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Assessing ship ownership opportunities for South Africa based on competitive advantage

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ASSESSING SHIP OWNERSHIP OPPORTUNITIES FOR SOUTH AFRICA BASED ON COMPETITIVE ADVANTAGE

By

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South Africa

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Declaration

We certify that all the material in this dissertation that is not our own work has been identified, and that no material is included for which a degree has previously been conferred on us.

The contents of this dissertation reflect our own personal views, and are not necessarily endorsed by the University.

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(Date): 24-September-2019

Supervised by: Professor Aref Fakhry

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P. Williams

Abstract

Title of Dissertation: Assessing ship ownership opportunities for South Africa based on competitive advantage.

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South Africa's merchant fleet ownership status has recently been a burning issue. Despite its important role as a maritime trading nation, the county's capacity to carry its own shipping trade has been lacking for a long time. The main challenge is to identify which segments of the shipping industry bring competitive advantage and how a country can exploit them to develop its merchant fleet, given the intense competition that the industry is facing. This dissertation provides a market-based holistic framework to determine the competitive advantage for South Africa in developing its merchant fleet. Accordingly, the notion of competitiveness and the competitive advantage of a country is explained. Overall, this method suggests that almost all of its attributes must be fulfilled in order for the shipping nation or company to claim a competitive advantage in the development of a national merchant fleet. Based on a deductive reasoning, this dissertation concludes that the competitive advantage of South Africa rest on its well-endowed bulk export trade, specifically coal and iron ore. The regression analysis was then performed to provide certainty on the future of this specific market, based on two of South Africa’s major seaborne commodity trades, coal and iron ore. After the regression of these two dependent variables was conducted, both equations were found to be linear. It was expected that Iron ore would perform better than Coal, but the findings show that the trade in coal by sea would grow significantly. In addition, a financial analysis is carried out to determine which types of vessels within this specific dry bulk market offers high returns and should be employed. The results indicate that the South African government or private shipping investors should consider investing in Cape size bulk career(s) to trade coal and/or iron ore, following the market trends set out in this research.

KEYWORDS: Assessment, Competitive Advantage, Forecast, Geographic Location, IRR, Maritime Policies, NPV, National Merchant Fleet, Shipping Demand and Supply, Ship Ownership, Ship Registry, Socio-Economic Benefits.

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Abbreviations

UNCTAD	United Nations Conference on Trade and Development
TEUs	Twenty Equivalent Units
BRICS	Russia, India, China and South Africa
CMTP	Comprehensive Maritime Transport Policy
RBV	Resource Based View
SDSMM	Shipping Demand and Supply Market Model
PP	Policy Perspective
VRIO	Value Rare Immobile Organized
SCA	Sustainable Competitive Advantage
US	United Sates of America
SA	South Africa
GDP	Gross Domestic Products
WTO	World Trade Organization
LPG	Liquefied Petroleum Gas
LNG	Liquefied Natural Gas
GT	Gross Tonnes
ULCC	Ultra Large Crude Carrier
VLCC	Very Large Crude Carrier
SADC	Southern African Development Community
UNCLOS	United Nations Convention on the Law of the Sea
SAMSA	South African Maritime Safety Authority
DoT	Department of Transport
MT	Metric Tonnes
DWT	Deadweight Tonnage
MCS	Marine Crew Services
BBBEE	Broad-Based Black Economic Empowerment
FOB	Free On Board
OLS	Ordinary Least Square

ARMA	Autoregressive–Moving-Average
CLRM	Classical Linear Regression Model
BFI	Baltic Freight Index
BDI	Baltic Dry Index
OECD	Organization for Economic Cooperation and Development
BIMCO	Baltic and International Maritime Council
KPSS	Kwiatkowski–Phillips–Schmidt–Shin
LM	Linear Model
WACC	Weighted Average Cost of Capital
NPV	Net Present Value
IRR	Internal Rate of Return
OPEX	Operating Expenses
TNPA	Transnet National Port Authority
DEDAT	Department of Economic Development and Tourism

CHAPTER 1

INTRODUCTION

1.1 Background

Maritime transport continues to be a significant human activity, and this has been seen throughout history. As Kumar and Hoffmann (2002) have pointed out, transport is one of the four main pillars of globalisation. According to Corbett and Winebrake (2008), globalization has brought about tremendous developments in international trade, enabling countries to exchange goods and services more effectively and efficiently. This implies that countries have become increasingly interdependent. Being the cheapest mode of transport, shipping underpins global trade, accounting for more than 90 percent of international trade in terms of volume (UNCTAD, 2018). Furthermore, its significance and contribution can be ascribed to many other aspects of economic, social and environmental interest. As an example, most African nations claim more than 50 percent of total tax income on imports and exports handled through ports (Kahyarara & Simon, 2018). This proclamation attests to the indispensable role of maritime transport to the global society. Indeed, "without shipping, half of the world would freeze and the other half would starve" (Mitropoulos, 2016).

South Africa is one of the many nations that benefit from shipping, with some 98 percent of its volume export trade being sea-borne trade (Chasomeris, 2002). The strategic location of South Africa on the southernmost tip of Africa as the gateway to major trade routes has been the primary driver for the growth of the maritime industry in the country (Veitch, 2017). The fertility of the soil in terms of agricultural produce and the abundance of valuable natural resources, such as coal, iron ore and manganese, have not only boosted the country's economic growth, but have also placed South Africa as one of the world's major maritime trading nations (The Maritime Heritage Project, South Africa, 2017). Some of the growth of the South African economy and the maritime industry has been attributed to strategic intergovernmental partnerships such as Brazil, Russia, India, China and South Africa (BRICS), the fast-growing population and an evolving middle class, including South Africa’s flourishing maritime economy (van Nieuwkerk, 2018). As such, South Africa is ranked among the top fifteen (15) nations that trade by ocean (Comprehensive Maritime Transport Policy (CMTP), 2017). The country has one of the largest bulk terminals on the globe and the busiest container ports and terminals in Africa (OECD, 2014). It has one of the largest refrigerated container installations and the largest seawater-based port in Africa.

Although the above shows that South Africa is a maritime trading nation, the country's capacity to trade with its merchant fleet has been lacking for many years. According to Veitch (2017), about 10945 foreign-owned vessels called at the South African commercial ports during the 2016/2017 financial year and carried a total of approximately 227.17 million metric tonnes of cargo, whereas the containerized shipments totalled up to 4.466,000 TEUs. As a result, South Africa has paid more than 36 billion Rand in 2007 to foreign owners and operators for maritime transport services (Bhengu, 2012). As international as shipping is, this does not imply that South Africa's national merchant fleet may be deployed in other shipping markets around the world. For that matter, the research conducted by Chasomeris (2006) revealed that South African shipping companies owned around seventy ships in total, mostly bulk, estimated at 0.3 percent in the global context. UNCTAD (2017) and CMTP (2017) reported about 0.07 percent of South Africa fleet ownership on a global scale, with only about four ships registered since 2015 after a long period of dry ship registry (Veitch, 2017). This position in terms of ownership of ships is insignificant even when compared to the country's counterparts, including Brazil (172 vessels), Russia (1 891 vessels), India (534 vessels) and China (2 044 vessels), which are among the world's largest shipping owners (Bhengu, 2012).

1.2 Problem statement

As explained above, South Africa's shipping industry has been established on the basis of strategic location advantage. However, the location based competitive advantage of South Africa has been declining due to owners diverting their vessels to nearby jurisdictions that offer better incentives (Bowmans, 2016); (Chasomeris, 2006). At the same time, the South Africa's ship registry has had the same experience for a long period, losing many vessels to foreign-flag nations that offer more favourable benefits to shipowners. The fact that shipowners may withdraw the registration of their vessels from a particular flag and/or redeploy them on other markets implies that a nation which seeks to exploit the economic benefits of the ideology of a domestic merchant fleet should adopt less speculative approach. A non-speculative and more reliable approach for South Africa to establish a globally competitive domestic merchant fleet could be achieved by identifying and re-establishing its competitive advantage. Currently, there has been a lack of evidence in South African maritime policies, including other related formal publications citing a market-based approach to developing a globally competitive national merchant fleet.

1.3 The aim of the study

The aim of this dissertation is to assess opportunities for South Africa to own ships on the basis of competitive advantage.

1.4 Significance of the study

Many scholars and professionals in South Africa have undertaken extensive studies to determine the potential for South Africa to establish a domestic merchant fleet. Some have argued on the grounds of socio-economic benefits, while others suggested fleet owned by means of ship registration (Mabiletsa, 2016); (CMTP, 2017). Some have suggested cargo reservations, revised laws, and some have gone as far as proposing locally oriented favourable trading terms (Incoterms) (Bowmans, 2016); (Meyer, 2004). Some experts, including Mokhele (2012) have recognized certain shipping sectors that could be exploited for the development of national merchant fleet, such as coal, iron ore, oil and gas shipping trade.

With the exception to Chasomeris (2006) and Krugman (1993), however, very few studies, if not nothing at all, proposed an adaptive market-based approach or solution that holistically investigates the competitive advantage of South Africa in establishing a competitive national merchant fleet. In line with this statement, Chasomeris (2006) proposed a market-based task force, similar to the Canadian one, which would assess the changing circumstances in the global shipping market and the possible need for measures to support the development of the South African shipping fleet. Along these lines, Krugman (1993) argues that shipping trade policy should be formulated on the basis of its effectiveness, not on the basis of "phoney numbers about jobs created or lost". Therefore, these recommendations not only validate the need for this study, but also confirm the significance of a market-driven competitive advantage approach for the development of South Africa's merchant fleet.

As Stopford (2008) and Reve, Lensberg and Gronhaug (1992) state, shipping is a highly capital-intensive and cyclical industry – it requires investors to have a strong understanding of the shipping industry in order to outperform their competitors. Therefore, this dissertation will provide a market-based econometrics and financial model that can guide investors in taking informed decisions at the right time. The regression analysis of the two major South Africa's seaborne trade commodities, coal and iron ore, will provide certainty on the future of this specific market. In addition, a financial analysis will determine which types of vessels within this specific market offers high returns and should be employed. This dissertation would contribute to the government in formulating policies that reflect the realities of the shipping industry, thus implementing the policies effectively. It could also be beneficial to the scholars as well as stakeholders, who work in the shipping segments relevant to this study. Last but not least, this dissertation provides self-fulfilment to the researchers who conducted the study. It will inspire future researchers to do more research and be innovative in carrying out work and finding solutions within their profession.

1.5 Research objectives and research questions

This dissertation sets some objectives in order to accomplish its purpose. The study objectives are answered through subsequent research questions set out in a logical manner. Table 1 shows a list of research objectives and research questions, with reference to the relevant chapters of the study.

Research objectives	**Research questions**	**Addressed in Chapter**
Provide a comprehensive view of the global shipping	• What are the structures and trends of the global shipping demand and supply?	Two

demand and supply, and South African maritime industry. Based on deductive rationale, identify the competitive advantage of South African shipping industry.	• What are the key factors that determine the competitiveness of shipping nations? • Do country-specific factors influence the competitiveness of a shipping nation or organisation? • Which models can be used to determine the competitive advantage of a nation or organisation for the development of a national merchant fleet? • What is the competitive advantage of South Africa that the country can use to leverage to develop national merchant fleet?	
To provide certainty on the future growth of South African coal and iron ore shipping trade. To identify which type of vessel can yield high return and should be used for the trade of South African coal and iron ore international trade.	• How should the finance and forecasting model for international trade of coal and iron ore be designed in order to meet the requirements this dissertation? • What data sources are available and can be analysed to inform a better modelling approach? • How can content-based econometric and financial data be used to improve forecasts?	Three
Provide econometric and financial rationality from finding of the empirical analysis.	• What are the impacts that the econometrics model suggests?	Four

	• What are the impacts that financial analysis suggests?	
Propose and validate the forecasting model South African coal and iron ore seaborne export trade. Based on financial analysis, recommend the types of ships that should be employed for South Africa to carry its own coal and iron ore trade.	• What are the key points of this research? • How can the result of the analyses be used in order to take informed decisions? • How can the models be validated in order to determine whether it is sufficiently accurate of the system under study?	Five

Table 1: Research objectives and related question. Compiled by author.

1.6 Scope of the study

This dissertation focuses on assessing opportunities for South Africa to own ships on the basis of competitive advantage. It should be noted that this dissertation does not cover the following aspects or at least not in detail:

- Mining charter
- Efficiency of trade or measures related to trade facilitation
- Ship chartering options
- Environmental and safety related issues
- Freight derivatives

These factors have a substantial impact in shipping, but will not significantly assist to achieve the objective of this study. Global trends in shipping demand and supply are covered and viewed in the context of the South African shipping sector. While these cover different shipping markets, only the dry bulk market (specifically, coal and iron ore) feeds into the empirical analysis of this dissertation. This does not imply that the primary objective of this dissertation is to evaluate the relationship between the dependent and independent variables of these particular commodities, but rather to use the forecast as a means of ensuring certainty in the quest for the development of a domestic merchant fleet in South Africa. The financial analysis will also be used in the same context.

1.7 Limitations of the study

Throughout this research, the limitations encountered by researchers have been:

- Time constrain to complete the study
- No comparison made to shipping nations nor companies due to lack of information and time constrains.
- Reliability, availability and accuracy of secondary data
- Lack of previous relevant studies, particularly on South African ship ownership

1.8 Disposition

Figure 1 demonstrates the overall visualization and presentation of this dissertation. Broadly, the first chapter introduces the recognition of the problem in respect of the chosen topic. This chapter also provides an insight into the approach, objectives and relevance of this study. It also presents the methods adopted to conduct this research. The second chapter contains a comprehensive review of the literature on the chosen field based on a macro and micro diagnostic approach. An empirical analysis of this study, which reflects the findings of the literature review is presented on chapter three. The fourth chapter covers the discussion and summary of key findings from preceding chapter(s). Finally, chapter five summarizes overall key findings and recommendations, and thus concludes this research study.

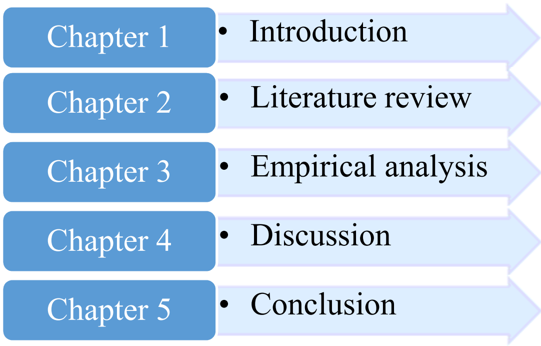


Figure 1:The overview of chapters of the research. Compiled by author

1.9 Methodology

- Quantitative method

In order to fulfil the objectives of this dissertation, a quantitative method has been used. According to Bacon-Shone (2015), Leedy and Ormrod (2001), and Williams (2011) this method is characterised by large and randomly selected data. Aliaga and Gunderson (2002) describe the quantitative method as the approach used to explain the hypothesis through numerical data, reflecting mathematical, statistical and financial dataset. This method follows a deductive rationale through quantifying and analysing data in order to get results. A deductive rationale, often referred to as top-down logic, implies that the researcher(s) follows a process that logically informs the conclusion based on the concordance of the various premises presumed to be correct (Neuman, 2003). Therefore, econometrics and financial mechanisms will be used to perform empirical analysis in order to justify the results. The primary benefit of these two mechanisms is that they enable researchers to use large amounts of data without the need for integration (Brooks, 2014); (Berger, 2006).

- Econometrics analysis

As the first four letters of the word indicate its roots to economics, econometrics is the application of statistical techniques to problems in economics (Brooks, 2014); (Profillidis & Botzoris, 2019). Accordingly, this dissertation will use the regression model to conduct econometric analysis. The regression model analyses the relationships between the dependent and independent variables in a numerical or rather mathematical form (Sykes, 1993). This analysis was conducted using interactive econometrics software called E-Views (Brooks, 2014).

- Financial analysis

Financial analysis was carried out using the Excel software program called. Excel is an instrument that allows the user to upload a quantitative dataset in the form of electronic spreadsheet to perform any mathematical analysis (Berger, 2006). According to Berger (2006), this software converts the computed quantitative dataset into information that can be used to formulate decisions in either professional or personal setting.

1.10 Data collection and analysis

Various data from the industry were gathered and analysed for the purpose of this study. Primary data were gathered from the Clarkson database, the shipping intelligence network, and analysed using the statistical methods already explained above. Secondary quantitative datasets were gathered from the Transnet divisions, and the Chinese bank. Secondary quantitative datasets were gathered from various reliable sources, including scholarly publishing institutions, and is mostly used to support arguments in the literature review. The inputs of the literature from Chapters 2 have been used throughout this dissertation to guide the analysis and interpretation of the final results. Overall, the data was analysed and interpreted as either validation of findings from previous studies or further input into modelling the structure of this dissertation.

CHAPTER 2

LITERATURE REVIEW

2.1 Competitiveness

Given that the concept of competitiveness is the pillar of this research, it is essential to explain the notion of its application. This research examines how the competitiveness of a nation or organisation in a particular industry can be influenced by the attractiveness of a given location. Jacobsen (2003) delineates an essential association between the competitiveness of the industry and the attractiveness of a given location. Jacobsen (2003) explains that the location has some special advantage that contributes to the nation's or firm's competitiveness.

According to Porter (1990),''a nation's competitiveness depends on the capacity of its industry to innovate and upgrade''. Porter (1990) explains further that the factors of competitiveness in each country are not the same; no nation can or will be competitive in all sectors. Hence, this requires shipping nations to determine their strengths in order to be able to exploit their full potential, herein referred to as competitive advantage. The modern approaches to competitiveness requires the assessment of a nation's strongest sectors by comparing them to other countries where those sectors are booming (Finckenhagen & Fjeld, 2008). This assessment requires the adoption of traditional conceptual theory or current practices (Jacobsen, 2003). According to Finckenhagen and Fjeld (2008), this implies that nations can no longer assume their competitiveness. Hence, nations must compete in order to remain relevant and attract more businesses.

2.2 Methods

This dissertation adopts three distinct models, namely Resource-Based View (RBV), Shipping Demand and Supply Market Model (SDSMM), and Policy Perspective (PP) to assess the competitive advantage of a shipping nation or company. These models are used in conjunction with Porter's national diamond model. They explicate the dynamics behind the competitive advantage of nations involved in a particular industry, which is shipping for the purpose of this dissertation. Porter (1990) established the concept of the national diamond consisting of mainly three attributes of a nation as follows:

- factor conditions
- demand conditions
- related and supporting industries

These attributes form a system often referred to as the ‘diamond of national advantage’. The diamond of national advantage can be defined as the approach that a nation uses for its industries to establish their competitive advantage (Finckenhagen & Fjeld, 2008). According to Porter (1990), nations are most likely to succeed in industries where the attributes of the national diamond are in harmony.

2.2.1 The RBV competitive advantage

Valentine, Benamara and Hoffmann (2013) states that since global trade began, maritime transport has become an extensively globalized business. In shipping, most countries essentially specialize in chosen avenues of shipping business, such as shipbuilding, registration, owning, and operating, with few that remain important players in more than two segments. This reflects the fact that development circumstances of the shipping industry differ based on the state of each country’s economic development (Bong-min & Sung-june, 2012). Along these lines, Yang (2010) suggested the RBV as an effective approach for a shipping nation or organization to establish its competitive advantage in a sustainable way. A sustainable competitive advantage (SCA) implies that a country or an organisation should not only find its niche, but also be capable of performing better than its rivals over a lengthy period of time (Jurevicius, 2013).

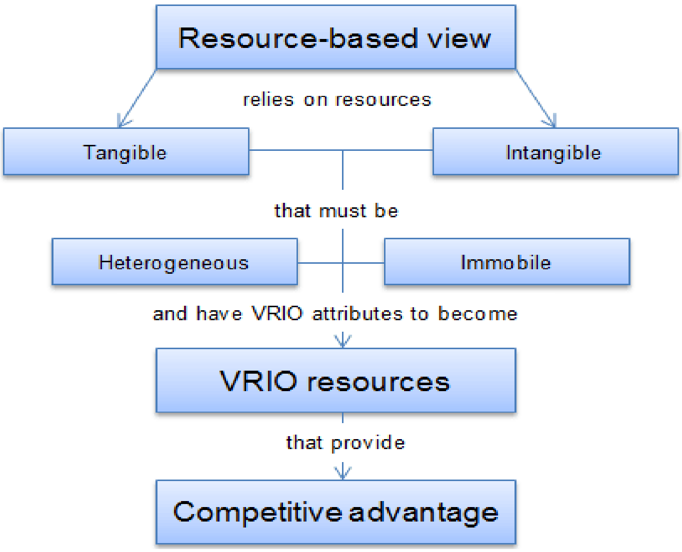


Figure 2: RBV model. Source: (Jurevicius, 2013)

As a rule of thumb, the RBV focuses on identifying the association and strength between resources and capabilities at an inter-organizational angle (Yang, 2010). For the latter, Figure 2 shows that the RBV model relies on tangible and intangible resources that must be different in nature, immobile, possesses value, be rare to duplication, costly to imitate, as well as organized to capture value (Jurevicius, 2013). As many researchers have cited, the original RBV model does not distinguish resources from capabilities, and is therefore deemed to be all-inclusive (Korhonen & Niemelä, 2005). However, capabilities are presumed to be a subgroup of resources.

Fahy (2000) and Barney (1995) define resources as economic assets, physical, human, reputation, technology, raw materials, geographical location all as organizational assets used as production factors, including capabilities. This resembles merits of the Porter's national diamond competitive advantage concept. Specifically, a more suitable attribute to the RBV model under Porter's national diamond competitive advantage concept is a factor production attribute. Essentially, it implies that every country that trades possesses production factors: labour, land, natural resources, capital and infrastructure (Porter, 1990). Porter (1990) describe these as basically the inputs that are needed to foster competition in the industry. Based on this background, the RBV model is adopted, reflecting the evidence that resources and capabilities are key elements influencing an organisation or nation's sustainable competitive advantage, profitability and superior performance (Korhonen & Niemelä, 2005). Accordingly, the superior performance and profitability of a country or organization in the shipping industry require fulfilment of the following factors: sector segment's desirability, proper allocation of resources, as well a competitive advantage higher than that of competitors (Yang, 2010).

