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„Assessing the Competitiveness of Shipbuilding Industries in China and South Korea: A Comparative Analysis based on Porter's Diamond Model"

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ABSTRACT

This thesis provides an analytical approach to assess the competitiveness of the two leading shipbuilding nations China and South Korea. Since global shipbuilding is a multi-billion dollar market a strong domestic shipbuilding industry can act as a catalyst for the economic development and growth of the countries involved and also has strong implications for their national defense industries. South Korean shipbuilders became market leaders in global shipbuilding in the mid-1990s and have since then maintained their strong position. In 2005 the Chinese central government announced a plan to establish the country as the world's leading nation in shipbuilding by 2015. Since then Chinese shipbuilders have gained significant market shares and are now challenging the South Korean supremacy in global shipbuilding. The industry has also been severely affected by the recent global economic and financial crisis. Due to a slump in new orders resulting in huge excess capacity global shipbuilding is in a restructuring process and only the most competitive shipyards will emerge victorious from this crisis.

For these reasons the author, through conducting this research, tried to shed light on the competitiveness of shipbuilding industries in China and South Korea. From the review of related literature it became clear that scholars have identified very different success factors in shipbuilding, of which most can be categorized into one of the dimensions of Michael E. Porter's diamond model of national advantage. For this thesis the original diamond model has been adjusted to shipbuilding based on some major points of critique of scholars that have been working with diamond theory. An extended and modified version of Porter's diamond model served as analytical framework in this thesis according to which the competitiveness of shipbuilding industries in China and South Korea has been analyzed.

As the results of this analysis suggest both Chinese as well as South Korean shipbuilders are highly competitive by international comparison. However, they base their success on very different factors, pursue different strategies and serve different market segments. Chinese shipbuilders have competitive advantage in terms of labor cost and also benefit from a strong home demand for new ships as well as from the well-established domestic steel industry which supplies domestic shipyards with large quantities of shipbuilding steel at exceptionally low prices. The major competitive disadvantage of Chinese shipbuilders is the low level of the domestic ship equipment industry which forces them to rely on imports of major ship components. Overall most Chinese shipbuilders focus on the production of standardized low to medium complexity ships and follow a cost leadership strategy. They are highly competitive in these market segments and hold a dominant position in the global market for bulk carriers.

One of the key success factors of South Korean shipbuilders is the very high productivity which at least partly offsets their disadvantage regarding labor costs. In South Korea shipbuilding is integrated into a sophisticated maritime cluster and shipyards benefit from a highly competitive domestic ship equipment industry. Korean shipbuilders source almost all major components domestically which gives them competitive advantage in the construction of higher complexity ships. Due to advantages in shipyard infrastructure, technical know-how and the quality of ship equipment the major South Korean shipbuilders Hyundai, Samsung and Daewoo focus on the construction of highly complex LNG/LPG carriers for which they dominate the global market. In recent years almost all major South Korean shipyards have also entered the offshore oil and gas sector where they hold a leading position in the construction of drill ships and offshore platforms.

In this thesis the key success factors of the two major shipbuilding nations have been revealed. This might be of interest to their international competitors as it allows them to direct their strategies accordingly. Since progress made in commercial shipbuilding also facilitates the upgrading of a nation's naval fleet the results of this thesis might also be of interest to parties involved or interested in the South China Sea conflict where China disputes with Southeast Asian nations about overlapping territorial claims. Last but not least it is also vital for potential market entrants and foreign investors into Chinese or South Korean shipbuilding to have certain knowledge of special characteristics of the local environment and competitive context. The results of this thesis might also contribute to foster such an understanding.

ACKNOWLEDGEMENTS

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List of Abbreviations

AHP	Analytical Hierarchy Process
CANSI	China Association of the National Shipbuilding Industry
CAST	China Association of Shipbuilding Trade
CGT	Compensated Gross Tonnage
CNY	Chinese Yuan
COSCO	China Ocean Shipping Group Company
COSTIND	Commission for Science, Technology and Industry for National Defense
CSIC	China Shipbuilding Industry Corporation
CSSC	China State Shipbuilding Corporation
DSME	Daewoo Shipbuilding and Marine Engineering
DWT	Deadweight Tonnage
FIOH	Finish Institute of Occupational Health
GT	Gross Tonnage
HCS	High Complexity Ship
HHI	Hyundai Heavy Industries
IMO	International Maritime Organization
JSTRA	Japan Ship Technology Research Association
KDB	Korea Development Bank
KEB	Korea Exchange Bank
KEXIM	Export-Import Bank of Korea
KFC	Korea Finance Corporation
KOMEA	Korea Marine Equipment Association
KOSA	Korea Iron and Steel Association
KOSHIPA	Korea Offshore & Shipbuilding Association
KRW	Korean Republic Won
LCS	Low Complexity Ship
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MCS	Medium Complexity Ship
MH	Man-Hour
MOSF	South Korean Ministry of Strategy and Finance
MOTIE	South Korean Ministry of Trade, Industry and Energy
OECD	Organisation for Economic Co-operation and Development

