of coal from a resource and can do so at much greater speeds; a continuous miner may be able to produce hundreds of tonnes per day while a longwall can produce more than ten thousand tonnes per day (Lien, 2012).

Following production, coal is commonly transported to a site where it can be resized, impurities can be removed and coals of different qualities can be separated. These sites have a variety of names, including coal handling and preparation plants (or CHPP), but the function is generally known as ‘coal processing’. Processing can also include blending operations, where different quality coals are mixed to achieve a desired output quality. Mining operations with multiple sites, or simultaneous recovery from multiple seams, have much more flexibility in the range of coal qualities available to their customers.

Clearly, mining operations require substantial physical and human capital to be operated effectively, capital which cannot be easily redeployed (Osbourne, 2012). This contributes to the issue of asset specificity which is discussed in Section 3.4.

2.1.3 Coal Usage

From the Industrial Revolution onwards, coal has been a major source of energy. Thermal coal is generally crushed (or pulverised) to a fine powder and introduced to the furnace of a boiler, where it is combusted. The heat generated during combustion is used to heat water which runs through the boiler in a series of pipes.
The water turns to steam and is pushed through pipes at high pressure to turn turbine blades. Large electromagnets attached to the turbine then convert the energy from the turbine into electricity.

Certain characteristics of coal can influence its effectiveness in the boiler, and therefore its usefulness (and value) to the end user (Speight, 2005). The most important of which are:

- Calorific value (a kilocalorie measurement of the energy which is contained within the product)
- Moisture content (a percentage measurement of the moisture within the coal, which impedes combustion)
- Volatile matter content (a percentage measurement which influences the ease with which the coal can be ignited)
- Sulphur content (a percentage measurement of the pollutant, emissions of which are strictly regulated in some jurisdictions)
- Hardgrove Grindability Index (HGI; an index value of how much force must be used to crush the coal)
- Ash residue (a percentage measurement of the waste product generated during combustion)

Boilers are built to process a particular range of qualities; this means that buyers are concerned about purchasing coal with qualities which are appropriate for their facilities. Even within the range of useable qualities, buyers may incur additional costs in use – for example, higher ash values lead to greater waste management expenses. There are therefore slightly different supply/demand balances for coals of different qualities, and different market prices for each.

Calorific value is the most important of these qualities as it determines how much product must be purchased to generate a particular amount of energy (Miller, 2012). A useful example here is the difference between Australian coal exports (with a typical gross calorific value between 5,500-6,500kcal/kg) and Indonesian exports (with a typical GCV of 3,800-4,200). If all other qualities were identical, 1.58
tonnes of Indonesian 3,800kcal/kg coal would be needed to generate the same energy as a single tonne of Australia 6000kcal coal. In an environment where the price of Australian coal is 1.6 times greater than Indonesian coal, buyers may be able to generate the same energy for less expense by swapping to larger quantities of the cheaper product.

As has been discussed in previous sections, product heterogeneity is a source of asset specificity issues and is also impediment to an efficient trading market.

2.2 Coal Geography

Although coal resources can be found in countries throughout the world, the economic geography is far more limited. International trade is typically limited to countries with easy access to export or import markets and the global market has been historically divided into two sub-markets (‘basins’). This section will consider the basins which exist, the major trading nations and the nature of coal transportation. These issues are important background knowledge for understanding issues of market concentration (the importance of which is discussed in Section 3.3).

2.2.1 Trading Basins

The global market for traded coal has historically been divided into the Atlantic and Pacific basins. The Atlantic market substantially pre-dates the Pacific and the market continues to be more mature, despite its smaller overall volume. Trade in the Atlantic is primarily exports from South Africa, the United States and Colombia heading into the major European ports of Amsterdam-Rotterdam-Antwerp (ARA), from which it is railed to coal-fired power stations throughout the continent (Ekawan & Duchene, 2006). The Pacific basin is principally supplied by Australia and Indonesia, which export into the East Asian markets of China, Japan, South Korea and Taiwan (Ekawan et al., 2006). Transportation costs are the main impediment to greater trade between markets, which are determined by the cost of chartering bulk cargo carriers and the sailing time between the geographical markets (Lundgren, 1996). This is an issue for the coal trade as the barriers between the
markets have impeded the development of an integrated global market; however these barriers appear to be falling and present less of an impediment than they once did (Warell, 2005). This issue is discussed more fully in Section 3.3.

2.2.2 Major Trading Nations

<table>
<thead>
<tr>
<th>Major Coal Producers</th>
<th>Major Coal Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>3650</td>
</tr>
<tr>
<td>China</td>
<td>1873</td>
</tr>
<tr>
<td>US</td>
<td>922</td>
</tr>
<tr>
<td>US</td>
<td>437</td>
</tr>
<tr>
<td>India</td>
<td>605</td>
</tr>
<tr>
<td>India</td>
<td>298</td>
</tr>
<tr>
<td>Australia</td>
<td>431</td>
</tr>
<tr>
<td>Japan</td>
<td>124</td>
</tr>
<tr>
<td>Indonesia</td>
<td>386</td>
</tr>
<tr>
<td>Russia</td>
<td>354</td>
</tr>
<tr>
<td>Russia</td>
<td>93</td>
</tr>
<tr>
<td>South Africa</td>
<td>260</td>
</tr>
<tr>
<td>South Korea</td>
<td>81</td>
</tr>
<tr>
<td>Germany</td>
<td>196</td>
</tr>
<tr>
<td>Germany</td>
<td>79</td>
</tr>
<tr>
<td>Poland</td>
<td>144</td>
</tr>
<tr>
<td>Poland</td>
<td>54</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>116</td>
</tr>
<tr>
<td>Indonesia</td>
<td>50</td>
</tr>
</tbody>
</table>

Mtpa\(^2\) 2012  Mtoe\(^3\) 2012

Table 1: Major coal producers and consumers (BP, 2012).

<table>
<thead>
<tr>
<th>Major Exporters</th>
<th>Major Importers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>146</td>
</tr>
<tr>
<td>Europe</td>
<td>154</td>
</tr>
<tr>
<td>Indonesia</td>
<td>276</td>
</tr>
<tr>
<td>China</td>
<td>137</td>
</tr>
<tr>
<td>Russia</td>
<td>81</td>
</tr>
<tr>
<td>Japan</td>
<td>106</td>
</tr>
<tr>
<td>Colombia</td>
<td>74</td>
</tr>
<tr>
<td>India</td>
<td>101</td>
</tr>
<tr>
<td>South Africa</td>
<td>63</td>
</tr>
<tr>
<td>South Korea</td>
<td>83</td>
</tr>
<tr>
<td>United States</td>
<td>59</td>
</tr>
<tr>
<td>Other</td>
<td>71</td>
</tr>
<tr>
<td>Other</td>
<td>26</td>
</tr>
<tr>
<td>Taiwan</td>
<td>62</td>
</tr>
<tr>
<td>China</td>
<td>6</td>
</tr>
<tr>
<td>Latin America</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>731</td>
</tr>
<tr>
<td>Total</td>
<td>731</td>
</tr>
</tbody>
</table>

Mtce\(^4\) 2013 (Forecast)  Mtce 2013 (Forecast)

Table 2: Major coal importers and exporters (OECD, 2013).

\(^2\) Million tonnes of coal per annum
\(^3\) Million tonnes of oil equivalent
\(^4\) Million tonnes of coal equivalent
2.2.3 Coal Transportation

While a substantial amount of the world’s coal is consumed in the same nation as it is produced, there is a large and growing international trade of thermal and metallurgical coal. For coal to be traded between nations, it requires overland or seaborne transportation channels. Typically this involves rail or barge transportation from inland mining operations to coastal (or off-shore) transhipment facilities. Bulk cargo carriers – which can carry between 10,000 and 400,000 tonnes of coal in a single shipment – move the product to destination ports, where barges or trains can shift it to the ultimate destination. Coal can also be trucked where alternatives are not available but this method has limited capacity and substantial variable costs (Zonailo, 2012).

Transportation costs are typically – although not exclusively – borne by the buyer. Coal traders generally relying on two of the International Commercial Terms set by the International Chamber of Commerce (ICC): FOB and CIF. FOB, or ‘Free on Board’, requires the seller to deliver the product on-board a vessel supplied by the buyer. The seller is only responsible for the costs of inland transportation and
transhipment; the buyer is responsible for chartering an appropriate vessel (which must be acceptable to both the loading and discharge ports) and meeting the costs of seaborne transportation and insurance. Alternatively, CIF, or ‘Cost, Insurance and Freight’, terms require the seller to charter and insure an appropriate vessel and deliver the cargo to the discharge port. The key difference here is that under FOB terms, the buyer pays for carriage while the seller pays under CIF (Steyn, 2009).

Another element of transportation costs is that of despatch-demurrage. Within the contracts for most vessel charters is an allowance for the amount of time the vessel will spending waiting off the port, loading or discharging the cargo, and departing the port. This time varies depending on the amount of cargo to be loaded and the vessel’s capabilities. If the vessel is able to dwell for less time than has been allowed, the vessel charterer is entitled to a rebate from the vessel owner (as the vessel will be used for less time than has been agreed); this rebate is known as despatch. Alternatively, if the ship remains at the port for more time than is allowed, the charterer must pay a penalty to the vessel owner; this penalty is known as demurrage. Due to the congestion of some coal ports – particularly in Australia – demurrage costs represent a significant additional expense. Demurrage rates are reflective of market charter rates; in June 2008, as Capesize\(^5\) charter rates hit an all-time high of $233,988 per day, demurrage rates at the Port of Newcastle easily exceeded $100,000 per day\(^6\). Buyers operating under FOB terms typically protect themselves from such payments by having back-to-back contracts with the vessel owner and the coal seller\(^7\); in this way, the cost of demurrage is ultimately borne by the coal producer (Singh, 2012). A similar dynamic can be observed at loading ports.

Atlantic market transactions also take place with DES terms, or ‘Delivery Ex-Ship’, which is an extension of CIF. CIF terms require the cargo to be delivered aboard a

\(^{5}\) Capesize is one of the three main vessel sizes used for transporting bulk commodities such as coal, iron ore and grain. Handysize vessels have a typical deadweight tonnage (DWT) of around 35,000 tonnes; Panamax vessels have an average of 75,000 tonnes; and Capsize vessels an average of 160,000 tonnes.


\(^{7}\) Back-to-back contracts are those where the buyer has identical contract clauses with the vessel owner and coal seller so that penalty payments may be passed on from the shipowner to the coal producer, without harming the coal buyer.
vessel which must dock at the buyer’s terminal, whereupon the buyer is responsible for the discharge operations. DES terms require the seller to discharge the cargo before the buyer can take delivery.

Understanding delivery terms is critical to understanding the risks which face buyers and sellers and where opportunism can potentially emerge. The issue of opportunism is discussed in Chapter 3.

2.3 Market Factors

This section considers some unique factors within the global coal market: a large, complex and often secretive network of buyers, sellers and traders. Major supply and demand factors are considered, contracting and pricing arrangements are discussed, key types of participant are identified and coal-specific financial products are explained.

2.3.1 Coal Pricing

Coal is traded in two main ways: through spot market transactions and long-term contracts. The following paragraphs describe the nature of these trades.

Long-term contracts (LTCs) are an ongoing relationship between two parties for multiple coal cargoes over an extended period. Historically, LTCs have been executed for periods of ten or twenty years – sometimes for the entire life of a mine – but when the risk of opportunism, such contracts can be regarded as inflexible and inefficient (Joskow, 1990). The duration of modern contracts varies with geography; Atlantic LTCs are typically only 1-2 years in length while 2-5 years is still common in the Pacific market. Although contracts may be of shorter duration, this does not mean that long-term relationships are less common; it is common in the Pacific market for buyers to have an equity stake in the producer’s organisation (or the mine business itself), which binds the two parties together. Shorter contracts enables each party to regularly renegotiate key terms and restructure the agreement to fit the prevailing market environment (Joskow, 1990).
For many producers and end users, these contracts form the commercial basis for their operations. New mining operations may need to execute such contracts with buyers before it is possible to acquire financing for the mine’s development.

Prices within LTCs are either partly or wholly negotiated and are fixed for a set period, such as 12 months, which gives both parties some certainty about upcoming expenditure/income. Although fully fixed prices was the standard approach in the Pacific market for decades (less so in the Atlantic), index-based pricing is becoming more common. Some contracts feature a price which is partly (e.g. 50%) negotiated and partly based on the price index on the day of delivery. Contracts may be arranged years in advance of expected delivery; these forward contracts may use fixed or floating prices, and are often used to provide a buyer (seller) with security of supply (demand) (Joskow, 1988).

As opposed to LTCs, spot market transactions are one-off deals for short-term delivery. Although this term is widely used in other resource markets to mean immediate delivery, the natural challenges of bulk commodities mean that delivery can take place during the next quarter (‘prompt’) and still be regarded as a spot cargo. Spot transactions are a useful way for producers to shift surplus or non-standard (‘off-spec’) production; similarly, it is useful for end users to purchase additional stock to cope with a peak in demand, without having to commit to a long-term contract (Schernikau, 2010).

Spot transactions can be executed with negotiated or index-linked pricing and such transactions are often incorporated into the indices for major ports (such as Richards Bay, South Africa). Indices are published as a record of the price and quantity of a particular specification of coal transacted on the spot market during a specific period. This information is used by market participants to assess the market value for the product, and is used for forecasts and in price negotiations. Spot transactions can be conducted over-the-counter (‘OTC’) or via an online trading platform (such as GlobalCOAL) (Steyn & Minnitt, 2010).
These contractual arrangements are central to the issues raised in Section 3.4 regarding governance structures (markets, hierarchies and hybrids).

**Figure 2** Fixed and Spot Coal Prices, 1987-2013 *(Japan price: BP, 2013; Newcastle price: IMF, 2013)*

### 2.3.2 Market Participants

**Producers**

Producers are organisations which engage in mining, processing and marketing of coal. Major global producers are often specialised, government-owned or -sponsored enterprises (such as the Shenhua Group, the largest coal miner in China), or integrated resources companies which are typically publicly listed and diversified across a range of commodities and geographies. For example, Glencore-Xstrata, the world's largest coal exporters, has invested in copper, nickel, zinc, aluminium, iron ore, oil, grains, cotton, sugar and coal, and has coal operations in Australia, Canada, Colombia and South Africa*. These organisations are responsible for mine development, production and coal marketing (selling to coal buyers, whether they be end users or traders) operations.


**End Users**
End users within the thermal coal market are largely the power generation utilities which convert the coal to electricity for sale into domestic, residential and industrial markets. These organisations are responsible for coal origination (sourcing of fuel supplies) and are generally located close to coal import terminals or have access to rail transportation facilities.

Utilities in some countries are still owned by government, and many private and public utilities must work around systems of regulated electricity prices. Participating in a global market of free-floating prices therefore presents challenges to firms which are expected to turn a profit, but are unable to control the price of inputs or outputs. Many utilities continue to have long-term arrangements with particular sellers of coal, a relationship which may be formally organised through a long-term contract or an equity stake by the utility in the mine or producer.

There are also a range of industrial firms (such as cement manufacturers) which purchase and consume coal. Even in aggregate, the impact of this category of buyers is too small to have a notable impact on market dynamics.

**Traders**

Traders are middlemen who intermediate between producers and end users; these firms range from small, sole-trader operations to multinational, publicly-listed corporations with equity stakes in production, transportation and generation assets. Traders rely on superior market information to identify and take advantage of arbitrage opportunities, such as price discrepancies between geographical regions (Kernot, 2000).

These organisations provide vital services to the thermal coal market by developing new markets (such as the burgeoning Newcastle-Mexico coal trade), bulk-breaking (creating export cargoes from a range of small domestic producers, or vice-versa for small consumers), improving price discovery, and – arguably the most important service – arbitrage and speculation. By buying in areas of relative abundance (as

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9 Arbitrage is the act of simultaneously buying a product and selling it (often in another location at a higher price) to achieve a risk-free profit. Speculation is the act of buying without a prearranged sale to potentially profit from changing prices.
signalled by low prices) and selling into areas of relative scarcity (as signalled by high prices), traders are ensuring that resources are efficiently allocated to wherever demand is greatest, and receive a profit for performing this service. These firms perform an important function which improves the overall welfare of society.

2.3.3 Financial Coal

Financial (or ‘paper’) coal refers to financial derivative products are contracts between financial traders and derive their value from an underlying asset or event, such as an index tracking the value of a commodity or the weather on a certain day. These products are useful to physical commodity market participants as they allow for particular financial risks to be isolated and managed (‘hedged’). They also enable financial investors to gain exposure to commodity markets without being exposed to firm-specific (or ‘idiosyncratic’) risks or having to take physical possession of the product.

Participants within financialised commodity markets can be broadly divided into two groups: hedgers, who are participating in the market to reduce their risk exposure, and speculators, who are participating in the market to increase their risk exposure in the hopes of gaining excess returns. This distinction is not absolute – physical traders may engage in some trades to limit their exposure to particular risks while engaging in other trades to amplify alternative risks.

The process of developing financial markets is the fourth stage of Roeber’s (1996) framework of commodity market development; its role is discussed in detail in Section 3.1. This section provides detail about the financial products which are used.

Futures

A futures contract is broadly similar to a forward contract in that an investor will buy the contract at a particular price today for delivery at a specific future date – but whereas a forward contract will settle with the delivery of the commodity, a futures contract settles in cash. The amount of cash is equal to the spot price of the
commodity on the settlement date. Producers with exposure to changing spot prices are able to eliminate this risk by taking an offsetting position in the futures market. In this way, floating prices are effectively transformed into fixed prices (Hieronymous, 1971). Futures are standardised contracts which are only available through a financial exchange (such as the Intercontinental Exchange (ICE), the New York Mercantile Exchange or the European Energy Exchange).

Swaps

Swaps are a derivative product that enables a party to exchange a floating price liability for a fixed price one, such as exchanging a future commitment to buy (sell) coal at the spot price for a predetermined spot price. Swaps can be standardised products which trade on exchanges or they can be custom-made and trade over-the-counter (OTC), to accommodate multiple shipments with a range of delivery dates. Physical market participants are able to use these products to lock in a price and therefore hedge the risk of a movement against them. These contracts allow physical market participants to enjoy the benefits of a floating price market without the consequent exposure to uncertain future cashflows (Geman, 2008).

Options

Options are a financial contract that gives the option-holder the right to buy (or sell) the commodity at (or before) a fixed future date for a predetermined price. A call option gives the holder the right to buy and a put option gives the holder the right to sell. This gives the holder a form of insurance against extreme changes in price and enable the option seller to speculate on the likelihood of particular price movements. Option combinations enable parties to profit from a variety of market scenarios, including when prices remain stable, when prices rise or fall, and when volatility rises or falls (Geman, 2008). Depending on the commodity, these may be traded through an exchange or OTC. Coal options are relatively rare compared with futures and swaps and are more common in the European and US domestic markets.

Forward Curve
Rather than an exchange-traded product, the Forward Curve could more accurately be described as a by-product of exchange-traded contracts. The information generated by prices at a range of future dates can be used by physical market participants to better understand the future supply/demand balance within the market – for example, when futures prices are greater than the expected spot price for the same date, the market is said to be in ‘contango’, which may suggest scarcity in the future relative to the present. In this situation, physical market participants may interpret the higher future prices as a signal to store the commodity rather than sell or consume it, and benefit from higher future prices (temporal arbitrage) (Routledge, 2000). A contango can be seen on the right-hand side of the example forward curve graph.

Contrarily, expected future spot prices may be higher than futures pricing, a condition known as ‘normal backwardation’. This may suggest that the future is oversupplied relative to the present, and prices are likely to fall. Commodity buyers may use these price signals to defer any unnecessary purchases until prices fall, shifting consumption from a time period of relative scarcity to one of relative abundance (Routledge, 2000). The left hand side of the below graph shows some backwardation between June 2013 and Q1 2014.

![Figure 3 Forward curve illustration. Author’s own creation using fictional data.](image_url)
2.4 Conclusion

This chapter has provided important background on the global thermal coal market. Section 2.1 considered product factors which account for the highly specific nature of coal production and consumption assets. Section 2.2 considered the geography of the global market and this may lead to problems of market concentration despite a competitive structure globally. Section 2.3 considered particular factors relevant to the structure of coal transactions.
Chapter 3: Literature Review

3.0 Overview

As outlined in the first chapter, this project seeks to improve understanding of the causal factors involved with commodity market development. This chapter will explore the relevant literature and synthesise a model of market development: Sections 1 and 2 consider the existing literature on commodity and coal market development; Section 3 looks at factors which appear to correlate with the development of the coal market and Section 4 investigates Transaction Cost Economics. Section 5 explores the research gaps identified in this review and concludes with the research questions for this project.