2.2.2 The SDSMM competitive advantage

From an economic point of view, Stopford (2008) characterises shipping as a skill game industry that requires shipping investors to have a strong knowledge of the market cycles in order to outperform their competitors. These market cycles are driven by the supply, demand, and freight market (Jugović, Komadina, & Hadžić, 2015). An in-depth understanding of the market cycles enables shipping investors to identify them as either an opportunity or a threat. Shipping market cycles can result in overwhelming earnings or losses for shipowners, which can mean growth or even prompt collapse in a short time (Stopford, 2008). Based on this rationale, Stopford established a SDSMM to better understand how the shipping market cycle works. Under the Porter's national diamond competitive advantage concept, this can be related to the 'demand conditions' attribute, which further encompass three broad attributes as follows:

- composition of nation's demand
- the size and pattern of growth
- internationalization of nation's demand

Combined with Stopford's model, all three demand attributes of Porter's national diamond are essential in determining competitive advantage of a nation. Nevertheless, Stopford's SDSMM approach focuses primarily on modelling factors affecting the relationship between the shipping transport demand and supply, which subsequently prompts the behaviour of the freight market (cash flow) (Fan, Zhang, & Yin, 2008). These factors stem from the fundamentals of economics of shipping as being a secondary market (derived demand), highly competitive (relatively unregulated), and cyclical (subject to drastic changes in supply and demand) (ESCAP, 1999). In order to map out the approach to SDSMM, Stopford (2008) selected a combination of ten factors that have major influence on the demand and supply of maritime transport, as shown in Table 2.

Demand	Supply
1. The world economy	1. World fleet
2. Seaborne commodity trades	2. Fleet productivity
3. Average haul	3. Shipbuilding production
4. Random shocks	4. Scrapping and losses
5. Transport costs	5. Freight revenue

Table 2: Ten variables in the shipping demand and supply market model. Source: (Stopford, 2008)

Figure 3 illustrates the association and the manner in which these variables function together, comprising three parts: 1. Demand-Model A, 2. Supply-Model B, and 3. Freight-market-Model C (Jugović, Komadina, & Hadžić, 2015); (Stopford, 2008).

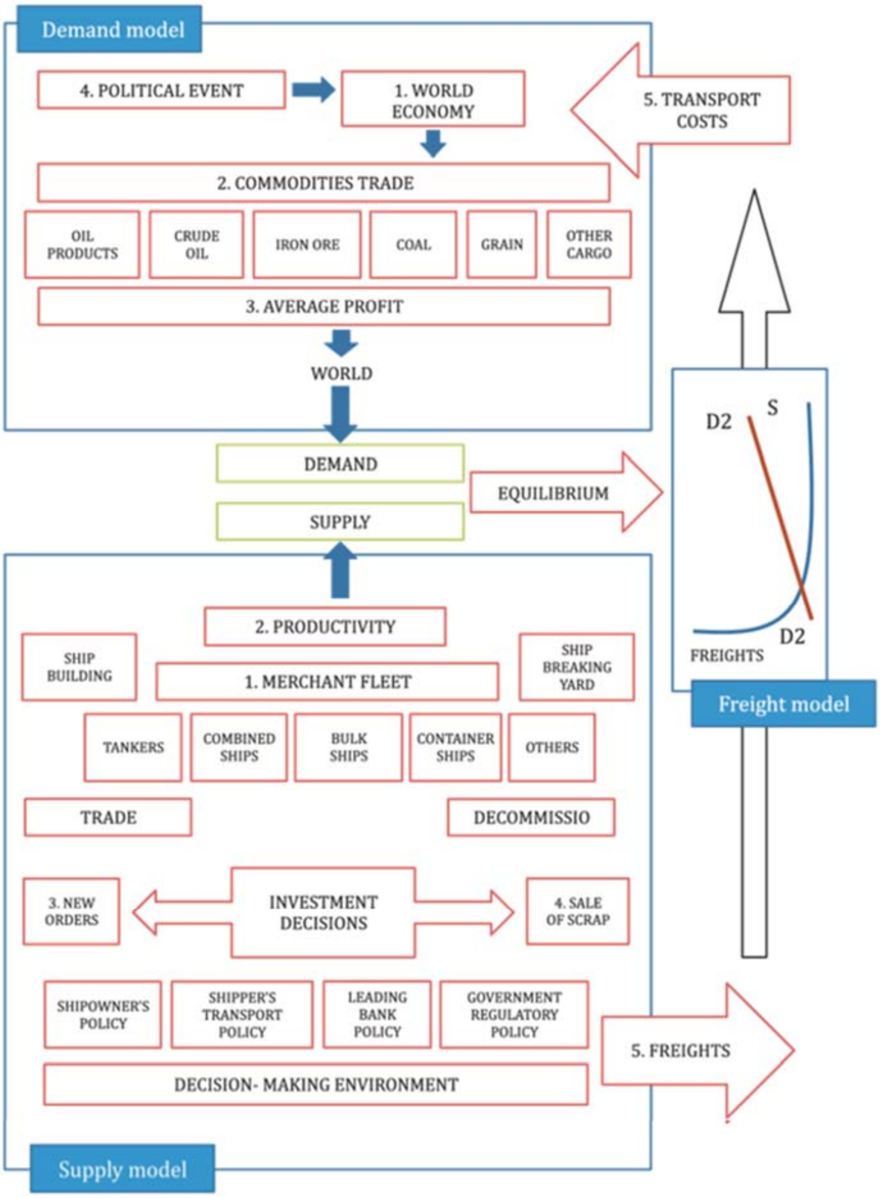


Figure 3: The shipping demand and supply market model. Source: (Stopford, 2008)

The mechanics of this model on the demand part (A) shows that the world economy, through a series of business events and developments in industrial activities, results in production that require shipping (Ma, 2018). Developments in some merchandises and economies may generate growth, resulting in the absolute demand for maritime transport services measured in ton-miles (Branch, 2014). In terms of supply (B), the merchant fleet provides a fixed shipping capacity for utilization (Jugović, Komadina, & Hadžić, 2015).

Accordingly, the size of seaborne trade and the level of available supply of shipping service (measured in deadweight tons) determine the productivity of the maritime transport supply (Ma, 2018). Ma (2018) explains that, when the demand for shipping space is low, some ships may be decommissioned in the form of being laid up or even demolished. Similarly, when the demand is high, the supply of fleet may be improved by building new ships, or purchasing second-hand vessels, or re-deploying unused capacity, and/or taking full advantage of the efficiency (the speed) of the existing fleet in the market (Stopford, 2008). Stopford (2008) concludes that this whole phenomenon leads to the third model, the freight market (C), due to imbalances between the model (A) and (B). (Jugović, Komadina, & Hadžić, 2015) describes model (C) as the equilibrium between model (A) and (B, where the cash flow is continuously regulated as a result of differences between balance of supply and demand. As such, this model reflects the shipping market's cyclicality, characterised by strings of uneven swings. Jugović, Komadina and Hadžić (2015) state that this connection is essential in shipping and that it is regulated by the shipowners, who decide how to manage it effectively.

2.2.3 The PP competitive advantage

The research shows that the maritime sector's development can be effectively fulfilled if properly harnessed with national policies. Under the Porter's national diamond competitive advantage concept, the PP approach can be related to the attribute of 'associated supportive industries'. According to Porter (1990), the associated support functions somehow create advantages in downstream sectors. Based on this concept, Olukoju (2006) took Japan and Nigeria as examples that although both countries each have a population in excess of one hundred million people, Japan has achieved significant progress in developing and implementing its maritime shipping industry policies.

ESCAP (1999) argues that the undesirable feature about shipping policies, in particular, is often the lack of the ability to achieve balance between the need for certainty and flexibility to respond to the changing shipping conditions at both macro and microeconomic levels. Symesa and Hoefnagel (2010) also affirm the argument that the success and failure of the shipping industry depends on the ability of maritime policies to calculate and capture the risks and uncertainties surrounding the sector. One of the examples that challenged the competitiveness of shipping policies was during the late 1990s, when shippers transitioned into integrated supply chain services following the introduction of supply chain management in their operations (Bong-min & Sung-june, 2012). Accordingly, shipping companies had to provide such an integrated service to maintain their competitive advantage in response to shippers increasing demand. These evolving circumstances required shipping policies to develop an adaptive policy that can allot sufficient resources to take advantage of the emerging opportunity. Another prominent example is the European Shipping Register project, which became ineffective as shipowners shifted their focus towards cost containment instead of the reputation of the flag state (Duru, 2014). From these examples, it can be seen that in order to remain competitive and relevant for the development of the national merchant fleet, shipping policies need to be adaptive. Furthermore, the validation of the above can also be drawn from the study by Yang (2014) on the ‘’effect of shipping aid policies on the competitive advantage of national flagged fleets’’. In this study, Yang (2014) state that adaptive 'shipping aid policies' are far more effective means of ensuring competitive national merchant fleet rather than passive shipping aid policies.

2.3 The Integrated RBV – SDSMM – PP sustainable competitive advantage model

The RBV has been somewhat criticised following its development to the extent that some critiques advocated for amendments. These critiques have been classified into eight categories. However, Kraaijenbrink, Spender and Groen (2010) argues that only three threatens the status of the RBV:

1) That resources must be Value Rare Immobile Organised (VRIO) is neither necessary nor sufficient for SCA
2) That value of a resource is too indeterminate to provide for useful theory

3) And lastly, that definitions of resources are all-inclusive and unworkable

While these critiques may be valid, the RBV remains effective, although its application may be marginalised, particularly in the shipping industry. In the shipping perspective, the RBV does not provide a precise economic rationality on the underlying factors influencing nations' competitive advantage from the demand and supply viewpoint. In addition, it focuses more on internal factors of the organization rather than external ones (Jurevicius, 2013). Therefore, the SDSMM leverages this gap and takes into account the derived demand nature of shipping (Stopford, 2008). It provides an economic approach for shipping nations or organisations on how to achieve competitive advantage in a competitive market, such as shipping. The SDSMM essentially provides empirical analysis on economic indicators influencing shipping demand and supply. Interchangeably, commonalities between the RBV and SDSMM approach seem to exist. However, the SDSMM does not provide a comprehensive approach to how shipping policies can achieve a competitive advantage for the development of the shipping nation's merchant fleet. For this reason, the PP approach is proposed to address the perspective of shipping policies in a comprehensive manner. This approach suggests an adaptive policy that is able to allocate resources effectively and efficiently in ever-changing shipping circumstances in order to ensure a sustainable competitive advantage in the development of the merchant fleet (Bong-min & Sung-june, 2012). Technically, the PP considers resources and economic indicators to be key factors, which is insufficient. Against this background, this dissertation adopts an Integrated RBV – SDSMM – PP model, which seeks to provide a holistic approach in establishing a sustainable competitive advantage for the development of a shipping nation or organization merchant fleet. Figure 4 provides an illustration of the relationship between the three models being integrated.

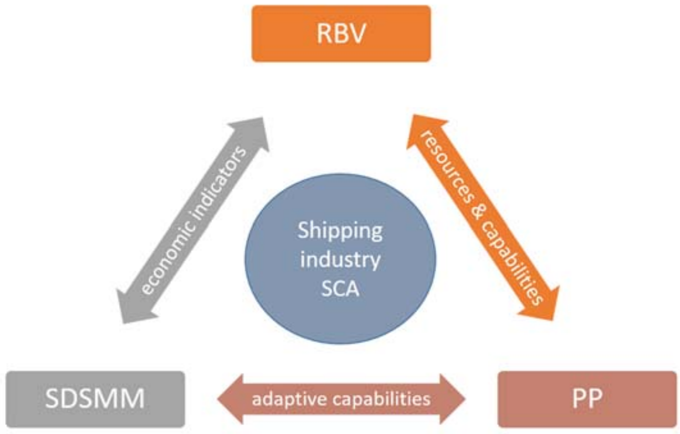


Figure 4: Relationship between the RBV – SDSMM – PP competitive advantage. Compiled by author.

This dissertation concludes that while there may be common elements between the three models, there are some considerable variations, hence the need to integrate. This is validated by Jenssen (2003)'s argument that the integration of "core competencies" within and between companies can result in a competitive advantage that is sustainable and difficult to imitate.

2.3.1 The merchant fleet competitive advantage

The shipping industry has undergone enormous changes in recent years, characterized by globalization-driven trends and a search for more competitive production factors (Sletmo & Hoste, 1993). Generally, shipping is made up of different markets, each with its own unique market features. These markets embody a number of competitive models, from perfect to monopolistic competition (Goulielmos, 2017). The tramp shipping market in particular, consisting of dry bulk and tanker markets, is driven by perfect competition (McConville, 1999). Bulk shipping companies operate under a perfectly competitive market, which is an extremely competitive and volatile environment (Ma, 2018). As international and competitive as it is, it is not certain if 'country-specific factors' are the main variables that influence the merchant fleet owned by nations (Nguyen, 2011). This has led to extensive research on critical factors influencing the competitive advantage of the merchant fleet in shipping. Using information from 84 shipping countries, Nguyen (2011)'s findings show that different country-specific variables do have some impact on the merchant fleet of nations, though at varying significance levels. Furthermore, Yang (2010) explains that shipping competitive advantage is determined by the type of service and price (freight rates) competitiveness. However, Yang (2010) concludes that price competitiveness is a critical factor which determines international competitiveness of shipping organisation and the shipping industry. In the same context, Yang (2014) conducted a study comparing Korean, Taiwanese, and Japanese shipping aid policies using 'gray relational analysis (GRA)'. The study found that the variables that best determine a domestic merchant fleet's competitive advantage includes ''the number of vessels, gross tonnage and deadweight tonnage of the fleet, number of seamen, and cargo volume transported by the fleet''. GRA is used to determine the gray relational area that can be used to explain the relationship between variables and to identify those that have a substantial impact on certain defined objectives (Sallehuddin, Shamsuddin, & Hashim, 2008); (Malek, Ebrahimnejad, & Tavakkoli-Moghaddam, 2017); (Yang, 2014). Nevertheless, many researchers have yet not been able to clearly determine the critical factors influencing the competitive advantage of the national merchant fleet (Yang, 2010), so the following is a summary of findings from other relevant studies:

Author(s)	**Findings**
Kokuryou (1993)	• Position of domestic shipping companies and cargo owners in international trade • Shipbuilding technology and ship construction and maintenance capabilities • Assurance of suitable current and future seamen • Quantity and quality of maritime capital and shipping finance • Maritime policy of the national government
Sletom (1993	• Ship tonnage • Ship nationality • Government subsidies

	• Forwarding ability • Shipping knowledge • Ship network system
Goss (1987)	• Seamen • Ship nationality • Tax rate
Wang (2003)	• Freight pricing • Ship tonnage • Fleet management • Cost • Voyage time • Value-added services (consolidation and warehousing)
Le (1997)	• Size of fleet • Ship tonnage • Capital cost.

Table 3: Summary of findings on critical factors influencing the competitive advantage of the national merchant fleet. Source: (Yang, 2010).

Table 3 shows that some findings are common or at least associated. On that note, Yang (2010) states that factors proposed by distinct writers more than once affirm the credibility and the significance of such factors, thereby reducing the reader's likelihood of questioning evidence.

2.3.1.1 The case of owned and operated merchant fleet competitive advantage

Given the above, the owned and operated merchant fleet presents an interesting paradigm of competitive advantage in shipping. Accordingly, this dissertation uses Greek and Norwegian fleet as exemplary cases to establish metrics of the competitive advantage of the owned and operated merchant fleet. As stated earlier, there is no single method to identify critical factors affecting the domestic merchant fleet's competitive advantage. For more than thirty years, the Greek merchant fleet has been in the leading position in the maritime league globally (UNCTAD, 2017). According to Lagoudis and Theotokas (2007), the competitive advantage of the Greek merchant fleet is ascribed to the level of uniqueness or specialized know-how in the management of operations, with cost competitiveness as the major contributor to their achievement. Furthermore, researchers state that the majority of the Greek merchant fleet is heavily engaged in the bulk shipping sector, with a small proportion active in the liner sector. As a result, most Greek shipping companies assert the competitive advantage of their fleet in bulk shipping activities. Comparatively, the Norwegian merchant fleet competitive advantage has been declining owing to the cost disadvantage arising from fierce competition from low-cost nations in Asia (Jenssen, 2003). Hence, this has pushed the Norwegian shipping as a high-cost country to place more emphasis on the need to innovate in order to survive and thrive in the international shipping markets.

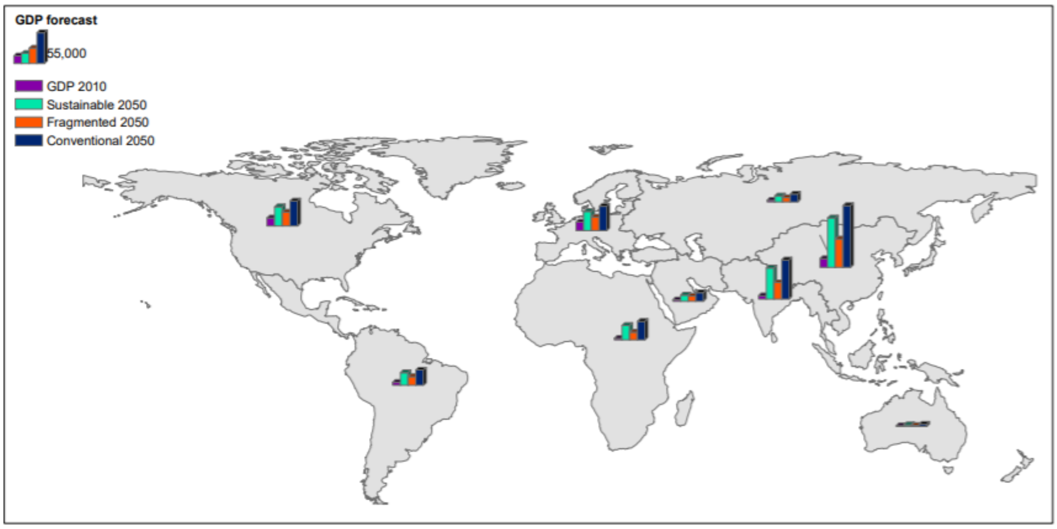
2.3.1.2 The case of registered merchant fleet competitive advantage

As for the competitive advantage of the registered fleet, there has been a substantial rise in the flagging-out of some shipowners from their national flags since the advent of open registries. Flagging-out is moving a vessel's registration from a national flag to an open register of another country (Eyre, 2006); (Haralambides & Yang, 2003). Taiwan is one of the countries with the highest of flagging-out record - about 15.24 percent of Taiwan-owned merchant fleet registered in Taiwan, while 84.76 percent flagged-out (Yang, 2010). This shows some discrepancy between the flag state of Taiwan and the desires of the Taiwan-based shipowners. According to UNCTAD (2017), more than 70 percent of the world merchant fleet is flagged in a country other than that of the vessels' beneficial ownership. One of the primary reasons for shipowners to flag out is driven by the pursuit to minimise cost (such as labour costs, taxes, management costs and more), with open registries offering low costs from +22 percent compared to +333 percent of registries other than open registries (Bergantino & Marlow, 1998). Panama, the Marshall Islands and Liberia are the three leading flags of registration, yet these are countries that are not significant shipowners (UNCTAD, 2018). Under the Liberian flag, the cost of owning and operating a ship is estimated at 3.6 million U.S. dollars compared to 11.4 million dollars under the U.S. flag (Eyre, 2006). With a flat 25 percent ship registration tax per annum, the low cost of Liberian ship registry has derived itself a price competitive advantage over other flag states (Liberian Registry, 2019). Based on these observations, Sletmo and Hoste (1993) argue that the establishment of national ship registries by conventional maritime nations will not suffice to halt the decrease of national fleet, hence the competitive advantage.

2.4 Structure and trends: the global demand for maritime transport service

2.4.1 World economy and merchandise trade

The world economy and merchandise trade is the most crucial influential factor in the demand for shipping (Stopford, 2008). Since the 1820s, the world has experienced an unprecedented increase in the global economy and merchandise trade. According to Luigi (2017), remarkable acceleration in the global economy and trade was during the period between 1870 and 1913 as this was considered the start of the first era of trade globalisation. During the period 1980-to-2010, notably, the world economy increased by on average 3.5 percent per annum (Artuso, 2015), while the world merchandise trade grew at an estimated average rate of 3.9 percent leading up to 2018 (Roberto, 2019). *Figure 5* shows nine regions from which this growth has been attributed to globally: North and Latin America, Russia, Europe, South Asia, East Asia, Africa, Australia/New Zealand. *Figure 5* shows that North America and Europe in particular were comparatively dominant during the period between the 1980s and 1990s.



Source: OECD, processed by project team, all figures in USD 2005

Figure 5: Major economic regions. Source: (Artuso, 2015)

The studies, however, reveal that this bipolar economy has undergone a paradigm shift into three poles since the 2000s, with East Asia as a newcomer and Africa showing high potential to follow (Artuso, 2015). Presently, Southern and Eastern Asia, which consists of the gigantic economies of Singapore, Hong Kong, South Korea and others such as India has a very significant contribution to the global economy and trade, with more than 7 percent growth per annum (Branch, 2014). Accordingly, the prospect is that the economy of East Asia will become 2 to 2.5 times bigger than that of Europe or North America in terms of GDP by 2050 (Artuso, 2015). Artuso (2015) further states that the South Asian economy is expected to be 1.2 to 1.6 larger than the economy of Europe and North America, thus becoming the second-largest after East Asia. Africa is also anticipated to experience substantial growth, almost at the rate of South Asia (Kahyarara & Simon, 2018). According to Beresford and Pettit (2017), this exponential growth has been driven primarily by variables such as the increasing level of economic activity and per capita revenue of these countries, rapid demographic growth, access to quality education, healthcare and enhanced capital inflows. Altogether, these factors have given rise to amplified industrialisation and economic reforms, which, in turn, has fueled free trade and, consequently, increased demand for consumer products (Artuso, 2015).

2.4.2 Global seaborne trade

It is stated that the maritime transport carries more than 80 percent of world trade in terms of volume (UNCTAD, 2018). The world seaborne trade is essentially another important demand variable resulting directly from the activities of the global economy. Over the past years, the maritime industry has experienced a continuous growth in trade (Alizadeh & Nomikos, 2009). Beresford and Pettit (2017) attribute this growth to the increase in the global economy, continuing to move in tandem, albeit at different rate. However, as Branch (2014) points out, global trade and the economy can grow at different rates. For the past two decades, the WTO (2014) recorded a consistent factor of two, showing that trade grows two times faster than the world economy. Looking into the future, however, this relationship is uncertain due to many unforeseeable underlying factors affecting the demand for seaborne trade.