POSCO	Pohang Iron and Steel Company
PRC	People's Republic of China
R&D	Research and Development
ROK	Republic of Korea
SAJ	Shipbuilders' Association of Japan
SASTIND	State Administration for Science, Technology and Industry for National Defense
SEA	Ships & Maritime Equipment Association
SHI	Samsung Heavy Industries
SOE	State Owned Enterprise
SWOT	Strengths, Weaknesses, Opportunities, Threats
TQM	Total Quality Management
ULCC	Ultra Large Crude Carrier
USD	United States Dollar
VAT	Value Added Tax
VLCC	Very Large Crude Carrier
WAI	Work Ability Index
WTO	World Trade Organization

1 Introduction

Global leadership in modern shipbuilding has shifted several times in the history of the industry[1]. Until the beginning of the 19th century the United States held a leading position. At that time wooden sailing ships were used to carry out seaborne trade. However, the introduction of the steam engine and the use of iron and steel as shipbuilding materials in the early 19th century disrupted the US supremacy. Due to these technological breakthroughs steam powered steel ships became the industry norm. British shipbuilders applying advanced technology emerged as undisputed industry leaders in the 1850s and were able to maintain their leading position for almost a century until the 1950s (Cho & Porter, 1986, pp. 550-551).

After the Second World War many Western European countries in an attempt to expand their merchant fleets made efforts to develop and improve their domestic shipbuilding industries. At that time also Japan became a major player in global shipbuilding. During World War II the vast majority of Japanese vessels had been destroyed and after 1945 the Japanese government strongly supported the domestic shipbuilding industry in order to rebuild the country's merchant fleet. However, European countries commanded over more sophisticated technologies and were therefore able to produce at lower costs than their Japanese competitors. Only British shipbuilders struggled due to rising labor costs and labor unionization and gradually lost market shares (Cho & Porter, 1986, p. 552).

While Japanese shipbuilders after World War II first produced only for domestic purposes they soon also started to compete on the international market. A government led program provided Japanese shipbuilders with guaranteed orders and supported them in their development (Mickeviciene, 2011, pp. 202-203). In 1965 Japan became the world's leading nation in shipbuilding while European shipbuilders together still dominated the market with a combined market share of 75 percent. However, market shares of Japanese yards gradually increased and in the 1970s also the Republic of Korea (ROK)[2] entered the international shipbuilding market. The fierce competition from East Asia eroded the once leading position of European yards which could not compete with Asian low cost producers and had to resort to niche markets (Bruno & Tenold, 2011, p. 201).

South Korea's entry into the international shipbuilding market in the 1970s was fueled by strong government support, low labor costs compared to its international rivals, labor repression and favorable access to funds (Bruno & Tenold, 2011, p. 201). The support of the

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[1] For an in-depth analysis of shipbuilding history see Cho and Porter (1986) or Stopford (2009).
[2] Referred to in this thesis as "South Korea" or simply "Korea" from now on.

domestic shipbuilding industry by the Korean government was part of a series of five-year economic plans that aimed for promoting economic development and industrial growth in Korea. In the 1970s these plans emphasized on heavy industries including shipbuilding and three major chaebol[3] companies, namely Hyundai, Samsung, and Daewoo started to build large commercial vessels (Shin & Hassink, 2011, p. 1392). Due to strong government support Korean yards heavily expanded their capacities and gained market shares in the 1970s and 1980s. Over the course of time Korean shipbuilders developed competitive advantage over Japanese yards mainly due to lower labor costs, the ability to produce bigger vessels and the low value of the Korean won and the strengthening of the Japanese yen against the US dollar (Shin & Hassink, 2011, p. 1394). Due to Korean shipbuilders' competitive advantage the country overtook Japan and became global market leader in shipbuilding in the mid-1990s. Heavily supported by the government, Korean yards as at that time low cost producers focused on the construction of large tankers, containerships and liquefied petroleum gas (LPG) carriers as well as liquefied natural gas (LNG) carriers (Mickeviciene, 2011, p. 203).