3.1 Commodity Market Development

This section will review the relevant literature regarding the development of commodity markets in general and thermal coal markets in particular.

3.1.1 Model of Commodity Market Development

Although a lot of research has been conducted into commodity markets, this research has largely focused on the financial, social and environmental effects of the commodity trade or towards explaining the cyclicality of resource markets, such as Radetzki (2006). Comparatively little work has been done in understanding the ways in which these markets change over time or what has been driving such changes.

An important exception to this rule is (Roeber, 1996), who drew on empirical work in the UK oil and gas industries to identify four key stages of commodity market development. The stages were identified as:

1. Physical balancing
2. Price transparency
3. Price feedback
4. Financialisation
Although commodities have enormous underlying differences, Roeber notes that mature commodity markets have exhibited significant similarities in their development. These stages appear to be independent of market cycles. Each stage will now be considered in detail.

*Physical Balancing*

Historically, large-scale resource production (or consumption) operations have been developed within the framework of long-term contracts, giving an assurance of purchase (or supply) which is necessary to achieve financial support for the project (Crocker & Masten, 1991; Takeuchi, 1990). This creates stability with regard to price and output, but can create challenges when markets must respond to shocks (Rogers & Robertson, 1987).

The relationship between the two parties is such that production and consumption schedules must closely align to avoid either firm experiencing an inventory surplus (deficit). Large-scale industrial processes retain an element of stochasticity which can result in schedule misalignment, forcing one firm to sell (purchase) surplus stock at market prices to balance the misaligned schedules. This is the birth of the commodity’s spot market.

*Price Transparency*

Growing spot markets leads to a problem of information asymmetry, where frequent traders have better information about the depth and liquidity within the market and the market value of the commodity. This disadvantages infrequent traders – especially those for whom trade is mainly conducted through long-term, fixed-price contracts – and incentivises the creation of price reporting agencies (PRAs) (Verleger, 1988). These agencies report prices informally (typically reporting price, quantity and quality for each available spot transactions) or formally (through an index with a standardised quality at a particular location). Indices can reflect spot prices (transactions for immediate delivery), prompt prices (transactions for delivery in the next quarter) or forward prices (transactions for delivery at a set future date). Improving reliability of indices can support a virtuous cycle, where
price transparency leads to enhanced liquidity, which leads to better price information and greater reliability (Steyn & Minnitt, 2010).

The value of transparent prices in reducing asymmetry, and their importance for financialised markets, has been widely noted, for example (Hieronymous, 1971). An interesting recent study identified that transparent prices not only allows the asymmetry to be reduced but does, in fact, improve market efficiency and resource allocation Mandelson & Tunca (2007). Campbell, Orskaug & Williams (2006) raise the problem of ‘incomplete’ markets, where reliable price indices are not universally available, and highlight the effects that this can have on uncertainty and hedging decisions.

**Price Feedback**

As price reports (particularly indices) become accepted as an accurate indicator of market value, spot market participants may find it more efficient to rely on an index for price decisions than to achieve them through negotiation. Some traders – particularly infrequent traders who remain disadvantaged by information asymmetry – will begin using spot price indices for contracts in lieu of negotiated prices (Takeuchi, 1990).

This stage also marks a shift away from long-term contracts, which typically rely on fixed prices, and towards spot contracts. Polinsky (1987) identified relative uncertainties and risk aversion as being central to this shift at the firm level; while spot contracts increase the risks associated with valuation uncertainties, they decrease the risks associated with supply/demand uncertainty. Other research has found that LTCs inhibit market adjustment, and the shift to spot creates greater efficiency (Rogers & Robertson, 1987).

Roeber (1994) notes that this shift is more important than that of structural changes in the market – which have been observed concurrently with this development in each of the major energy commodity markets, including oil (Roeber, 1994), gas (Roeber, 1996) and coal (Li, 2010) – as it marks the emergence of new institutions which replace, rather than complement, existing institutions.
Financialisation

Financialisation is the growing use of financial products (‘derivatives’) to manage risk of uncertain future cash flows which result from spot prices (Roeber, 1996). Common derivatives include futures contracts, swaps and options. Futures contracts enable investors to speculate or hedge future prices (without necessarily incurring a position in the physical market); swaps are essentially a staggered series of futures contracts (e.g. a combination of six-month, 12-month, 18-month and 24-month futures contracts); and options allow investors to enjoy the right (but not the obligation) to buy or sell at a predetermined price at a specified future date (Geman, 2005).

Financial commodity markets typically entail two broad groups: hedgers, physical market participants who are looking to offset the risk of floating prices; and speculators, financial investors seeking to gain exposure to commodity markets. Financial investors appear to be drawn by the benefits of diversification, especially prior to the Global Financial Crisis, and by the desire for yield, especially as monetary stimulus in key states has led to low returns (Basu & Gavin, 2010). Profits are generated through risk absorption or superior information (Dewally, Ederington, & Fernando, 2011). Recent research suggests that financial markets can influence the underlying (physical) market, with some papers suggesting that the behaviour and strategies of physical participants becomes more like financial participants (Domanski & Heath, 2007; Muermann & Shore, 2005).

The existing literature on the drivers of financialisation have focused on explaining recent growth rather than the emergence of the phenomenon. The behaviour of physical market participants and financial investors is particularly relevant. In general, physical participants act to hedge while financial investors act to speculate (although these distinctions are far from fixed).

Studying the profits of commodity traders, Dewally et al. (2011) found significant evidence that trader profits were maximised when taking positions which contrasted the aggregate position of hedgers. This suggests that hedging remains
the primary activity of commodity markets despite the involvement of speculators and financial investors.

Other research (Basu & Gavin, 2010; Domanski & Heath, 2007; Falkowski, 2011) identified that the growth of financial commodity markets can be partly explained by investors using commodity investments (particularly commodity futures contracts) to diversify their asset holdings and reduce overall portfolio risk; behaviour which intensified during periods of low interest rates. Decisions about investment allocation between asset classes appears to have explanatory power for the overall level of investment within a market and appears to be driving increased integration between commodities and other financial markets – that is to say, the factors driving financial markets (such as interest rates, exchange rates, etc) are now driving commodity markets as well. This does not appear to drive prices away from equilibrium but does appear to reduce the cost of hedging and the level of price volatility (Irwin & Sanders, 2012).

Financialisation provides a key benefit in improving price discovery in the physical market. The theoretical relationship between prices in the physical and financial markets (specifically futures) is anchored by price convergence at the time of settlement. The difference in prices can be generally explained with reference to time (opportunity costs), storage costs, and the convenience yield (the benefits associated with physical ownership of the commodity). If prices were to diverge from this relationship, it would present an arbitrage opportunity for investors (Geman, 2008).

Despite this, prices increased greatly across commodity markets in the 2000s, in the same period as many commodities experienced financialisation. This led some to suggest speculators were driving prices away from equilibrium and the no-arbitrage relationship had broken down, and a considerable research effort was undertaken. A United Nations report identified fundamental drivers (such as the growth and urbanisation of developing nations) but said the key driver was in fact financialisation and speculative investment, leading to price bubbles and wild price swings (United Nations Conference on Trade and Development, 2011). This
contrasted with a range of apolitical research which found that fundamental factors were much more important (Dwyer, Holloway, & Wright, 2012), that the evidence for the speculation hypothesis was weak (Irwin & Sanders, 2012) and that causality was in fact reversed in soft agricultural markets (Capelle-Blancard, 2011).

Understanding the true behaviour of futures markets is important in explaining whether these markets are providing reliable signals to physical market participants about future price directions. If the signals are reliable, futures markets provide a socially useful function which may explain their emergence; if the signals are flawed or unreliable, they will lead to resource misallocation.

Another benefit of financialisation is that financial markets provide improved information on future prices. The forward curve is a representation of futures prices for a particular commodity. Commodity futures prices are typically backwardated, a condition where the spot price (immediate delivery) exceeds the futures price (delayed delivery). A large convenience yield – the flow of benefits from owning the commodity – leads to greater discounts in futures pricing.

Physical participants rely on forecasts of future prices in making future production and storage decisions; this can be done formally (as when futures contracts are used to lock in future sales, and used as the basis for obtaining capital investment) or informally (such as when futures prices are used when conducting a cost-benefit analysis for production decisions). Having reliable future price information gives producers more accurate information about future demand and can help to allocate resources efficiently – a function for which futures markets are able to provide highly reliable data.

However the utility of this data is affected by the precision of information regarding the size of the convenience yield (an underestimate would tend to overestimate real future prices) and the size of inventories. Spot and futures price volatility is central to both of these, as heightened volatility leads to greater demand for storage and higher yields (Pindyck, 2004; Routledge, 2000). Greater levels of futures
market activity by financial investors appear to result in reduced volatility and thus improve the precision of price forecasts (Bohl, 2013).

3.2 Coal Market Development

Li (2010) investigated the international thermal coal market and found that its evolution closely paralleled Roeber’s stages of development. The study concluded that the market was presently in the final stage of development (financialisation) and was approaching maturity. This section examines the events at each stage of development and considers the causes and implications, as well as highlighting related factors.

**Physical Balancing**

Fitting with the first stage of Roeber’s model, early research into the coal trade between the two major trading countries of the 1970s-1990s, Australia and Japan, has shown that there was a high degree of cooperation and interaction between coal producers and consumers (Anderson, 1987). Efforts were made to closely integrate companies and to ensure that production and consumption schedules were closely aligned; long-term contracts (LTCs) were routinely signed for periods as long as 20 years or the entire life of a particular mine. These arrangements appear to exist to protect against opportunism (especially with the enormous capital costs of mine development) and guarantee sellers access to markets (Tang, 1993). Prices were open to regular (typically annual) renegotiations, with the largest producer (BHP for many years) negotiating directly with the largest buyer (typically the Japanese Steel Mills consortium, or JSM) to set a benchmark price for the Asia-Pacific market (Colley, 1998). A study of this price system in the domestic US coal market found that prices generally tracked prevailing market conditions and disparities with spot prices were only 10-15% on average (Joskow, 1988). It is difficult to say whether this reflects the situation in the Asia-Pacific market as there were no reliable price indices operating in the 1970s and 80s. Although LTCs were highly detailed and specific, they were not generally enforced as much as was possible; the lack of alternative counterparties meant maintaining a positive
relationship was vital for trade (Joskow, 1987). To cement the relationship, Japanese buyers went further and routinely took an equity position in their long-term partners – though it is debatable whether this was to build relationships or provide buyers with access to inside information (Colley, 1997). An alternative view is simply that enforcing contracts internationally is difficult and costly, and that integration is a cost-effective method of managing this challenge, especially when the coal trade is of a large scale (Vogelsang, 1979).

There is dispute about whether the market structure of buying and selling arrangements (bilateral oligopoly) produced excess benefits for cartelised Japanese buyers at the expense of major producers (Anderson, 1987; Dowling, 1987; Koerner, 1993). Although earlier modelling had demonstrated the alternative market structure (bilateral monopoly) was likely to produce a less efficient outcome (Smith, 1977), it was clear that certain parties remained dissatisfied with the system and were open to considering alternatives.

Price Transparency

The transition from LTCs with fixed prices towards spot contracts was gradual and began in the Atlantic basin. This process appears to have started with a limited number of 12-month (multiple cargo) contracts in the 1980s before progressing to a flow of spot (single cargo) contracts. A recent study found that spot deals in the Atlantic increased from 14% of all trades in 1983 to 80% in 2003 (Ekawan & Duchene, 2006). LTCs were still common in the Pacific basin in the 1990s but were beginning to face serious competition from spot contracts by the late 1990s and are believed to account for only a small number of residual contracts today (Ekawan et al., 2006; Warell, 2005).

The central driver of this transformation is not certain. Misalignment between production/consumption schedules appears to have been a major factor, pushing producers and consumers into the market; rising production costs, the reduction of trade barriers and falling seaborne transportation costs also led to changes in market structure, as more nations shifted from domestic production to
international trade (Ekawan & Duchene, 2006; Lundgren, 1996; Steenblik, 1990). This increase in the size of the market may have reduced the need for long-term contracts and close relationships, allowing an efficient spot market to emerge.

An earlier study of fixed and floating-price contracts found that preferences could be explained largely by the risk aversion of each party and the size of uncertainties associated with demand and supply (Polinsky, 1987). For a producer, a larger number of potential buyers reduces demand uncertainty and therefore the importance of LTCs; for a consumer, a larger number of sellers reduces supply uncertainty. Spot contracts also allow for diversification away from a single major buyer or seller, and allow for easier production/consumption scheduling variation (Roeber, 1996). However this may also have made it more difficult for some parties to access capital financing.

The most important implication of the market transformation was the emergence of floating prices, which began to be publicly reported by agencies like Argus\textsuperscript{10}, McCloskey\textsuperscript{11} and Barlow-Jonker\textsuperscript{12}. Previously, negotiations were informed by models based on data gathered from company and government reports. These estimates of the global supply-demand balance were the only information available to guide negotiators, which led to fixed price agreements that may not necessarily reflect the true market value of coal (Steyn & Minnitt, 2010). Floating prices provided information to the market about the types of transactions which were occurring, the prices and delivery periods, and improved understanding about the underlying market value.

One of the important consequences of this was increased pressure on major producers – previously protected by LTCs from strong market competition – to cut costs and become more efficient in production (Barnett, 1994; Steyn & Minnitt, 2010). This lead to the closure of some producers (including the entire Canadian coal export industry) but the expansion of others, as lower-cost producers were

\begin{itemize}
\item \textsuperscript{10} Argus Media: \texttt{http://www.argusmedia.com}
\item \textsuperscript{11} McCloskey Coal: \texttt{http://www.mccloskeycoal.com}
\item \textsuperscript{12} Barlow-Jonker, now part of WoodMackenze: \texttt{http://woodmac.com/}
\end{itemize}
able to capture greater market share and move towards economies of scale (Ekawan et al, 2006).

**Price Feedback**

The use of spot contracts led to the emergence of price reports within the coal market; as these contracts became more commonly used, price reporting became more regular and standardised until particular price indices appeared. These were a regular record of the selling price for a particular quality and quantity of coal, at a particular location, and enabled participants to track the market value of the product over time. Early international reporting focussed on the price of South African and US exports before spreading to the Pacific market, in the form of Australian export prices, and to European import prices (Ekawan et al., 2006; Steyn & Minnitt, 2010). Notable coal indices included the Argus-McCloskey’s API #2 (South Africa) and API #4 (Europe), Barlow-Jonker Indicator, and in recent years, the globalCOAL Newcastle index.

As reliable price reporting became common for particular major trading locations, and was accepted by market participants as genuinely reflecting market value, spot contracts increasingly used index values as a substitute for price negotiation. This appeared to be of most use for forward contracts, where negotiations about future prices could be superseded by using the actual market value on the day of delivery. This did however have the effect of creating uncertainty for both parties about their likely revenue/expenditure. Liberalisation of electricity markets allowed some coal-consuming power generators to pass on the cost uncertainty to end users, but this does not appear to have been common (Joskow, 2007).

Overall, the use of spot prices appears to have increased the competitiveness and the efficiency of global coal markets.

**Financialisation**
The final stage of Roeber’s model is the emergence of financial products for managing price uncertainties. The use of spot prices in contracts for future deliveries led to uncertainty regarding future prices and this uncertainty fuelled the growth of the over-the-counter (OTC) coal swaps market. Swaps are a financial product offered by banks and other institutions, in which the floating price of a future cargo can be ‘swapped’ for a fixed price, which is agreed today. The swap eliminates the price uncertainty of spot market transactions (Steyn, 2009). These first emerged in the Atlantic market (likely due to the earlier transformation to spot contracts) in the 1990s but are now firmly established in the Pacific as well (Ekawan et al., 2006). Despite the advantages of using swaps, they also create counterparty risks – if the financial institution defaults, the price uncertainty has not been eliminated at all. The risk of this may be small but means price risk is not entirely eliminated through swaps.

In the early 2000s, globalCOAL emerged as an online exchange where coal could be traded through major hubs including Amsterdam-Rotterdam-Antwerp (known as ARA; north-western Europe), Richards Bay (South Africa) and later Newcastle (Australia). Although globalCOAL was not the first attempt to launch a central trading venue for international coal markets but is the only one which has survived; no evidence appears to exist to explain why this may be so. At any rate, the platform’s success vastly reduced the transaction costs associated with trading coal, as it was then possible to buy or sell the commodity without deploying a traditional marketing or origination team (Ekawan & Duchene, 2006). In 2008, globalCOAL (in conjunction with ICE, a European exchange and clearinghouse) offered coal futures contracts. Futures contracts allowed participants to hedge or speculate on the value of coal without taking a physical position. These could be used in much the same way as swaps, to eliminate price risk, but with the benefit of reducing counterparty risk. All trading was conducted through the exchange, instead of bilaterally between buyer and seller (Schernikau, 2010). Trading in these products is also offered through local exchanges such as the European Energy Exchange (EEX), the New York Mercantile Exchange (NYMEX) and the China Taiyuan Coal Transaction Centre (CTCTC).
While offering swaps allowed major financial institutions (and some major coal traders) to gain exposure to the coal market and to speculate, the availability of coal futures opened the market to all financial investors. The global financial coal market (incorporating mainly futures and swaps) is now several times larger than the entire physical coal market but still relatively immature, as compared with the oil market (in which the financial market is 50-200x the physical market) (Deans, 2013).

The drivers of coal’s financialisation appear to be in minimising the cost of transacting and price risk, and the major benefits have been improved price discovery and more efficient price reporting, as well as the ability to use long-dated futures data to create a forward curve for price forecasting.

3.3 Correlated Factors in Market Development

This section will look at factors which appear in the literature to exhibit some correlation with market development. The major factors include the structure of the coal market, the integration of the two coal basins (Atlantic and Pacific), the transaction costs faced at each stage of development and other, minor factors.

3.3.1 Market Structure

The structure of markets has important implications for the behaviour of participant firms and the resultant prices and output. For example, if a regional market has a limited number of suppliers, the sellers may be able to restrict output and raise price.

The Atlantic Basin

Although the transatlantic coal trade considerably predates the 1970s, it is at this point in time that the modern industry began to emerge. This was principally in reaction to the oil crises of 1973 and 1979, which demonstrated the strategic weakness of relying on oil imports and led to energy diversification policies in many countries. At this time, the Atlantic market was primarily comprised of South African and US exports being delivered into north-west Europe (commonly referred
to as ‘ARA’ for the ports of Amsterdam, Rotterdam and Antwerp). There were also large domestic coal production operations in countries such as Germany, Poland, Russia and the UK, with some overland trade between adjacent nations. Trading was typically conducted with rigid, long-term contracts and the only exceptions to this were 12-month, multiple-cargo transactions; there was virtually no spot market (Ellerman, 1995). LTCs were not normally between producer and consumer but were intermediated by a coal trading company (Ekawan & Duchene, 2006). The market structure was one of bilateral oligopolies, where firms were forced into cooperation by large capital costs for new supplies and scarcity of substitute suppliers (Abbey & Kolstad, 1983).

The oil crisis precipitated a change in national policies in European states which had a significant impact on the broader market. Demand for coal increased as oil-fired power stations converted their feedstock to coal and new coal-fired power stations were constructed. In the early 1980s, new supplies (largely from Canada, China, Colombia and South Africa) tended to be high cost, substantially increasing the marginal cost of production (MCP) and therefore the market price; these supplies were anchored by 10-year LTCs with annual price renegotiations. The US became the residual supplier (or swing supplier), placing a ceiling on coal prices during short-run supply shocks (such as in the UK during the 1984/85 strike). By the mid-80s, nuclear plants were coming online and the demand growth for coal slowed, then collapsed with a general slowdown in economic activity (Cameron, 1997).