Table 5 shows the evolution of the world seaborne trade. In 2017, UNCTAD reported that global maritime trade has increased at an average annual rate of around 3 percent, rising from 2.6 billion tonnes in 1970 to more than 10 billion tonnes. It is clear that at this rate, the world seaborne trade can be expected to double in the coming years. Furthermore, UNCTAD (2017) stated that natural resources account for the majority of the composition of maritime trade in terms of volume: the tanker trade recorded one-third of total seaborne volumes in 2017, and ‘other dry cargo’ including container shipment accounted for about 40 percent. The five major dry bulk seaborne commodities namely ‘iron ore, coal, grain, bauxite and alumina and phosphate’ recorded an about 28 percent share of total seaborne trade (Beresford & Pettit, 2017) – a tremendous growth, surpassing oil and gas, from 448 million tons in 1970 to over 29 billion tons (UNCTAD, 2017). This significant growth in the dry bulk commodity trade reflects a fast increasing demand for materials, including iron ore and coal, hence these are primary inputs used in steel production and other industrial activities taking place particularly in developing economies such as Asia, which are heavily investing in infrastructure development (Valentine, Benamara, & Hoffmann, 2013). China, with its strong demand for iron ore imports, with a complete market share of more than 70 percent, and coal, India, and other Asian countries continue to be the primary drivers of growth for global dry bulk trade (UNCTAD, 2018). On the other hand, the stagnant growth of energy seaborne commodity trade has been somewhat pointed to higher energy efficiency constrains and increasing domestic production (Artuso, 2015). Nonetheless, shift in energy demand towards emerging economies such as China, India and the Middle East have spurred growth in the trade of energy commodities (Valentine, Benamara, & Hoffmann, 2013).

In value terms, UNCTAD estimates that seaborne trade contributes about 380 billion U.S. dollars of value to the global economy, equivalent to 5 percent of global trade. The container seaborne trade alone accounts for at least 52 percent of value in total – the highest over the estimated 22 percent of take trade, 20 percent general cargo, and 6 percent dry-bulk cargo (Clarkson, 2019). Overall, this exposition evidences that the growth in the world seaborne trade has increased in line with the global economy and ton-miles. Thus, it has affected the demand for sea transport.

2.4.3 Average haul or maritime geography

Although it has been noted that over 10 billion tons of cargo have accounted for the maritime transport in 2017, (Ma, 2018) argues that this measure does not reflect accurate size of the world maritime transport needs. In essence, Ma (2018) explains the distance factor is important for maritime transport demand, hence, the appropriate measure generally used is the ton-mile. In 2018, Clarkson report that a total of 59 334 billion ton-miles were transported by the world shipping industry in 2018. Although this shows positive traits, the closure of the Suez Canal, which resulted in an increase to 11000 miles from 6000 in average shipping distance between the Arabian Gulf to Europe, demonstrated the significant impact that change in average haul has on the maritime transport demand (Stopford, 2008). These waterways, including the Panama Canal provides the shortest maritime routes, partly displacing the use of the Cape of Good around South Africa (Ma, 2018). The importance of these waterways led to a number of developments that have taken place, which consequently had a positive impact on the demand for shipping transport. The Panama Canal is expected to accommodate more and larger vessels passing through, due to recent expansions that completed in 2016 (Jim, Minton, Miller, & Ruiz, 2015). On the other hand, the Suez

Canal transited about 16 991 vessels in total between 2013 and 2014 (Beresford & Pettit, 2017).

2.4.4 The impact of random shocks on shipping demand

The shipping industry has experienced random shocks such as wars, natural disasters, strikes, and many others – and these shocks pose a substantial impact on the demand for maritime transport service (Shun, Meersman, Van de Voorde, & Frouws, 2014). According to Stopford (2008), random shocks affect the stability of the economic system, which consequently contributes to cyclicality of the shipping market. These shocks do not essentially pose a direct impact on the demand for shipping, rather their consequences are usually indirect but significant (Shun, Meersman, Van de Voorde, & Frouws, 2014). Consequently, the impacts are often realised through high shipping costs in the form of surges in bunker prices resulting from oil shocks, as well as soaring stockpiles or resulting economy recessions. Table 4 presents a summary of prominent examples that have been observed in the shipping industry since the 1950s.

Date	*Political event*
1951	Korea War
November 1957	Suez crisis
August 1967	Suez Crisis/Israel and Egypt War
October 1973	Yom Kippur War
October 1978	Iranian Revolution
September 1980	Iran–Iraq War
August 1990	Persian Gulf War
December 2002	Civil unrest in Venezuela
March 2003	Iraq War

Table 4: Major random shocks since 1950s. Source: (Shun, Meersman, Van de Voorde, & Frouws, 2014)

One of the most recent shocks that caused considerable impact, particularly on the demand for iron ore seaborne trade was the Vale dam disaster in Brazil (1H 2019 Shipping Market Review, 2019). The impact of this incident on the global iron ore shipping demand was estimated at about 4.1 percent decline, equivalent to1.529 billion tons (Jones, 2019). Another one is the trade war presently going on between the US and China, however, its impact on the shipping demand has not been measurable at this stage. Given these points, random shocks seem to have a huge impact on the shipping demand.

2.4.5 The impact of transport costs on shipping demand

According to Hummels (2007), one of the main driver for the increase in international trade is the reduction in international transport costs. Goods, particularly raw materials, are transported from areas of excess supply to areas of scarcity, provided that the cost advantage of transport is achieved (Ma, 2018). In this way, transport costs play a very important role in shipping demand. In the 1980s, ‘’transport costs accounted for about 20 percent of the cost of dry bulk cargo delivered to trading countries (Stopford, 2008)’’, although this has improved over the past decade through efficiency and economies of scale. Harley (1980, 1989); North (1958, 1968); Mohammed and Williamson (2004) as cited by Hummels (2007) have shown how technological advances have resulted in a substantial decrease in shipping costs between 1850 and 1913. In their study, Brancaccio, Kalouptsidi and Papageorgiou (2018) associate shipping costs with fuel prices. They measured the elasticity of seaborne trade relative to fuel costs at an average of 0.35, but noted that the elasticiy varied from 0.1 up to 1.2 depending on the level of cost of fuel. This shows that transport costs have substantial impact on the demand for shipping.

2.5 Structure and trends: the global supply of maritime transport service

2.5.1 Development of merchant fleet

The supply of maritime transport is made of a combination of various types of ships, which includes: ‘oil tanker, chemical tanker, LPG vessel, LNG vessel, bulker, general cargo, container, offshore and others’ (Stopford, 2008). According to Valentine, Benamara, and Hoffmann (2013), most of these vessels are built by Asian counties – In 2011, particularly, almost 39 percent of gross tonnage (GT) was delivered by Chinese shipyards, 35 percent from the Republic of Korea, 19 percent from Japan and the Philippines 1.6 percent. The remainder was supplied mostly by countries such as Vietnam, Brazil and India, which accounted for only 5.3 percent of the global tonnage. The quest for reduced transport costs through economies of scale resulted in enormous developments in sizes of these ships, as globalisation precipitated economic growth and increased maritime trade, which also had a multiplier effect on shipping transport demand and distance over which the seaborne trade is carried (Beresford & Pettit, 2017). Essentially, this practice proliferated concentration of the global merchant fleet, with the shipping industry growing by about 44 percent in number of vessels and by about 185 percent in volume terms between 1980 and 2014 (Artuso, 2015). As of May 2019, the global shipping fleet comprised over 2 billion deadweight tonnes in capacity, as shown in Figure 6.

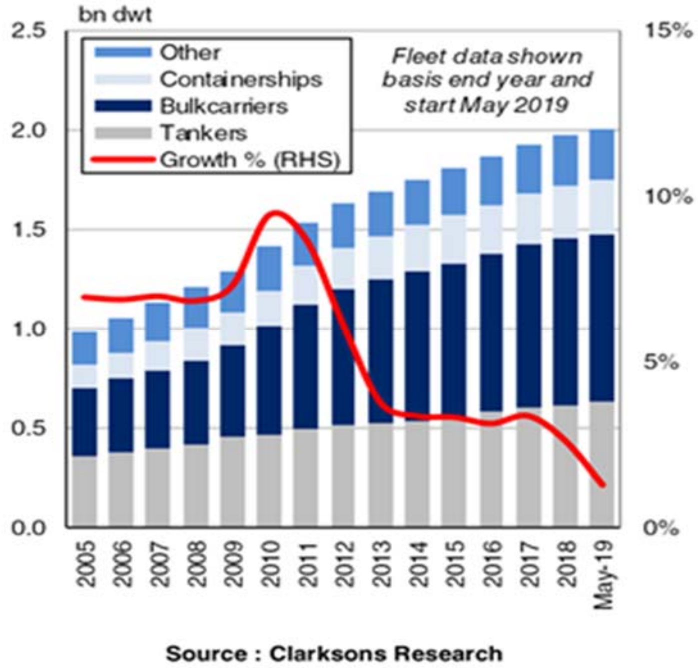


Figure 6: Development of merchant fleet. Source: (Crowe, 2019)

Figure 6 shows that the merchant fleet has grown significantly from 2005 to 2019. It indicates that bulk ships grew at an average rate of 5 per cent more than tankers. Container vessels, on the other side, have increased exponentially, more than all kinds of vessels, at an average growth rate of 10 percent. Overall, this development reflects a general increase in economies of scale and merely in terms of vessel numbers (Artuso, 2015). Currently, the largest liquid bulk vessel is known as the Ultra Large Crude Carrier (ULCC) and is deployed on the shortest paths (Beresford & Pettit, 2017). As for container ships, the Triple E class vessels (18 000 + TEUs), initially introduced by Maersk Line in 2012, are currently the largest, most of which serve the far East-Europe trade routes (Beresford & Pettit, 2017). On bulkers, the largest ship currently carries over 300 000 tonnes of iron ore in one shipment from Brazil to Rotterdam (Beresford & Pettit, 2017). Artuso (2015) states that the rise in size (economies of scale) and amount of vessels is driven by the overall growth of the shipping industry, and estimates that economies of scale will continue to increase. As the result, by 2040 ‘’the average size of a bulker is expected to increase by 50 percent, an oil tanker by 35 percent, and by 100 percent for a container ship’’ (Artuso, 2015).

2.5.2 Fleet productivity

Fleet productivity depends on the use of the vessel. As noted by Lemper and Tasto (2015), speed is the most effective factor that can be used by a vessel to provide shipping capacity over a short period of time. According to Lemper and Tasto (2015), the productivity of fleet can be measured as follows:

- the time spent by a vessel while engaged in cargo operations at sea and port
- the time spent in ballasting
- the time spent during maintenance of a vessel

Stopford (2009) provides an example of a very large crude carrier (VLCC) on a 365 calendar day routine. The example shows that a VLCC spent a maximum of only 137 days carrying cargo, 111 days on ballast, and 40 days on cargo operations at port(s). The remaining days were accounted for by activities not related to trading, such as incidents maintenance, delays, and lay-up. Merikas, Polemis and Triantafyllou (2014) state that fleet productivity can change over time due to the changes in technology and demand patterns. Hence, fleet productivity affects the demand for shipping transport.

2.5.3 The shipbuilding

The shipbuilding industry has a substantial impact on the adjustment of the merchant fleet. Ionescu (2011) explain that the level of production changes according to the demand. This is encompassed by a lengthy business cycle and time lag of about one to four years between placing an order to buy a ship and the actual delivery of a vessel (Stopford, 2009). According to Stopford (2009), vessels that were produced in

1974 accounted for around 12 percent of the merchant fleet, while in 1996 they had declined to about 4.7 percent, and by 2007 they had increased to approximately 9 percent. In 2018, UNCTAD reported that a total of 65 million gross tons of vessels was delivered in 2017, equivalent to 5.2 percent of the total merchant fleet. This shows that changes in the shipbuilding industry ultimately has a significant impact on the total supply merchant fleet. However, Springer (2019) state that recent developments in shipbuilding indicate that the consequences of shipbuilding industry will not be catastrophic. In terms of the share of shipbuilding, China, Japan and Korea currently hold about 90 percent gross tonnage of ship deliveries, and these countries will remain dominant in the shipbuilding industry for some time (Springer, 2019).

2.5.4 Demolition and losses

Demolition and losses essentially reduce the merchant fleet capacity. The level of growth of the merchant fleet is determined by the equilibrium between the vessels delivered and those decommissioned in the form of scrap or total losses (Springer, 2019). According to Lemper and Tasto (2015), demolition of ships is driven by a number of factors, including the ‘’age, technical obsolescence, scrap prices, current earnings and market expectations’’ Stopford (2009). The age is the key driver for vessel scrapping. Stopford (2009) noted that some 216 vessels that were demolished in 2007, with dry bulk vessels were scrapped at an average of age of five years more than tankers. UNCTAD (2018) reported some 23 million gross tons of vessels were demolished in 2017, with India, Bangladesh and Pakistan as major destinations for scrapping. This amounted to about less than a quarter in gross tons of vessels scrapped than in 2016, a sign for an optimistic market. Accordingly, segments such as bulk and container ships did not record significant scrapping due to improved market conditions, but instead increased recycling (Rex, 2018). Overall, demolition and losses of vessels have substantial impact on the supply of maritime transport service.

2.5.5 The freight revenue

Lastly, the supply of maritime transport service is affected by changes in freight prices. As Stopford (2009) notes, this is the primary regulator employed by the shipping industry to encourage shipping investors to improve their capacity in the short-run, and find means to minimize costs and enhance their competitiveness in the longer-run. Therefore, freight revenue is the result of the supply and demand function, as described in Figure 3, freight market (C).

2.6 The South African maritime sector

2.6.1 The geographical location

As shown in Figure 7, South Africa is strategically located as the gateway to the world's busiest shipping markets in Asia, Africa and South America (Veitch, 2017). It also plays an important economic role as one of the major corridors for the southern African Development Community (SADC) and the entire African continent (Kahyarara & Simon, 2018).

Figure 7: South Africa`s strategic geographic location. Source: World Bank

However, the existence of waterways such as Suez and the Panama Canal, which provide the shortest alternative routes to important shipping traffic (Ma, 2018), threatens the competitive advantage of South Africa's geographical location. Since the opening of these canals and, in part, the absence of incentives for vessels calling at ports in South Africa, there has been a continuous decline in the number of commercial vessels calling for bunker port facilities, supplies and repairs at the respective ports (Bowmans, 2016). According to (Ullmann, 2019), reduced prices, particularly in the Suez Canal, are the main incentive for carriers to divert large vessels from transiting through the Cape of Good Hope. As a consequence, the amount of vessels calling at South African ports has reduced considerably. The 2014/2015 financial year represents a decrease from 12,000 vessels to 10,945 in 2016/2017 in eight business ports of South Africa (Veitch, 2017). The possibility is that, if the Suez Canal continues to offer low prices to ships passing through the canal, more vessels will most likely cross the Suez Canal, displacing some traffic from the Cape of Good Hope (Ullmann, 2019).

2.6.2 The South African ship registry

The registration of a ship is required under international law, United Nations Convention on the Law of the Sea (UNCLOS), and is regulated by the Ship Registration Act (SAMSA, 2019). Ship registration generally proves ownership and allows the ship to participate in international trade (Mitroussi & Marlow, 2010). South African Maritime Safety Authority (SAMSA) is the custodian of the South African ship registry, commissioned by the Department of Transport (DoT) of South Africa. Since 1990s, there has been few to zero vessels registered under the South African ship register, with many ships leaving the country's registry (Bowmans, 2016). Safmarine and Grindrod were among the domestic carriers flagged out of the country register (Chasomeris, 2002). Instead, these domestic carriers registered their ships in open registries such as St Vincent and the Grenadines (Swart, 2016). Swart (2016) linked domestic carriers' decisions of the to the promulgation in United States of America of the Comprehensive Anti-Apartheid Act in 1986, which had immediate demurring effect on the South African ship register. Furthermore, the registration regime itself, characterized by inflexible legislation in the sense that it provided unfavourable incentives and strictly concerned with registering only South African-owned vessels, is alleged to have aggravated the effect (Bowmans, 2016). As a result, South Africa holds a share of about 0.02 per cent on the world league table of the national flagged fleet, equivalent to approximately 428 thousand DWT (UNCTAD, 2017). Following the latest tax structure changes and abandoning mandatory registration, the South African ship register is forging a promising future. Since the end of 2015, about four vessels have been registered under the jurisdiction of the South African ship register (Veitch, 2017), including the former Liberian registered vessel, LEFKAS (Bizcommunity, 2016), and Greatship Manisha (Odendaal, 2017) owned by

Marine Crew Services (MCS). Notwithstanding the promising future, some areas remain gray to the attractiveness of the new ship registration regime to shipowners (Bowmans, 2016). These areas are linked to issues such as compliance with Broad-Based Black Economic Empowerment (BBBEE) and strict labour legislations of South Africa. As far as job opportunities are concerned, Lamb (2013) points out that there is minimal link between job creation and ship registration. Lamb (2013) has taken Indonesia as an example, which does not have a ship register but offers crew at competitive rates to vessels flagged around the globe.

2.6.3 The South African ports

Ports primarily provide an intermodal link between the maritime and inland transport system through which cargo operations are carried out (Everton, 1998). They play an essential role in integrating and developing the world economic system (Dwarakisha & Salim, 2015). According to Trujillo, González, and Jiménez (2013), there are about eighty ports serving the global and regional trade, and many other small to medium-scale ports focused on handling local trade. With this in view, there are about eight commercial ports in South Africa, namely Saldanha Bay, Cape Town, Mossel Bay, Port Elizabeth, Ngqura, East London, Durban, and Richards Bay, as shown in Table 5.

Range	Port Depth	Function
Western	Saldanha Bay (20.5 m)	Bulk export (ore)
	Cape Town (14.0 m)	Regional hinterland
	Mossel Bay (6.5 m)	Local hinterland
Central	Port Elizabeth (12.2 m)	Local hinterland
	Ngqura (16.5 m)	Bulk export and transhipment
Eastern	East London (10.4 m)	Local hinterland
	Durban (12.8 m)	Regional hinterland and transhipment
	Richards Bay (17.5 m)	Bulk export (coal)

Table 5: Main South African ports. Source: (ITF/OECD, 2013)

The port of Durban, East London, Port Elizabeth and Cape Town are multi-purpose ports responsible for handling general cargo, dry and liquid bulk cargo, but predominantly specialize in containers (ITF/OECD, 2013). Their functionality is mainly influenced by their hinterland's level of business activity, and the port of Durban accounts for about 60 percent of South Africa's total container trade. The port of Ngqura specializes in container shipments as a transhipment hub, but also handles dry and liquid bulk cargo. Finally, Saldanha Bay, Richards Bay, and Mossel Bay are principally single-purpose ports specializing in the handling of export bulk cargo including coal and Iron ore (Jacka, 2015). These ports handled a total of about 227.17 million metric tonnes in 2016/2017, while containerized cargo accounted to approximately 4 466 000 TEUs total volume of cargo (Veitch, 2017). In the study Chang, Shin and Lee (2014) projected that, without ports activities, the economy of South Africa would lose (direct and indirect losses) at least 3.215 billion Rands in total. That being said, some challenges have been identified in the ports of South Africa. The main challenge stems from the absence of clearly defined policy objectives for the South African ports, which led to conflicting strategic port objectives (Meyiwa & Chasomeris, 2016). Essentially, (Meyiwa & Chasomeris (2016) argued that South Africa is using a port system that does not represent the rates charged to port users in relation to the costs incurred and the profits generated. Other challenges points to the port governance, capacity and connectivity (ITF/OECD, 2013). Although this shows that there is still room for improvement, the ports of South Africa are among the most developed ports in and beyond Africa. The port of Saldanha, for example, is one of the largest and deepest natural ports in the Southern Africa, with a dredged depth of up to 23 meters (Jacka, 2015). Looking to the future, South Africa's ports infrastructure is being developed to position the country as a premium future destination for maritime services such as oil rigs, repairs and maintenance in the ever-growing maritime industry (Lee, Lee, & Chen, 2012). These developments also include revamping and the expansion of the rail system, which will enable a more efficient transport network and thus boost the maritime sector in South Africa (Ratshomo & Nembahe, 2017).

2.6.4 The South African seaborne trade

According to SAMSA (2012), South Africa is listed among the major maritime trading nations. Trade in South Africa contributes about 50 percent of the GDP produced by overall import-export trade other than gold goods. In terms of volume, the seaborne trade in South Africa accounts for about 98 percent of total trade and 80 percent in terms of value. It represents more than 3.5 percent (equivalent to 22 940 billion ton-miles) of global seaborne trade in volume terms. Table 6 shows the composition of South Africa’s total trade includes mainly:

Top 5 exports	**Value**	**Top 5 imports**	**Value**
Platinum	$6.03 billion	Crude petroleum	$6.54 billion
Coal Briquettes	$3.81 billion	Corn	$630 million
Iron Ore	$3.58 billion	Diamonds	$352 million
Diamonds	$1.97 billion	Wheat	$305 million
Citrus Fruits	$1.16 billion	Palm Oil	$287 million

Table 6: the composition of South Africa’s total trade vs value. Source: (Pines, 2016).

Of major import-export trade of South Africa, coal and iron-ore are the backbone of the country's seaborne trade, particularly export trade. Accordingly, Mokhele (2012) noted that a viable strategic approach to establish the merchant fleet of the South Africa should be based on the key trades of the country, which are exports of bulk raw materials. Given the latter, South Africa is the 33rd largest export economy in the world (Oehler-Şincai, 2018). The main export destinations for South Africa comprises large economies of China (6.81 billion US dollars), followed by the US, Germany, Botswana, Namibia, and India (Pines, 2016). After Colombia, South Africa is the sixth largest exporter of coal, accounting for a general share of around 5 percent of the global coal export trade (Workman, 2019). India is one of the major importers of coal from South Africa – it accounts for about 40 percent of total coal exports from South Africa, followed by Pakistan, which imports around 7.3 percent annually. According to Ratshomo and Nembahe (2017), the export of South Africa's coal export will remain significant, given the estimated 200 years’ worth of reserves. In addition, South Africa is the third largest exporter of iron ore after Australia and Brazil – it holds about 5 percent of a global export market annually (Christie, Mitchell, Orsmond, & van Zyl, 2011). Despite the general decrease of about 45 percent in iron-ore trade over the last five years and being among the top fifteen nations prone to decline in export volumes, South Africa did not experience any significant decrease in its iron-ore exports (Pines, 2016). As the result, Mokhele (2012) argues that iron ore and coal bulk trade alone would support the national fleet of South Africa. According to Mokhele (2012), this can be achieved if the government policy, Maritime Charter, could be implemented, imposing at least 25 percent of trade on the country's domestic fleet. South Africa's estimated total dry bulk trade is about 300 MT per year, which means that 25 percent would equate roughly to 75 MT (Meyiwa & Chasomeris, 2016). Mokhele (2012) further argues that promotion of South Africa's national fleet could be accomplished if South Africa's maritime policies were to enforce the 40-40-20 rule through the WTO, which would allow 40 per cent of exports and 40 per cent of imports to be reserved for national carriers, totalling up to 240 MT in South Africa's interest. To date, some of these recommendations have not yet been implemented.