South Korea has since then maintained a leading positing in the global shipbuilding industry. However, over the past decade the People's Republic of China (PRC)[4] has emerged as a third major player besides Japan and South Korea. Since the introduction of market reforms and the shift from a centrally planned to a socialist market economy China has seen an unprecedented economic development and growth. In 2001 China also became a member of the World Trade Organization (WTO) which further contributed to the opening up of its economy. The country's economic development and growth has been heavily driven by exports and China overtook Germany as the world's largest exporter of goods in 2009 and became the world's largest trading nation ahead of the United States in 2013 (Monaghan, 2014).

China's economic rise over the past decades also benefited the domestic shipbuilding industry. With the increased trading volume also demand for shipping services accelerated. In order to meet this demand the Chinese government heavily supported the built up and development of its domestic shipbuilding industry instead of relying on foreign services (Tsai, 2011, p. 42). China entered the global shipbuilding market in the 1980s. A milestone in China's rise as a world leading shipbuilding nation was the decision of the Fifth National Congress to establish the China State Shipbuilding Corporation (CSSC) in 1982. All state shipbuilding activities were from then on performed under the umbrella of the CSSC which was provided with a certain level of economic authority (Collins & Grubb, 2008, p. 5).

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[3] Chaebol are Korean family-owned business conglomerates operating in various industries; for a more precise description see Chapter 4.4.2 of this thesis or Jung (2004).
[4] Referred to in this thesis as "China" from now on.

Backed by strong government support and growing domestic demand for new ships, Chinese yards started to expand production capacities and commercial output rose steadily. When the global shipbuilding market recovered from a deep recession in the 1980s and the number of new orders increased, Chinese shipbuilders utilized the favorable market conditions and established the country as the third largest producer of commercial vessels behind Japan and South Korea in 1996 (Collins & Grubb, 2008, p. 8). From 2002 to 2007 the global shipbuilding industry again saw a new building boom in which number of orders and order volumes for new ships were increasing continuously. Global new orders for commercial ships while totaling 18.9 million compensated gross tons (CGT)[5] in 2002 more than quadrupled over a period of six years to an order volume for new ships totaling 87.3 million CGT in 2007 (Korea Offshore & Shipbuilding Association [KOSHIPA], 2016).

In 2005 Chinese government officials announced a plan to support the domestic shipbuilding industry with the aim to establish China as the world's leading nation in shipbuilding by 2015 (Lu, 2005, p. 9). This plan included secured minimum orders for state yards, tax incentives and numerous other subsidies. Together with the by far lowest labor costs compared to rival yards in Japan and South Korea these incentives created an environment that allowed Chinese shipbuilders to gain significant market shares. In 2006 China for the first time in the history of modern shipbuilding surpassed Japan in terms of new shipbuilding orders. New contracts won by Chinese yards totaling 15.8 million CGT in 2006 almost doubled within only one year to 31.4 million CGT in 2007. As a consequence order backlogs of Chinese yards increased significantly totaling 53.1 million CGT in 2007. In this year China also overtook Japan in terms of total orderbook volume and became the second largest shipbuilding nation just behind South Korea (KOSHIPA, 2016).

However, the recent global financial and economic crisis has hit the global shipbuilding industry hard. Many already placed orders were cancelled or deferred and new shipbuilding orders plummeted (Organisation for Economic Co-operation and Development [OECD], 2009). Within only two years new orders contracted by more than 80 percent from totaling 87.3 million CGT in 2007 to only 16.6 million CGT in 2009. Since then the global shipbuilding market has not yet fully recovered and newly placed orders remain below pre-crisis levels. However, while the global shipbuilding market stagnated, China mainly due to strong government support and high domestic demand for new vessels managed to increase its market share in terms of new orders, order backlogs as well as ship deliveries (KOSHIPA, 2016).

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[5] Compensated gross tonnage (CGT) is a "measure of shipbuilding output based on the gross tonnage of the ship multiplied by a cgt coefficient reflecting its work content" (Stopford, 2009, p. xxii).

In 2009 Chinese yards received new orders of 14.9 million gross tons (GT)[6] making up 44.5 percent of the global market share. Compared to the 25.4 percent market share of South Korean yards and 25.3 percent market share of Japanese shipbuilders it was the first year in which China outpaced South Korea in terms of new order volume (Shipbuilders' Association of Japan [SAJ], 2015, p. 1). In the same year China also surpassed South Korea in terms of order backlogs making it the world's largest shipbuilding nation if measured by these two major industry indicators. Only one year later Chinese yards also exceeded South Korean shipbuilders in terms of vessel delivery, which constitutes the third main indicator according to which market share in global shipbuilding can be measured (KOSHIPA, 2016).