By the early 1990s, the industry’s structure had shifted considerably, from a bilateral oligopoly to a more competitive marketplace. This reflected an increased number of trading nations, as high prices and low shipping rates encouraged Pacific nations (particularly Australia) to export through the Suez and into Europe. The slowdown in demand growth for coal temporarily arrested this improvement in competitiveness and proved to be a healthy influence, forcing high-cost producers (such as Belgium and Portugal) out of the market and enforcing a commercial discipline amongst suppliers which had disappeared in the 1980s. Colombian imports also grew strongly, offsetting much of the decline of British production
(Ekawan & Duchene, 2006) and inefficient producers were consolidated (Rademacher, 2008).

The slowdown continued until the mid-90s, when prices began rising, partly due to the liberalisation of downstream electricity markets and decreasing financial support by governments for domestic coal production. Electricity utilities – the demand side of the coal market – were thus exposed to market discipline in the same way as the supply side had experienced it (Cameron, 1997).

It was during this period in which spot contracts became more commonplace but it remains to be seen as to whether this growth was a result of the structural changes, a cause of the changes or whether the two were simply correlated (Ekawan & Duchene, 2006).

By the early 2000s, spot contracts were well established in the European market, accounting for more than 80% of all trading activity (Ekawan & Duchene, 2006). Spot trading grew as the market power exercised by major players decreased, and the market moved closer to being a competitive environment.

The process of financialisation was also underway, with OTC swaps widely traded amongst power utilities and financial institutions. This accelerated with the launch of globalCOAL in 2000, an internet-based coal trading platform which was an initiative of six major coal producers and traders, and intended to increase price transparency (including forward prices) and reduce costs for coal transactions, which further increased the competitiveness of the European market (Schernikau, 2010). Price information was now available in real-time for bids and offers, as well as providing transparency on the amount of cargo available in particular trading hubs. Recent work has confirmed that, although the market is not consistently represented by a competitive equilibrium, this equilibrium appears to have greater explanatory power than other market structure scenarios which have been studied (specifically Bertrand and Cournot oligopolies) (Truby & Paulus, 2012). This confirms that the process of development in the Atlantic market is correlated with growing competitiveness.
The development of the Pacific basin proceeded later than the Atlantic but was initially stimulated by some forces. Although exports had existed since at least 1801 (Ekawan et al., 2006), and an international trade in metallurgical coal had existed since the early 1960s, the modern industry came as a reaction to the 1970s oil crises. Prior to the crises, Japan – a major industrial nation – was highly dependent on oil imports, which was exposed as a strategic weakness following the 1973 OPEC embargo. From that time, Japanese energy policy has been one which emphasised a diversity of fuel supply (particularly oil, coal and gas) and suppliers. Consequently, Japan incentivised the development of large-scale coal export industries in Australia and Canada (and additionally took supplies from South Africa and the United States). Growing demand and the 1979 oil crisis led coal prices to peak in the early 1980s and then relaxed over the next decade as new supplies became available (Ekawan et al., 2006).

Transactions were typically conducted within the framework of LTCs, with prices typically reflective of the annual ‘benchmark’ negotiation between the biggest exporter in each country and the biggest importer (the Japanese Steel Mills, or JSM) (Graham, 1998). It has been claimed that the Japanese price itself is informed by earlier negotiations in the Atlantic market, with South African exports being the transmission mechanism (Cameron, 1997). This benchmark price also informed the prices paid for the small amount of South Korean and Taiwanese imports. While these facts are broadly accepted, the market structure – as well as the motives and fairness behind Japanese behaviour – has been disputed.

The most prominent explanation is that which claims the market structure resembled a bilateral monopoly, with Japanese policy forcing buyers to deal with at least two producer countries; under this explanation, the surplus created from the trade is divided roughly equally between each party (Anderson, 1987; Bowen & Gooday, 1993). The alternative view is one of Japanese monopsony, where the buyers are supporting an otherwise-unviable export industry in Canada to ensure the market is oversupplied and prices remain depressed (Bowden, 2012; Colley,
Regardless of the true structure, these authors agree that the market was far from competitive during the 1970s and especially in the 1980s, as oversupply kept prices (and producer profitability) low.

Prices began to recover somewhat at the start of the 1990s, as South Korean and Taiwanese demand began to increase, and some tonnes (particularly from South Africa but also some Australian exports) were diverted from the Pacific to the Atlantic market. Many of these cargoes were sold as spot transactions and two price indices emerged: the weekly Barlow-Jonker Index (BJI), which represented exports from the Australian port of Newcastle, and the ACR Asia Index, which was published in arrears and recorded Australian government export data for spot and fixed-price exports (Ekawan et al., 2006). This appears to have been the beginning of price transparency in the Pacific basin.

By the late 1990s, the behaviour of producers was beginning to change as cost-cutting initiatives drove up the number of tonnes in the market (as each producer expanded to achieve greater economies of scale) and kept prices down. The supply side of the market began to consolidate as the most efficient producers acquired less-efficient competitors, and the Japanese chose to stop supporting Canadian metallurgical producers. Alberta mines were less accessible: they were located further from export terminals and shipping distances were longer; this forced up production costs and made Canadian coal uncompetitive when compared with Australian (or, increasingly, Indonesian) exports (Bowden, 2012). Low prices may also have led the Japanese government to conclude that supply security was not the danger it had once been. Whatever the case, the closure of the Canadian export industry concentrated more market power in the hands of Australian producers. Numerous Australian studies during the late 1990s demonstrated domestic concern about the potential for the exercise of market power by the Japanese (Colley, 1998; Hogan, Thorpe, Swan, & Middleton, 1999; Koerner, 1993). These studies suggest that market power may have been exercised but do not provide conclusive evidence.
Demand was to become even more competitive through the mid-2000s, as prices began rising in response to an upturn in East Asian demand, partly driven by traditional buyers Japan, South Korea and Taiwan, but also from China (Lucarelli, 2011). Increased – and discounted – supply from Indonesia increased competition on the supply side (Lucarelli, 2011). By 2004, prices were breaking out of the range in which they had remained for decades, beginning a transformation of the market (BP, 2012). The resources boom stimulated a supply expansion in Australia, Indonesia and South Africa, and even brought Russia and the United States to export into the Pacific market (Bowden, 2012). The development of the Indonesian coal industry – which was to overtake Australia is the region’s biggest coal exporter before the decade’s end – vastly improved competition within the market, and brought the market closer to perfect competition (Bowden, 2012). Growth in competition in this period was mirrored by growth in the use of spot contracts – with spot prices beginning to lead the fixed prices for the first time (Ekawan et al., 2006).

Although the OTC market was slower to develop in the Pacific basin than in the Atlantic, coal futures contracts became available through globalCOAL in 2008 and are widely used today, albeit in smaller quantities than are traded for the Atlantic. This likely reflects that long-term agreements are still more common in the Pacific (Lucarelli, 2011) and may present a growth opportunity, as LTCs expire and are replaced by shorter term or spot contracts. A lack of evidence for the exercise of market power suggests that price and output are now driven largely by market forces (Haftendorn & Holz, 2010).

The available literature for the development of the Atlantic and Pacific markets, from the Second World War to today, exhibits a significant survivorship bias – failed indices and coal exchanges (for example, those operated by the ASX13 and Bain Refco14) do not appear at all. This limits the ability of researchers to explore the

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alternative products available at different times and to reach conclusions about why such products failed.

3.3.2 Integration

A second important factor which may have influenced the development of the coal market has been integration between regional markets. Historically there has been no ‘global’ market to speak of – production and consumption operations were closely located and operations were often vertically integrated. Following the 1970s oil crises, coal production began to shift to areas which enjoyed cost advantages through specialisation or scale economies; this increased the amount of trade occurring in the international market and led to equilibrium prices which were determined by global supply and demand factors, instead of regional factors. This process – broadly defined as market integration – assumes the existence of a single global price for a homogenous commodity, one which only varies to reflect local transportation costs (Warell, 2006). Therefore, the degree of integration influences price and output, as well as the behaviour of economic agents, and may be an important driver of development.

An important factor in the integration of global coal markets is the cost of transportation. The majority of the world’s coal trade uses FOB pricing, which places the cost burden of seaborne transportation on the buyer (Steyn & Minnitt, 2010). Buyers, therefore, consider not only the price and quality of the commodity but also the cost of shipping; these costs are affected by the vessel’s cargo capacity, distance between ports, and steaming speed (which itself may be influenced by fuel efficiency and the cost of bunkers) (Lundgren, 1996).

Prior to the 1970s oil crises, it was simply not cost-effective to transport coal, particularly given that coal’s primary substitute, oil, was so cheap. Moving a tonne of coal between the US and Europe cost an average of $32 in the 1950s – more than double the cost of the underlying commodity (Ellerman, 1995). As has already been discussed, the oil crises drove an energy market transformation and international seaborne trade in coal quadrupled between 1970 and 1990, from a base of
100Mtpa to approximately 400Mtpa. Transportation markets – now one of the most efficient asset markets in the world (Talley & Veenstra, 2012) – reacted predictably: the path of prices was one of gradual decline (excluding temporary demand shocks in 1979), as supply increased and technology drove the cost below $10/t (Lundgren, 1996). Falling transportation prices improved the integration between regional markets, just as inefficient (and often subsidised) domestic producers were exposed to competition and electricity generators were liberalised. The decline of LTCs further enabled markets to become more integrated, as prices were able to move more freely and efficiency improved in all parts of the industry. This transformation would not have been possible if transportation costs did not react as they did, making shipping one of the fundamental forces influencing the integration of coal markets.

There have been two periods of research into whether a global market exists for coal; one in the 1990s, when the market was in the earlier stages of development, and one more recently, as the market has moved towards maturity.

**Early Integration**

Prior to the emergence of global physical and financial exchanges, some authors had declared that a ‘global price’ existed for coal, with the implication that the regional markets were effectively integrated. This claim rested on the understanding that price discrepancies were capped by the ability of a central player to address supply/demand imbalances and restore a global equilibrium. Given the high transportation costs which existed during this period (1973-2000), imbalances could not be addressed through buying coal in an area of relative abundance and delivering it to one of relative scarcity. Different mechanisms were at work for each of the central players proposed in the literature, South Africa and the United States.

Given its strategic position, South Africa was able to address global imbalances through the 1980s and 1990s by redirecting future production away from one market and into another. In this respect, it has been called a ‘swing supplier’ in that
it could swing its exports into the Atlantic or Pacific basins (Henriksson, 2003). While there is evidence that South Africa did indeed send its cargoes into either market, it is difficult to assess whether the volume was sufficient to move prices back towards a global equilibrium. This is supported by later work on the Richards Bay coal chain, which suggested the industry lacked the ability to rapidly increase capacity in response to demand shocks (Steyn & Minnitt, 2010). Unless a considerable proportion of its exports were sold under spot contracts—during a time in which spot contracts were only beginning to become common—it is difficult to see how South Africa could have unilaterally maintained an integrated global market.

More credible are the claims that the United States functioned as the global market's residual supplier, able to redirect tonnes from domestic to export markets when international coal prices justified it (Ellerman, 1995). The implication here is that US domestic production costs effectively determine the global price of coal. Supporting evidence for this claim is that the domestic US market (and US production capacity) was large enough that it could absorb a large volume being exported (Ellerman, 1995) and the more common use of spot contracts for domestic coal sales (Polinsky, 1987). But while evidence exists for the mechanism, there does not seem to be any convincing evidence that the US maintained pricing parity between the two basins, beyond imposing an effective price ceiling. There are also large costs in exporting into the Pacific market, given the lack of export facilities on the western coast of the US—exports would need a terminal in the Gulf of Mexico and to travel through the Panama Canal, adding substantial additional costs (Osleeb, Buckley, Lee, & Kuby, 1986).

Humphreys (1995) responded to this claim by demonstrating that Australia, a low-cost producer with spare production capacity, was more likely to act as a swing supplier and displace the United States, a high-cost producer. The fact that it did not do so demonstrated that the world market was not fully integrated but rather “a series of interlocking markets” where regional price disparities were limited by
arbitrage opportunities. This claim neatly accounts for the available – and quite limited – evidence.

Mature Integration

Recent attempts to answer the question of market integration have taken a quantitative approach, using econometric (cointegration/error correction) models to analyse the degree to which prices in different locations are influenced by, or independent of, each other. The standard models for cointegration are adjusted for this market due to the long adjustment periods which have traditionally characterised the coal trade (and other commodities) (Li et al., 2010).

The earliest periods under analysis are the 1980s and 1990s, in which some interesting results are identified: while there is some evidence for integration during the 1980s, this fades during the 1990s (Warell, 2006). Although the author suggests that this may be evidence of an anti-competitive merger in the early part of the 1990s, it seems more likely that it is the result of a market downturn and subsequent consolidation amongst producers.

Another study compares twelve-month data from three distinct periods (1980, 1990 and 1998) and finds that the market is broadly becoming more integrated, with Europe moving from virtual self-sufficiency in 1980 to a major global importer by 1998 (Henriksson, 2003). Interestingly, the study finds that South Africa and the United States are a major actor only in the Pacific basin in 1980; while South Africa assumes a dual role for the other years, the US only acts in the Atlantic basin. This certainly challenges the swing/residual supplier idea present in earlier publications.

The most recent study looks at continuous data between 1995-2007 and also finds evidence that the coal market is improving over time and is now largely integrated (Li et al., 2010). It finds that the improvement process is slow and suggests the lack of an ‘anchor’ producer is part of the reason; this connects favourably with the previous study.
Together, the available studies clearly suggest that the coal market was not well-integrated in earlier stages of development but has been improving over time and may have been integrated by 2007. These studies do not however make any claims about causal factors; econometric analysis is able to identify integration with some precision but cannot conclude why this is occurring. A number of related factors appear to be important, including a more competitive marketplace (the increase of both supply and demand side actors); more efficient pricing (wider use of spot contracts); improved price transparency (exchange trading and indices); and the reduced cost of seaborne transportation. The relationship between these factors – an explanation about which are causing other factors, and which are merely concurrent – is presently unclear; the explanation of this gap will make a major contribution into understanding the development of commodity markets.

3.4 Transaction Cost Economics

This section considers Transaction Cost Economics (TCE) and its application to the Roeber model. TCE rejects some of the fundamental assumptions of the neoclassical school and develops an alternative framework for understanding and explaining the behaviour of economic agents. This framework appears to have the potential to explain the development of the global thermal coal market.

3.4.1 Overview of Transaction Cost Economics

Transaction cost economics is a major school of thought in economics which rejects some fundamental assumptions of the neoclassical (orthodox) school, particularly with regard to agents operating with zero transaction costs, perfect information and perfect rationality. TCE shifts the unit of analysis from the level of the firm to the level of the transaction. Although enormous differences exist between the two schools, many transaction cost economists see the field as modifying and extending the neoclassical view, rather than substituting it. TCE is often regarded as a core branch of new institutional economics (NIE), although this is not a universal view; the terms ‘transaction cost economists’ and ‘new institutional economists’ will be used synonymously in this paper.
3.4.2 Behavioural Assumptions

The concept of bounded rationality in economics emerged with Herbert Simon, who rejected the idea of ‘economic man’, an omniscient agent with perfect rationality, and substituted it with ‘administrative man’, an agent who sought ‘satisficing’ – a combination of satisfying and sufficient – rather than utility maximisation (Simon, 1947). Bounded rationality, together with imperfect foresight, limits the feasibility and effectiveness of complex contracts: agents cannot know or contract for every possible eventuality. This incompleteness creates uncertainty for both parties and imposes protection costs. The greater the uncertainty about the future, the more likely an unanticipated event may lead one or more parties to demand a contract be updated, renegotiated or terminated. In some situations, the costs of uncertainty may be so great that no transaction occurs (Hart, 1993) – such as when one party fears non-performance by the counterparty which will not be enforced by a court. Such situations present the possibility that an agent may act in an opportunistic way, which goes beyond simple self-interest and takes advantage of asymmetric information with guile (Williamson, 1993b). Common examples include problems of adverse selection and moral hazard; the latter includes examples such as shirking or reneging on contractual agreements. TCE acknowledges that such behaviours exist and claims that firms must engage in protective behaviour to minimise the potential costs from opportunism, such as by contracting against contingencies or assessing the trustworthiness of a counterparty before transacting. This imposes substantial costs to transacting. TCE claims that firms select governance structures to minimise their transaction costs.

3.4.3 Dimensions

These behavioural assumptions – bounded rationality and opportunism – lead advocates of TCE to conclude that transactions are structured in such a way so as to minimise the costs of these issues. In order to understand the effect of these costs, transactions are described with particular regard to three key dimensions: the

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15 Simon later used the terms *homo economicus* and *homo psychologicus* in place of economic and administrative man.
frequency of transactions, the amount of uncertainty, and the specificity of assets to the transaction or series of transactions (Williamson, 1993a).

The degree of standardisation and the frequency with which a transaction is executed lead to different characteristics; the cost of establishing a contract (or other governance structure) for frequent, standardised transactions can be amortised over many transactions and may not represent a substantial impediment to trade. However, transactions which are infrequent and highly specialised may carry large costs which must be recouped by the transaction if any exchange is to occur. It is likely that highly specialised governance structures will only emerge with trades where the gains are sufficiently large that the costs of such a structure can be absorbed (Williamson, 1985). The application to the coal market here is obvious: if a mine and a power utility have an interdependent relationship for a non-standard product\textsuperscript{16} with frequent transactions, the relationship could be governed by ongoing spot market transacting or through a common management structure which resolves questions of production/consumption scheduling and pricing. The latter structure is costly and such costs would only be worth bearing if the alternative structure presented greater costs: i.e., the risk of future opportunism was high.

There are two types of uncertainty which face firms: environmental uncertainty, in which exogenous events may affect the firm, and behavioural uncertainty, in which endogenous agents (parties to the contract) may act opportunistically. The focus of TCE is on the latter, whereby opportunistic behaviour may be undertaken ex ante or ex post (that is to say, it may be premeditated or it may be brought on by environmental changes) and it may be lawful or unlawful (in terms of the contract to which the parties have agreed) (Macher, 2008). Recent research has suggested that behavioural uncertainty is a greater problem when incentives are not well aligned between contracting parties (Niesen, 2012; Wathne, 2000). The costs of uncertainty are the potential cost from opportunism and the costs of protecting

\textsuperscript{16}That is to say, the product (or assets) would have substantially less value in alternative uses as it does not meet the common standards of other users.
against it; when these costs are large, they can prevent trade from occurring or it can lead to changes in governance structure. (Williamson, 1979). To return to the earlier example, uncertainty about future choices would increase the likelihood of a hierarchical relationship.

The most important dimension is the degree to which particular assets are specific to that transaction. Assets which can be easily repurposed – such as generic office space in a central location – present very little risk to the owner of the asset; contrarily, owners of a highly specific asset may struggle to find other willing counterparties, or repurpose the asset, should a transaction fail to execute as expected (Williamson, 1993a). When a transaction (or relationship) requires a specific investment, the party faces greater risks from opportunism, and consequently, greater transaction costs to protect against such risks.

Asset specificity can be broken down into four key categories: site, physical asset, human asset and dedicated asset. Site specificity involves an asset (such as a steel mill) being located at a particular site (such as being adjacent to a coal mine); the particular risk in this example is that the commercial arrangement between the mill and the mine may break down, and the mill owner would face higher transportation costs to acquire coal elsewhere. Knowing this, the mine manager may seek to act opportunistically and renegotiate the contract in his favour. Physical asset specificity involves specialised, single-purpose equipment being purchased for the transaction (such as particular types of machinery). Human asset specificity involves human capital assets, such as highly specialised learning (especially acquired in a learning-by-doing process). Dedicated assets involve an investment in an asset which will only be used by a single counterparty (such as increased production capacity). Each of these assets are investments which are only made for the purposes of a particular transaction (or relationship) and present the same opportunism risk as present in the first example. In either scenario, it is possible for a trading partner to exploit a party which has invested in a relationship-specific asset by holding that investment ‘hostage’: that is to say, demanding terms be renegotiated or terminating the contract, leaving the investment stranded. As
the risks of opportunism become greater, so too do the costs of protecting against such behaviour (Williamson, 1993b). Where substantial investment in relationship-specific assets is required by both sides of a transaction, the potential for opportunism can be reduced through an alliance structure that offers protection to both parties, in exchange for commitments to protect the other’s investment. Where mutual, credible commitments can be made, this outcome may be more efficient than vertical integration.