2.6.5 The status of ship ownership in South African

Although South Africa is a maritime trading nation, its position in terms of ship ownership has not been significant in the global scale. There has always been an imbalance between the supply of the South African-owned fleet and the volume of trade the country exports from all sorts of shipments (Swart, 2016). According to UNCTAD (2017) and the CMTP (2017), South Africa accounts for approximately 0.07 percent of global fleet ownership, equating to 1300 thousands DWT. This concentration of ownership of the fleet is the result of the consolidation of the following South African ship-owning firms (Berry, 2017):

- African Coasters
- Aliwal Steamship Co
- Cephalonia Shipping
- Durban Lines
- Grincor
- Irvin & Johnson (I&J)
- Jupiter Shipping Lines
- Northern Steam Ship Company
- Point Shipping
- Safmarine Container Lines NV
- South African Lines (SAL)

- Southern Steam Ship Company
- Smith's Coasters
- Thesen's Steam Ship Co.
- Tristan Development Corporation
- Unicorn Lines
- Union Steam Ship Company of South Africa

However, Berry (2017) states that some of these companies have acquired or merged with other shipping companies, while others have ceased to exist. Berry (2017) also points out that Unicorn shipping, a subsidiary of Grindrod Limited, whose operations are mainly product tanker and bulk, sets a practical example as the company acquired Durban Lines around 1976. Although some of the company's business was transferred from London to Singapore in 2010, Grindrod limited remains one of the biggest South African shipping companies, with origins dating back to the 1910's (Grindrod Shipping, 2019). Grindrod owns and operates a fleet of more than 34 merchant ships, including IVS (Island View Shipping) under its dry bulk division. It provides shipping services for the shipping of petroleum and dry-bulk products along and beyond the Southern African coast as well as East and West Africa. Safmarine is another large ship-owning firm that South Africa lost to AP Moller-Maersk in 1999 (Greve, Hansen, & Schaumburg-muller, 2007).

2.6.6 The South African maritime policy

In South Africa, the maritime sector falls under the DoT (Department of Transport). As part of its primary objective under the Maritime Charter (2003), the Department of Transport committed itself to developing South Africa into one of the top 35 maritime countries worldwide (Chasomeris M. G., 2006). To fulfil this aspiration, *inter-alia*, the DoT has formulated and implemented a number of policies, including the National Transport Master Plan (NATMAP) 2050, the Comprehensive Maritime Transport Policy (CMTP) of 10 August 2010, and the African Maritime Transport Chamber Veitch (2017). These policies show the concerted effort of the DoT by cooperating with other African nations to fast-track the development of the South African and by and large the African maritime transport. In addition, the government's efforts have been manifested by the roll-out of the project called Operation Phakisa in 2014 for the development of the relatively untapped "Blue Economy" of South Africa. This project is estimated to contribute about 177 billion Rands to the country's GDP and to create more than 1 million jobs by 2033 (Jacka, 2015). (Jacka, 2015) states that increasing the number of owned and flagged South African merchant fleet that eventually contributes to job creation in the maritime transport industry of South Africa, is at the core of this project. A revision of the '1998 Ship Registration Act' was conducted along these lines following the launch of the Blue Economy initiative (SAMSA, 2017). This led to a more vibrant South African ship registration regime, although further improvements such as revised tariff schemes still require serious attention (Bowmans, 2016). In the same context Mokhele (2012), points out that the misguided South African maritime policy, particularly on import-export-trading terms, is detrimental to the country and that urgent interventions are needed. Mokhele (2012) explains that, as a result, the country is exporting on the Free On Board (FOB) terms, thus losing a number of affreightments that could generate a monetary and other additional benefits for the country.

2.7 The summary of key points

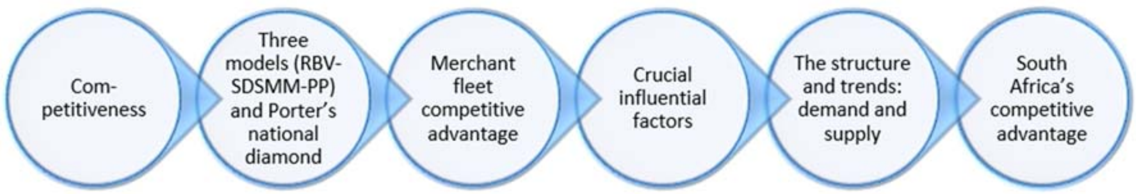


Figure 8: The summary of key points. Compiled by author.

This dissertation is underpinned by the concept of competitiveness of a shipping nation or firm. Essentially, this concept implies that shipping nations or companies need to compete in order stay relevant and attract more business. An important association between the competitiveness of a shipping nation and a given location is established. In particular, the tramp market is the most competitive market in shipping. Therefore, it is necessary for nations or organizations in the shipping sector to evaluate their strengths in order to exploit their full potential. To achieve this, three models, namely RBV, SDSMM and PP, are used together with Porter's national diamond model to determine the competitive advantage of a shipping organization or nation for the development of a merchant fleet in a sustainable manner. The study then established a holistic approach that integrates the three models into one shown in Figure 8. In short, the RBV focuses on assessing the competitive advantages of a shipping nation or organisation in terms of resources and capacities. The SDSMM explains the rationale of the derived demand nature of the shipping service. The SDSMM also considers the demand and supply as economic indicators to be key determinants of the competitive advantage of the shipping organization or nation in the development of merchant fleet. Finally, the PP argues that the competitive advantage of the shipping nation or organization for the development of the merchant fleet is difficult to achieve without effective shipping policies. The PP, therefore, stresses that shipping policies should be adaptive to the ever-changing conditions of the shipping industry for the development of the national merchant fleet.

Yang (2010) argues that the global maritime trade of a country is aggregated from the international competitiveness of the nation's economy. Hence, Yang (2010) concludes that factors such as the volume of global trade, given location, and national maritime policy determine the competitive advantage of the merchant fleet. The structure and patterns of shipping show that world sea-borne trade rose to more than 10 billion tonnes, with almost half attributed to dry bulk commodities (UNCTAD, 2018). In 2018, the UNCTAD report show that containerized and dry bulk commodities are anticipated to grow faster at the cost of other segments, such as tankers. Similarly, the merchant fleet has grown at almost a similar pace.

In view of the above notion, South Africa holds a competitive advantage over its major export trade, including coal and iron ore in particular. The projected rise in the export of these commodities in South Africa is consistent with global trends of the shipping industry, showing continuous growth in trade of dry bulk commodities. This research further observes that the recent developments in South Africa's maritime infrastructure, particularly in bulk ports, backed by market-based shipping policies such as CMTP of 2010, support the anticipated growth of South Africa's coal and iron ore export trade. However, South Africa's geographical location is losing some of its competitive advantage, mainly due to the following reasons:

- the existence of alternative routes, such as Suez and Panama Canal, which provides shorter routes for carriers (Ullmann, 2019).
- carriers rather opting to call in other neighbouring jurisdictions offering better incentives (Bowmans, 2016).

Bowmans (2016) also points out that despite the most recent amendments to the 1998 South African Ship Registration Act in 2015, reflecting the present circumstances of the shipping industry, such as improved tax incentives, the South African ship registry still needs further improvement to enhance its competitiveness. These amendments were made following a long period of dry ship registry owing to unfavourable conditions offered to shipowners. Overall, the export trade in coal and iron ore is a competitive advantage for the development of the South African merchant fleet mainly due to the abundance of reserves, affordability and proximity to major markets.

CHAPTER 3

EMPIRICAL ANALYSIS

3.1. Introduction

This chapter discusses the quantitative approach to research methodology in two parts. Part A seeks to ascertain the forecasting of the top two South African commodity exports. This objective can be attained through regressions on E-views using data collected from solely reliable sources such as the Shipping intelligence network and Transnet National Port Authority (TNPA). However, the main objective is to emphasize the importance of bulk cargoes to South Africa and to exploit the possibility of introducing a domestic bulk carrier fleet with the view to enhance the quantity of bulk cargo exports.

Part B evaluates which particular types of bulk carrier will be most suitable for the domestic bulk carrier fleet in order to obtain positive Internal Rate Returns (IRR) and Net Present Value (NPV). The data presented in this section has been obtained from reliable source i.e. Shipping intelligence network.

Part A: Forecasting of two top South African commodity exports.

The dependent and independent variables for Iron ore and Coal, which were considered for the purpose of this research, are listed in the table below. The Iron ore data is based on the monthly frequency with 232 number of observations, whereas Coal data is collected on the annual frequency with 20 number of observations.

SA iron ore exports	**SA coal exports**
Aus iron ore export	Bunker Price Singapore
Brazil iron ore export	Exchange rate South Korea
BFI	Global oil production
BDI	Industry production south east Asia ave.
Cape size demolished	China industry production
Exchange rate Japan	India industry production

Cape size sales	OECD industry production
China iron ore imports	South Korea industry production
South Korea iron ore imports	Exchange rate India
Japan iron ore imports	Brent crude oil price
Japan steel production	Exchange rate euro index
Russia steel production	Bulk carrier fleet demolishing
India steel production	Total bunker sales
US steel production	Bulk carrier fleet dev
Canada iron ore export	Bulk carrier order book
Cape size fleet growth	Exchange rate China
Taiwan iron ore imports	World steel production
Taiwan exchange rates	Thermal coal price Australia
	World seaborne LNG trade
	World seaborne coal trade
	BFI
	BDI
	Bulk carrier demolishing average age

Table 7: List of variables. Source: Clarkson and TNPA. Compile by author.

3.1.1 Data Analysis

The data selected for this regression is collected from reliable sources; however, it is essential to conduct the preliminary analysis as an initial step to examine the accuracy of the data. This is done by viewing the data in a graphical form to observe any "broken lines" or discontinuity that will symbolise the missing values of data. The data collected from Clarkson is combined on one Excel sheet and changed into logarithms values to reduce difference units; however, logarithms can only be done on positive values. Thereafter, the data will be transferred to E-views for preliminary analysis, stationarity test and all the necessary steps following the OLS chart flow.

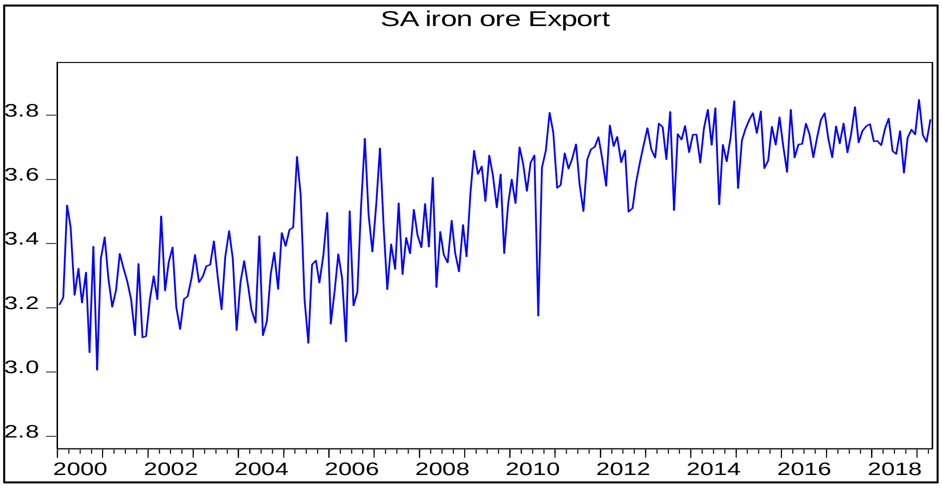


Figure 9: (Y) SA iron ore exports. Compiled by author.

The South African iron ore exports show a significant growth since the large volume of iron ore imports from China, hence South African is one of the top three countries that supply the iron ore commodity to China, following Australia and Brazil (Workman, 2019). The fluctuations on the graph are based on the market volatility prior to 2010; during that same year the South African iron ore exports had drastic declines due to commodity price increase, the world economic crisis and lastly the 2010 South African Soccer World Cup.

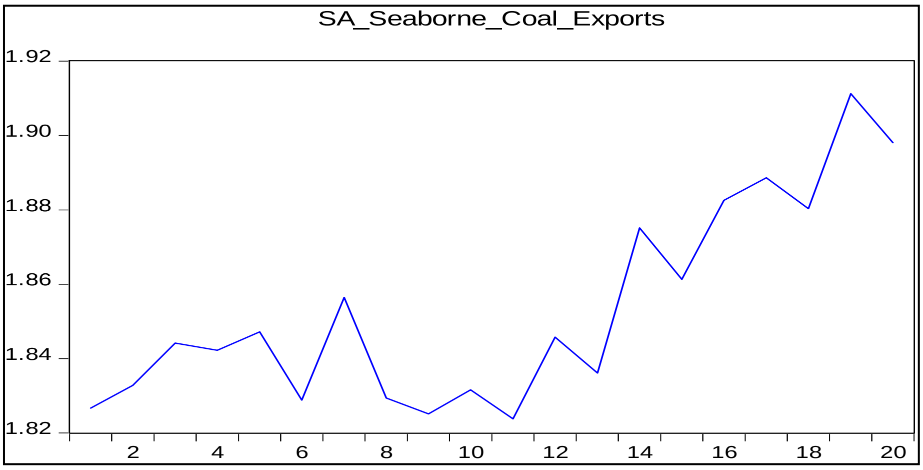


Figure 11: SA seaborne coal exports. Compiled author.

According to Africa (2018), South Africa is one of the top six countries of major coal exporters. In 2016, the country accounted for 6 percent of the global total exports by contributing 68,9Mt of coal to the global seaborne trade. Moreover, the observation of graphs was conducted to all independent variables to identify any discontinuities, missing data values or human error and they all had satisfactory results. The following table is an example of how the preliminary analysis of variables selected for the purpose of this study before proceeding with the regressions would look in table form.

	SA_IRON_ORE	AUS_IRON_ORE_EXP	BDI	BFI	BRA_IRON_ORE_EXP	CAPE_SIZE_D	CAPE_SIZE_S
Mean	3.520219	4.484856	3.243667	3.243667	4.341725	3.326619	5.364393
Median	3.552605	4.501696	3.190825	3.190825	4.368677	5.179807	5.768998
Maximum	3.847943	4.896035	4.035175	4.035175	4.596674	6.563141	6.672046
Minimum	3.006422	4.007114	2.487004	2.487004	3.599992	0.000000	0.000000
Std. Dev.	0.213204	0.260794	0.320214	0.320214	0.157983	2.792130	1.548210
Skewness	-0.354126	0.016140	0.471483	0.471483	-0.872504	-0.333158	-3.012134
Kurtosis	1.861920	1.618689	2.606490	2.606490	4.028278	1.158334	10.68314
Jarque-Bera	17.36952	18.45428	10.09233	10.09233	39.65663	37.07855	921.4498
Probability	0.000169	0.000098	0.006434	0.006434	0.000000	0.000000	0.000000
Observations	232	232	232	232	232	232	232

Table 8: Preliminary analysis table from excel. Compiled author.

3.1.2 Unit Root test

The Unit root is conducted to check the stationarity of the variables. Whenever there is an external shock on the variable as a result of negative news from the market, the properties of the variables tend to change based to that shock; after the shock the properties of the variables are anticipated to move back to its original form. Thus, in that case, the variable is known to be "Stationary". However, if the properties do not change after the shock, then the variable is known to be "Non-Stationary". The rationale behind the stationary test is to ensure that the regression is run only on stationary variables; if the variables are non-stationary, that regression is defined as a Spurious regression. This means the model is vulnerable to external shocks and will not remain persistent to attain positive results.

The stationarity test is carried out on both dependent (Y) and independent variables (X), by testing the variables on Augmented Dickey-Fuller and Phillip Peron in three forms (Level, 1st difference and 2nd difference); if there is a conflict between the two tests, that can be confirmed by the KPSS test. The following table shows the Unit root test conducted on all variables.

Variables	Augumented Dickey-Fuller	Phiilip Perron	KPSS	Result
SA iron ore Export	I(1)	I(0)	I(1)	I(1)
BFI	I(1)	I(1)		I(1)
EX Japan	I(1)	I(1)		I(1)
EX south korea	I(1)	I(1)		I(1)
BDI	I(1)	I(1)		I(1)
Aus iron_ore exp	I(1)	I(1)		I(1)
Bra iron_ore exp	I(1)	I(0)	I(1)	I(1)
Cape size_D	I(0)	I(0)		I(0)
Cape size_S	I(0)	I(0)		I(0)
China iron_ore imp	I(1)	I(1)		I(1)
SK iron_ore imp	I(1)	I(0)	I(1)	I(1)
JPN iron_ore imp	I(0)	I(0)		I(0)
Russia Steel	I(0)	I(0)		I(0)
US Steel	I(0)	I(0)		I(0)
China Steel	I(0)	I(0)		I(0)
India Steel	I(1)	I(1)		I(1)
JPN Steel	I(0)	I(0)		I(0)
SK Steel	I(1)	I(0)	I(1)	I(1)
CND Iron Ore Exports	I(0)	I(0)		I(0)
Capesize Fleet Growth	I(1)	I(1)		I(1)
Taiwan Iron Ore Imports	I(0)	I(0)		I(0)
Taiwan Ext Rate $	I(1)	I(1)		I(1)

Table 9: Unit root test from the excel sheet. Compiled author.

The table above shows the variables that are stationary; P-value < 5 percent at level I (0), 1st difference I (1) and no variables were stationary on 2nd difference I (2). The dependent variable is stationary at 1st difference and this means that the cointegration test will be carried out. Cointegration is conducted only when the dependent variable is an I (1) process.

3.1.3 Correlation

This test is conducted to determine whether the correlation exists between the independent variables. The results of the correlation are always symmetrical against the diagonal which is 1, indicating that the linear correlation exists between the independent variables. The independent variables are deemed to be highly correlated when the coefficient value is greater than 80 percent, thus, one variable between the two highly correlated is removed, providing an economic justification. The following tables shows the highly correlating variables from both models coal and iron ore respectively.

	I(1)_Bunker_P_Sin	Rates_Sout	Global_Oil_	South-Eas	dus_Prod	dus_Prod	s_Prod_O	_Prod_S-K	Ex_Rates_	ht_Crude_	Rates_Eur	BC_Fleet_	BC_Demol	tal_Bulker	BC_Orderb	Ex_Rates_	World_Steel	l_Coal_Pri	Seaborne_	Seaborne_	Demolition_	ln_BDI	ln_BFI
I(1)_Bunk	1,00																						
I(1)_Ex_R	-0,51	1,00																					
I(1)_Glob	0,16	-0,38	1,00																				
I(1)_Indus	0,24	-0,59	0,15	1,00																			
I(1)_Indus	0,38	-0,45	0,15	0,46	1,00																		
I(1)_Indus	0,11	-0,28	0,12	0,52	0,20	1,00																	
Indus_Pro	0,06	0,23	-0,03	-0,78	-0,32	-0,31	1,00																
Indus_Pro	0,42	0,04	0,12	-0,52	0,19	-0,31	0,51	1,00															
I(1)_Ex_R	-0,42	0,52	-0,21	-0,47	-0,47	-0,35	0,18	-0,03	1,00														
I(1)_Brent	0,96	-0,56	0,35	0,24	0,39	0,02	0,06	0,43	-0,44	1,00													
I(1)_Ex_R	0,39	-0,20	-0,05	0,13	0,33	-0,06	0,11	-0,09	-0,46	0,40	1,00												
I(1)_BC_F	0,09	-0,10	-0,10	-0,21	-0,36	-0,32	0,04	0,10	0,24	0,06	-0,05	1,00											
I(1)_BC_D	-0,12	0,51	-0,41	-0,54	-0,39	-0,34	0,27	0,26	0,45	-0,23	-0,22	0,41	1,00										
I(1)_Total	-0,44	-0,05	-0,30	0,29	0,25	0,17	-0,20	-0,36	0,13	-0,48	-0,03	-0,13	-0,25	1,00									
ln_BC_Or	-0,27	0,17	-0,27	-0,06	-0,49	-0,16	-0,23	-0,37	0,36	-0,33	-0,30	0,70	0,35	-0,03	1,00								
I(2)_Ex_R	-0,22	0,54	0,10	-0,50	-0,42	-0,15	0,27	0,10	0,53	-0,19	-0,06	0,19	0,52	-0,34	0,13	1,00							
I(1)_Worl	0,63	-0,83	0,37	0,64	0,54	0,19	-0,39	0,06	-0,67	0,70	0,28	0,12	-0,48	-0,12	-0,19	-0,49	1,00						
I(1)_Therm	0,43	-0,04	0,35	0,06	0,12	-0,13	0,09	0,15	-0,52	0,56	0,43	-0,16	-0,28	-0,51	-0,22	-0,03	0,41	1,00					
I(1)_Worl	0,68	-0,44	0,20	0,34	0,59	0,15	-0,18	0,39	-0,56	0,69	0,19	0,10	-0,16	-0,28	-0,17	-0,30	0,74	0,50	1,00				
I(1)_Worl	0,65	-0,54	0,41	0,36	0,36	-0,06	-0,36	0,20	-0,26	0,70	0,14	0,37	-0,25	-0,35	0,08	-0,29	0,74	0,36	0,65	1,00			
I(1)_BC_D	0,40	-0,39	0,02	0,28	0,48	0,44	-0,05	0,10	-0,42	0,36	0,24	-0,36	-0,65	0,20	-0,44	-0,56	0,31	0,03	0,33	0,15	1,00		
ln_BDI	0,20	0,24	-0,20	-0,21	-0,21	-0,09	0,07	0,30	-0,08	0,17	0,10	0,33	0,46	-0,23	0,09	0,21	-0,06	0,14	0,24	0,02	-0,02	1,00	
ln_BFI	0,17	0,24	-0,22	-0,21	-0,23	-0,10	0,06	0,26	-0,09	0,15	0,13	0,35	0,46	-0,22	0,11	0,20	-0,07	0,14	0,22	0,01	-0,03	1,00	1,00

Table 10: Correlation table – independent variables (SA coal exports). Compiled author.