3.4.4 Unit of Analysis

One of the fundamental differences between neoclassical economics and TCE is the unit of analysis. Neoclassical economics has focussed on the behaviour of firms, largely driven by the marginal revolutionists (Jevons, Menger and Walras in the 1870s and Marshall in the 1890s). This focus was criticised by John Commons, who sought to correlate law, economics and ethics, with a single unit of activity, to achieve general principles applicable to human behaviour. Commons believed that the ultimate unit must unite mutually-dependent interests, conflict and order; it was at the level of the transaction, not the firm, at which he claimed such principles were contained (Commons, 1932). TCE brings these three principles together under the label of ‘governance structures’, which are considered later in this section.

The different approaches have significant implications. Whereas neoclassical economists focus on supply and demand, new institutional economists focus instead on governance structures – that is to say, how transactions are structured. A key consideration in TCE, which is totally absent in the neoclassical school, is in understanding and explaining the factors which lead to continuity or breakdown in transacting relationships. This in turn helps to explain the choice of institutional structure between two parties – whether they contract in the way supposed by neoclassical economists (a market structure), engage in vertical integration (a hierarchical structure) or some hybrid, which establishes a mutual commitment outside of these two structures (Williamson, 1975; Williamson, 1991). A further implication is that limitations are imposed on the possible structure of markets; neoclassical economists are inclined towards comparing observed structure with
the ideal of perfect competition, which is only possible if the school’s assumption of zero transaction costs is real. Given positive transaction costs, observed structures cannot be compared with an idealised structure but only with other feasible structures; this has important implications for regulatory approaches (Williamson, 1999). All of this results from shifting the unit of analysis from the level of the firm to that of the transaction.

3.4.5 Levels of Analysis

NIE posits that there are four levels at which social analysis can be undertaken, each of which can exert some control over the practices which can be undertaken at lower levels; lower levels can be changed more easily and rapidly than higher levels. The top level, social embeddedness, entails the culture which exists – the social norms, customs and traditions which are able to influence the behaviour of participants within a market. The second level is the institutional environment, often referred to as the ‘rules of the game’ (North, 1991), and includes the role of government in establishing laws and systems for enforcing property rights or resolving disputes. The third level is governance, or the ‘play of the game’, where relationships are structured in a way to minimise transaction costs. It is at the second and third levels in which NIE operates and the third alone which accounts for TCE. Finally, the fourth level is that of resource allocation, where neoclassical economics and marginal analysis plays a role and most variables – such as the governance structure – are simply accepted as given (North, 1986). The transaction costs which are relevant to this project occur at both the third and fourth levels, with the analysis of each conducted by Williamson and Coase respectively.

Transaction Costs at the Governance Level

At the governance level, firms are faced with choices about the optimal way in which transactions can be structured. Governance structures incorporate each of the ideas previously presented in this section; analysing the dimensions of uncertainty, frequency and asset specificity enables agents to understand the (potential) problems resulting from bounded rationality and opportunism. Once
they are understood, the costs of transacting can be estimated and agents are able to compare the costs incurred with different structures (Williamson, 1993a). When the problems of opportunism are limited, and bureaucratic costs are high, it is efficient for a firm to rely on a market structure. When these opportunism problems are larger, or bureaucratic costs are low, it may be more efficient for a firm to rely on a hierarchical structure. Intermediate, or ‘hybrid’ structures, can also provide efficient solutions to specific problems; examples include long-term contracts, joint ventures, equity partnerships, franchises, etc. These costs may have the potential to explain the transformation of the coal market from a quasi-integrated, hierarchical structure to one of markets.

Transaction costs may be incurred prior to the transaction occurring (ex ante) or afterwards (ex post). The problems of opportunism which are discussed here occur only when the investment in specific assets has occurred but prior to the conclusion of the relationship – that is, they are an ex post transaction cost.

Transaction Costs at the Allocation Level

At the allocation level, firms are faced with choices about the optimal way in which resources are distributed. The neoclassical school relies on marginal analysis, which operates under the assumption of frictionless exchange – that is to say, transaction costs are zero. TCE challenges this assumption and claims that transaction costs at this level are both positive and meaningful. The work of Coase (1937, 1960) pioneered the idea that there were costs to using the price system. Most relevant to this analysis are the three types of transaction costs, which are generally incurred ex ante: information costs, which include the costs of searching for potential traders and information about prices and quality; negotiation costs, which include the costs of bargaining with potential traders; and enforcement costs, which include the costs of enforcing contractual agreements and of non-performance (Dahlman, 1979). Even at a low level, these costs can distort and impede trade, leading firms to seek transaction cost-economising solutions.
The costs which are discussed here largely occur prior to the transaction being executed; to some extent, they can be estimated beforehand and have the potential to meaningfully affect the behaviour of market participants.

3.4.6 Application

While transaction costs can be significant at the level of resource allocation (which is the traditional domain of neoclassical economics), the work of Williamson (Williamson, 1981) demonstrates that costs can also be significant at the governance level, in which relationships are structured. This subsection explores the different levels and the transaction costs incurred.

*Governance Level*

Following the oil crises, the global coal market exhibited a large degree of integration, with joint ventures and equity partnerships common between producers and consumers and long-term contracts the industry norm (Dowling, 1987). To understand why this was the case, TCE advocates the investigation of the frequency of transactions, uncertainty and asset specificity. All of these characteristics existed at the time in the global coal market. And indeed, it can be observed that these factors appeared to be important. The frequency of transactions was low, with observed contracts extending as long as 30 years in some markets (Joskow, 1987). Uncertainty also appeared to be minimised with integrated operations, with aligned scheduling providing operational certainty about product offtake and fixed prices providing financial certainty about future cash flows (Joskow, 1988). Asset specificity also appears to be a major concern. Technical requirements during the 1970s and 1980s were extremely precise and fuel switching was not a design consideration, which meant combustion was designed around an extremely specific coal quality (Elliot, 1981; Schweinfurth, 2002). Mines would be developed for particular buyers; similarly, power stations would be developed for particular coal qualities. Switching fuel sources – when it was even possible – meant changes in costs for ash disposal, sulphur removal and general plant wear-and-tear, and required testing and modelling to determine the
appropriate technical characteristics to maximise fuel performance (Shih, 1995). Given these factors, the threat of opportunism appears to be high, so too the associated transaction costs of contracting. This fits with the theoretical proposition that transactions with these characteristics are likely to exhibit a hierarchical governance structure, so as to minimise transaction costs and uncertainty.

This contrasts with the present state of the industry, in which market structures predominate and spot transacting has become the norm (Schernikau, 2010). Analysing the same factors of frequency, uncertainty, and asset specificity reveals the dramatic shifts which have occurred. Transactions have become far more frequent; spot transactions and limited term contracts (generally no more than 1-2 years) mean that both buyers and sellers are required to enter contracts more regularly and negotiations – relatively rare under the integrated structure – are now common (Steyn, 2009). Although more contracts would appear to mean increased negotiation costs, these costs may not have increased substantially; standardised contracts, brokerages/trading houses and price indices all exist for the coal market and would contribute to lowering the costs of frequent transactions.

There is no evidence for the level of uncertainty; while integrated structures allow for low operational uncertainty, it does not necessarily follow that dis-integrated structures are worse. The use of forward contracts and planned spot selling may provide a similar level of certainty, but there is no evidence to confirm or contradict this claim. Most importantly, asset specificity has declined enormously as consumption facilities have broadened the range of acceptable qualities. This is likely due to changed designs (with a focus on low-cost fuel switching) and improved technology (Juniper, 1997). The declining importance of ash and sulphur quality in international coal pricing suggests that these qualities had become less important (costly) and market participants were able to focus purely on the calorific value (energy generation) of the product (Lorenz & Sbigniew, 2003).

Asset specificity was likely also reduced by changes in the market environment. As has been discussed in Section 3.3, the number of participants in each regional market grew enormously, increasing the set of possible buyers/sellers and reducing
the uncertainty faced by any market participant. Growing integration between the regional markets would have further increased this set. Even without technical changes to quality requirements, this expansion of the market would have had the effect of reducing the specificity of coal assets. From this, it is apparent that the costs of asset specificity had declined markedly, as had the amount of uncertainty. There has been an ambiguous effect on the costs from frequent trading; the amount of trading (and trading partners) has certainly increased but the extended fixed-price negotiations were replaced with much faster methods of price agreement, and the degree to which one would have offset the other is unclear. Overall, the theory suggests declining transaction costs would reduce the need for hierarchical structures and would therefore lead to market structures dominating the market. This certainly fits with the observed state of affairs.

Given the available evidence, it seems that there is a strong case to be made that changing transaction costs were closely associated with changing governance structure. TCE would make the claim that changing costs in fact caused the change in structure, but this has not been subject to testing. That said, there is considerable circumstantial evidence that it is the case and no contradictory evidence has emerged.

*Allocation Level*

Once choices have been made at the governance level about how the relationship is to be structured, transaction costs at the allocation level become important. Transaction costs at this level – particularly information and negotiation costs – appear to complement the Roeber model for market development. The first stage of development, which marks the emergence of spot transactions, appears to be triggered by factors operating at the institutional level. This also triggers a shift in the allocative transaction costs: although it may be cost-minimising overall, the declining costs in opportunism are partially offset by rising information and negotiation costs. Spot market participants must acquire information about the willingness of other participants to trade, the quality and volume of product available at various locations, as well as a range of price data; participants also
begin to frequently bargain with other participants and negotiate a range of short-term contracts. These costs are substantial; coal producers and end users need to have large marketing teams who can build expertise about markets and build up relationship networks with other marketers (a ‘bilateral telephone network’, as Roeber describes it) in order to participate in the trade (Kernot, 2000). Given the large costs which are incurred, it is not surprising that the market would adapt to offer efficient cost-minimising solutions; this appears to be the rationale underlying the Roeber model.

The second stage of the model observes the emergence of publicly reported prices by specialist firms (Price Reporting Agencies, or PRAs, to use a phrase from the oil market); Roeber observes that these prices are initially irregular and prone to manipulation, but over time the quality of reporting improves. Quality here is a reflection of the quality of information, which may be compiled using more reliable methods, and may also reflect the focus of reporting prices for commonly-traded product grades (or specifications). This makes the information more useful – and more valuable – to market participants. Within the coal market, transparent prices would primarily play a role in reducing information costs: when such data is public (or publicly-available), marketing teams no longer need to spend time compiling data to assess supply and demand and estimating the market equilibrium (Steyn & Minnitt, 2010). Even if the cost of finding and providing this information are the same for a PRA as a market participant, the provision of it to multiple firms would surely reduce costs to a fraction of their previous level; this is true even if there are multiple, competing PRAs. Negotiation costs are likely also marginally reduced at this point as there is better information about the balance of the market. Savings in transaction costs appear to explain why there is the shift from the first to the second stage of the model.

At the third stage of the model, public prices are fed back into forward and long-term contracts as a substitute (or partial substitute) for discrete negotiations (Steyn & Minnitt, 2010). Given that the strongest observed benefit from the previous stage was reducing information costs, it appears that the benefit from the third stage is in
reducing negotiation costs. While negotiating a spot price may be a straightforward affair given the existence of price indices, it would seem to be far more difficult to forecast future prices and negotiate on that basis. By pricing contracts for future deliveries at the future spot price, both parties to the transaction are assured of receiving a fair market price. While this reduces the costs of transacting, it may not be possible until price indices are available for the specific product grade and location, and are compiled using a reliable method. It is therefore possible that indices may exist for some time before market participants have sufficient experience to determine their accuracy or susceptibility to manipulation.

The fourth stage of the model, financialisation, is the one which has emerged most recently in the coal market and for which there is very little information – let alone peer-reviewed evidence. There also appears to be no studies within the TCE literature which links theory to the development of financial markets. Despite this gap, it may be possible that financial markets emerge as a result of cost-minimising behaviour of market participants. Financial markets may be defined as institutions which exist to minimise the uncertainty of physical market participants, and provide products which enable price risk management (such as futures and swaps) as well as providing information which can be used to reduce future price uncertainty (through the forward curve). In order to provide this function for physical market participants, financial markets must allow for participation by speculators who do not participate in the financial market. This appears to fit with evidence from the financial field of market microstructure theory, where a leading practitioner has demonstrated that changing market rules to reduce ambiguity can increase participation (Easley, 2010). This suggests some investors trade on financial exchanges as a way of reducing their uncertainty, offering support to the proposition.

The Roeber model, therefore, may be considered from a transaction cost-economising perspective where each stage is designed to reduce the costs of participating in a spot market. The first stage is the result of activity at the governance level and introduces high costs for spot transactions. The second stage
reduces information costs, the third stage reduces negotiation costs, and the fourth reduces uncertainty. If the validity of this perspective could be confirmed, it would present a novel account of coal market development and may provide a valuable perspective on the development of commodity markets more generally.

3.5 Research Gap

This literature review has demonstrated that the global thermal coal market has changed substantially over the past three decades, from a highly concentrated and somewhat integrated industry with two major regional markets to one which is highly contested and decentralised. The impact of these changes is that coal is now priced in a flexible manner and is more responsive to market forces.

However, an investigation of the scholarly literature has not provided any evidence of prior investigation into this phenomenon and no substantive evidence appears to exist to explain why the market may have changed, what drove these changes and what implications it may have for economic theory, industry or policymakers. The model proposed by Roeber (1996) provided a description for the evolution of commodity markets which was tested with coal markets by Li (2010). This appears to offer a good, evidence-based description of the process of development, but is not grounded in the literature and lacks support. Alternatively, transaction cost economics provides a good theoretical explanation of why structural change may have occurred but lacks supporting evidence. It also appears that the development of financial markets has not yet been addressed by the TCE literature.

This project therefore seeks to bridge the gap between these explanations by conducting qualitative research to identify what factors were causally responsible. The research question is then:

*What factors were causally responsible for the development of the global thermal coal market?*

Sub-questions have also been identified which were expected to provide valuable insights:
1. *Do current theories, such as the Roeber model and TCE, adequately explain what has been observed?*

2. *If current theories are limited, how can they be improved?*

The next chapter considers the methodology and method with which these questions are investigated.
Chapter 4: Method

4.0 Overview

This chapter considers the methodology and method used for this research project: 4.1 considers the philosophical paradigm of ‘scientific realism’ under which the research was conceived and conducted, including an exploration of ontological and epistemological realism; 4.2 discusses the goals of the research; 4.3 reflects on the challenges faced by research within this field and the consequent design of the project; 4.4-4.6 look at the technical details of how the research was undertaken, as well as the relevant limitations and ethical considerations.

4.1 Research Paradigm

This project will use the paradigm of scientific realism to guide and inform the choice of method and the execution of the research. This section will consider the philosophical foundations of the research project.

Scientific realism relies on a realist perspective of the ontological question and affirms the view that there exists a single objective reality, which is potentially knowable, and is therefore a suitable subject for research. For a single reality to exist, it must necessarily be independent of those who experience it. If it were not independent, it would exist only in the mind of those who perceived it and would not be a single reality – nor one which could be studied and understood objectively. It is only when reality is objective that it can be studied rigorously and valid interpretations made about what does and does not exist.

Ontological realism makes claims that specific entities exist; these entities are therefore both real and irreducible (Maki, 2008). Although a thing may literally be composed of another – for instance, an economy is composed of many millions of independent agents – a realist chooses to focus on a particular entity and not allow it to be reduced any further. If the entity was further reduced, a realist would not be claiming that ‘X exists’; rather they would be saying that ‘X is Y’ and then making a second claim that ‘Y exists’. No claim that ‘X exists’ would be possible. If a realist
were to claim that the economy was simply independent agents, he would not be a realist about the economy and his research would not be a study of the economy – he would instead be claiming that agents are real and agents would therefore be the subject of inquiry.

Causation, too, is an irreducible entity. When one phenomenon produces effects in an entity which would otherwise not have occurred, the phenomenon may be regarded as causal. While the phenomenon may have the literal potential to be reduced into its constituent parts, it may be possible that no individual component had the power to produce the observed effects. For example, it is known that hyperinflation causes serious problems with regard to monetary stability. If the concept of hyperinflation were to be reduced to its lowest literal level – for instance, to the level of an individual price change – it may be difficult to observe that a causal relationship exists, even though the literature clearly shows that it does. This is not to say that any reduction is to be avoided – if a bundle of factors is shown to cause a phenomenon, and then a later study finds that only one factor is necessary for causation, then the reduction is appropriate. To be a realist about causation is to reduce causation to its lowest level without descending to a level where causation is studied with regard to non-causal notions. (Kim, 1988).

Although the paradigm of scientific realism is widely accepted amongst researchers in many disciplines, the paradigm must be adapted somewhat if it is to apply to economic phenomena. Scientific realism typically assumes ‘mind independence’ – that is to say, a thing exists objectively if it exists independently of the human mind. That a thing continues to exist without human conception is therefore a key assumption. But this qualification is somewhat limiting for certain economic phenomena – for example a contract between two parties. Although the contract exists on paper, the paper is only a representation of ideas in the minds of participants – ideas about rights and obligations. The contract itself does not continue to exist once the mind stops conceiving of it; it does not exist independently and therefore would not qualify as being real under the typical
assumptions of scientific realism. It cannot be a subject of study or investigation, nor can it be said to have causative properties (Maki, 2008).

An alternative approach would be to consider as real any elements which are independent of scientific investigation. Maki (2011), who has been at the forefront of thinking about economics and scientific realism, advocates for this view. ‘Science independence’ is making a claim similar to mind-independence and saying that for a thing to be real, it must exist independently of the theories, explanations and understanding which is provided by scientific investigation. If an entity exists, and would continue to exist, even in the absence of a theory about its existence, it could be said to constitute science-independence. Science independence justifies existence in the same way as mind independence does for mainstream scientific realists.

There is an important condition which should be clarified here, with regard to science-independence. The work of scientists can have a dramatic and long-lasting influence on the social world: through identifying and explaining phenomena, they can affect the way decisions are made and the behaviours which individuals engage in. A theory of realism which denied the reality of such outcomes would exclude many phenomena from analysis which appear to have a deep casual effect on the world. Therefore the concept of ‘science independence’ must be modified to account for the causal relationship which scientific work can have, and acknowledge that the outcomes of such work objectively exist. Maki (2008) does so by claiming non-causal science independence; he acknowledges a channel by which scientific research can make discoveries which go on to shape the beliefs, and then the actions, of individuals. Although these things have been caused by science, once discovered they are not dependent on science to continue existing. For example, Alfred Marshall created the laws of supply and demand within his theory of marginal analysis, a theory which generated testable predictions of price and quantity and these predictions, when tested against the data, generated statistically significant results and has long shaped commercial behaviour. Were the science to
cease existing, the law of demand would shape behaviour. Therefore it can be concluded that the behaviours associated with it exist independently of the science.

Non-causal science independence allows economic phenomena to be regarded as objectively existing. As such phenomena are external and objective, as they exist independently of the science, they are therefore potential subjects of academic inquiry. This is also the case with the causes and consequences of their existence, which may also be examined.

Scientific realism makes claims which constitute genuine knowledge of the world. Having accepted that things exist independently and objectively, it can be further claimed that it is possible to understand these things which goes beyond knowledge of what is observed. This can be said to constitute epistemological realism. Unlike instrumentalists, epistemological realists claim that genuine knowledge is important and valuable in and of itself, and not merely because it is a useful tool in helping to predict a phenomenon.

In the words of Thomas Aquinas, a statement is ‘true when it conforms to an external reality’ (Aquinas, 1952). Although he was not the first to advance such a claim – the ancient Greeks considerably predate Aquinas – it is clearly put, and the claim suggests that truth is an association between a statement and the reality on which it is predicated. This idea, which was expanded by Russell (1912), who demonstrated that truth could neither be found in the statement nor in reality (‘the state of affairs’) but rather in the accurate reflection of the latter by the former. The idea that true statements must correspond with reality is now widely known as the correspondence theory of truth.

In more philosophical terms, it can be said that there are truthbearers: claims, judgements or statements which carry the potential for being true or otherwise. The conclusions of academic research – and the theories which they shape – can be said to fall into this category. In addition to truthbearers, there are truthmakers: the entity (such as facts or states of affairs) which make the truthbearer true. The state of being ‘true’ comes as a result of a truthmaker corresponding with the
truthbearer, of objective reality corresponding with the claims made of it (Armstrong, 2004). If a claim is made without a corresponding truthmaker, it would not necessarily disprove the initial claim; rather it would simply point to the absence of facts or states of affair to make the truthbearer true. A claim would only be false if a truthmaker existed to make the claim false.