There are two highly correlated independent variables shown in the table above, which are the Brent crude oil price with bunker price Singapore at 0.96 correlation, and BDI with BFI at 1.00 correlation. Firstly, the bunker price Singapore is removed from the model since the Brent crude oil has a dual effect of commodity demand and as far as the bunker for vessels. Secondly, the BFI is removed from this model following the significant effect of the dry index. The following is an illustration of the SA iron ore correlation table.

	BFI	EX Japan	EX south korea	BDI	Aus iron_ore exp	Bra iron_ore exp	Cape size_D	Cape size_S	China iron_ore imp	SK iron_ore imp	JPN iron_ore imp
BFI	1										
EX Japan	0,036131	1									
EX south korea	-0,45655	-0,03605	1								
BDI	1	0,036131	-0,456554739	1							
Aus iron_ore exp	-0,45105	-0,2591	-0,136026631	-0,45104659	1						
Bra iron_ore exp	-0,19279	-0,32208	-0,264029145	-0,192791936	0,841159547	1					
Cape size_D	-0,67602	-0,28667	0,295738377	-0,676015775	0,526557354	0,332511245	1				
Cape size_S	0,118184	-0,09649	-0,134788835	0,118183722	0,196333519	0,235024247	0,010446201	1			
China iron_ore imp	-0,27337	-0,38346	-0,224548919	-0,27337478	0,937168498	0,853363329	0,435915268	0,237024871	1		
SK iron_ore imp	-0,47792	-0,23685	-0,092991178	-0,477916086	0,816103392	0,680917335	0,483470328	0,087286413	0,730841754	1	
JPN iron_ore imp	0,180379	0,042586	-0,377431494	0,180378858	-0,036504842	0,080981338	-0,135955508	0,033429598	-0,066628412	0,144098078	1
Russia Steel	0,100926	-0,1023	-0,644972663	0,100925674	0,593544603	0,635101903	0,078849379	0,303685136	0,621931146	0,497644615	0,31342606
US Steel	0,334965	0,251696	-0,522999117	0,334964993	-0,322215942	-0,191893201	-0,352395021	0,001567449	-0,379804317	-0,115380482	0,545955724
China Steel	-0,23013	-0,39029	-0,288967072	-0,230131259	0,924743895	0,846196307	0,419010535	0,247707525	0,987379939	0,722561754	-0,030936903
India Steel	-0,40173	-0,34843	-0,165159878	-0,401730501	0,974305686	0,844716699	0,537412123	0,190651987	0,964814938	0,797764149	-0,053057941
JPN Steel	0,433939	0,125111	-0,621951239	0,433939237	-0,124050821	0,025142645	-0,339183345	0,103458185	-0,10479386	0,001414048	0,715243837
SK Steel	-0,44284	-0,34968	-0,177887013	-0,44284435	0,927275642	0,792985576	0,543052568	0,218646043	0,875559516	0,846933873	0,081613427
CND Iron Ore Exports	-0,33049	-0,21858	-0,103354404	-0,330492139	0,779825372	0,697551682	0,434511574	0,211765893	0,719481984	0,654192263	-0,023040443
Capesize Fleet Growth	0,434086	-0,62739	-0,175638229	0,434086261	-0,22233941	-0,031900457	-0,140096435	-0,008323761	0,001005263	-0,204415075	0,008242615
Taiwan Iron Ore Imports	-0,40232	-0,06034	-0,127351756	-0,402315324	0,615977752	0,478757528	0,426821335	0,080860671	0,501186434	0,61394214	0,167455851
Taiwan Ext Rate $	0,232945	0,603224	0,354195517	0,232944938	-0,633583869	-0,576571584	-0,397408275	-0,057494781	-0,615242028	-0,592995208	-0,106075253

	Russia Steel	US Steel	China Steel	India Steel	JPN Steel	SK Steel	ron Ore Ex	ize Fleet Gr	Iron Ore I	wan Ext Ra
BFI										
EX Japan										
EX south korea										
BDI										
Aus iron_ore exp										
Bra iron_ore exp										
Cape size_D										
Cape size_S										
China iron_ore imp										
SK iron_ore imp										
JPN iron_ore imp										
Russia Steel	1									
US Steel	0,337896192	1								
China Steel	0,654849427	-0,329427726	1							
India Steel	0,595416108	-0,346211901	0,960584831	1						
JPN Steel	0,50367012	0,768692257	-0,041403714	-0,115367635	1					
SK Steel	0,674893694	-0,129945363	0,874826557	0,925317004	0,048255872	1				
CND Iron Ore Exports	0,490606523	-0,228249148	0,722123526	0,759694562	-0,066171343	0,74824	1			
Capesize Fleet Growth	-0,001356154	-0,012220839	0,041855767	-0,104672441	0,099190222	-0,12056	-0,17936	1		
Taiwan Iron Ore Imports	0,49167781	0,100066276	0,50602297	0,579887582	0,182556374	0,660275	0,515923	-0,25739	1	
Taiwan Ext Rate $	-0,495719406	-0,046583723	-0,630253115	-0,669571393	-0,08352865	-0,72062	-0,49341	-0,2323	-0,45367	1

Table 11: correlation table – independent variables (SA iron ore exports). Compiled by author.

The table above shows that the Australian iron ore is highly correlated with five other independent variables (China iron import, South Korea iron ore import, China steel, India steel and South Korea steel). In accordance with tonne-mile, Australia poses a disadvantage to South African iron ore exports over the Asian market, thus the Australian iron ore exports are removed from this model.

The Brazilian iron ore export is also highly correlated with three independent variables (China iron import, China steel and Indian steel). Fundamentally the aim is to save as many independent variables as possible in order for the model to perform better, hence Brazil iron ore export is sacrificed in this model<Additionally, Brazil is the second largest iron ore exporting country in the world and is highly competitive to South Africa.

The China iron ore import correlated with three independent variables (China steel, India steel and South Korea Steel). The predominant rationale behind a large volume of iron ore imports may be for steel manufacturing and perhaps to do trade with the neighbouring countries in the region, for example China; therefore, in this case, China iron ore imports are removed from the model, provided the other independent variables also are significant to the dependent variable (SA iron ore export).

South Korea iron ore imports correlated with the South Korea steel. South Korea steel is removed from the model. Also, BFI has been removed after a highly correlation with the BDI, the BDI contains more significance to the dry bulk fleet. Throughout the process of eliminating the correlated independent variables from the model, the equation on the T-test is defined in a mathematical formula as follows:

Y (SA_iron ore exp) $= \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots\ldots\ldots \beta_k X_k$

where:

- Y = dependent variable
- α = constant
- X_s = independent variables (BDI, Capesize demolish, Capesize sale, Capesize fleet growth, China steel, Canada iron ore exports, exchange rate Japan, exchange rate South Korea, India steel, Japan iron ore import, Japan steel, Russia steel, South Korea steel, Taiwan exchange rate, Taiwan iron ore imports and the US steel).

3.1.4. T-test and F-test

The T-test is done to determine the independent variables which have a significant effect to the dependent variable. Thus, the F-test is introduced to conduct the robust test that will remove all the insignificant independent variables from the regression. The following tables (iron ore and coal) indicate the results of the equation after the t-test.

Dependent Variable: D(SA_IRON_ORE_EXPORT)				
Method: Least Squares				
Date: 08/09/19 Time: 01:39				
Sample (adjusted): 2000M02 2019M04				
Included observations: 231 after adjustments				
Variable	Coefficier	Std. Error	t-Statistic	Prob.
C	0.955105	1.253905	0.761704	0.4471
D(BDI)	0.069576	0.116611	0.596650	0.5514
CAPE_SIZE_D	-0.002496	0.004415	-0.565521	0.5723
CAPE_SIZE_S	0.002120	0.006687	0.317045	0.7515
D(CAPESIZE_FLEET_GROWTH)	-0.115547	0.089317	-1.293678	0.1972
CHINA_STEEL	0.040698	0.084058	0.484174	0.6288
CND_IRON_ORE_EXPORTS	-0.056164	0.074234	-0.756581	0.4501
D(EX_JAPAN)	1.777857	1.031651	1.723312	0.0863
D(EX_SOUTH_KOREA)	-0.330506	1.238071	-0.266953	0.7898
D(INDIA_STEEL)	-1.302533	0.493964	-2.636899	0.0090
JPN_IRON_ORE_IMP	-0.043573	0.296903	-0.146757	0.8835
JPN_STEEL	-0.022900	0.563283	-0.040655	0.9676
RUSSIA_STEEL	-0.226775	0.476932	-0.475487	0.6349
D(SK_STEEL)	0.936268	0.399628	2.342851	0.0201
D(TAIWAN_EXT_RATE_$)	1.619112	2.572274	0.629448	0.5297
TAIWAN_IRON_ORE_IMPORT!	0.067030	0.100202	0.668944	0.5043
US_STEEL	-0.013030	0.319889	-0.040732	0.9675
R-squared	0.083730	Mean dependent \		0.002488
Adjusted R-squared	0.015224	S.D. dependent va		0.141957
S.E. of regression	0.140872	Akaike info criteri		-1.011184
Sum squared resid	4.246819	Schwarz criterion		-0.757846
Log likelihood	133.7918	Hannan-Quinn crit		-0.909004
F-statistic	1.222228	Durbin-Watson sta		2.872065
Prob(F-statistic)	0.252589			

Table 12: Regression results after the t-test (iron ore). Compiled by author.

Dependent Variable: I_1__SA_SEABORNE_COAL_EXPORTS
Method: Least Squares
Date: 08/12/19 Time: 12:20
Sample: 1 19
Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.743610	0.248137	-2.996766	0.2050
I_1__BC_DEMOLITION_AV_AGE	-1.122496	0.246188	-4.559504	0.1374
I_1__BC_FLEET_DEV	0.104842	0.599456	0.174896	0.8898
I_1__BRENT_CRUDE_OIL_PRICE	0.062441	0.039959	1.562642	0.3624
I_1__EX_RATES_EURO_INDEX	-1.370225	0.285483	-4.799667	0.1308
I_1__GLOBAL_OIL_PROD	-3.301999	0.578937	-5.703550	0.1105
I_1__INDUS_PROD_CHINA	1.363112	0.283815	4.802823	0.1307
I_1__INDUS_PROD_INDIA	0.152795	0.027016	5.655717	0.1114
I_1__INDUS_PROD_S_KOREA	-0.083009	0.018641	-4.453088	0.1406
I_1__INDUS_PROD_SOUTH_EAST_AS...	0.201431	0.048133	4.184909	0.1493
I_1__THERMAL_COAL_PRICE_AUSTR...	0.516790	0.114236	4.523886	0.1385
I_1__TOTAL_BULKER_SALES	-0.032561	0.029154	-1.116879	0.4649
I_1__WORLD_SEABORNE_COAL_TRADE	0.316055	0.320993	0.984616	0.5049
I_1__WORLD_SEABORNE_LNG_TRADE	-4.344075	0.806861	-5.383922	0.1169
I_1__WORLD_STEEL_PROD	0.953458	0.358930	2.656390	0.2292
LN_BC_ORDERBOOK	0.120338	0.032744	3.675083	0.1691
LN_BDI	0.012326	0.010132	1.216544	0.4380
LN_INDUS_PROD_OECD	0.277173	0.055811	4.966279	0.1265
R-squared	0.990899	Mean dependent var		0.008654
Adjusted R-squared	0.836177	S.D. dependent var		0.041532
S.E. of regression	0.016810	Akaike info criterion		-6.383358
Sum squared resid	0.000283	Schwarz criterion		-5.488626
Log likelihood	78.64190	Hannan-Quinn criter.		-6.231933
F-statistic	6.404386	Durbin-Watson stat		1.386622
Prob(F-statistic)	0.302353			

Table 13: Regression results after t-test (coal). Compiled by author.

The tables above illustrate the results of the t-test. Looking at Table 12, there are only three significant independent variables (in blue) and thirteen insignificant independent variables, on the other hand looking on Table 23, all independent variables are insignificant. Therefore, the F-test is required to carry out a robust test to remove solely insignificant variables from the regression. Logically, after both the T-test and the F-test, the regression is anticipated to have only significant variables remaining. The following tables will illustrate the results of the F-test.

Dependent Variable: I_1__SA_SEABORNE_COAL_EXPORTS
Method: Least Squares
Date: 08/12/19 Time: 13:51
Sample: 1 19
Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.790373	0.156248	-5.058455	0.0039
I_1__BC_DEMOLITION_AV_AGE	-1.289141	0.236817	-5.443616	0.0028
I_1__BRENT_CRUDE_OIL_PRICE	0.111459	0.041147	2.708785	0.0423
I_1__EX_RATES_EURO_INDEX	-1.486751	0.249717	-5.953737	0.0019
I_1__GLOBAL_OIL_PROD	-3.319228	0.735700	-4.511658	0.0063
I_1__INDUS_PROD_CHINA	1.459898	0.278641	5.239345	0.0034
I_1__INDUS_PROD_INDIA	0.165625	0.028513	5.808664	0.0021
I_1__INDUS_PROD_S_KOREA	-0.094532	0.016416	-5.758586	0.0022
I_1__INDUS_PROD_SOUTH_EAST_AS...	0.221714	0.045296	4.894730	0.0045
I_1__THERMAL_COAL_PRICE_AUSTR...	0.563300	0.105377	5.345567	0.0031
I_1__WORLD_SEABORNE_LNG_TRADE	-4.590174	0.812353	-5.650465	0.0024
I_1__WORLD_STEEL_PROD	1.078684	0.266663	4.045119	0.0099
LN_BC_ORDERBOOK	0.141812	0.026998	5.252711	0.0033
LN_INDUS_PROD_OECD	0.308793	0.058071	5.317468	0.0031

R-squared	0.918416	Mean dependent var	0.008654
Adjusted R-squared	0.706297	S.D. dependent var	0.041532
S.E. of regression	0.022508	Akaike info criterion	-4.611189
Sum squared resid	0.002533	Schwarz criterion	-3.915287
Log likelihood	57.80630	Hannan-Quinn criter.	-4.493415
F-statistic	4.329716	Durbin-Watson stat	1.499817
Prob(F-statistic)	0.057834		

Table 14: F-test results (coal). Compiled by author.

Dependent Variable: D(SA_IRON_ORE_EXPORT)				
Method: Least Squares				
Date: 08/09/19 Time: 02:15				
Sample (adjusted): 2000M02 2019M04				
Included observations: 231 after adjustments				
Variable	Coefficier	Std. Error	t-Statistic	Prob.
C	0.004889	0.009152	0.534155	0.5938
D(EX_JAPAN)	2.014443	0.907658	2.219385	0.0274
D(INDIA_STEEL)	-1.371061	0.471812	-2.905951	0.0040
D(SK_STEEL)	0.984335	0.365722	2.691485	0.0076
R-squared	0.065778	Mean dependent \		0.002488
Adjusted R-squared	0.053432	S.D. dependent va		0.141957
S.E. of regression	0.138112	Akaike info criteri		-1.104336
Sum squared resid	4.330023	Schwarz criterion		-1.044727
Log likelihood	131.5508	Hannan-Quinn crit		-1.080293
F-statistic	5.327680	Durbin-Watson sta		2.880494
Prob(F-statistic)	0.001450			

Table 15: F-test regression results (iron ore). Compiled by author.

The null hypothesis on the F-test is that all the insignificant variables are equal to 0. Therefore, when conducting the F-test, the insignificant variables are defined as C (insignificant variable) = 0. After running this test, if the P – value is greater than 5 percent, then the null hypothesis is rejected. In both of the above equations the null hypothesis is rejected; therefore, the insignificant variables were removed individually.

Wald Test:			
Equation: EQ1			
Test Statistic	Value	df	Probabilit
F-statistic	0.322517	(13, 214)	0.9881
Chi-square	4.192722	13	0.9890
Null Hypothesis: C(2)=0, C(3)=0, C(4)=0, C(5)=0, C(6)=0, C(7)=0, C(9)=0, C(11)=0, C(12)=0, C(13)=0, C(15)=0, C(16)=0, C(17)=0			
Null Hypothesis Summary:			

Wald Test:
Equation: EQ01

Test Statistic	Value	df	Probability
F-statistic	6.404386	(17, 1)	0.3024
Chi-square	108.8746	17	0.0000

Null Hypothesis: C(2)=0, C(3)=0, C(4)=0, C(5)=0, C(6)=0, C(7)=0, C(8)=0, C(9)=0, C(10)=0, C(11)=0, C(12)=0, C(13)=0, C(14)=0, C(15)=0, C(16)=0, C(17)=0, C(18)=0
Null Hypothesis Summary:

The SA iron ore exports equation was left with three significant variables after the f-test while the SA coal exports has thirteen significant variables. Practically, after the f-test, if a minimum of three variables remain, such a model is highly expected to perform poorly. However, for the purpose of this research the SA iron ore model can be defined as a "Non-blue" model.

3.1.5 Cointegration

The cointegration test is to determine whether the error of the paired variables is stationary, by doing an Augmented Dickey Fuller test on the residual on level I (0). This test may only be conducted when the dependent variable (Y) is an I (1) process, meaning that this variable is stationary at 1st difference. Therefore, if the (Y) and (X) are both stationary at 1st difference, then both dependent and independent variables will be paired and the run a regression. The residual of the equation will be saved and tested in a unit root test, if the residual is stationary on level I (0) thus the exist cointegration between Y and X. However, if the residual has the ability to go back to its original form after the shock, then the paired variables are deemed to have a long-run equilibrium relationship, therefore the residual is defined as the Error-correction term with – (1) and added into the model as ECT – (1).

Following the SA iron ore regression, three error correction term were added after the dependent variable (Y) cointegrated with all three independent variables.

However, two ECT were removed from the model as they cause the independent variables to be insignificant; thus the model after the cointegration test is defined as the following mathematical formula:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots \beta_k X_k + \mu$$

On the other hand, the SA coal regression has all I (1) process variables not cointegrating; therefore there is no ECT added to the equation. The model is defined as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots \beta_k X_k$$

The following table illustrates the results of the regression after the cointegration test.

Included observations: 230 after adjustments				
Variable	Coefficier	Std. Error	t-Statistic	Prob.
C	0.003871	0.008284	0.467243	0.6408
D(EX_JAP/	1.158347	0.833050	1.390490	0.1658
D(INDIA_S	-1.041559	0.429023	-2.427749	0.0160
D(SK_STEE	0.962462	0.332397	2.895517	0.0042
ECT_1(-1)	-0.435329	0.059668	-7.295885	0.0000
R-squared	0.244530	Mean dependent v		0.002404
Adjusted I	0.231099	S.D. dependent va		0.142261
S.E. of reg	0.124744	Akaike info criteri		-1.303604
Sum squa	3.501250	Schwarz criterion		-1.228863
Log likelih	154.9144	Hannan-Quinn crit		-1.273455
F-statistic	18.20694	Durbin-Watson sta		2.310808
Prob(F-sta	0.000000			

Table 16: Co-integration results. SA iron ore exports model. Compiled by author.

The table above shows the results after the co-integration test: there is only one error correction term left, other errors are removed from the model as they cause the independent variables to be insignificant. The SA coal export does not contain any error correction terms since all P –values of the co-integrated values are greater than 5 percent.

Dependent Variable: I_1__SA_SEABORNE_COAL_EXPORTS
Method: Least Squares
Date: 08/12/19 Time: 23:07
Sample: 1 19
Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009243	0.009748	0.948190	0.3563
I_1__BC_DEMOLITION_AV_AGE	-0.089741	0.147786	-0.607233	0.5517

R-squared	0.021230	Mean dependent var	0.008654
Adjusted R-squared	-0.036345	S.D. dependent var	0.041532
S.E. of regression	0.042280	Akaike info criterion	-3.389687
Sum squared resid	0.030390	Schwarz criterion	-3.290272
Log likelihood	34.20203	Hannan-Quinn criter.	-3.372862
F-statistic	0.368732	Durbin-Watson stat	3.310252
Prob(F-statistic)	0.551721		

Table 17: Co-integration results. SA iron ore exports model. Compiled by author.

3.1.6 ARMA

The ARMA process is carried out to strengthen the model to perform better and be more accurate by adding the AR (1) – (5); MA (1) – (5) {Autoregressive process and Moving average process} into the model. Thereafter, the added AR; MA values are removed from the model individually, starting from the highest order, which may be the AR (5) or MA (5) until significant variables are attained.

Dependent Variable: D(SA_IRON_ORE_EXPORT)				
Method: ARMA Conditional Least Squares (Gauss-Ne				
steps)				
Date: 08/09/19 Time: 03:47				
Sample (adjusted): 2000M08 2019M04				
Included observations: 225 after adjustments				
Failure to improve likelihood (non-zero gradients) a				
Coefficient covariance computed using outer produ				
MA Backcast: 2000M03 2000M07				
Variable	Coefficier	Std. Error	t-Statistic	Prob.
C	0.002169	0.000827	2.622070	0.0094
D(EX_JAP	0.358715	0.567327	0.632290	0.5279
D(INDIA_S	-0.072320	0.279207	-0.259019	0.7959
D(SK_STEE	0.481014	0.269552	1.784497	0.0758
ECT_1(-1)	0.284982	0.219859	1.296205	0.1963
AR(1)	-0.487243	0.551154	-0.884042	0.3777
AR(2)	0.356355	0.453753	0.785351	0.4331
AR(3)	-0.199911	0.344914	-0.579595	0.5628
AR(4)	-0.164498	0.336494	-0.488859	0.6255
AR(5)	-0.016942	0.093927	-0.180380	0.8570
MA(1)	-0.620731	0.501217	-1.238447	0.2169
MA(2)	-0.797027	0.547359	-1.456132	0.1468
MA(3)	0.785336	0.368624	2.130456	0.0343
MA(4)	-0.093958	0.490937	-0.191385	0.8484
MA(5)	-0.273354	0.341849	-0.799635	0.4248

Table 18: ARMA test. SA iron ore exports. Compiled by author.

The table shows that after adding the ARMA process to the model, all independent variables became insignificant. Therefore, the AR; MA processes are removed individually from the model until the variables are significant.