To express the idea in technical, philosophical terms:

A claim is true if – and only if – the claim corresponds to some facts or states of affairs that obtains.

A claim is false if – and only if – the claim corresponds to some facts or states of affairs that do not obtain.

Therefore it can be seen that a statement for which there is inadequate (or incomplete) evidence is not necessarily false but lacks correspondence. It is not until a fact or state of affairs emerge which contradict the truthbearer that it can be said to be false (Armstrong, 2004).

The relationship with research is clear. Given that there is an objective reality independent of the human mind, and given that knowledge of such a reality is possible, for any research to make claims of truth, it is necessary for it to satisfy the condition of having a truthmaker that corresponds with the claims that are made. Once such a truthmaker is shown to exist, the claims can be accepted as providing insights into the external reality that we face.

Given this choice of paradigm, it is possible to use data gathered through qualitative techniques (such as semi-structured interviews) as truthbearers, statements which may be regarded as true and insightful, should they correspond with truthmakers. These statements can then used as evidence for or against the research propositions.

4.2 Research Goals
The goal for this research was to collect qualitative data from experienced coal market professionals about the process by which the physical market developed towards financialisation. In particular, this research hoped to gain insights on the key factors identified within the literature (market structure, market integration and transaction costs), as well as any other factors that emerge from the data. These insights were used to identify which factors were important drivers of the market development process, which factors were occurring concurrently, and which factors were in factor a consequence of development. This information would provide context and further the understanding of previous research conducted by Roeber (1996) and Li (2010).

4.3 Research Design

One of the major challenges facing investigations into the commodities trade is information scarcity; physical market participants are regarded as being extremely secretive (Kernot, 2000), which makes it difficult for researchers to understand the basics of the industry, let alone gain access for research projects. It is noteworthy that there were few completed projects on the coal industry this century; just a handful were conducted with primary data (all by those with industry experience, including Lucarelli (2011), Schernikau (2010), and Steyn (2009)) while the rest used secondary data (Haftendorn and Holz (2010), Li (2010), Truby and Paulus (2012) and Warrell (2006)). Secondary data in the coal trade is generally limited to publicly-available price and quantity information (published by principally by governments, PRAs and multinational energy companies), which limits the depth to which any analysis can reach. This is a major limitation for coal market researchers.

Ideally, a research project such as the one which has been undertaken would use quantitative analysis to properly test a range of data for correlation and causation; data would be required on the volume of trade (physical and financial) by participants in various locations, as well as contract terms, delivered prices, index prices, etc. A conclusive study would need to include data from counterfactual situations to demonstrate whether transaction costs had indeed been minimised. As such data does not exist, such an approach is not possible for this study.
It was therefore decided that the second-best approach would be to approach market participants directly. Qualitative research techniques are able to deliver insights into phenomena for the building of theory and can lay the groundwork for future testing, should quantitative data become available (Eisenhardt & Graebner, 2007). Through focussed research on the experiences of those who were active in the market before, during and after key developments, interviews are able to reveal information about these events and can yield valid conclusions about causal factors (Bewley, 2002).

Semi-structured interviews enable individual research participants the opportunity to respond to open-ended questions, in which they can relate their own observations, opinions and knowledge (Patton, 2002). The semi-structured nature of the interviews allowed the researcher to ask all participants the same introductory questions, and to ask for more information on particular remarks made in responses. This structure enabled deeper insights to be gathered on key points.

To avoid the problem first raised by Machlup (1946), who suggested that participants were often unaware of their own motivations (and therefore made qualitative economic research unreliable), questions avoided personal motivations entirely and focussed instead on the role of various factors as were discussed at the time. (It is important to note that the shift to financialisation was not generally an individual decision but one made by a team or a firm; individual motivations therefore matter far less than they would for personal decisions.)

4.4 Data Collection

This subsection will review the technical details of the way this research was conducted.

4.4.1 Participant Selection and Recruitment

The research goal required all research participants to have relatively deep experience of the physical coal market over the period of financialisation (which is
roughly dated 2000-present). To accomplish this, participants were initially identified from a publicly-available list of globalCOAL exchange clients (globalCOAL, 2013). This included both physical and financial clients, so entities with purely financial operations (who therefore had no knowledge of the physical market prior to financialisation) were excluded. Initially, participants were to be sorted by their role (trader, marketer, exchange personnel, etc) to ensure a diversity of views. However, it became clear that some participants were simultaneously engaged in multiple roles (e.g. a marketing role within a trading house) or their careers had involved a number of roles. Sorting was not possible but the goal – a diversity of perspectives – was nonetheless achieved through the backgrounds of participants. Representatives from each company were progressively approached by phone and email. Members with less than ten years’ experience in physical coal markets were excluded, which unfortunately limited the participation from originators (i.e. coal consumers). Several Asian buyers and utilities were approached but were unable to identify anyone with the required experience. Regular rotation of staff into different corporate roles appears to be the reason for this, as it meant staff typically had less than 10 years’ experience. Some participants were recommended following interviews with other participants. Approaches and interviews continued until a large, diverse data set had been generated.

The twelve participants in this research are anonymous, however they represent some of the most experienced and influential figures in the industry. Experience within physical coal markets ranged from 13 to 33 years with a combined total of more than 200 years. Present roles included three chief executive officers, four heads of coal/commodity trading, two general managers of marketing, and one company director and several coal traders. All participants are extremely well-respected within the industry. Although the number of participants was relatively small, the experience and variety of those involved is believed to be sufficient for this project.

4.4.2 Interview Structure
Members were contacted by phone or email and provided with a copy of the Participant Information Statement (Appendix II) and asked to participate in the research project by replying, whereupon arrangements were made for interviews to be conducted at their offices (or, where appropriate, a neutral third-party location) or, in the case of foreign participants, over the phone. Authority to conduct audio recording was sought prior to the commencement of the interview; this was confirmed at the beginning of each interview, in writing (where possible) or orally.

Following completion of an interview, audio recordings were transcribed and any identifying material (such as names of individuals and companies) were removed. This was completed within seven days of each interview. Participants were asked to review the transcription for accuracy and to ensure identifying or sensitive material was satisfactorily removed; they were asked to do this within fourteen days or it would be assumed that there was no further editing required. Following the verification process, the original recording and transcriptions were destroyed. Physical recording authorities were also destroyed. De-identified transcriptions and digital authorities were retained on an encrypted device in a secured location.

4.4.3 Research Instrument

Semi-structured interview questions were used as the basis for interviews. These questions were intended only to be used as prompts, to encourage discussion on the topic of coal market development with particular reference to factors identified in the literature. The use of the instrument varied greatly – some participants began with an extended reflection on the process of development which negated the need for some questions, while others preferred to stick with the structure. The instrument is included as Appendix IV.

The interviews were conducted in a warm, professional manner intended to evoke the experience of colleagues sharing tacit and institutionalised knowledge. Where possible, participants were allowed to speak at length and not interrupted. Questions were structured so as to begin with light ‘icebreaker’ questions, to
relieve anxiety and build rapport between researcher and participant, followed by
general background information about the participant and then questions
contained in the instrument. In the course of the participant’s response, specific
questions were asked to elicit more information on particular phenomena. The final
question, which was posed to all participants, was to identify any other factors or
issues which they felt were important or relevant to market development.

Follow-up or probing questions could be asked at any time in order to gather more
detail on a particular response. Prefatory statements were only used to define
specific concepts (e.g. financialisation, transaction costs) which may have been
open to misinterpretation but jargon was deliberately avoided where possible.
Leading questions were avoided entirely to avoid biasing responses (Patton, 2002).

4.5 Data Analysis

Following completion of the interviews, the transcriptions were reviewed and
coded. Codes for factors affecting market development were identified from the
literature (e.g. ‘price transparency’, ‘information costs’, ‘uncertainty’) and those
which emerged from the data. Coded data was then extracted and re-coded to
reflect whether claims or implications had been made about the factor being
causal, concurrent or consequential of other factors or of market development
generally.

Coded data was then grouped to identify which factor states were idiosyncratic (i.e.
they had only been identified as causal in a single case) and which recurred
throughout the data, and may therefore have represented a common view of the
phenomenon. Once the resultant data had been considered and preliminary
conclusions had been established, data was shared with a number of research
participants. This enabled a small number of participants to reflect on the research
conclusions and offer feedback on its validity. Feedback was positive and reinforced
the research results, but was limited by the participants’ lack of theoretical
knowledge. Through examination of the factors which were idiosyncratic and which
were broadly supported by the experience of other participants, it is possible to
overcome problems of internal validity. Idiosyncratic responses were included in the results but were carefully labelled and considered to be possible indicators, rather than accepted as being reflective of the overall experience.

4.6 Limitations

Qualitative research is principally limited by the challenge of interpreting truth from an enormous volume of data. For the analysis to be credible, interviews must reflect the honest opinions (or ‘voice’) of the participant and not the preconceived views of the researcher. Interviews must also have a focus on topics which the participant feels to be important. It is believed that the open-ended nature of responses and the semi-structured approach of the interviews has enabled this project to achieve a credible outcome.

Validity is also limited by the degree of openness of the participant. The data generated – and conclusions reached from analysis – are only valid if participants have been open to divulging all relevant information and covering all relevant topics. This is a particular concern given the ‘secretive’ nature of the industry being researched. As this cannot be directly tested, validity concerns can only be assuaged with analysis of the internal consistency of each interview.

One limitation was the inability to identify participants on the demand side. Although it is not expected that their views would have fundamentally differed from those captured in the research, it has nonetheless limited the depth and variety of responses.

Overall, no concerns were noted during the interview process or in later reflection. The interviews broadly reflected an external consistency, which suggests that issues of validity are minimal.

4.7 Ethical Considerations

Within any form of qualitative research, there is the potential for harm to participants. Ethically, practitioners are obligated to undertake projects in such a way that this potential is minimised. Within this project, there was the potential for
personal and commercial harm. Personal harm could result from a participant’s personal knowledge or opinions being disclosed publicly, or from the relationship of respect and trust between interviewer and participant being broken. Commercial harm could result from the disclosure of company information, market intelligence, trade secrets or other private information.

To minimise the potential for either form of harm to occur, participants were de-identified as soon as was practical. Additionally, any identifying information (including recording authorities) was digitised, with originals destroyed and digital copies encrypted and stored offline.

Once interviews have been recorded, transcriptions were generated and original recordings destroyed. Transcripts were de-identified and participants were given copies for review, and were able to remove any data which they felt had the potential to cause them personal or professional harm.
Chapter 5: Results

5.0 Overview

This chapter explores the results of the qualitative research outlined in the previous chapter. The data generated from fieldwork is compared with the theoretical model proposed in Chapter 3 to determine its validity in explaining the development of the global thermal coal market. With some refinements, the data strongly supported the proposed model and endorsed the view that Transaction Cost Economics could provide a valid account of the development of a commodity market. Direct quotes are used from ten of the twelve participants.

This chapter proceeds in the following way. Section 5.1 considers the initial stage of market development. Section 5.2 looks at the role of information costs and price transparency. Section 5.3 looks at negotiation costs and price feedback. Section 5.4 examines the final stage of development, incorporating uncertainty and financialisation. Section 5.5 considers the role of enforcement costs, which play an important role outside the model. Section 5.6 concludes.

5.1 Stage I – Opportunism

Proposition

The first stage of the Roeber model claimed that commodity markets would begin shifting from long-term contracts (LTCs) to spot contracts when production and consumption schedules between contracting parties became misaligned, forcing one (or both) parties to begin trading on the open market. Contrarily, Transaction Cost Economics (TCE) theory posited that LTCs existed to protect parties from the threat of opportunistic behaviour. The TCE-adapted model therefore claimed that firms would continue to prefer LTCs so long as the costs of opportunism outweighed the benefits of trading in an open market; once the costs of opportunism declined or the benefits of spot market trading rose, firms would shift away from LTCs.
Data

No data emerged to support the Roeber model’s claim that scheduling had become problematic. Several participants commented that many buyers maintained large stockpiles by default, which suggests that misalignment (or even logistical interruptions) may have occurred and a solution emerged which did not require changes to the contractual relationship.

The issue of opportunism had more support in the data and is closely related to the idea of ‘supply security’. It was noted multiple times that the power generation industry who bought the coal had, historically, been led by engineers. As Trader #5 said, in an Asian example:

“JPUs [Japanese Power Utilities] are run by the engineers who put the coal into the boilers and provide the electricity down the power lines to these areas, that’s it.”

The focus of engineers was on the technical, rather than commercial, performance of power generation assets. Trader #3 said:

“It took a long time for the engineers who run power stations to realise their best day at the office was not sitting in their office, looking out of the window at a large pile of their favourite coal and a lot of steam coming out of the cooling towers, because they were running full bore.”

This attitude is perfectly understandable in the context of utilities which were owned or protected by the state, and were not intended to be operated for commercial reasons. As many coal-fired power stations were built in response to the 1970s oil crises (particularly in Asia), supply security became an important consideration: buyers wanted continued access to the product, and were willing to pay for it. The supply side of the market was not competitive, as Marketer #3 observed:

“[…] today there’s just an abundance of supply. In the early 1980s, you did not have Indonesia as a major coal exporter. You basically had the United
States, Australia and South Africa, and you also had a lot of production in Germany ... and even the UK.”

This situation led to a response from buyers to ensure security of supply. Trader #5 explained how the Japanese resolved this problem:

“If you look back at the history of investment in the [mining] assets, the Japanese came in huge in the late 1980s and the early 1990s, to underpin coal mines. In return for that, they got their evergreen contracts. Their view was that if they spent the money, they’d get access to the tonnes. To do that, we’ll guarantee the mine a fixed price on a term contract and the price is negotiated every year, and that’s what happened.”

The risk of opportunism was that coal producers would engage in the same behaviour as OPEC and restrict supply, which would lead to a massive increase in electricity prices and create an energy crisis in developed countries. This risk was compounded by the concentrated nature of coal supply. Buyers responded by engaging in quasi-integration and expanding supply: by investing in the development of new mines through equity investments, joint ventures and LTCs (which could be used to acquire outside financing), buyers were able to reduce the risk of opportunistic behaviour by coal producers. The costs of quasi-integration were high – Trader #1 noted that a failed Japanese investment in the Canadian coal industry had cost US$4bn (in today’s dollars), and that the mine had failed despite being paid twice the per-tonne rate as Australian producers – but the cost of opportunistic behaviour would be far higher, a negative supply shock that in 1973 led many economies into recession (Wen, 2007). These costs could be absorbed by coal buyers because of the pass-through mechanism by which public utilities transferred costs to retail electricity customers (i.e. the general public). The incentive of the coal buyers was not to minimise cost.

This changed with the deregulation and liberalisation of the downstream (electricity) markets, which began in Europe. Deregulation meant the pass-through
mechanism was lost and electricity prices were no longer fixed. As Trader #6 described in an example:

“The market’s now deregulated, prices go up and down like a yo-yo, and it’s very difficult for us – the power generator – to manage our margins. There’s no point buying coal for $100/t today, which might translate into £50/MWh. That’s all fine and well if I can get £50/MWh but if prices go down to £30/MWh and I’m paying $100/t for my coal, how do you make that work?”

This demonstrates the costs and benefits of the LTC arrangement were changing. The costs were increasing and, on the other side of the ledger, the benefits were diminishing as the market structure changed and the risk of opportunism declined. Marketer #3 explained:

“The big change now, in my view, is that the customer’s got so much more choice. They can get whatever they want, it’s easy. You don’t need that security of supply stuff. You don’t need the long-term contract to secure the supply.”

The deregulation of downstream markets and the changes in the supply structure changed the dynamic of the industry. Section 3.4 discussed how firms seek to economise on transaction costs; at the governance level, the relative costs/benefits of a hierarchical approach had shifted in favour of markets. This triggered the shift from a quasi-integrated market of fixed-price LTCs to a spot market.

The shift started in Europe, as Marketer #2 explained:

“In Europe, the utilities forced the producers to accept indexation for sales because the consumers were selling power on variable prices and had no way to manage that risk on the purchasing side. They went to the producers

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17 ‘MWh’ is megawatts per hour, a measure of electricity generation. The numbers used here are purely illustrative.

18 Here, ‘indexation’ is used to mean ‘selling at the spot price’.
and said, ‘Thou shalt do indexation, because we need to manage our dark spreads and clean spreads\textsuperscript{19}, our margins on our power stations’.”

The transformation also took root in the Asia-Pacific market, as Trader #1 explained:

“Hong Kong were the first to break from it, they were the first to break and go to the spot market, and to a semi-spot market. There was a whole debate with that. Then the Taiwanese followed it with their industrial market – their cementers, their paper manufacturers – they went to the spot market. Then the Koreans cementers and paper manufacturers – non-power utilities, non-steel mills – went to the spot market. Then the utilities in Hong Kong went to the spot market. Then the utilities in Taiwan started to work the spot market, because you could get these cheap tonnes, $20/t in a $35 market. Then the Koreans were late on the game; they came in, but as they were coming in with the utilities, the general industry in Japan started going to the spot market. This is in the late 1980s. We had all sorts of craziness going on at the time.”

The higher price noted here refers to the LTC price set between Australia and Japan, known at various times as the benchmark or reference price. It is unclear why there was such a large disparity between the LTC and spot prices; Marketer #3 simply explained that LTCs attract a large premium. It may simply be that coal producers had excess capacity at the time and expanded production when it became possible to sell additional tonnes without committing to a long-term supply agreement.

A clear example of the importance of downstream deregulation is KEPCO, the Korean Electricity Power Company, as explained by Marketer #1:

“Korea split KEPCO – Korea Energy – into five ... companies called Gencos [Generation Companies]. Each one got a couple of power stations, coal-fired

\textsuperscript{19} The ‘dark spread’ is the price of electricity minus the cost of purchasing coal and generating electricity. When the spread is positive, it is efficient to generate using coal-fired power stations.
and ... they might have some hydros and some oil-fired as well. And they set them up all individually. And they set them up in order to compete. And what they said to these guys was, you can go and buy whatever coal you like, and you can burn it in your power stations ... but when we want extra power, we will allocate that extra power to the group which has the cheapest import price of fuel. So they forced all of these to compete.”

Marketer #3 confirmed the importance of this by saying, “Korea: all of those guys, they’ve become quite spot since they chopped up the business into the five utilities.” This clearly shows that deregulated downstream markets played a role in changing the incentives and buying behaviour of the generators.

The shift into spot contracting was far more pronounced in the European than the Asia-Pacific market. Various reasons are offered for this, many of which can be reduced to an observation that the price signal (and therefore the financial incentive) is far stronger in some markets than others. Trader #3 explained the very strong price shift in Europe:

“People realised, probably, that there were buyers of coal – when I talk about buyers, I generally mean about coal, so sellers of electricity – became more diversified, they had portfolios of coal, gas, hydro in some cases, even nuclear in some cases, and the merit order\(^{20}\) started to change and it changed a bit more dynamically. It wasn’t quite so set in stone, but the ability to pass on costs in the tariff ... was whittled down. They had to become competitive, and actually they realised security of supply was less important because they had alternative sources of power, they didn’t have to burn coal all the time, at any cost. They only buy coal if it was competitive with their opportunity to sell gas or to stand coal idle temporarily or just run peak plants, at peak hours...”

\(^{20}\) The ‘merit order’ means the progressive selection of assets generating into a grid
Marketer #2 noted that the interconnected grids in Europe further strengthened the pricing signals; power generators were no longer simply competing at a national level but an international level.

“The other thing that makes it unique is the interconnection to the grids. You don’t have any interconnecting grids in Asia; you do in Europe. That means it’s way more competitive so they have to manage their costs much more closely.”

Downstream markets have not developed to the same extent in Asia as they have in Europe. The electricity grids are not interconnected and in some countries (particularly Japan), power generation is still controlled by state-owned utilities. Trader #2 explains:

“I think one of the main reasons why that probably hasn’t evolved the way it has is because most of the utilities have pass-through ability, where they can pass through the cost of their coal through the electricity price to consumers. [...] Most of the utilities have pass-through mechanisms where the government still controls electricity prices and there’s a formula, and the utility says, right, well this is the cost of my coal for the previous quarter or next quarter or whatever it is, and therefore the government sets the power price based on the cost of the inputs.”