Dependent Variable: D(SA_IRON_ORE_EXPORT)						
Method: ARMA Conditional Least Squares (Gauss-Newton / Marquardt steps)						
Date: 08/09/19 Time: 03:51						
Sample (adjusted): 2000M03 2019M04						
Included observations: 230 after adjustments						
Failure to improve likelihood (non-zero gradients) after 26 iterations						
Coefficient covariance computed using outer product of gradients						
MA Backcast: 2000M02						
Variable	Coefficier	Std. Error	t-Statistic	Prob.		
C	0.001830	0.000795	2.301162	0.0223		
D(EX_JAP/	0.115812	0.223190	0.518894	0.6043		
D(INDIA_S	0.044338	0.265882	0.166758	0.8677		
D(SK_STEI	0.522865	0.226518	2.308271	0.0219		
ECT_1(-1)	0.167510	0.066670	2.512521	0.0127		
MA(1)	-0.999849	0.001260	-793.5378	0.0000		
R-squared	0.427838	Mean dependent v		0.002404		
Adjusted R	0.415066	S.D. dependent va		0.142261		
S.E. of reg	0.108802	Akaike info criteri		-1.572826		
Sum squai	2.651703	Schwarz criterion		-1.483137		
Log likelih	186.8750	Hannan-Quinn crit		-1.536647		
F-statistic	33.49948	Durbin-Watson sta		2.020324		
Prob(F-sta	0.000000					

Table 19: ARMA test results. SA iron ore exports. Compiled by author.

The ARMA test results shows that this model is a MA (1) process with an Adjusted R squared of 41.5 percent.

3.1.7 Jarque – Berra Test

The Jarque Berra test is applied to the model to determine whether the errors are normally distributed. The null hypothesis of this test says the errors are normally distributed therefore if the P– value is greater than 5 percent the null hypothesis can be accepted. However, if the P– value is less than 5 percent,then the null hypothesis is rejected; thus dummy variables are added to the model until the null hypothesis results is satisfied.

In the SA iron ore exports model, after conducting the JB test it was found that is not normally distributed and a number of variables were added to the model. The SA coal exports results show that the model is normally distributed, hence there are no variables added. The following tables show the results of both the iron ore and the coal models

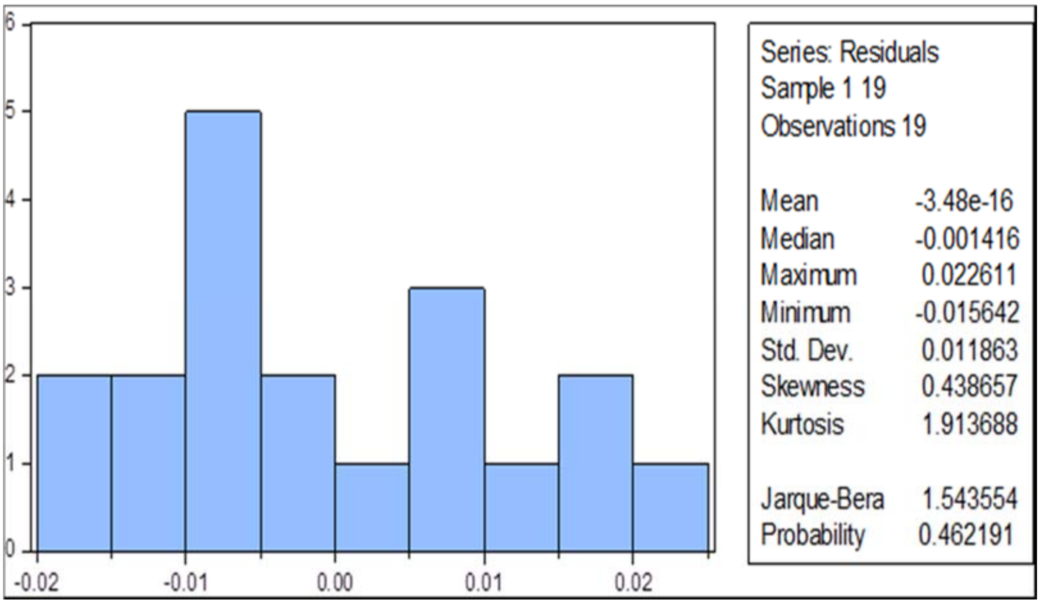


Table 20: Jarque – Berra test results. SA coal exports. Compiled by author.

The P– value of the JB is 46 percent, therefore, the null hypothesis is accepted that this model is normally distributed without adding the dummy variables.

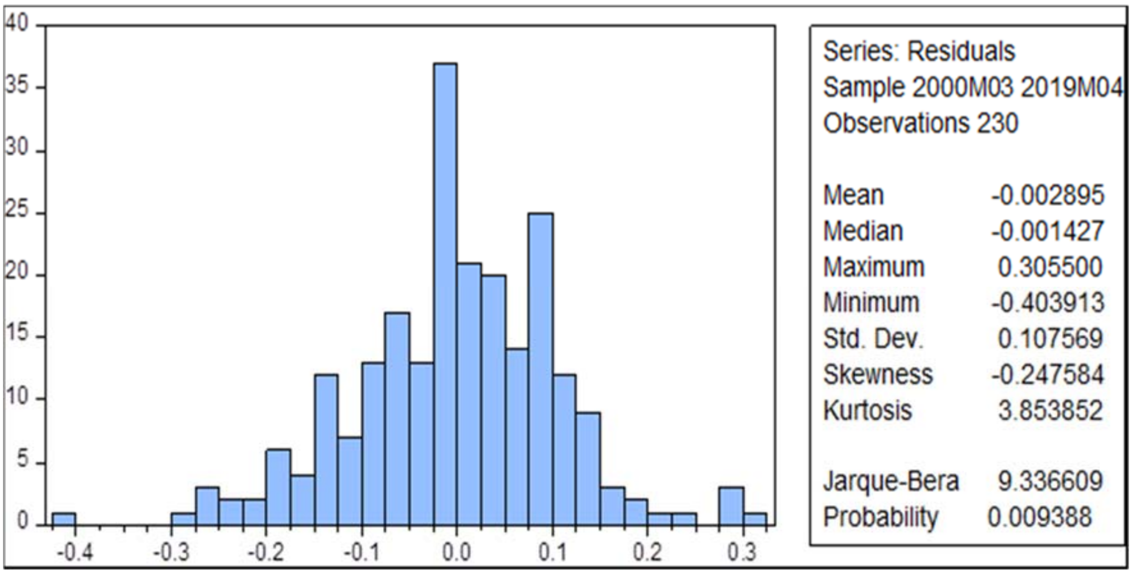


Table 21: Jarque – Berra test results. SA iron ore exports. Compiled by author.

The P– value of this test is less than 5 percent, therefore, the dummy variables were added to the model. The table below illustrates the results of the JB after inserting four dummy variables to the model.

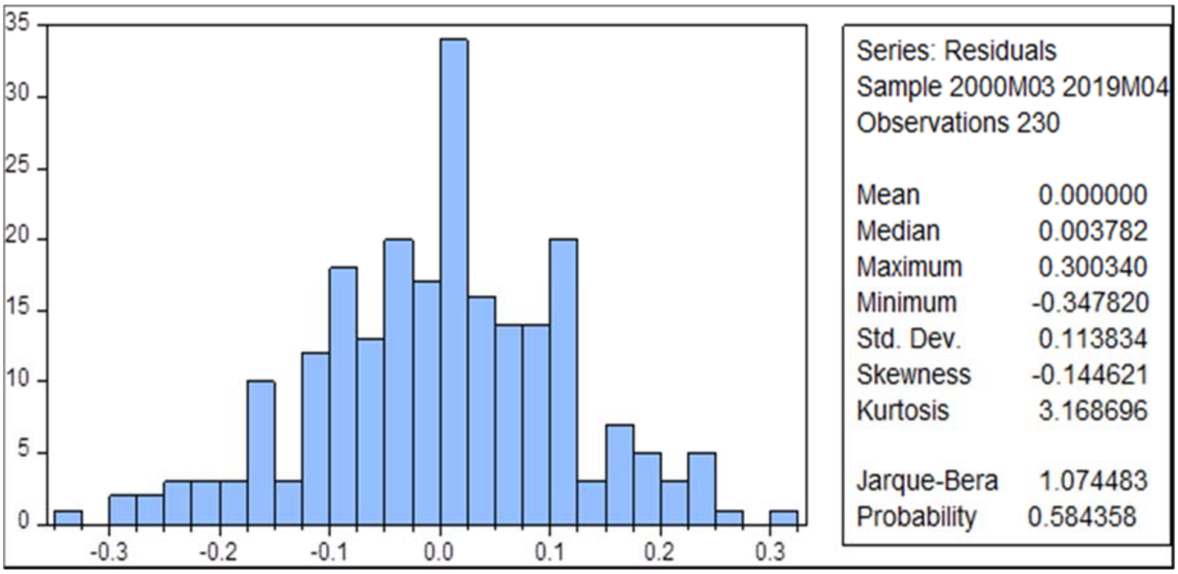


Table 22: Jarque – Berra test. SA iron ore exports. Compiled by author.

The P– value is then 58 percent after inserting four dummy variables to the model, thus the model becomes normally distributed.

3.1.8 Heteroscedasticity

The heteroscedasticity is carried out using a white test to check if the variance of the error term is changing over time or not. Essentially, it is highly preferable if the variance is not changing over time, so the model can be defined as being homoscedastic. The null hypothesis says there is homoscedasticity, however, that is determined by the P– value, if the P– value is greater than 5 percent, then the null hypothesis is accepted. This will mean that the model is homoscedastic and finite overtime. If the P– value is less than 5 percent, t the null hypothesis is rejected, meaning the model is heteroscedastic.

Thereafter, the serial correlation LM test follows using the Breusch– Godfrey test to check whether yesterday`s error has a negative effect in today`s error. The null hypothesis in the serial correlation, which is similar to the F – test, says that all the coefficients are equal to zero. The null hypothesis is accepted if the probability is greater than 5 percent Moreover, it also essential to mention that the number of legs is determined by the frequency (daily, monthly and annually; the SA iron ore exports used a monthly frequency, thus the test was checked on leg (14), whereas for SA coal exports the frequency is annual and test was checked on leg (2).

In this study, the SA iron ore exports is a homoscedastic model (P > 5 percent) and a serial correlation exists as the null hypothesis is rejected that there is no serial correlation (P– value < 5percent, therefore a "Newey West correction" was applied. Meanwhile, the SA coal export is also a homoscedastic model with the P– value greater than 5 percent and there is no serial correlation due to the probability value which is greater than 5 percent therefore there are no corrections required.

The heteroscedasticity test and the serial correlation LM test have two different types of corrections to be applied when both correspond. The following shows which type of correction to apply in different results:

- Homoscedasticity – No Serial correlation {No correction required}
- Homoscedasticity – Serial correlation {Newey west correction}
- Heteroscedasticity – No Serial correlation {White correction}
- Heteroscedasticity – Serial correlation {Newey west correction}

The following tables shows the results of both (heteroscedasticity test and Ssrial correlation LM test) on both equations.

Heteroskedasticity Test: White

F-statistic	1.496837	Prob. F(13,5)	0.3455
Obs*R-squared	15.11593	Prob. Chi-Square(13)	0.3002
Scaled explained SS	0.478229	Prob. Chi-Square(13)	1.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 08/13/19 Time: 02:32
Sample: 1 19
Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.47E-05	0.000157	0.285126	0.7870
I_1__BC_DEMOLITION_AV_AGE^2	0.006935	0.006199	1.118730	0.3141
I_1__BRENT_CRUDE_OIL_PRICE^2	0.000439	0.000405	1.083073	0.3282
I_1__EX_RATES_EURO_INDEX^2	-0.002217	0.006817	-0.325248	0.7582
I_1__GLOBAL_OIL_PROD^2	-0.040772	0.084536	-0.482307	0.6500
I_1__INDUS_PROD_CHINA^2	0.000232	0.001058	0.219365	0.8350
I_1__INDUS_PROD_INDIA^2	1.38E-05	2.28E-05	0.603087	0.5728
I_1__INDUS_PROD_S_KOREA^2	-5.97E-06	9.41E-06	-0.634913	0.5534
I_1__INDUS_PROD_SOUTH_EAST_AS...	1.48E-05	7.15E-05	0.206752	0.8444
I_1__THERMAL_COAL_PRICE_AUSTR...	-6.80E-05	0.000244	-0.278392	0.7919
I_1__WORLD_SEABORNE_LNG_TRA...	-0.005940	0.003976	-1.493937	0.1954
I_1__WORLD_STEEL_PROD^2	0.027263	0.010227	2.665738	0.0446
LN_BC_ORDERBOOK^2	-1.00E-06	3.14E-06	-0.320084	0.7618
LN_INDUS_PROD_OECD^2	3.80E-05	3.50E-05	1.083317	0.3281

R-squared	0.795575	Mean dependent var	0.000133
Adjusted R-squared	0.264071	S.D. dependent var	0.000131
S.E. of regression	0.000112	Akaike info criterion	-15.21176
Sum squared resid	6.31E-08	Schwarz criterion	-14.51586
Log likelihood	158.5117	Hannan-Quinn criter.	-15.09399
F-statistic	1.496837	Durbin-Watson stat	3.009765
Prob(F-statistic)	0.345489		

Table 23: Heteroscedasticity white test results. SA coal export. Compiled by author.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.490224	Prob. F(4,1)	0.7736
Obs*R-squared	12.58303	Prob. Chi-Square(4)	0.0135

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 08/13/19 Time: 02:38
Sample: 1 19
Included observations: 19
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.329958	0.525189	-0.628266	0.6429
I_1__BC_DEMOLITION_AV_AGE	-0.501438	0.789438	-0.635183	0.6397
I_1__BRENT_CRUDE_OIL_PRICE	0.010432	0.056421	0.184890	0.8836
I_1__EX_RATES_EURO_INDEX	-0.516899	0.850046	-0.608083	0.6522
I_1__GLOBAL_OIL_PROD	-0.849393	1.716792	-0.494756	0.7075
I_1__INDUS_PROD_CHINA	0.620213	0.979258	0.633349	0.6406
I_1__INDUS_PROD_INDIA	0.060627	0.099824	0.607336	0.6525
I_1__INDUS_PROD_S_KOREA	-0.032688	0.061185	-0.534245	0.6876
I_1__INDUS_PROD_SOUTH_EAST_AS...	0.086734	0.157904	0.549281	0.6802
I_1__THERMAL_COAL_PRICE_AUSTR...	0.247877	0.367912	0.673741	0.6226
I_1__WORLD_SEABORNE_LNG_TRADE	-1.721771	2.774780	-0.620507	0.6464
I_1__WORLD_STEEL_PROD	0.275250	0.622053	0.442487	0.7348
LN_BC_ORDERBOOK	0.056236	0.090174	0.623646	0.6450
LN_INDUS_PROD_OECD	0.129660	0.208845	0.620846	0.6463
RESID(-1)	1.317130	1.556421	0.846256	0.5529
RESID(-2)	-0.863191	1.711347	-0.504393	0.7026
RESID(-3)	-0.011683	1.479585	-0.007896	0.9950
RESID(-4)	1.419586	1.340778	1.058778	0.4818

R-squared	0.662265	Mean dependent var	-3.48E-16
Adjusted R-squared	-5.079237	S.D. dependent var	0.011863
S.E. of regression	0.029249	Akaike info criterion	-5.275629
Sum squared resid	0.000856	Schwarz criterion	-4.380898
Log likelihood	68.11848	Hannan-Quinn criter.	-5.124205
F-statistic	0.115347	Durbin-Watson stat	2.387520
Prob(F-statistic)	0.990933		

Table 24: Serial correlation LM test. SA coal export. Compiled by author.

Heteroskedasticity Test: White				
F-statistic	1.318617	Prob. F(19,210)	0.1738	
Obs*R-squ	24.51507	Prob. Chi-Square(1	0.1771	
Scaled exp	24.32157	Prob. Chi-Square(1	0.1841	
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Date: 08/09/19 Time: 21:19				
Sample: 2000M03 2019M04				
Included observations: 230				
HAC standard errors & covariance (Bartlett kernel, Newey-We				
bandwidth = 5.0000)				
Collinear test regressors dropped from specification				
Variable	Coefficier	Std. Error	t-Statistic	Prob.
C	0.009638	0.002033	4.740071	0.0000
D(EX_JAP/	0.089663	5.793625	0.015476	0.9877
D(EX_JAP/	2.222386	7.671869	0.289680	0.7723
D(EX_JAP/	-4.850170	4.759422	-1.019067	0.3093
D(EX_JAP/	0.474126	1.166592	0.406420	0.6848
D(EX_JAP/	-6.230879	2.083295	-2.990877	0.0031
D(EX_JAP/	1.113457	0.746586	1.491399	0.1374
D(EX_JAP/	-4.968440	1.600021	-3.105234	0.0022
D(EX_JAP/	-2.622532	2.097906	-1.250071	0.2127
D(EX_JAP/	0.972221	0.276288	3.518872	0.0005
D(EX_JAP/	-0.095810	0.115520	-0.829387	0.4078
D(INDIA_S	3.431298	2.996341	1.145163	0.2534
D(INDIA_S	-2.428588	3.222938	-0.753532	0.4520
D(INDIA_S	0.616409	0.707039	0.871817	0.3843
D(INDIA_S	-0.038261	0.085672	-0.446600	0.6556
D(SK_STEE	0.298020	1.314155	0.226777	0.8208
D(SK_STEE	-0.501637	0.443647	-1.130714	0.2595
D(SK_STEE	0.067472	0.058984	1.143909	0.2540
ECT_1(-1)^	0.125991	0.052756	2.388198	0.0178
ECT_1(-1)	-0.005064	0.011740	-0.431357	0.6667
R-squared	0.106587	Mean dependent v	0.012902	
Adjusted R	0.025755	S.D. dependent va	0.019041	
S.E. of reg	0.018795	Akaike info criteri	-5.027560	
Sum squar	0.074179	Schwarz criterion	-4.728597	
Log likelih	598.1694	Hannan-Quinn crit	-4.906965	
F-statistic	1.318617	Durbin-Watson sta	2.164880	
Prob(F-sta	0.173794			

Table 25: Heteroscedasticity white test. SA iron ore exports. Compiled by author.

Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	12.45302	Prob. F(2,218)		0.0000
Obs*R-squ	23.58274	Prob. Chi-Square(2		0.0000
Test Equation:				
Dependent Variable: RESID				
Method: Least Squares				
Date: 08/09/19 Time: 21:22				
Sample: 2000M03 2019M04				
Included observations: 230				
Presample missing value lagged residuals set to zer				
Variable	Coefficier	Std. Error	t-Statistic	Prob.
C	-0.000107	0.007413	-0.014486	0.9885
D(EX_JAP/	-0.218556	0.743999	-0.293758	0.7692
D(INDIA_S	-0.128336	0.395187	-0.324747	0.7457
D(SK_STEE	0.098400	0.304266	0.323401	0.7467
ECT_1(-1)	0.070095	0.112531	0.622893	0.5340
DUMMY_2	-0.032219	0.112667	-0.285967	0.7752
DUMMY_2	-0.008512	0.112269	-0.075820	0.9396
DUMMY_2	0.027433	0.113187	0.242370	0.8087
DUMMY_2	0.063005	0.115353	0.546190	0.5855
DUMMY_2	0.038468	0.111439	0.345196	0.7303
RESID(-1)	-0.255052	0.124056	-2.055935	0.0410
RESID(-2)	-0.258731	0.083348	-3.104221	0.0022
R-squared	0.102534	Mean dependent v		0.000000
Adjusted I	0.057249	S.D. dependent va		0.113834
S.E. of reg	0.110528	Akaike info criteri		-1.516340
Sum squa	2.663163	Schwarz criterion		-1.336962
Log likelih	186.3791	Hannan-Quinn crit		-1.443982
F-statistic	2.264186	Durbin-Watson sta		1.980259
Prob(F-sta	0.012469			

Table 26: Serial correlation LM test. SA iron ore exports. Compiled by author.

Dependent Variable: D(SA_IRON_ORE_EXPORT)					
Method: Least Squares					
Date: 08/09/19 Time: 21:24					
Sample (adjusted): 2000M03 2019M04					
Included observations: 230 after adjustments					
HAC standard errors & covariance (Bartlett kernel, Newey-We					
bandwidth = 5.0000)					
Variable	Coefficier	Std. Error	t-Statistic	Prob.	
C	0.007659	0.005684	1.347502	0.1792	
D(EX_JAP/	0.994681	0.818919	1.214626	0.2258	
D(INDIA_S	-0.892555	0.468572	-1.904839	0.0581	
D(SK_STEE	0.744554	0.350099	2.126697	0.0346	
ECT_1(-1)	-0.436227	0.054698	-7.975253	0.0000	
DUMMY_2	-0.249396	0.018687	-13.34608	0.0000	
DUMMY_2	-0.219903	0.017535	-12.54098	0.0000	
DUMMY_2	0.347201	0.021172	16.39917	0.0000	
DUMMY_2	-0.321185	0.035324	-9.092571	0.0000	
DUMMY_2	-0.458981	0.010201	-44.99550	0.0000	
R-squared	0.359714	Mean dependent v		0.002404	
Adjusted I	0.333521	S.D. dependent va		0.142261	
S.E. of reg	0.116139	Akaike info criteri		-1.425551	
Sum squa	2.967424	Schwarz criterion		-1.276070	
Log likelih	173.9384	Hannan-Quinn crit		-1.365254	
F-statistic	13.73295	Durbin-Watson sta		2.267012	
Prob(F-sta	0.000000				

Table 27: Newey west correction. SA iron ore exports. Compiled by author.

The Newey west correction was conducted on SA iron ore export after it has been discovered to be a homoscedastic model and a serial correlation existed.

3.1.9 Ramsey Test

The purpose of the Ramsey test is to check the linearity of the model. The linearity can be checked on E – views; however, prior to conducting a linearity test, the variables have to be logged. In most cases, if the variables are not a logarithm value, the model is highly likely to be non-linear. Practically, the non-linear model cannot be applicable, thus such a model may be dropped. The probability exists of both SA iron ore exports and SA coal exports being greater than 5 percent, therefore the results are accepted that the model is a linear model. See tables below.