Japan is one of the biggest buyers of internationally-traded thermal coal – Trader #5 estimated they would purchase 180Mt of a 750Mt market (or 24%) in 2013 – and the largest to continue using LTCs. The Japanese utilities have continued to focus on ensuring security of supply, signing fixed-price LTCs at a premium to the market – several participants noted that the highest price in any year is the Japanese benchmark price – and passing those costs on to electricity customers. This does appear to be changing since the Fukushima earthquake in March, 2011, and the consequent shutdown of nuclear operations. Trader #5 explains:

“March 2011 occurred, where the nuclears went down – and nuclear is very capital-intensive but it’s very cheap to run – that they realised they’d sunk
the cash, they’re not getting the returns from it, they’ve got to replace their fuel burn through extra coal, extra LNG, extra oil, which is all just pure cost in the market. The market reacts because of that, so they’re paying more for the stuff anyway, they’re all negative cash. Now there’s been a massive focus on how they can change it. A massive focus on how they can get the optimal price for the fuels that they need.”

Even though the JPUs are state-owned, the increase in costs is not being offset by equivalent increases in retail electricity prices. Consequently, the JPUs are under several financial strain and the cost-benefit calculation of quasi-integration has changed. There is evidence that some of the JPUs are beginning to shift towards spot trading; one participant cited the example of Chubu Electric, the third-largest utility, which has established a joint venture (‘Chubu Energy Trading’) with a trading company to manage their costs – indeed, the CET website specifically mentions “security of supply and cost competitiveness” as their key objectives. A participant noted the Japanese government is attempting to introduce reforms which would further regulate the downstream market and may incentivise further shifts toward spot contracting by the utilities.

The relationship between opportunism and the shift towards spot contracting seems to be well-supported by the data. This appears to be a stronger explanation than that posited by the Roeber model.

**Other Observations**

Over time, this shift also appears to have had some interesting and unpredicted effects on the dynamics of the market: the emergence of large-scale blending operations and small traded parcels.

Trader #1 said that he drove the ‘reinvention’ of blending in Newcastle, the mixing of coals from different locations, seams or producers to achieve a product of a particular quality. This behaviour was not accepted by many LTC buyers, some of whom insisted on source certification to ensure the product was not a blend from

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different sites. The ‘brand’ was extremely important. Several participants noted that this attitude was much less prevalent after the shift to spot; the focus on buyers shifted to the product quality, rather than the source.

Several traders also noted the size of coal trades declined (although the overall volume has, of course, increased dramatically). Trader #4 said:

“Previously, you’d be buying multi-cargo, years out to here; ... [now you’re] trading small little clips in and out, 25,000 tonnes at a time, instead of Panamaxes or Capes.”

This is an interesting observation, well supported in the data, but was not an effect anticipated by the TCE-adapted model. Logically, it does follow that reduced asset specificity will lead to greater trading and that the additional cost and inflexibility of trading large parcels will give away to an optimal parcel size less than that observed in a less-frequently traded market.

5.2 Stage II – Information Costs

Proposition

The second stage of the Roeber model is that spot prices become transparent; the TCE-adapted model concurs but grounds this claim in a broader context. TCE first claims that the shift to spot trading will increase multiple classes of transaction costs, one of which is information costs. The model then claims that participants will seek to economise on these costs, leading to the emergence of various firms, products and services which are able to provide information at a lower cost than the producer or consumer could achieve internally. As one of the informational requirements of firms is knowledge of market prices, the two models are complementary for this stage.

Data

22 Panamaxes and Capes are classes of bulk carriers, carrying approximately 75,000 and 150,000 tonnes respectively.
Several participants noted the paucity of information which was available in the early days of the thermal coal spot market. Throughout the 1980s and 1990s there were relatively few sources of news and information. Trader #3 noted:

“...a lot of it was empirical – word of mouth, what’s going around the market, who’s done what. Then you had a handful of publications that came out, typically weekly or fortnightly. IHS McCloskey’s main publication is still a fortnightly newsletter; Platts used to come out once a week and Argus used to come out once a week.”

‘Empirical’ news – what may be a polite euphemism for gossip – was, and remains, one of the major sources of information. Trader #8 confirmed that a major source of market intelligence is, “gossip, plenty of gossip.” Some producers and traders went a step further and contracted local representatives in destination countries to be a source of information (empirical and otherwise). Marketer #3 explained the situation in the late 1980s:

“You relied mostly on information from your representative in the target country. Agency agreements were prevalent, you’d have an agency agreement with someone for a country, they get paid either a percentage or a fixed fee per tonne, they would know the local market, they would talk to their people, network, and give me information. In those days, a lot more was relationship-based. Very, very relationship-based. If you had good relationships, you knew what was going on in the market.”

Publications were emerging during this period, a subscription to which could be much cheaper than maintaining a full-time representative (or office) in a foreign country. Marketer #2 explained:

“Platts was, when I first joined, was just at the start of their reporting. McCloskey was up there already. He used to report for the Financial Times and then moved and started his own publication. You had Argus and you also had Barlow Jonker.”
At first, these publications reported news and gossip, reporting trades and ‘whispers’. By the early 1990s, several had launched coal price indices, the utility of which is disputed. Trader #1 said:

“…this was in the early days of Barlow-Jonker – it was the only measure that had any value, when Barlow-Jonker was Barlow & Jonker, Chris and Jeremy – they tried to give a balanced view of the market. It was the nearest thing we had to something we could use. We had McCloskey, Gerard trying to put some numbers together, but Gerard was always fudging it this way and that way…”

Interestingly, Trader #8 had entirely the opposite opinion about the same publication:

“McCloskey. That was the weekly Bible, because you were getting good info about pricing around the market. [...] McCloskey was the only one that ever seemed to be regularly on the money, and I didn’t spend much time looking at the other indices, because I knew how they came up with pricing. They would often contact me [for price information] and you could really say anything. I didn’t really think that that was necessarily a reliable means.”

Trader #1 then relayed a story about a news report about a tender, which he lost but knew the value of the winning bid. When Barlow-Jonker published another number as the winning bid, the trader reacted:

“When that came out, I cancelled all my subscriptions to their data. If you cannot present the [true] values, don’t bother presenting bullshit to me, I don’t need it.”

This was a recurrent theme in discussions about the news reports and indices of the time. Trader #2 simply described them as “Pretty useless, actually. Nothing that we could use.” Trader #1 raised a problem of methodology:

“If they can’t work out what the facts are, they just make it up. That’s what they did with it. They just rang around people and said, “What’s the price
today, Bob?” “$10.” “What’s the price today, Harry?” “$20.” And then they mushed it together, popped it out and got it down. It was useless.”

And a problem of subjectivity, here referring to Barlow-Jonker:

“I think Jeremy had a systematic bias up, because he wanted to see the coal industry in Australia do well. I think that could’ve been a problem.”

Interview participants suggested that market participants were attempting to reduce their information costs by outsourcing data collection and analysis but the information they were receiving was not perceived to be reliable; whether it was actually reliable or not is not clear, but the perception was clear. Indices were reliant on the parties to a transaction reporting this information, voluntarily, to the journalists compiling the index – the issues of adverse selection abound, but several research participants noted the lack of alternative information meant that a poor, biased index was better than no index.

Two participants noted that Tradition Financial Services was the first firm to successfully improve the reliability of pricing information by introducing the All-Publications Index (API), which combined the Argus, McCloskey and Platts indices into a single product: TFS API 1, reporting CIF ARA23. Later, one company’s involvement would become problematic for the index’s reliability, as Trader #6 explained:

“...people were getting annoyed with Platts. There was a lot of angst with Platts’ involvement with TFS API 1. So what actually happened was that Platts was removed from TFS API 1 and removed them from the journalists’ composition and they called it TFS API 2, which is what we’ve got today.”

Later on, the API 4 index was successfully launched, which tracks the FOB cost for coal being exported from Richards Bay, South Africa. For the first time, market participants could see the differential prices between the major Atlantic producer

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23 CIF ARA is the delivered cost of coal into the main European ports of Amsterdam-Rotterdam-Antwerp.
(South Africa) and the major importer (Europe). When this differential was compared to freight rates, it showed whether it would be profitable to buy in one location and sell in another – an arbitrage window. When compared with the (less reliable) Asia-Pacific indices, traders could determine whether an arbitrage existed between the two markets. In this way, improved indices dramatically lowered the information costs of market participants.

The next major development was the launch of the globalCOAL trading platform in 2000. Although brokers did exist in the market prior to globalCOAL, several participants commented that the market was ‘underbroked’. Brokers play a key role in connecting buyers to sellers, and the lack of brokers meant that it was sometimes difficult for eager traders to find willing counterparties. Before globalCOAL, at least two online brokerages had launched and failed – Bain Refco and Enron Online, the latter of which failed only when the company went bankrupt – without having much effect on the broader market. As a broker, globalCOAL provided far more information to clients than its contemporaries and was able to provide it in real-time; parties were able to see live bids and offers, as well as the tonnes and qualities, in the three main trading hubs of ARA, Richards Bay and Newcastle. The details of trades which had executed through the platform (“on the screen”, in industry parlance) were visible to all users, with the exception of the parties’ identities. This has dramatically improved the transparency of the entire market, as parties have been able to see the quality, tonnes, volatility and trends of transactions as they are occurring. globalCOAL developed an index based off trades in the Newcastle hub which has become one of the global standards (the NEWC index). Based on real transactions rather than reports, the globalCOAL index had a marked effect on other indices. Marketer #2 noted:

“So when globalCOAL would publish its transparent data, no longer could the publications be too far out. It was sort of a balance and check mechanism as well.”

There was general agreement that the number, frequency and reliability of publications had improved substantially since the launch of globalCOAL. Most
participants remarked that the market was now highly transparent; this suggests the quality of published information is now quite high and the costs of acquiring that information are relatively low.

Since the spot market began developing in the early 1980s, the informational costs of transacting have therefore been falling through higher-quality news, price reporting and brokering services. Agency relationships and empirical data have been replaced by rigorously-compiled indices and transparent transaction data provided in realtime. This confirms the second stage of the proposed model: a shift to spot contracting leads market participants to economise on information costs.

Other Observations

A further issue which was noted by most participants is the need for credit information about counterparties prior to trading. There was a consistent view that credit checks (and ongoing credit surveillance) are a widespread risk management practice, particularly following the Global Financial Crisis (GFC). Less clear is the importance which was given to it prior to the GFC or earlier; most participants did not volunteer it as a concern when discussing the spot market in the 1980s and 1990s unless specifically asked about it. Checking the creditworthiness of actual and potential counterparties is an information cost and this model would predict that market participants would seek to economise on this cost. There was insufficient data to conclude that this was indeed the case; there was also insufficient data to conclude whether this cost emerged (or increased) as a response to changes in market structure, the development of the spot market or some other factor.

5.3 Stage III – Negotiation Costs

Proposition

The third stage of the Roeber model is that spot prices will be fed back into forward and long-term contracts; as with the previous stage, the TCE-adapted model concurs with Roeber but grounds the claim in a broader context. In addition to information costs, the TCE model claims that negotiation costs will be higher in spot
contracting and market participants will seek to economise on these costs, through standardised indices, contracts and trading mechanisms. The two models are again complementary for this stage.

Data

The process of establishing an LTC – particularly with some of the North Asian utilities – was long and costly. Marketer #1 said:

“You’ll [present them with a contract] and say, ‘This is our draft.’ They’ll look at it, and go back to you, and back and forth a dozen times, agree all the shipping terms and all these sorts of things, and you have it there in black and white, and you’ll get internal legal review, and it’s up to the other side to get internal legal review for their part. Then you come back and you have a signing ceremony, or whatever, and away you go.”

This process could involve multiple rounds of negotiations and multiple visits by the seller to the buyer. Once the LTC was established, annual price negotiations could also be costly:

“The initial [annual] negotiation with [a JPU] was long. It would probably start in December and finish – hopefully – by the end of March. [...] Negotiating with the Japanese wasn’t easy. They were very bureaucratic.”

In contrast, spot negotiations were also said to be burdensome but in different ways. Trader #1 noted that during the 1980s and 1990s, a JPU might purchase 50-75% of a mine’s output; Marketer #1 explained that an individual spot contract could be far easier to arrange but was burdensome because of the sheer quantity of contracts required. Whereas 1Mtpa of volume could be sold through a single LTC, selling in Panamax-size cargoes would require 13 separate deals, each of which required contractual agreement on price, quality, delivery and payment terms. Clearly, such negotiations were costly.

The first major step in reducing these costs was SECA, the Standard European Coal Agreement, which was jointly produced by Spectron Global Markets (which would
SECA reduced negotiation costs in two ways: first, the contract enabled trade through the Enron Online web platform and second, the contract standardised quality and contractual terms for the first time. Trader #6 noted that it was 15 pages long, which was a “very long, very detailed” contract for the time; the contract was more complete than many spot contracts, which meant it was robust enough for general use. The trader also commented:

“It was trading physically, so a physical contract, most people were trading it such that it was being closed out\textsuperscript{24}, hardly anyone was taking physical delivery. Back in those especially, the coal quality was too broad, in our view, so very few people took physical delivery.”

The contract did not survive and was soon superseded by SCoTA. SCoTA, the Standard Coal Trading Agreement, was developed by globalCOAL to support its platform in the same way as SECA supported Enron Online’s coal platform. This contract featured quality and delivery terms specific to each of the major trading hubs and remains the only standardised contract which is used globally. Trader #5 described it as “very strong”. Marketer #1 commented that SCoTA had reduced the contractual arrangements:

“A lot of the SCoTA deals nowadays, it might be a one-pager. It might say, we’re going to sell you this volume, this quality, this is the money, all terms as per SCoTA.”

In other words, the contracting process was reduced to a few points of negotiation and a term sheet: a far more economical way of trading than writing individual contracts for every separate spot transaction. Trading online through the globalCOAL platform reduces costs further. Trader #6 explained:

\textsuperscript{24} ‘Closing out’ before the contract expiry meant the contract was being used as a vehicle for hedging or speculation rather than the actual trade of coal.
“[You can] buy and sell coal against a standardised contract [SCoTA] where nothing changes other than price, volume and maturity, online. With a couple of clicks of a button, you could have bought or sold tonnes.”

The other major reduction in costs came from the use of index, rather than negotiated, pricing. Marketer #2 noted the requirements of establishing an accepted price index:

“…there are three things you need with an index: robustness of calculation, that’s industry accepted; support by the industry; and the frequency of the trade. If you have those three elements, it becomes more accepted.”

Trader #5 described the process of becoming convinced that the globalCOAL index was not prone to manipulation, and could be used as the basis of pricing in contracts:

“This is not a reflection on the index or the system as such, it’s more a reflection on what we thought people could do. They could drive [prices] to a prescribed end for themselves but when we saw the methodology that was set up and the protections that was set up, we got more comfortable with what was going to happen on there. [...] We were concerned that you could have someone bidding $1 and someone offering $200, to get the $100 number. And one day they only did $1, so therefore the index came down. Then we saw the rules and regulations, the caps and collars that were in, and we started to get some more understanding that this does actually have some legs to it. And the performance was critical.”

Once the index was found to be reliable, it could be used as the pricing basis for forward contracts. For example, parties contracting today for delivery in three months’ time could substitute a negotiated price for the index price on the day of delivery. The same was true of LTCs, as Marketer #2 noted:

25 The index price is a daily average.
26 For some time, globalCOAL had limits on the range by which prices could move in a single day. While limits no longer apply, all bids, offers and transactions are audited daily to ensure the system’s integrity.
“I think for producers, [it] actually helped us because, by having an index-linked pricing mechanism, we’re less about arguing about the absolute price and more about arguing the differential versus that index. Which means that your differential of bid and offer – your spread between the consumer and the producer – is much more narrow, which means hopefully you can get a negotiation done quicker.”

Since the spot market developed, the cost of negotiating has fallen as contracts became standardised, as online platforms such as globalCOAL emerged to make negotiations faster and simpler, and reliable indices enabled participants to reduce the time and energy spent negotiating on price (price feedback). As index-linked pricing depends on the development of indices, the move to minimise negotiation costs necessarily follows (in part) the move to minimise information costs. This confirms the third stage of the model: that participants would seek to economise on negotiation costs.

Other Observations

A factor emerged in the research which appeared to be relevant but for which there was insufficient evidence to draw conclusions. Several participants noted that contracts had become more legalistic and complete, which would undoubtedly have raised negotiation costs. It is unclear whether this transformation began with the development of the spot market or was caused by some later phenomenon. It seems to reflect a growing danger of transactions ending up in legal disputes, as Marketer #3 noted:

“Ten years ago, you would never take a customer to court because it’s important for the long-term relationship, the long-term contract. Now, if they want to walk on a contract and there’s a contract signed, bang, you take them to court.”

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27 Differential here refers to the premium or discount to the index made for differences in the quality of coal.
Alternatively, it may be an efficient response to the rising costs of enforcing contracts (which are discussed in Section 5.5). There is simply insufficient data to account for this phenomenon at present.
5.4 Stage IV – Uncertainty

Proposition

The final stage of the Roeber model is financialisation, or the development of financial products which derive their value from a commodity price index. The final stage of the TCE-adapted model again grounds the Roeber model’s claim in a broader context. Having minimised information and negotiation costs, the TCE model claims that market participants will then seek to minimise the uncertainty which is created from trading in a spot market, particularly uncertain future cash flows from forward contracts linked to index prices, and uncertain future states of the market. As financial products are central to economising on these costs, the two models are again complementary.

Data

Trading in any commodity spot market leaves firms exposed to uncertainty. As Marketer #3 noted:

“Spot contracts are a highly volatile pricing environment. [...] The market as such, even though it’s a very large market, it’s a very finely balanced market, the international seaborne thermal traded market. What happens is that when you get a perceived shortage of supply, you get this massive drive in pricing, and when you get a perceived oversupply ... you get the poor prices you have today.”

Most participants noted that, given the volatility of the market, price is one of the fundamental risks to any business, and needs to be managed. Given this volatility, Trader #2 explained how traders manage their risk:

“We’ll manage it in two ways. We’ll either manage it through the financial products ... or manage it through other physical contracts, offsetting physical contracts that we can negotiate as well. [...] We’ll take the position on and at some other point, we’ll enter into another physical contract which is designed to defray that risk.”
For participants in the spot market in the 1980s and early 1990s, there was no way to manage this risk except for offsetting contracts (which were only practical for traders). Trader #5 noted (of the early 1990s):

“There was no futures market, there was no derivatives, there was no paper and no opportunities to have a hedging business.”

Firms lacked the tools for managing price risk. Those who traded in other commodities could see the tools which were available in other markets and soon began looking at the prospects of bringing them to coal. One trader, who had experience in the development of the swaps market, explained:

“I spent a lot of time learning what was happening in more mature markets – oil, grain, etc – and when you drill down to it, there’s not a huge amount of difference between coal and oil, or even grain for that matter, the way it trades or the way it moves.”

Trader #3 explained how the market then came into existence:

“As the power markets did become liberalised and you got less engineering influence in the purchasing decision and more economists’ interest, you started to see people with new techniques, who were new to the coal industry, and new skill-sets, becoming involved in wanting to try and hedge paper markets. [...] Gradually, over the 1990s, small volumes of swaps started to emerge. Mostly on a trial basis to begin with. It was less speculative in most cases, it was buyers of coal needing to hedge their dark spread ... so they were able to lock in margin between the coal price and the power price.”

Trader #6 concurred:

“This was the infancy of the swaps market, trading against API 2 – which is what we have today – but all this was happening because you had a group of participants in the industry who were interested and were trialling it, back at this time. [...]That was all 2000-ish, end 1999, beginning 2000. The
API 2 market was an experiment to start with, it was just like people playing games because you couldn’t really lose or make too much, and then it got a certain critical mass and the limits of what you could lose or make disappeared. It just grew from there. That’s all happened in the last 13-odd years.”

The development of the swaps market meant any participant with exposure to a floating price could exchange it for a fixed price. This allowed participants to enjoy the benefits of fixed prices without incurring the transaction costs of entering into LTCs. It also meant each party to a transaction could fix prices independently – one party could have a floating price, the other could have a fixed price; one party could immediately fix the price on signing the contract, the other could wait six months. The flexibility of swaps contracts\(^\text{28}\) enabled participants to reduce uncertainty without having any effect on the physical counterparty.

Trader #1 found the swaps market to be an excellent tool:

“We traded the swaps markets until our eyes fell out. We loved it, it was fantastic. People got in there and said, “It’s too dangerous.” Hey, if you’re going to give me a swap today for [coal in] two years’ time at $150/t\(^\text{29}\)? Money for jam. So the market goes to $200? Who cares? I still make $75/t on a piece of paper transaction!”

The development of the futures market further improved the ability of market participants to minimise uncertainty. Like swaps, futures enable price risk to be hedged through offsetting contracts. Unlike swaps, futures were centrally cleared, which reduced the risk of a counterparty defaulting on payment, and standardised, which allowed for a large, liquid market to develop. This liquidity is partly provided by banks, hedge funds and others who may not participate in the physical market; the ability to trade in the absence of a physical transaction enables prices to move in response to new information, far faster and easier than they can move in the

\(^{28}\) Swaps contracts are bespoke products which can be customised to suit the swap buyer’s requirements.

\(^{29}\) At the time of the interview, the coal price was approx. $75/t
physical market. Reduced risk and greater liquidity also meant the bid/offer spread was narrower and the product was therefore cheaper than corresponding swap contracts.

A major advantage of the futures market was the ability to view transaction data for coal to be delivered as many as four years into the future. This data provided participants with the ability to see the market value of coal – not an estimate or forecast, but actual transaction data. When asked about the reliability of the information, Trader #1 responded:

“As good as the numbers anyone wants to put there. If you think the market should be up, go and do it. Go and put them there. I put a lot of pressure on [globalCOAL] to allow a bigger range. If I think the 2016 [price] should be $200, and I can argue that case, I think it should go on there. And if you think it shouldn’t be there, well take me out. Whichever side of the equation you are. If you think my number is too big or too small, smack me and take me out of the game.”

Unlike the forward curves provided by the news agencies, the futures market provides data which is supported by actual transactions and the prevailing market price represents the weighted average of price expectations of those who are part of the market. Accurate knowledge of future prices is incredibly beneficial for physical producers and consumers, as Trader #5 explained:

“If you look at the current scenario we’re in, where we’re almost at the cost of production, if there was no future, then CFOs would have made the decision to cut down mines. But because they can see a [forward] curve in front of them that they can theoretically trade into, they can see future returns which allow them profitability.”

The ability to view future prices helps firms to reduce their uncertainty about the future conditions of the market. Without such knowledge, firms may engage in expansions or shutdowns in response to temporary market conditions, which may create greater volatility in the future. Futures prices also enable temporal arbitrage,
in which traders can shift product from periods of relative oversupply to periods of relative undersupply (as indicated by low and high prices, respectively). This reduces price volatility over time and reduces the likelihood of periods of extreme gluts or shortages.

By trading long-dated futures contracts, physical market participants are able to hedge their exposure to future changes in price, further reducing uncertainty. A producer has a natural long position in the market, meaning the firm will benefit if prices rise; by selling futures contracts one and two years ahead, the firm can reduce its long position and its risk profile.

A third financial product, coal options, also exists in the market although there is limited evidence for the extent to which they are used. Marketer #2 explained the limitations of options for coal:

I’d say the banks offer these types of services and some of the traders will be happy to make markets and/or trade options. But if you think about options, the beauty of an option is that it allows you to buy insurance. That’s all it is, a form of insurance. If you’re selling it, you’ve got unlimited risk. If you’re buying it, you’ve got your margin – or your premium – that you pay. But the premium you pay in the oil market is small; in coal, it’s high, because there isn’t a lot of liquidity in the underlying instruments that you’re writing options on.”

Since the spot market developed, market participants have faced uncertainty about cashflows and future states of the market. This uncertainty has been reduced over time, as financial products have been developed which enable positions to be hedged and information about future prices to be determined. As each product depends on the development of indices, the move to minimise uncertainty necessarily follows (in part) the move to minimise information costs; as the physical delivery of product under futures contracts requires standardised agreements, the move to minimise uncertainty also follows the move to minimise negotiation costs.
This confirms the fourth stage of the model: that participants seek to reduce uncertainty.

*Other Observations*

Although futures contracts enable participants to create hedge positions, one trader explicitly warned of the risks which financial products can create. When a profit-making physical position is offset by a loss-making futures position, a firm may be in a state where it is making neither a profit nor a loss. Unlike the physical position, the futures position is marked-to-market, where the firm is required to cover its losses at the end of each trading day. When prices move far beyond their initial values, the firm is required to post large sums of collateral to cover losses on the futures position without receiving any collateral from the physical position. It is possible, the trader warned, for a firm to be “margined out of existence.” This demonstrates that the use of financial products may eliminate some forms of uncertainty but it does not eliminate the risks faced by firms.

5.5 Enforcement Costs

*Proposition*

The TCE-adapted model claims that each stage of market development has a role in reducing a specific cost of transacting: opportunism, information costs, negotiation costs and uncertainty. The literature identified an additional cost – that of monitoring and enforcing contractual agreements – which does not appear to have a distinct stage in market development. However, market participants do appear to engage in behaviour to economise on enforcement costs throughout the development of the market.

*Data*

Almost all participants agreed that trust was one of the most important parts of the coal industry culture. Trader #1 described trust in the industry by saying:
“It’s probably one of the most honourable businesses on the planet. That’s how good it is. I have done multi-million tonne deals on the back of coasters. They are actually in the files, on the coaster. Where we’re sitting here, we’re talking, we’ll write it down, there’s the deal. We might write two coasters out so he’s got one. [Laughter] It is a very, very honourable business.”

He went on to explain the concept:

“Honour in the business of meeting your commitment is really what it’s about. That’s what it’s about. It’s about meeting your commitment to somebody. If you’re committed to the business, that’s what you want.”

Trader #2 added:

“I think the fundamental premise is that you have a relationship with someone that is built on mutual trust and looking after each other and those principles haven’t changed. If you do the right thing by someone, they’re going to do the right thing by you – generally. But if you try and screw someone, you’re likely to get it back.”

Trader #8 echoed a common view of the origins of this phenomenon:

“If you’re underground, or you’re in an operation, everybody is responsible for everybody else, whether that’s from a safety point of view or production efficiency point of view. There is a multi-generational culture over hundreds of years of, despite being very different personalities, bonding as crews and teams together. I think it’s very much part of the culture.”

Although this may well be the case, the role of trust appears to have an important role in the operation of the market: first, trust was often viewed as a willingness to perform a contract even when it was no longer efficient for that firm to do so. Trader #6 explained such a situation for a producer who is out of the money:
“They’ve really only got two choices in today’s world: they either take the coal and put it on the ground and just bear the cost, or they say, ‘Listen Mr Producer, I’ve had an issue with my station, I can’t now perform. You sort it out.’ We don’t see that, in the more deregulated, it’s just not acceptable. You can try and not perform, if you don’t like the price, but not too many people are going to do business with you thereafter, because it’s all about performance.”

He went on to explain the behaviour of some Asian buyers:

“In Asia – other than maybe Japan – generators and the way they risk manage, they go, ‘Oh, I’ve bought this coal last year at $200/t, the market’s now $100/t’, and they do everything they can not to perform that. They’ll try and not perform, try and delay the cargoes because they’re too high a price, and they look stupid because they’re now taking delivery of coal at $200/t when the market’s really $100/t.”

The consistent message from marketers and traders was best expressed by Trader #1 who linked trust to reputation and commented that, “It’s one of the few things you hold in the game.” Trader #6 went on to link trust to the willingness of others to transact with a particular firm:

“The business that we do in our life, where we do the biggest business or the biggest contracts, they were the companies we had the best relationships with, where we get on and will work together, not against each other. ... [Defaulting] might be good today for them or me, but you don’t want to do just one trade in life, the idea is that you want to trade as much as you can. Liquidity is the most important factor in any of this. When you buy something, you want to be able to sell it. Or when you sell something, you want to be able to buy it. You don’t want to be getting into a market where you can’t buy or sell it, you want to be buying and selling as much as you can – or having the ability to buy and sell as much as you can at any given time. More liquidity is the most important thing about any mature marketplace.”
Trust and the belief that a counterparty will perform a contract, regardless of circumstances, clearly plays an important part in the willingness of a firm to transact with another. Trader #2 expressed a common view, saying:

“We’ve got a pretty stringent process before we’re allowed to trade with anyone. We try and vet them.”

This is an institutionalised feature of globalCOAL, as Marketer #3 added:

“To be able to trade on globalCOAL, there is a standard agreement called SCoTA. In order to sign a SCoTA agreement, you need to have already executed an agreement with the guy with whom you’re trading.”

When firms failed to perform contracts, agreements to trade could be revoked and a firm could suddenly find itself with far fewer potential counterparties. This reinforced the important of trust and reliability in the marketplace.

Trust was also linked to a willingness to show flexibility when a situation demanded it. Trader #6 explained:

“If you’re doing business against a commoditised, standardised contract, they’re very black and white – very contractual, very prescriptive. They don’t really have much in the way of grey area. [...] When there’s a problem, or things don’t quite go the way you expected, it becomes very difficult, but if you know that person, know them well, got a good relationship with them, you make it work. It’s a bit of give and take, if you help someone out today then hopefully they’ll help you out later. That’s very important. It can be the difference between making and losing a lot of money in these markets.”

Trust is linked to performance and flexibility, two vital elements for ensuring that contracts are able to be completed. This informal method of increasing the likelihood that agreements will be executed to the mutual satisfaction of the contracting parties is more important in coal than some other markets due to the difficulty of enforcing contracts. When asked about enforcing contracts with Chinese counterparties, Trader #5 responded:
“I’ll just be brutally honest, it’s China Inc. It’s the state enterprise, the whole country is a state enterprise. If you have any defaults, you’re basically dealing with the state. Legal recourse is long and painful, very long, very painful, and probably fraught with low levels of success.”

Trader #2 explained added:

“Ultimately, you can enter into a deal with someone and have something on a piece of paper but no one wants to end up in court, so it comes down to relationships and how you manage relationships.”

Several participants noted that instances of arbitration or legal disputes were relatively rare, although one marketer showed a greater willingness to engage in legal recourse than any other participant. It seems likely that informal mechanisms – such as reputation and the ability for news of non-performance to spread throughout the industry and lead to a loss of liquidity – are a powerful tool in the market for ensuring contracts are respected, and are, in general, a more economical solution than legal disputes.

Interestingly, while all traders expressed a view that trust was equally or more important since the spot market developed, three of four marketers expressed the view that it had become less important. There is an absence of evidence to draw conclusions for why this may be the case.

5.6 Conclusion

The data collected from this research project found clear evidence supporting the TCE-adapted model. In the first stage, evidence supported the claim that the development of the spot market was triggered by the declining risk of opportunistic behaviour and the rising costs of fixed-price LTCs. In the second stage, evidence supported the view that large information costs led to the emergence of news reports, price indices and brokerages, leading to an economical and transparent market. In the third stage, evidence supported the claim that large negotiating costs led to the emergence of standardised contracts and trading platforms to
economise on such costs. In the fourth stage, problems of uncertainty led to the emergence of financial products which reduced risk and provided market participants with greater certainty about future cashflows and product prices. Throughout these stages of development, evidence supported the emergent view that large enforcement costs meant trust was used as a tool to ensure contractual performance. The TCE-adapted model was therefore supported at all stages by the evidence and has been found valid. It significantly outperformed the existing Roeber model, by expanding the claims of what events transpire at each stage of development and by identifying the underlying economic causes in the market’s development. It can therefore be concluded that the TCE-adapted model offers a superior explanation of the causes and explanation of the development of the global thermal coal market.
Chapter 6: Discussion

6.0 Introduction

This chapter will consider how this research project contributes to answering the research questions posed in Chapter 2. Section 6.1 will summarise the relevant literature and revisit the gaps to be addressed. 6.2 will summarise the project and discuss the contribution made towards filling those gaps. The implications of the work for the industry and government are explored in 6.3, followed by a discussion of avenues for future research – including operationalization of the model and potential application in other commodity markets – in 6.4. Section 6.5 considers the project’s limitations before 6.6 concludes the chapter.

6.1 Research Gap

This section will revisit the key literature and identify the gaps and research questions which were examined in this thesis.

6.1.1 Literature Summary

The discussion in Chapter 3 of the relevant literature on transaction cost economics (TCE) is dominated by the contributions of two particular theorists: Ronald Coase and Oliver Williamson. This project relies on key ideas from both as the theoretical foundations for the proposed model.

Williamson’s work demonstrated that, when firms face the threat of opportunistic behaviour, they seek to change the governance structure of the commercial relationship (Williamson, 1999). When the threat of opportunism is large (and depending on other variables, notably asset specificity and transaction frequency), firms will enter a more hierarchical structure, such as vertical integration or complex contracting (such as long-term contracts). Alternatively, when this threat is low, firms will opt for a market-based structure, such as one-off spot contracts. When the threat of opportunism changes, so too does the governance structure; in turn, this leads to changes in incentives and transaction costs (Williamson, 1993).
Coase’s work demonstrated that these transaction costs are significant and firms will naturally seek to economise on them (Coase, 1937). Dahlman (1979) provides three categories into which transaction costs can be sorted: information costs, negotiation costs and enforcement costs; to this, uncertainty can also be added (Joskow, 1988).

Also discussed in Chapter 3 was the literature on the development of the modern international market in thermal coal, which was largely a response to the OPEC oil shocks of 1973 and 1979 (Ekawan & Duchene, 2006). The trade was initially high concentrated, with demand dominated by national electricity companies and supply dominated by the few producers with export capabilities (Ekawan, Duchene, and Goetz, 2006). Buyers often underwrote the development of new mines and export infrastructure, in relationships governed as joint ventures (JVs) or long-term contracts (LTCs).

By the turn of the century, both sides of the market had become much more competitive and spot contracts had come to dominate governance arrangements. Deregulation of wholesale and retail electricity markets, privatisation of national electricity companies, and pro-competition policies had led to an expansion in the number of firms on the demand side, alongside demand growth as a result of increased populations and income (Schernikau, 2010). The supply side had also expanded with the entry of many new producer firms (most notably Xstrata, now the world’s largest thermal producer) and some new producer nations (such as Indonesia) (Lucarelli, 2011). The growth in the spot market, which is believed to have begun operation in the early 1980s, was accompanied by the emergence of related firms, including traders, brokers, news reporters and later by online trading platforms and financial products (Schernikau, 2010).

According to Li (2010), the market is now approaching maturity; this conclusion was based on an analysis using a model originated by Roeber (1996) from empirical work in the global oil and UK domestic gas markets. The Roeber model identifies four stages of market development, including physical balancing, price transparency, price feedback, and financialisation. Although this model had been
successfully applied to several markets, it had been developed without theoretical foundations and no study had attempted to explain the phenomena underlying the model. This was identified as an important gap in the literature. This research project sought to investigate the potential for a synthesis of the Roeber model with TCE, in order to provide a theoretical foundation for the model and to explain the phenomenon of commodity market development.

6.1.2 Research Questions

The literature review highlighted the existence of an empirical model for commodity market development which lacked theoretical support, and a body of theoretical work which could account for some phenomena in the market but had not yet been systematically applied to the development of these markets. A gap therefore existed which allowed the two to be synthesised into a single model. The following research questions were therefore selected for investigation:

- What factors were causally responsible for the development of the global thermal coal market?
  
  a) Do current theories adequately explain what has been observed?
  
  b) If current theories are limited, how can they be improved?

6.2 Research Project

This section will discuss how the research questions were investigated. The proposed model will be summarised before the details of the fieldwork are explained and a response to the questions offered.

6.2.1 Model Summary

The proposed model is a synthesis of the empirical model developed by Roeber (2010) with the theoretical work of transaction cost economics (TCE). The model adapts the four stages of development identified by Roeber and interprets each stage in light of the underlying shift in transaction costs. The below table shows the stages.
<table>
<thead>
<tr>
<th>Stage</th>
<th>Roeber Model</th>
<th>TCE</th>
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<tbody>
<tr>
<td>1.</td>
<td>Physical balancing</td>
<td>Reduction in risk of opportunism</td>
</tr>
<tr>
<td>2.</td>
<td>Price discovery</td>
<td>Reduction in information costs</td>
</tr>
<tr>
<td>3.</td>
<td>Price feedback</td>
<td>Reduction in negotiation costs</td>
</tr>
<tr>
<td>4.</td>
<td>Financialisation</td>
<td>Reduction in uncertainty</td>
</tr>
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</table>

The first stage marks the origin of the spot market, growing out of an existing integrated market (that is, a market characterised by joint ventures and long-term contracts). Roeber claims that this is a consequence of misaligned schedules between producers and consumers – one party eventually ends up with a vast surplus or deficit of product and is forced to begin trading on the spot market. TCE would suggest that such problems may be coincident but the key driver is likely to be a shift in the underlying threat of opportunism. If the market has experienced growth in the number of participants and the volume being traded, the costs of any opportunistic behaviour are reduced; if such costs are reduced beyond a certain point, it will become more efficient for a firm to trade via spot markets rather than within a long-term contract.

The second stage marks the entry of intermediary firms to the market. Roeber’s model identifies price transparency as the key development at this stage, as prices become visible to the market; this occurs first through gossip and then progressively becomes more professionalised and structured (first as news reporters enter the market and then as formal price indices are established). TCE concurs that transparency is the key development at this stage but claims it is part of a larger shift towards reducing the information costs of market participants. It explains the entry of traders, brokers, news reporters and indices as efficient methods of reducing information costs.

The third stage of the model is where transparent prices are recognised by market participants as being a reliable indicator of the product’s true value and are adopted for use within forward contracts (spot contracts negotiated months in
advance of delivery) or long-term contracts, in lieu of negotiated prices. TCE suggests that the underlying phenomenon at this stage is the reduction of negotiation costs, and effects are wider than the use of price indices. Standardised contracts also emerge at this time, which in turn enables the establishment of central trading exchanges (both physical and digital). Both of these also reduce the negotiation costs incurred by market participants.

Roeber labels the fourth stage as financialisation and describes it as being the introduction of financial products based on commodity prices, including futures, swaps and options. The data generated through the prices of these products enables the construction of a forward curve, which provides insights into the price of the underlying commodity at various points in the future. It is the final stage of development as it depends on the introduction of price indices (in the second stage) and their adoption in forward contracts (in the third stage). The ability to trade these products without any physical interest enables financial investors (speculators) to participate. TCE interprets these products as reducing uncertainty for market participants, by removing price risk for future transactions (futures, swaps) and for future investments (forward curve). According to Li (2010), progression through this final stage represents the maturity of a commodity spot market.

This represents the synthesis of TCE theory with the empirical observations of Roeber. The next subsection will describe how this model was tested.

6.2.2 Research Summary

Although the proposed model offered a plausible account of a commodity market’s developed, it was necessary to test the model and investigate its validity. The ideal way to test the model would be to compare the transaction costs of alternative governance structures for each stage of development, and determine if the proposed model did, in fact, minimise costs. As such data depends on information which cannot be known, a qualitative method was selected to acquire information from participants in a commodity market and determine the reasons why
developments occurred. These were then subjected to direct content analysis to determine if this data supported the proposition. The global thermal coal market was the ideal commodity market with which to test the proposed model as it had recently developed and was highly accessible to the researcher.

Qualitative data was gathered through a dozen interviews with highly experienced coal market participants, each of whom had between 10-35 years of experience in the thermal market. Present roles included chief executive officers, general managers of coal marketing, heads of coal trading, and others; participants worked at a variety of companies, including listed coal producers, listed financial institutions, and major coal/commodity trading companies. Participants were based in Australia, Europe and Asia. Nine interviews were conducted in person and three interviews were conducted over the phone, as the participants were overseas at the time; these were conducted in the last quarter of 2013.

The conclusions of the research (in Chapter 5) strongly supported the adapted model of commodity market development, in the context of the thermal coal market.

6.2.3 Contribution

The research demonstrated the significant role played by transaction costs in the development of the global thermal coal market. It also provided clear answers to the research questions, which are discussed in this subsection.

The first question asked what factors were causally important in the market’s development. Transaction costs were unambiguously the key factor, but it was instructive that only two of Dahlman’s (1979) three cost categories (information and negotiation costs) were drivers of development, while the third (enforcement costs) was barely supported. It appears that enforcement costs may be minimised regardless of governance structure, whether hierarchical or market, and that shifts between the two do not cause any change in the incentives regarding minimising enforcement costs. It was also interesting that another category, uncertainty, emerged as an important factor which drove the final stage of development.
(financialisation). Although uncertainty has been present in TCE research, it had not been expected to play a major role in this research prior to fieldwork. The importance of uncertainty to TCE has been confirmed by this study, at least as it extends to commodity markets.