Ramsey RESET Test					
Equation: EQ2					
Specification: D(SA_IRON_ORE_EXPORT) C D(EX_JAPAN)D(IND					
EL) D(SK_STEEL) ECT_1(-1) DUMMY_2000M11 DUMMY_2013					
DUMMY_2006M10 DUMMY_2005M06 DUMMY_2010M08					
Omitted Variables: Powers of fitted values from 2 to 3					
	Value	df	Probability		
F-statistic	0.104453	(2, 218)	0.9009		
Likelihood	0.220301	2	0.8957		
F-test summary:					
	Sum of Sq	df	Mean Squares		
Test SSR	0.002841	2	0.001420		
Restricted	2.967424	220	0.013488		
Unrestrict	2.964583	218	0.013599		
LR test summary:					
	Value				
Restricted	173.9384				
Unrestrict	174.0486				
Unrestricted Test Equation:					
Dependent Variable: D(SA_IRON_ORE_EXPORT)					
Method: Least Squares					
Date: 08/09/19 Time: 21:27					
Sample: 2000M03 2019M04					
Included observations: 230					
HAC standard errors & covariance (Bartlett kernel, Newey-We					
bandwidth = 5.0000)					
Variable	Coefficier	Std. Error	t-Statistic	Prob.	
C	0.008175	0.008596	0.951113	0.3426	
D(EX_JAP/	0.963492	0.844511	1.140888	0.2552	
D(INDIA_S	-0.844573	0.474245	-1.780877	0.0763	
D(SK_STEE	0.712388	0.342915	2.077447	0.0389	
ECT_1(-1)	-0.409074	0.078327	-5.222626	0.0000	
DUMMY_2	0.010454	0.497082	0.021030	0.9832	
DUMMY_2	-0.083269	0.276481	-0.301176	0.7636	
DUMMY_2	0.312318	0.115052	2.714574	0.0072	
DUMMY_2	-0.154942	0.322649	-0.480218	0.6316	
DUMMY_2	0.108634	1.017089	0.106809	0.9150	
FITTED^2	-0.284620	1.999666	-0.142334	0.8869	
FITTED^3	4.019458	6.751355	0.595356	0.5522	
R-squared	0.360327	Mean dependent \		0.002404	
Adjusted I	0.328050	S.D. dependent va		0.142261	
S.E. of reg	0.116615	Akaike info criteri		-1.409118	
Sum squa	2.964583	Schwarz criterion		-1.229740	
Log likelih	174.0486	Hannan-Quinn crit		-1.336761	
F-statistic	11.16357	Durbin-Watson sta		2.274811	
Prob(F-sta	0.000000				

Table 28: Ramsey test results. SA iron ore exports. Compiled by author.

The Ramsey test shows that the P– value < 5 percent, therefore, the null hypothesis is accepted that this model is linear.

Ramsey RESET Test
Equation: EQ02
Specification: I_1__SA_SEABORNE_COAL_EXPORTS C
I_1__BC_DEMOLITION_AV_AGE I_1__BRENT_CRUDE_OIL_PRI
CE I_1__EX_RATES_EURO_INDEX I_1__GLOBAL_OIL_PROD
I_1__INDUS_PROD_CHINA I_1__INDUS_PROD_INDIA
I_1__INDUS_PROD_S_KOREA I_1__INDUS_PROD_SOUTH_EA
ST_ASIA_AVERAGE I_1__THERMAL_COAL_PRICE_AUSTRALIA
I_1__WORLD_SEABORNE_LNG_TRADE I_1__WORLD_STEEL_
PROD LN_BC_ORDERBOOK LN_INDUS_PROD_OECD
Omitted Variables: Powers of fitted values from 2 to 3

	Value	df	Probability
F-statistic	0.482122	(2, 3)	0.6583
Likelihood ratio	5.295359	2	0.0708

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.000616	2	0.000308
Restricted SSR	0.002533	5	0.000507
Unrestricted SSR	0.001917	3	0.000639

LR test summary:

	Value
Restricted LogL	57.80630
Unrestricted LogL	60.45398

Unrestricted Test Equation:
Dependent Variable: I_1__SA_SEABORNE_COAL_EXPORTS
Method: Least Squares
Date: 08/13/19 Time: 02:58
Sample: 1 19
Included observations: 19

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.268295	0.517485	-2.450881	0.0916
I_1__BC_DEMOLITION_AV_AGE	-1.935893	0.710382	-2.725144	0.0722
I_1__BRENT_CRUDE_OIL_PRICE	0.179707	0.083940	2.140898	0.1217
I_1__EX_RATES_EURO_INDEX	-2.233580	0.811008	-2.754081	0.0705
I_1__GLOBAL_OIL_PROD	-5.064885	1.960361	-2.583649	0.0815
I_1__INDUS_PROD_CHINA	2.277723	0.889700	2.560102	0.0832
I_1__INDUS_PROD_INDIA	0.250371	0.092113	2.718094	0.0727
I_1__INDUS_PROD_S_KOREA	-0.143413	0.053103	-2.700656	0.0737
I_1__INDUS_PROD_SOUTH_EAST_AS...	0.346761	0.137173	2.527916	0.0856
I_1__THERMAL_COAL_PRICE_AUSTR...	0.865838	0.330057	2.623299	0.0788
I_1__WORLD_SEABORNE_LNG_TRADE	-7.084923	2.700101	-2.623948	0.0787
I_1__WORLD_STEEL_PROD	1.479594	0.512214	2.888623	0.0631
LN_BC_ORDERBOOK	0.225340	0.090341	2.494315	0.0881
LN_INDUS_PROD_OECD	0.480708	0.186836	2.572892	0.0823
FITTED^2	8.020917	9.309825	0.861554	0.4523
FITTED^3	-150.2369	153.6343	-0.977886	0.4002

R-squared	0.938260	Mean dependent var	0.008654
Adjusted R-squared	0.629559	S.D. dependent var	0.041532
S.E. of regression	0.025278	Akaike info criterion	-4.679366
Sum squared resid	0.001917	Schwarz criterion	-3.884049
Log likelihood	60.45398	Hannan-Quinn criter.	-4.544767
F-statistic	3.039386	Durbin-Watson stat	1.415552
Prob(F-statistic)	0.195545		

Table 29: Ramsey test result. SA coal exports. Compiled by author.

The table above shows that the SA coal exports is linear, the probability value is greater than 5 percent; therefore, the null hypothesis is accepted.

The main objective of this study was to check the linearity of both models and the forecasting results. Therefore, the Chow test is not considered hence the structural break-point is not mentioned.

3.1.10 Forecasting

Two types of forecasting were conducted on E– views for the purpose of this study. Firstly, the Dynamic forecast, which gives more accuracy for a long term forecasting, and secondly, the Statistic forecasting which is highly preferable for the nature of this regard; thus it provides more accurate results for a short-term forecast. The following figure illustrates the forecasting results of the model:

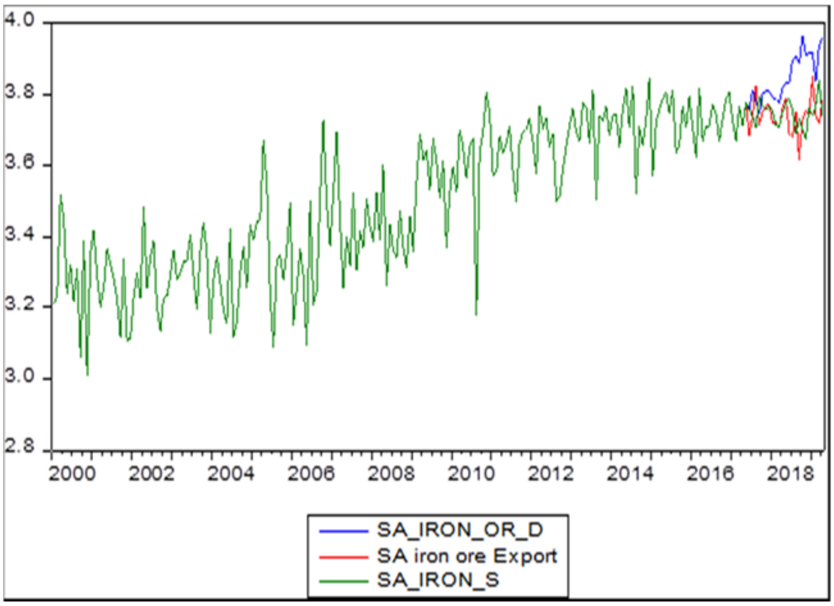


Figure 12: Comparison of Dynamic and Statistic forecasting. Compiled by author.

The graph shows that the dynamic forecast is relatively distant from the actual forecast than Statistic forecasting, therefore in this case it can be concluded that the statistic is performing better.

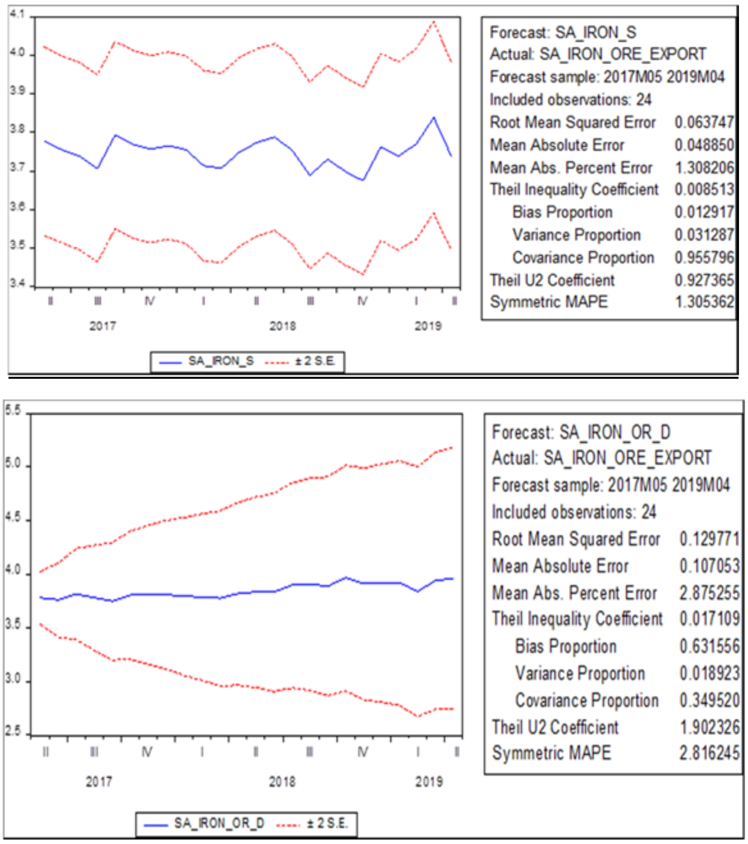


Figure 13: Comparison of Dynamic and Statistic forecasting. Compiled by author.

Referring to the tables above, the root mean square error, mean absolute error and the mean absolute percentage error values of the Dynamic forecasting are relatively higher than those of the Statistic forecasting, therefore the author can infer that the statistic forecasting performs better. It is also important to highlight that the bias proportion values of the statistic forecasting should be as close as possible to zero and the variance proportion to be always less than the covariance proportion values.

3.1.11 Comprehensive Analysis

This section seeks to discuss with economic justifications, how the remaining variables in both models significantly affect the dependent variables. The remaining significant variables are listed in a table below:

Iron ore export	**Coal exports**
Exchange rate Japan	Bulk carrier demolition average age
India steel	Brent crude oil price

South Korea steel	Exchange rate euro index
	Global oil production
	Industry production India
	Industry production South Korea
	Industry production south east Asia
	Thermal coal price Australia
	World seaborne LNG trade
	World steel production
	Bulk carrier order book
	Industry production OECD

Table 30: A list of significant variables. Compiled by author.

The correspondence between these significant variables and the dependent variable can be ex The correspondence between these significant variables and the dependent variable can be expressed in a mathematical formula as follows:

- Y (SA iron ore exports) = $c + 0.115X_1 + 0.044X_2 + 0.522X_3 + \mu$
- Y (SA coal exports) = $c + 0.007X_1 + 0.000X_2 + (-0.002X_3) + (-0.040X_4)$ ……. $+ \mu$

The equations above determine the variables which have a positive relationship with SA iron ore exports and SA coal exports; therefore an increase in these variables may result to a significant impact to the dependent variable. The negative values are an indication of an insipid relationship with a dependent variable, thus they not economically justified in this study.

The following are the positive variables on the SA iron ore exports equation and SA coal exports respectively.

SA iron ore exports:

- Exchange rate Japan
- India steel

- South Korea steel

SA coal exports:

- Bulk carrier demolishing average age
- Brent crude oil price
- Industry production China
- Industry production India
- Industry production South East Asia
- World steel production
- Industry production OECD

Providing economic justification for these variables can be done by beginning with the global trends. In 2017, the world seaborne trade saw a rise of 4.2 percent extending the world seaborne volumes to 10.7 billion tonnes (Clarkson, 2018). This growth is a result of the recovery of the dry bulk market, which has a contribution of approximately half of the world seaborne trade volume increase in 2017 driven by the improvement in the world economy. The major dry bulk cargo contributed 42.3 percent of the total dry cargo trade whereas minor dry bulk contributed 25.4 percent. This growth was predominantly driven by the increase of dry cargo demands in China.

According to (UNCTAD, 2018), Asia dominated the world seaborne trade by importing 61 percent of the global seaborne import volumes and exported approximately 42 percent of the global seaborne export volumes. This confirms the positive significance from the remaining variables; India steel, South Korea steel, Industry production South East Asia and Industry production China. It is due to large volumes of dry cargo imported to the region. South Korea is one of the top countries that import iron ore to sustain their steel production. The country utilizes the steel production for ship buildings following the record of having the top building companies in terms of gross tonnage in 2012. The top ship building companies were Hyundai heavy industry, Daewoo ship building and Samsung heavy industry; these benefited the country in terms of the fastest growth in industrialization.

Furthermore, the global coal seaborne trade also grew by 5.8 percent, which is driven by the Asian countries i.e. China, Republic of Korea and the South East Asian countries. Indonesia is the leading coal exporting country which contributed 32 per cent of coal exports in 2018, followed by Australia, South Africa, Colombia and the United States. China is importing the largest volumes of this commodity (18 percent), followed by India (17 percent), Japan (15 percent), European countries (13 percent) and the Republic of Korea (12 percent. However, it is also important to highlight that all the remaining variables have a coefficient of less than 1, which means a change on these variables may have a minor or no impact at all to the depend variables. pressed in a mathematical formula as follow:

- Y (SA iron ore exports) = $c + 0.115X_1 + 0.044X_2 + 0.522X_3 + \mu$
- Y (SA coal exports) = $c + 0.007X_1 + 0.000X_2 + (-0.002X_3) + (-0.040X_4) \ldots\ldots + \mu$

The equations above determine the variables which have a positive relationship with SA iron ore exports and SA coal exports, therefore an increase in these variables may result to a significant impact to the dependent variable. The negative values are an indication of an insipid relationship with a dependent variable thus they not economically justified in this study.

The following are the positive variables on the SA iron ore exports equation and SA coal exports respectively; SA iron ore exports:

- Exchange rate Japan
- India steel
- South Korea steel

For SA coal exports:

- Bulk carrier demolishing average age
- Brent crude oil price
- Industry production China
- Industry production India
- Industry production South East Asia

- World steel production
- Industry production OECD

To provide economic justification for these variables can be done so by beginning with the global trends. In 2017, the world seaborne trade saw a rise of 4.2 percent extending the world seaborne volumes to 10.7 billion tonnes (Clarkson, 2018). This growth is a result of the recovery of the dry bulk market, which has a contribution of approximately half of the world seaborne trade volume increase in 2017 driven by the improvement in the world economy. The major dry bulk cargo contributed 42.3 percent of the total dry cargo trade whereas minor dry bulk contributed 25.4 percent. This growth was predominantly driven by the increase of dry cargo demands in China.

According to (UNCTAD, 2018) Asia dominated the world seaborne trade by importing 61 percent of the global seaborne import volumes and exported approximately 42 percent of the global seaborne export volumes. This confirms the positive significance from the remaining variables; India steel, South Korea steel, Industry production South East Asia and Industry production China, it`s is due to large volumes of dry cargo imported to the region. South Korea is one of the top countries that import iron ore to sustain their steel production. The country utilizes the steel production for ship buildings following the record of having the top building companies in terms of gross tonnage in 2012. The top ship building companies were Hyundai heavy industry, Daewoo ship building and Samsung heavy industry, these benefited the country in terms of the fastest growth in industrialization.

Furthermore, the global coal seaborne trade also grew by 5.8 percent which is driven by the Asian countries i.e. China, Republic of Korea and the South East Asian countries. Indonesia is the leading coal exporting country which contributed 32 percent of coal exports in 2018 followed by Australia, South Africa, Colombia and the United States. Whereas China is importing the largest volumes of this commodity (18 percent) followed by India (17 percent), Japan (15 percent), European countries (13 percent) and the Republic of Korea (12 percent). However, it is also important to highlight that all the remaining variables has a coefficient of less 1 which means a change on these variables may have a minor or no impact at all to the depend variables.

Part B: Financial Appraisal

3.2.1 The IRR and NPV for Capesize and Panamax vessels

This section seeks to determine the type of vessel which may contribute the highest returns and may be best suited for the trade of the South African bulk cargoes. For the purpose of this research, the information regarding the ship finance interest rate and the operation cost is obtained from the Exim bank (Export – Imports China Bank) and the Freight waves. Exim Bank is an international bank (China) which provides ship finance interest of about 4.9 percent and a deposit fee of about 8 percent it is one of the top ship financers in the world.

According to Wilson (2019) the dry bulk rates for the Capesize vessel and the Panamax are $8000/day and $6896/day respectively. However, these figures were used to calculate the NPV and IRR of these vessels to ascertain the feasible option for the South African ship ownership. The following tables depicts the NPV and IRR Excel calculations for the above-mentioned vessels over a period of 15 years:

CASHFLOW PROJECTION		
Vessel		Cape size
DWT		180 000
Built		2014
Project Cost		$30 000 000
Advance ratio		80%
Loan Amount		$24 000 000
Repayment per Year		$2 400 000
Equity		$6 000 000
Amortization (no of years)		15
Grace Period (no of years)		5

ASSUMPTIONS		
Opex (day/year)		365
Breakeven (day/year)		360
No. of Repayments/year		1
Interest on Loan		5%
Opex Escalation		2%
TC escalation		1%
Deposit Rate		8%
Preference Share Coupon		0%
T/C Rate (day)		$20 750

YEAR	1	2	3	4	5	6	7	8
AGE	0	1	2	3	4	5	6	7
Cash Outflow								
Opex/day	$8 000	$8 160	$8 323	$8 490	$8 659	$8 833	$9 009	$9 189
Opex/year	$2 920 000	$2 978 400	$3 037 968	$3 098 727	$3 160 702	$3 223 916	$3 288 394	$3 354 162
L/O Period	$24 000 000	$19 200 000	$19 200 000	$19 200 000	$19 200 000	$16 800 001	$14 400 001	$12 000 002
Principal Repayment	$0	$0	$0	$0	$0	$2 400 000	$2 400 000	$2 400 000
Interest on Principal	$1 176 000	$940 800	$940 800	$940 800	$940 800	$823 200	$705 600	$588 000
interest on Principal	4,9000%	4,9000%	4,9000%	4,9000%	4,9000%	4,9000%	4,9000%	4,9000%
Breakeven/year	$4 096 000	$3 919 200	$3 978 768	$4 039 527	$4 101 502	$6 447 115	$6 393 994	$6 342 162
Breakeven/day	$11 378	$10 887	$11 052	$11 221	$11 393	$17 909	$17 761	$17 617
Average Breakeven	$14 403							
Cash Inflow								
T/C/day	$20 750	$20 958	$21 167	$21 379	$21 593	$21 808	$22 027	$22 247
T/C/year	$7 470 000	$7 544 700	$7 620 147	$7 696 348	$7 773 312	$7 851 045	$7 929 556	$8 008 851
Cash Surplus	$3 374 000	$3 625 500	$3 641 379	$3 656 821	$3 671 810	$1 403 930	$1 535 562	$1 666 689
Interest on Cash	$24 300	$299 562	$617 492	$962 461	$1 336 623	$1 742 306	$1 997 151	$2 283 301
Preference Share Div	$0	$0	$0	$0	$0	$0	$0	$0
Cumulative	$3 698 300	$7 623 362	$11 882 234	$16 501 516	$21 509 948	$24 656 184	$28 188 897	$32 138 887
-4 800 000	3 698 300	3 925 062	4 258 871	4 619 282	5 008 433	3 146 235	3 532 713	3 949 990
-4 800 000	3 421 184	3 358 885	3 371 456	3 382 764	3 392 918	1 971 683	2 047 993	2 118 315

9	10	11	12	13	14	15
8	9	10	11	12	13	14
$9 373	$9 561	$9 752	$9 947	$10 146	$10 349	$10 556
$3 421 245	$3 489 670	$3 559 464	$3 630 653	$3 703 266	$3 777 331	$3 852 878
$9 600 002	$7 200 003	$4 800 003	$2 400 004	$4	-$2 399 996	-$4 799 995
$2 400 000	$2 400 000	$2 400 000	$2 400 000	$2 400 000	$2 400 000	$2 400 000
$470 400	$352 800	$235 200	$117 600	$0	-$117 600	-$235 200
4,9000%	4,9000%	4,9000%	4,9000%	4,9000%	4,9000%	4,9000%
$6 291 645	$6 242 470	$6 194 663	$6 148 253	$6 103 266	$6 059 731	$6 017 678
$17 477	$17 340	$17 207	$17 078	$16 954	$16 833	$16 716
$22 469	$22 694	$22 921	$23 150	$23 382	$23 615	$23 852
$8 088 940	$8 169 829	$8 251 527	$8 334 043	$8 417 383	$8 501 557	$8 586 572
$1 797 295	$1 927 359	$2 056 864	$2 185 790	$2 314 117	$2 441 826	$2 568 895
$2 603 250	$2 959 694	$3 355 545	$3 793 950	$4 278 309	$4 812 296	$5 399 880
$0	$0	$0	$0	$0	$0	$0
$36 539 431	$41 426 484	$46 838 893	$52 818 633	$59 411 060	$66 665 181	$74 633 956
4 400 544	4 887 053	5 412 409	5 979 740	6 592 427	7 254 122	7 968 774
2 183 108	2 242 798	2 297 778	2 348 410	2 395 032	2 437 952	2 477 457
						R34 919 080,36
					NPV	R34 647 731,21
					IRR	82%

Table 31: Capesize NPV and IRR results. Compiled by author.

The tables above show a positive NPV of $34 647,21 and IRR of 82 percent over a period of 15years with OPEX of $8000/day and 2 percent annual increase.

CASHFLOW PROJECTION		
Vessel		Panamax
DWT		80 000
Built		2014
Project Cost		$24 000 000
Advance ratio		80%
Loan Amount		$19 200 000
Repayment per Year		$1 920 000
Equity		$4 800 000
Amortization (no of years)		15
Grace Period (no of years)		5

ASSUMPTIONS		
Opex (day/year)		365
Breakeven (day/year)		360
No. of Repayments/year		1
Interest on Loan		5%
Opex Escalation		2%
TC escalation		1%
Deposit Rate		8%
T/C Rate (day)		$14 200

YEAR	1	2	3	4	5	6	7
AGE	0	1	2	3	4	5	6
Cash Outflow							
Opex/day	$6 896	$7 034	$7 175	$7 318	$7 464	$7 614	$7 766
Opex/year	$2 517 040	$2 567 381	$2 618 728	$2 671 103	$2 724 525	$2 779 016	$2 834 596
L/O Period	$19 200 000	$19 200 000	$19 200 000	$19 200 000	$19 200 000	$17 280 001	$15 360 001
Principal Repayment	$0	$0	$0	$0	$0	$1 920 000	$1 920 000
Interest on Principal	$940 800	$940 800	$940 800	$940 800	$940 800	$846 720	$752 640
interest on Principal	4,9000%	4,9000%	4,9000%	4,9000%	4,9000%	4,9000%	4,9000%
Breakeven/year	$3 457 840	$3 508 181	$3 559 528	$3 611 903	$3 665 325	$5 545 735	$5 507 235
Breakeven/day	$9 605	$9 745	$9 888	$10 033	$10 181	$15 405	$15 298
Average Breakeven	$12 544						
Cash Inflow							
T/C/day	$14 200	$14 342	$14 485	$14 630	$14 777	$14 924	$15 074
T/C/year	$5 112 000	$5 163 120	$5 214 751	$5 266 899	$5 319 568	$5 372 763	$5 426 491
Cash Surplus	$1 654 160	$1 654 939	$1 655 223	$1 654 996	$1 654 243	-$172 972	-$80 744
Interest on Cash	$24 300	$160 255	$307 286	$466 249	$638 070	$823 747	$876 460
Preference Share Div	$0	$0	$0	$0	$0	$0	$0
Cumulative	$1 978 460	$3 793 654	$5 756 163	$7 877 408	$10 169 721	$10 820 497	$11 616 212
-4 800 000	1 978 460	1 815 194	1 962 509	2 121 245	2 292 313	650 776	795 716
-4 800 000	1 830 213	1 553 359	1 553 583	1 553 417	1 552 907	407 828	461 294

8	9	10	11	12	13	14	15
7	8	9	10	11	12	13	14
$7 921	$8 080	$8 241	$8 406	$8 574	$8 746	$8 921	$9 099
$2 891 288	$2 949 114	$3 008 096	$3 068 258	$3 129 623	$3 192 215	$3 256 060	$3 321 181
$13 440 002	$11 520 002	$9 600 003	$7 680 003	$5 760 004	$3 840 004	$1 920 005	$5
$1 920 000	$1 920 000	$1 920 000	$1 920 000	$1 920 000	$1 920 000	$1 920 000	$1 920 000
$658 560	$564 480	$470 400	$376 320	$282 240	$188 160	$94 080	$0
4,9000%	4,9000%	4,9000%	4,9000%	4,9000%	4,9000%	4,9000%	4,9000%
$5 469 847	$5 433 593	$5 398 495	$5 364 577	$5 331 863	$5 300 375	$5 270 139	$5 241 181
$15 194	$15 093	$14 996	$14 902	$14 811	$14 723	$14 639	$14 559
$15 224	$15 377	$15 530	$15 686	$15 842	$16 001	$16 161	$16 323
$5 480 756	$5 535 563	$5 590 919	$5 646 828	$5 703 297	$5 760 330	$5 817 933	$5 876 112
$10 909	$101 970	$192 424	$282 251	$371 434	$459 955	$547 793	$634 932
$940 913	$1 018 011	$1 108 729	$1 214 123	$1 335 329	$1 473 577	$1 630 193	$1 806 610
$0	$0	$0	$0	$0	$0	$0	$0
$12 568 034	$13 688 015	$14 989 168	$16 485 542	$18 192 305	$20 125 836	$22 303 822	$24 745 363
951 822	1 119 981	1 301 153	1 496 374	1 706 763	1 933 531	2 177 986	2 441 541
510 446	555 622	597 133	635 269	670 293	702 453	731 974	759 064
							R9 358 619,52
						NPV	R9 274 855,63
						IRR	37%

Table 32: Panamax NPV and IRR results. Compiled by author.

On the other side, the Panamax show a positive NPV of $9 274,63 and IRR of 37 percent over a period of 15 years with OPEX of $6896/day and 2 percent pex escalation.

It is essential to highlight that this study is conducted solely on second-hand vessels as they may be a better decision and a quick solution to the South African maritime challenges. The second-hand vessel has advantages, such as: immediate profit generating and require a low capital cost. However, their disadvantages would be low performance, a shorter lifespan and higher operational costs which may reduce competitiveness of a shipping company. Moreover, a new built vessel may also be a good decision for long-term planning and investment and to adopt a new technology (Fan & Meifeng, 2013). The decision for the purchase of a vessel can be determined by a variety of strategic approaches, such as the government may invest in a second-hand vessel to utilize the immediate profit for new built vessels. The government is not driven by profit but has more interest in socio-economic benefits that come with the investment

CHAPTER 4

DISCUSSION

This chapter aims to analyse the findings attained in the previous chapter which used the regressions in Part A and the cost benefit analysis in part B. This was done with the research objectives in mind in order to effectively answer the research questions. Essentially, the discussion will focus on the findings from the literature review, which proved the importance of the bulk cargoes in South Africa, and it will be followed by the interpretation of the results presented in the previous chapter. These two crucial matters will be highlighted to ensure that the goal and purpose of this dissertation is achieved.

4.1 Theoretical Analysis

According to Tsietsi (2012), 98 percent of South African trade in volume and 80 percent in value is carried by sea. South Africa is one of the top five major global exporters of iron ore and coal. The following figure depicts the world seaborne trade by region.

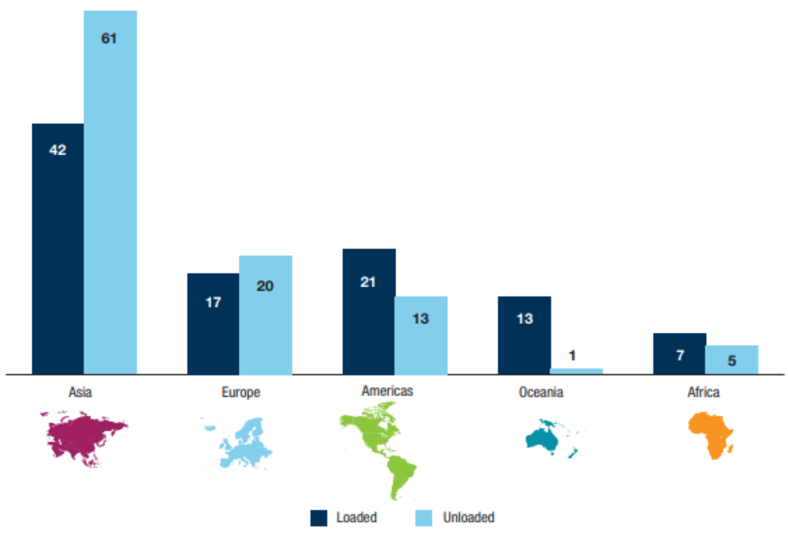


Figure 14: World seaborne trade in volumes by region. Source: UNCTAD 2018

The world seaborne trade saw an increase of 4 percent in 2017, the fastest growth in five years. The dry bulk commodities i.e. iron ore, coal and grain accounted for 42.3 percent of the total dry– bulk shipment. This drastic increase is driven by the large volume of imports from China. The total iron ore imports in China increased by 5 percent due to the rise in steel production demand and the large import of the high grade iron ore. Australia and Brazil accounted for approximately 85 percent of the total Chinese imports. However, Australia is leading the iron ore exports to China followed by Brazil, South Africa and the rest of the world.

Iron ore exporters	**Iron ore importers**
Australia (56%)	China (72%)
Brazil (26%)	Japan (9%)
South Africa (4%)	South Korea (7%)
Rest of the world	Other

Table 33: Major global Iron ore exporters and importers in 2017. Source: UNCTAD 2018.

According to Clarkson (2018), global coal trade increased by 5.8 percent in 2017 following a significant decline from the previous two years (2016 &2015). The highest import demand of this commodity is led by China followed by the Republic of Korea and some of the South-East Asian countries. Indonesia is leading the exports of this commodity followed by Australia, Russia, Colombia and South Africa.

Coal exporters	**Coal importers**
Indonesia (390 MT)	China (271 MT)
Australia (378 MT)	India (200 MT)
Russia (185MT)	Japan (194 MT)
Colombia (105 MT)	South Korea (148 MT)
South Africa (88 MT)	Taiwan (69 MT)

Table 34: Major global Coal importers and exporters by volume in 2017. Source: China Coal research association.

Based on Chasapis (2018) the analyst of Allied shipbrokers stated that the total dry bulk fleet stood on approximately 10 198 vessels in December 2018 with an order book of 907 vessels equivalent to 8.9 percent. Nevertheless, with a complete zero recycle market of old vessels, the dry bulk market is still facing a growth of 5.3 percent for 2019. Furthermore, provided that most of the forecast predicts an increase of 1.5 to 2 percent for the seaborne trade of the main dry bulk commodities (Iron ore, Coal and Grain), the fundamentals show the overall balance outlook for the supply and demand dynamics in a short to medium – term.

According to BIMCO (2019) the Chinese dry bulk imports, the drivers of the demand has shown weakness in terms of growth by an estimated 2.8 percent in 2018, where a hefty decline is anticipated from soya beans, grain and iron ore commodities. Moreover, one of the reasons for the decline in the iron ore exports to China is a result of a devastating dam collapse in Brazil that occurred end of January 2019, which had approximately 140 people killed and also that has crippled Brazil's iron ore for the foreseeable future. The Vale, one of the biggest mines in Brazil, has reported that this incident has a negative impact to the amount of 40 million tonnes of annual production of iron ore. Hence the company reported the suspensions of mining operations on 6 February, this news has been disturbing to the Capesize market in a negative way as the volumes of the iron ore commodity from Brazil to Australia and China go down. It is said that for every loss of 10 million tonnes of iron ore exports to China from Brazil, approximately five Capesize vessels will become redundant.

The foregoing discussions highlight the role of Brazil and Australia in the bulk trade to China. To situate this work, subsequent discussion will focus on South Africa's contribution to this trade. Particularly, the potential of this trade in developing the maritime industry in South Africa. The following regression analysis seeks to tease out essentials in the South African maritime trade which could make the nation emerge as a top exporter to China.

4.2 Econometrics Analysis

In the third chapter, the authors conducted regressions to determine whether the model of the top bulk cargoes exported from the country (iron ore and coal) will be linear and have a positive forecasting result to right assure feasibility of trading these commodities using a ship type determined in part B of the empirical analysis.

There are 23 independent variables that were considered for the SA coal exports and 18 independent variables for SA iron ore, are deemed to be determining factors of these commodity exports and the data used for each variable is obtained from Clarkson. Initially, the preliminary analysis was conducted to ensure that there is no human error on the data collected and no discontinuity on the graphs that illustrates the data of the variables before proceeding to the second step of the OLS chart flow. In the second step, which is the Unit root test, some variables were stationary at level and at first difference, thus the KPSS was conducted for the conflicting variables. The correlation test is carried out to identify variables that highly significant and remove them with economic justification. BDI and BFI were highly correlating at close to 100 percent on both models; therefore, BFI was removed from the model with the presumptions that the BDI constitutes more significance.

The T– test and F– test was carried out to ensure that all insignificant variables are removed from the equation. The Exchange rate Japan; India steel and South Korea steel were identified as the remaining significant variables on the SA iron ore equation, whereas on the SA coal equation there were seven remaining significant variables, namely bulk carrier demolishing average age; Brent crude oil price; industry production china; industry production India; industry production South East Asia; world steel production; industry production OECD. Moving forward with the regressions, the cointegration existing in the SA iron ore model as the dependent variable was an I (1) process, thus the error correction term was added to the model. However, the SA Coal was an I (0) process, therefore the cointegration was not applied on this equation. The SA iron ore model is defined as an MA (1) after conducting the ARMA model; nevertheless, the MA (1) had to be removed from the model due to causing one of the independent variables to be insignificant after inserting dummy variables. To determine the linearity of these models, the Ramsey test was conducted and both models were found to be Linear with the F– statistic results of 90 percent (SA iron ore exports) and 65 percent (SA coal exports).

The Chow test was not conducted, however; the statistic method was used preferably, to determine the short-term forecasting of both models. Eventually, both models showed positive performing results with Adjusted R^2 of 63 percent (SA coal exports) and 33 percent of (SA iron ore exports). The results show that the SA coal exports are predicted to perform better than the SA iron ore export, the importance of technology and innovation with software such as E– views may be useful to governmental institutions and or private companies as the forecasting tools that may assists in policy formulation which may attract international markets to invest in these commodity exports.

The Capesize and Panamax second-hand vessel data is collected from the shipping intelligence network source. The information regarding shipping finance interest rate and daily operation costs for these respective vessels is collected from the Exim bank (China) and (Wilson, 2019). This information is collected to calculate the net present value and internal rate returns of both these vessels over a period of 15 years. However, the Capesize vessels results are more feasible for the operation of this nature based on the quantity of bulk that is exported from the country and considering "tone-mile" to the Asian market, additionally the amount of the NPV over 15 years is relatively higher than that of the Panamax vessel.

4.3 Plans for the South African Maritime industry and the objectives of Operation Phakisa.

The Operation Phakisa initiative was formed and launched by the government to promote economic growth and to create jobs with the same objectives stipulated in the National Development plan 2030. Essentially it is to unlock the South African oceans economy which, through a comprehensive investigation, is envisaged to contribute about R20 billion to the GDP by 2019 and to create 1 million jobs by 2033 (Strategic Plan, 2015).

Even though one of SAMSA`s objectives is to grow the country`s maritime industry, there are crucial challenges arising to support this strategy. These challenges are due to the shortage of both sea- and shore-based human resources needed to support the industry. However, the key challenge is the shortage of berth availability to train South African cadets which led to the government resorting to donating to the third party shipping company to render training at no cost to them. Once the cadets are trained and qualified, the foreign shipping companies are free to employ them on their fleets This strategy was aimed to address high unemployment issues and to increase human capital in the industry (SAMSA, 2014).

4.4 International demand and supply of seafarers:

According to Leslea (2016), the recent report from BIMCO and the International Chamber of Shipping contained detailed data analysis to show how the maritime manpower has developed gradually since 2010. Additionally, it predicts the demand and supply of seafarers over the next 10 years. A comprehensive study indicated a shortfall of approximately 16,500 officers (2.1 percent) and yet forecasts a demand of about 147 500 additional officers by 2025 to service the world merchant fleet. Despite the fact that there is a gradual increase in the number of officers, it is surpassed by the amount of demand for seafarers, since a report estimates a surplus of about 119 000 ratings, equivalent to 15.8 percent. The figure below depicts how the demand outpaces the supply.

Figure 15: Global supply and demand for seafarers. Source: BIMCO/ICS.

China is currently deemed to be the largest single source of qualified seafarers for international trade; however, the Philippines still produce the largest number of ratings. The Chinese saw an increase of about 1.58 million registered seafarers in 2018, a significant growth of 6.2 percent year on year according to the White paper by the Ministry of Transport (Wang, 2019). The data from the International Chamber of

Shipping sees that the extent to which Chinese seafarers are available for international trade may be more limited, with the Philippines and Russians seen as equally essential sources of officers, followed by Ukraine and India (Leslea, 2016).

The Secretary-General of the International Chamber, Peter Hinchliffe said, "*Without continuing efforts to promote careers at sea and improve levels of recruitment and retention, the report suggest it cannot be guaranteed that the will be an abundant supply of seafarers in the future*".

The South African Department of Transport and SAMSA are working on an initiative which envisage sthe South African maritime industry and its potential to promote careers at sea by formulating a plan that is necessary to include (SAMSA, 2017):

- Develop and owning a South African merchant fleet for economic growth;
- Develop a seafarer's culture and create employment opportunities for qualified South African seafarers;
- Develop a career plan;
- Strengthen the capacity of the domestic training vessel;
- Integrate technological advancement in the industry.

4.5 Potential Development of Shipbuilding Capacity

The establishment of a national shipping line offers the state the possibility of developing shipbuilding capacity. The trade in bulk cargo offers the incentive to drive a shipping line which could translate into the development of existing ship repair yards to shipbuilding yards. Shipbuilding capacity could propel South Africa into the league of world leaders in the maritime sector, particularly due to the absence of shipbuilding yards in the whole Africa continent. This is certainly a huge opportunity to be exploited. especially when South Africa accounts for 25 percent of exports. However, development of shipbuilding yards is a capital-intensive activity which spans the training of naval architects, shipbuilders and artisans with highly technical skill sets. This may even require the establishment of training institutes and administrative systems to support such functions. This could be an extensive project which needs to be planned and executed carefully lest it fails. Regardless, the benefits of shipbuilding yards are massive and such a project should be pursued at the earliest.

Nevertheless, the Department of Economic Development and Tourism (DEDAT) and Wesgro saw a window of opportunity and took an initiative to construct a floating caisson in the Port of Cape Town Sturrock Dry-dock after the discussions with their industry and strategic partners Transnet National Port Authority (TNPA) to improve the port’s infrastructure. The amount of R98 million has been invested under the Operation Phakisa programme to redevelop the port`s ship repair facilities which is identified as the strategic industry for the ports (DEDAT, 2019). South Africa is amongst the top 15 countries in terms of tonnage transported to and from its 8 commercial ports, the Port of Cape Town is a hub of South African shipbuilding industry and this programme will double the productivity of the Sturrock Dry-dock, making it the biggest dry dock in the southern hemisphere (DEDAT, 2019). Since 30 000 ships navigate around the South African coast per annum, 12 000 ships are calling at all ports, thus such a programme to redevelop ship repairs will create more job opportunities and contribute to the provincial economy.

4.6 Summary of key findings

4.6.1 The forecast for the two top South Africa’s seaborne commodity trade

- Independent variables were considered for both SA coal and SA Iron ore.
- After conducting regressions for these dependent variables, both equations were found to be linear.
- It was anticipated that the iron ore would perform better than coal however, the coal is deemed to have seen significant growth according to bulk cargoes seaborne trade predictions.
- The regressions were used to ascertain the type of bulk cargo that will future of South African coal and iron ore shipping trade for the development of domestic merchant fleet.

4.6.2 The IRR and NPV for Capesize and Panamax vessels

- Data for the calculation of the internal rate of returns and the net present value is collected from Clarkson and Transnet.
- The Capesize vessel has higher IRR and NPV compared to Panamax, with R34 647 731.21 and 82 percent over a period of 15 years.
- Therefore, the interpretation of these findings indicates that South African government or private sector may consider investing in a Capesize bulk career to trade coal and/or iron ore following the market trends stipulated in this study.

4.6.3 Socio Economic Benefits

- This study works in conjunction with the Operation Phakisa objectives which intend to create employment opportunities and skills development.
- Offers a platform to expand the training institutions and skills for South African cadets.
- Creates a potential to develop a shipbuilding and ship-repair facilities in South Africa

CHAPTER 5

SUMMARY AND CONCLUSION

The shipping nations have been faced with immense competition since globalization. At the same time, liberalization of maritime trade meant that shipping services, such as ship registration and merchant ships, may be accessed globally (Kumar & Hoffmann, 2002). Unlike in the past, this has implied that shipping companies' competitiveness has become less dependent on country variables. As such, shipping policies that sought to impose protectionist measures on a nation's external trade seem to have become ineffective. Shipping countries, therefore, had to look for niches that would offer them a competitive advantage in a highly competitive industry such as shipping.

Against this background, the dissertation used a market-based integrated RBV-SDSMM-PP model to provide a holistic approach in determining the competitive advantage of a shipping nation for the establishment of the merchant fleet. Essentially, this model follows the logic similar to that of Porter's national diamond, which states that almost all attributes of the model must be satisfied in order for the nation to achieve its competitive advantage. This dissertation concludes that the location advantage of South Africa and the ownership of ships through registration of tonnage have been declining, and rather speculative on the basis of the evidence provided in the previous discussions. Therefore, the RBV-SDSMM-PP model suggests that the competitive advantage of South Africa lies on its well-endowed bulk export trade, specifically coal and iron ore. The findings of the RBV-SDSMM-PP and the subsequent regression models show that South Africa's coal and iron ore shipping trade has enormous potential than other niches of competitive advantage that could be exploited for the development of a domestic merchant fleet. This was based primarily on the fact that coal and iron ore are the country's major seaborne trade and are expected to grow, which is consistent with the industry's predicted overall growth of global bulk shipping demand.

It is important to note that the RBV-SDSMM-PP, in conjunction with Porter's national diamond, recognizes the complexity and internationalised nature of factors influencing the competitiveness of a shipping nation. Both these models also note that the country's specific factors alone are not sufficient to determine the competitive advantage of a shipping nation, hence the holistic view. The findings show that the support functions of the industry, including South African maritime policies and port infrastructure, are also in line with the results of the regression-forecast that South Africa's coal and iron ore export trade will increase. Iron ore was expected to perform better than Coal, but the findings show that trade in coal by sea would increase significantly, with an adjusted R^2 of 63 percent compared to 33 percent of SA's exports of iron ore. Findings of the financial evaluation suggest the development of a domestic merchant fleet by the use of a Capesize vessel for South Africa. The following provides a clear understanding on how to apply framework and findings of this study.

a) Figure 4 provides an overview of crucial factors influencing the competitive advantage of shipping nation for the establishment or development of national merchant fleet. This approach mostly reflects the international perspective of the shipping industry in the form of adaptive shipping policies, economic indicators, resources and capabilities of a shipping nation. It exposes the weaknesses and strengths of each distinct model in order to explain the logic that led to the need to integrate them into model that guarantees high effectiveness. Also, it is mainly effective for shipping nations that seek to achieve sustainable competitive advantage. Most importantly, this approach is effective is all of its attribute are fulfilled.
b) Figure 3 presents an approach that is technically the consequence of Figure 2. However, Figure 3 focuses primarily on country-specific factors and is only effective when used with a global view.
c) Both regression models were found to be linear, which means that coal and iron ore seaborne commodities are predictable, non-stochastic. The historical data gathered for both coal and iron ore was annual and therefore as observation from 2001 to 2018. This implies that the forecast for trade in these

commodities is reliable for as far 12 months, forward looking. It is therefore suggested that the shipping decisions are taken on the basis of the results be implemented within the timeframe of this forecast.

d) The Capesize ships have shown high returns of about 82 percent more than other bulkers. The evaluation assumes that the ship will be purchased on loan, and therefore used Clarkson's and Chinese bank's financial data. Thus, when drawing financial inferences from this dissertations, it is recommended that loan interests be verified with the relevant bank as it may differ significantly depending on the investor's liquidity.

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