The second question asked if current theories adequately accounted for development. Given the confirmed validity of the proposed model, it would appear that existing work was inadequate to fully explain development. The Roeber model’s lack of theoretical support meant it could not explain the phenomena underlying development, why markets developed in this particular way, or identify the triggers for development. Existing TCE research offered the theoretical support to explain these shifts but had not been systematically organised and applied to explaining the development of commodity markets such as thermal coal.

The third question asked how current theories could be improved. Clearly, the synthesis of empirical with theoretical work has led to a model which appears able to explain the path and drivers of commodity market development in a relatively predictable manner. This is superior to the current literature and represents a contribution to the identified literature gap.

6.3 Implications

The research confirmed Roeber’s basic path of commodity market development and found that transaction costs were indeed a key driver of that process. This finding has implications both for market participants and governments.

6.3.1 Market Participants

There are three main implications for the industry: first, the key role played by transaction costs in development; second, the nature of competition amongst intermediaries; and third, the potential for market reversion. Each will be briefly discussed in this subsection.

First, the role of transaction costs is not well-understood by industry as a driver of change. Participants recognised the spontaneous nature of change in the market
and recognised the value of innovations (albeit often after the fact) but the systemic nature of change was not identified by any research participant or previous researchers. A deeper understanding of the role of the transaction costs in driving change would help market participants to understand changes occurring in commodity markets and, at a general level, allow for some predictability.

Second, the model shows that intermediary firms face direct competition from other firms selling the same product (as is already well-understood) but also face indirect competition from firms seeking to reduce the same transaction cost. For example, a news agency like Argus must compete with other agencies (such as Platts) but also compete indirectly with brokers, who also seek to reduce information costs. Given the powerful economies of scale at work in bulk commodity industries, this suggests long-run competition is likely to be between several large, hyper-efficient cost minimisers, rather than being restricted to competition within a product category.

Third, this model suggests that the market’s development is not a one-way evolution but could potentially revert to a predominately hierarchical structure. This outcome is unlikely, but possible. Should the potential costs of opportunism grow on one side of the market – perhaps due to a concentration of supply – it could drive the other side to more integrated governance structures (eg LTCs). The risks and impact of opportunism would need to be substantial for this to overcome a spot market which has grown increasingly efficient with progression through the stages of development, but it nonetheless remains a plausible outcome.

6.3.2 Government

The model also has implications for policymakers and regulators. These will be discussed with reference to two major issues in commodity markets at the time of writing (March, 2014): the European Commission’s (EC) investigation into how Platts sets prices with its oil indices; and the proposed restrictions on banks trading in commodities by the Dodd-Frank legislation and the Commodity Futures Trading Commission (CFTC) in the United States.
The ongoing investigation into Platts is based around concerns that its oil indices may have been manipulated in the same way as the London Interbank Offered Rate (LIBOR) market. Instead of relying on actual price data, the index is generated through the collection of various bids and offers for a particular product. There are concerns that false information was submitted to deliberately raise or lower the day’s index value, which can then influence the price at which contracts or futures prices settle (and consequently the profits or losses which may be realised from holding those contracts). As this investigation is ongoing and no report is yet available, it is not possible to say what the EC will conclude or recommend, but the model proposed in this thesis shows the important role which is played by price indices in reducing transaction costs for all market participants. Where regulation interferes and raises the cost of using spot prices, it may lead to an outcome where some participants find it more efficient to use LTCs. This reduces the efficiency of the overall market and demonstrates the potential for regulatory changes in tightly-connected commodity markets to have far-reaching and unintended consequences.

The implementation of the Dodd-Frank legislation by the CFTC offers a similar lesson for policymakers. While the details of the rules have not yet been finalised, proposals are expected to put limits on the size of positions which financial institutions (particularly banks) can take in commodity futures markets, or their ability to trade with proprietary (internal) funds. While the details of this change are not vital, the effect will be a reduction in the number of firms operating in the financial commodity markets, leading to a loss of liquidity, less efficient pricing and an increase in uncertainty for physical market participants. Regulatory change has the ability to cripple the trade in commodity futures, which would prevent market participants from accessing reliable forward curve data and potentially leading to inefficient future investments. This is not an argument that the Dodd-Frank rules should not be implemented, but an observation on the importance of identifying the mechanisms by which regulatory changes may impact markets and that such impacts be considered as part of any cost-benefit analysis.

6.4 Further Research
This subsection discusses the prospects for further research resulting from this research. In particular, it considers how the claims of TCE may be operationalized to provide quantitative results on market development and then how the model proposed by this research may be applied to guide industry practice or government policy selection.

6.4.1 Operationalisation

Recent developments in the field of transaction cost economics have meant that the concept has greater potential for operationalization. Williamson (2009) discusses the specific requirements for successful operationalization – in particular, a focus on a specific phenomenon (in this case, contract selection), the measurement of several key dimensions (such as asset specificity, uncertainty, etc) and comparison between alternative governance modes. Given adequate access to corporate records and decision-makers, it may be possible for future researchers to construct broad estimates of transaction costs and to determine if the chosen approach did (or was expected to) minimise such costs. This would require a high degree of cooperation from the firms and agents, which would be difficult in an industry that has been described as secretive (Kernot, 2000) but is theoretically possible. It would yield quantitative evidence and provide interesting complementary or contrasting results with the findings of this research project.

6.4.2 Application

The proposed model was validated through the global thermal coal market but appears likely to be applicable in other commodity markets. This subsection will discuss the potential application of the model to global iron ore, metals and natural gas markets.

Iron Ore

Iron ore is a commodity used for the production of iron and steel; it is principally extracted in Australia and Brazil for consumption predominately in China (BP, 2012). Until recently, the trade was almost entirely conducted within vertically-
integrated firms or long-term contracts with annual pricing, but this is now shifting to quarterly and monthly pricing under spot contracts. Financial products have recently been offered but it is unclear if these will be successful.

The recent development of this market and close parallels with the thermal coal market presents an opportunity to test whether the model can also explain this phenomenon. Should such a test be successful, it would confirm the importance of transaction costs in driving bulk commodity market development.

**Base and Precious Metals**

The metals group of commodities is a large and varied assortment of products which include precious metals (such as gold, silver and palladium) and base metals (such as copper, iron, lead, and nickel). These markets vary widely in their states of development: some are relatively mature, with centralised trading platforms and financial derivatives, while others are traded without any apparent signs of standardisation or financialisation.

Research into these commodity markets would offer an opportunity for broader testing of the proposed development model, may also provide insights into the different speeds at which markets develop, and how smaller markets may develop differently to larger markets.

**Natural Gas**

Roeber’s initial model was partly based on his experience in the UK natural gas market, well before the global market began to develop. Since that time, the global market has been dominated by product from Russia and the Middle East being sold into Europe and Asia, predominately under LTCs. More recently, new entrants to the global market have emerged in Australia and the United States, the former underwritten by LTCs with Asian buyers. US laws controlling the export of natural gas have created a domestic oversupply; combined with an undersupply (and consequently, exorbitant prices) in Asia, this has led some US producers to advocate for relaxed export controls. If this were to occur, the model would predict
a rapid change in the risks of opportunism, leading to the emergence of a global spot market for natural gas.

In this scenario, the proposed model may offer valuable insights to market participants on the likely path and drivers of development and an opportunity to test the utility of the model as a predictive tool.

6.5 Limitations

The principal limitations of this research is that the research was based on a relatively small (though highly experienced) pool of market participants and that, although it was able to incorporate the views of some buyers (as coal traders both buy and sell), it was not able to incorporate the perspectives of any pure consumers, particularly Asian originators, who have played an important role in the market’s development. The research is also limited by its ability to make estimates about the size and impact of transaction costs.

6.6 Conclusion

This chapter has discussed the project’s contribution to the scholarly literature of coal and commodity market development. It summarised the relevant literature on market development and transaction cost economics, identifying a clear gap and research questions. It discussed the synthesis of the two topics into a single model, discussed how the model was tested, and the contribution made towards the literature gap. Implications of the research for industry and government were explored, and avenues for further research were identified in both the operationalization of the model and the potential for it to be applied to other commodity markets. Limitations were identified and the chapter concluded.


Appendices

Appendix I: HREC Consent Form

**HUMAN RESEARCH ETHICS COMMITTEE**

**Notification of Expedited Approval**

| To Chief Investigator or Project Supervisor: | Doctor Andrew Nadolny |
| Cc Co-investigators / Research Students: | Mr Jonathon Deans |
| Re Protocol: | The Financialisation of Coal |
| Date: | 13-Jun-2013 |
| Reference No: | H-2013-0160 |
| Date of Initial Approval: | 12-Jun-2013 |

Thank you for your Initial Application submission to the Human Research Ethics Committee (HREC) seeking approval in relation to the above protocol.

Your submission was considered under L1 Low Risk Research Expedited review by the Chair/Deputy Chair.

I am pleased to advise that the decision on your submission is Approved effective 12-Jun-2013.

In approving this protocol, the Human Research Ethics Committee (HREC) is of the opinion that the project complies with the provisions contained in the National Statement on Ethical Conduct in Human Research, 2007, and the requirements within this University relating to human research.

Approval will remain valid subject to the submission, and satisfactory assessment, of annual progress reports. *If the approval of an External HREC has been "noted" the approval period is as determined by that HREC.*

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal Certificate of Approval will be available upon request. Your approval number is **H-2013-0160**.

*If the research requires the use of an Information Statement, ensure this number is inserted at the relevant point in the Complaints paragraph prior to distribution to potential participants* You may then proceed with the research.

***Please note/action the following:***

1. Amendments to the Information Statement.
   a. Please ensure that the version distributed to potential participants contains the University logo on page 1.
   b. Ensure the supervisor’s phone number is included in the letterhead details.
c. Under ‘What you are being asked to do?’ at the second paragraph, if there is potential for anyone other than the named researchers to undertake the transcription, this should be stated along with an assurance that the transcriber will be bound by a confidentiality agreement. If it is the researchers who will undertake the transcribing then no amendment is required.

d. Under ‘How will your privacy be protected?’ amend the word at lines 1-2 to “de-identified”.

e. At the complaints statement, note that the approval number is H-2013-0160.

2. Amendment to the Consent Form.
a. Must identify the project supervisor in the letterhead details (it’s fine to also include the student for contact but this can’t replace the supervisor’s information).
b. With regards to the consent process, the researchers may wish to note that return of consent under cover of a participant’s email would be acceptable (rather than having to wait till the beginning of the interview). If the researchers decide to change to this process, the Information Statement will need to be amended accordingly.

Please ensure a copy of the amended documents are submitted via email (human-ethics@newcastle.edu.au) for our file record.

Conditions of Approval

This approval has been granted subject to you complying with the requirements for Monitoring of Progress, Reporting of Adverse Events, and Variations to the Approved Protocol as detailed below.

PLEASE NOTE:
In the case where the HREC has “noted” the approval of an External HREC, progress reports and reports of adverse events are to be submitted to the External HREC only. In the case of Variations to the approved protocol, or a Renewal of approval, you will apply to the External HREC for approval in the first instance and then Register that approval with the University’s HREC.

• Monitoring of Progress

Other than above, the University is obliged to monitor the progress of research projects involving human participants to ensure that they are conducted according to the protocol as approved by the HREC. A progress report is required on an annual basis. Continuation of your HREC approval for this project is conditional upon receipt, and satisfactory assessment, of annual progress reports. You will be advised when a report is due.

• Reporting of Adverse Events

1. It is the responsibility of the person first named on this Approval Advice to report adverse events.

2. Adverse events, however minor, must be recorded by the investigator as observed by the investigator or as volunteered by a participant in the research. Full details are to be documented, whether or not the investigator, or his/her deputies, consider the event to be related to the research substance or procedure.

3. Serious or unforeseen adverse events that occur during the research or within six (6) months of completion of the research, must be reported by the person first named on the Approval Advice to the (HREC) by way of the Adverse Event Report form (via RIMS at https://rims.newcastle.edu.au/login.asp) within 72 hours of the occurrence of the event or the investigator receiving advice of the event.

4. Serious adverse events are defined as:
   o Causing death, life threatening or serious disability.
   o Causing or prolonging hospitalisation.
Overdoses, cancers, congenital abnormalities, tissue damage, whether or not they are judged to be caused by the investigational agent or procedure.

- Causing psycho-social and/or financial harm. This covers everything from perceived invasion of privacy, breach of confidentiality, or the diminution of social reputation, to the creation of psychological fears and trauma.
- Any other event which might affect the continued ethical acceptability of the project.

5. Reports of adverse events must include:
   - Participant’s study identification number;
   - date of birth;
   - date of entry into the study;
   - treatment arm (if applicable);
   - date of event;
   - details of event;
   - the investigator’s opinion as to whether the event is related to the research procedures; and
   - action taken in response to the event.

6. Adverse events which do not fall within the definition of serious or unexpected, including those reported from other sites involved in the research, are to be reported in detail at the time of the annual progress report to the HREC.

- Variations to approved protocol

If you wish to change, or deviate from, the approved protocol, you will need to submit an Application for Variation to Approved Human Research (via RIMS at https://rims.newcastle.edu.au/login.asp). Variations may include, but are not limited to, changes or additions to investigators, study design, study population, number of participants, methods of recruitment, or participant information/consent documentation. Variations must be approved by the (HREC) before they are implemented except when Registering an approval of a variation from an external HREC which has been designated the lead HREC, in which case you may proceed as soon as you receive an acknowledgement of your Registration.

Linkage of ethics approval to a new Grant

HREC approvals cannot be assigned to a new grant or award (i.e. those that were not identified on the application for ethics approval) without confirmation of the approval from the Human Research Ethics Officer on behalf of the HREC.

Best wishes for a successful project.

Professor Allyson Holbrook

Chair, Human Research Ethics Committee

For communications and enquiries:

Human Research Ethics Administration

Research Services
Research Integrity Unit
The Chancellery
The University of Newcastle
Callaghan NSW 2308
T +61 2 492 18999
Participant Information Statement for the Research Project:

The Development of Coal Markets. Version 1, 30 August 2013

You are invited to participate in the abovementioned research project that is being conducted by Mr Jonathon Deans and his doctoral supervisor, Dr Andrew Nadolny, from the Newcastle Business School at the University of Newcastle. The research forms part of the requirements of Mr Deans’ Doctor of Business Administration degree.

Why is the research being done?

Over the past decade, developments within the global thermal coal market have led to substantial change: the market has expanded in size considerably, prices have grown much more volatile, and financial coal products have become more widely used. Theoretical work suggests that the coal market is maturing but no empirical work has been done to investigate this phenomenon. Also, no work has yet proposed reasons why this development might be occurring.

The purpose of this research is therefore to investigate recent changes in the market, through a series of interviews with market participants. It is hoped that these interviews will provide insights into whether maturation is indeed occurring and to explain the drivers and implications of this process. A better understanding of the development of thermal coal markets may also yield valuable insights into the future development of other commodity markets, such as metallurgical coal and iron ore.

Who can participate in the research?

You are eligible to participate in this research project if you are a senior coal marketer/trader working for a coal producer, trader or end user and you have at least ten years’ experience in coal markets. From a list of GlobalCOAL market members, your firm has been identified because it has Australian operations which are accessible for this research project.
What choice do you have?

Participation in this research is entirely your choice. Only those people who give their informed consent will be included in the project. Whether or not you decide to participate, your decision will not disadvantage you. If you do decide to participate, you may withdraw from the project at any time without giving a reason and have the option of withdrawing any data which may identify you. If you decide to withdraw, all data related to you will be withdrawn and destroyed.

What you are being asked to do?

If you agree to participate in the project, you will be interviewed by the student researcher, Mr Jonathon Deans. During the interview you will be asked a series of questions about changes in the coal market, as well as the broad benefits and costs which you or your firm have experienced. This research does not intend to capture any confidential or private information.

With your permission, the interview will be recorded digitally and during the interview you can ask for the recorder to be stopped and edited or erased. The recordings will be transcribed and edited to delete or change any identifying information. Transcriptions will then be sent to you to review and edit as required.

How much time will it take?

The interview will take no longer than sixty minutes.

What are the risks and benefits of participating?

There is minimal, if any, risk to you if you participate in this research. You or your firm will not be identifiable in the published output from the research. While we cannot promise any direct benefit to you or your firm, better understanding of thermal coal markets would be of practical assistance to the profession, universities and future researchers.

How will your privacy be protected?

All information received from you will be strictly confidential. The transcripts will be de-identified first by the researchers and then checked by you to ensure there is no identifying information. Codes (such as ‘Trader #2’) will be used in place of names throughout the research. The consent forms and transcripts will be scanned and shredded. The recordings will be destroyed once you have verified the recordings, and kept in soft copy. The consent forms and transcripts will be kept on password-protected computers accessible only to the researcher. The data will be kept for five years after the approval of the dissertation.
How will the information collected be used?

The results from this research will be used as the basis for a doctoral dissertation investigating a theory of coal market development. The dissertation may then be adapted and results may be used in conference papers and other scholarly publications. Although no individual person nor firm is identified, some anonymous quotations may be used in reports and scholarly articles. You will be sent a summary of the results once the dissertation is approved.

What do you need to do to participate?

Thank you for reading to this point and considering this request. If you consent to participate, please read this Participant Information Statement fully and be sure you understand its contents. If there is anything you do not understand, or you have questions, please contact the researchers at the contact emails and phone numbers given above. After you have read and understood the statement, if you wish to proceed, please send a return email indicating your willingness to participate in an interview. Once received, we will reply to arrange a date, time and location convenient to you for an interview. We have attached a copy of the consent form for your information. You will be invited to sign the consent form immediately prior to the interview taking place.

Further information

If you would like further information please contact Jonathon Deans or Dr Andrew Nadolny. Our contact details are listed on the letterhead. Once again, thank you for considering this invitation.

Yours sincerely,

Mr Jonathon Deans                   Dr Andrew Nadolny
Student Researcher                  Research Supervisor

Complaints about this research:

This project has been approved by the University’s Human Research Ethics Committee, Approval No. H-2013-0160. Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or, if an independent person is preferred, to the Human Research Ethics Officer, Research Office, The Chancellery, The University of Newcastle, University Drive, Callaghan NSW 2308, Australia, telephone (02) 49216333, email Human-Ethics@newcastle.edu.au.
Consent Form for the Research Project:

The Development of the Global Thermal Coal Market
Document Version 1.1 dated 1 September 2013

I agree to participate in the above research project and give my consent freely.

I understand that the project will be conducted as described in the Participant Information Statement, a copy of which I have retained.

I understand that I can withdraw from the project at any time and do not have to give any reason for withdrawing. During the interview I can ask for the recording device to be stopped and edited or erased. I may also review the transcript of the interview and edit my contribution. If I decide to withdraw, all data related to me will be withdrawn and destroyed.

I consent to:
1. Participate in an interview of approximately 60 minutes
2. The interview being recorded onto a digital recorder.

I understand that my personal information will remain confidential.

I have had the opportunity to have questions answered to my satisfaction.

Print name: ____________________________________________

Signature: ________________________________________ Date: _____/_____/______

Contact telephone number: ____________________________________________


Appendix IV: Research Instrument

Research Instrument

• Thank for taking the time to be interviewed.
• Have participant sign off on recording consent before commencing.
• Reassure that participation will be totally anonymous.

1. Could you please describe your current role and how much experience you have in the industry?
2. There was a big shift in the 1980s and 90s as more people were willing to trade outside of long-term contracts. What pushed people into trading spot?
3. What were the major challenges of moving from LTCs to a spot market?
4. There were shifts in the qualities people were willing to accept and the use of blending in this time. Do you think this had an impact on the market? How?
5. Trading in the spot market requires a lot more information and more frequent information. What information did you use in the past and how reliable was it?
   a. How has this changed over time?
6. How has globalCOAL changed the way you arrange and negotiate deals?
   a. Process in the past versus today
7. Going from LTCs to spot creates a lot of uncertainty for a business. Does this hold people back? How do you smooth the process for them?
8. What do you see as the major risks of trading? How do you manage them and has this changed over time?
9. Has the nature of relationships and trust changed as the market has developed?
10. Are there any other factors which you feel have been important in the market’s development?
• Thank for participating.
• Advise a transcript will be available for review within a week.