Until the end of 2014 China was still ahead of South Korea in terms of new order receipts, order backlogs and deliveries measured in terms of gross tonnage. However, in terms of value, bids won by South Korean yards with a total value of US$ 41 billion still outpaced Chinese shipbuilders which secured new orders worth US$ 32.7 billion in 2013 (KOSHIPA, 2014, p. 9). In the first half of 2015, the latest date for which data is available to the author, Korean shipbuilders again outperformed their Chinese counterparts in terms of new ship orders won. Interestingly they not only exceeded Chinese new order receipts measured by total contract value but also in terms of gross tonnage (13.3 million GT compared to 9.9 million GT). However, China is still in the leading position regarding order backlog volume with a market share of 38.6 percent followed by South Korea with 31.5 percent market share and Japan with its order backlog amounting to 18.4 percent market share as of June 2015 (SAJ, 2015, p. 1).

It is therefore questionable whether the Chinese government has fully achieved its goal to become the world's number one country in global shipbuilding by 2015. While the Chinese shipbuilding industry can be regarded as global number one if market share is measured in terms of total gross tonnage of orders and deliveries, South Korea is still ahead in terms of total contract value. Together these two countries hold more than 70 percent of market share in terms of order backlogs, making them the undisputed industry leaders followed at a respectful distance by Japan.

When China entered the global shipbuilding market domestic shipbuilders focused on the production of low-cost low-complexity ships such as smaller tankers and bulk carriers. However, since then Chinese yards have upgraded construction processes and learned about more advanced technologies. Therefore Chinese shipbuilders are now also capable of

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[6] Gross tonnage (GT) is an "internal measurement of the ship's open spaces (…) now calculated from a formula set out in the IMO [International Maritime Organization] Tonnage Convention" (Stopford, 2009, p. xxii).

producing sophisticated high-value ships such as very large crude carriers (VLCCs)[7], liquefied natural gas (LNG) and liquefied petroleum gas (LPG) carriers, large container ships and cruise ships and many yards are further pushing into these market segments (Collins & Grubb, 2008, p. 2).

From the end of the 1990s until the beginning of the global financial and economic crisis in 2007 both China as well as South Korea rapidly expanded their shipbuilding capacities as the global demand for new ships was soaring (Mickeviciene, 2011, p. 214). However, when the number of new orders plummeted in the wake of the global economic crisis and a significant amount of placed contracts was cancelled this resulted in significant excess capacity (OECD, 2009). In recent years the global shipbuilding industry has been challenged by a huge overcapacity of shipyards resulting in ever tougher price competition among yards to secure orders. In addition countries such as Vietnam, India and the Philippines have entered the market for commercial ships. This difficult situation in the global shipbuilding market caused many small and medium yards in China, Japan and South Korea to shut down, while larger firms merged in order to stay competitive. The current situation will most likely result in a significant reduction in global shipbuilding capacity (Mickeviciene, 2011, p. 211).

While Chinese shipbuilders supported by the national government are determined to further gain market shares, South Korea is not willing to resign from its hegemony in global shipbuilding, a position it held since it overtook Japan in the 1990s. Which nation's shipyards will be able to secure the lion's share of new orders in the future mainly depends on their level of competitiveness and to a lesser extent on potential government protectionism. As has been argued throughout this section, China and South Korea are the undisputed leaders in global shipbuilding. The thesis at hand therefore focuses on these two countries as the main actors in today's modern shipbuilding and analyzes their competiveness in this global industry. In order to do so a modified version of Michael E. Porter's diamond model of national advantage is applied to the two nations' shipbuilding industries in this thesis.

1.1 Research Intention and Relevance of the Topic

In this section the author briefly discusses the main reasons for conducting research on competitiveness of the Chinese and South Korean shipbuilding industries and presents the research question that is the guiding theme of this thesis. First of all, as of June 2015 China and South Korea with a combined market share of 70.1 percent measured by order backlogs in gross tons (GT) together dominated the global shipbuilding market. At the same time the

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[7] The VLCC ship category includes carriers of about 2 million barrels of oil and more generally all tankers between 200,000 and 320,000 deadweight tonnage (Stopford, 2009, p. xxiv).

total value of the global orderbook for new vessels stood at US$ 290 billion (Clarkson Research[8] as cited in European Ships and Marine Equipment Association [SEA Europe], 2015, p. 1). This figure illustrates the importance of shipbuilding as a multi-billion dollar industry for the economic development and growth of the countries involved.

Also South Korean and Chinese ruling authorities recognized the economic potential of shipbuilding for their national economies. The market entry of South Korea in the 1970s was heavily promoted by the national government which regarded shipbuilding a strategically important industry. Through establishing South Korea as a global industry leader the government wanted to ensure further economic development and growth for the country (Bruno & Tenold, 2011, p. 209). These government intentions were quite successful and by the end of 2013 more than 154.000 people were employed in the industry and ship exports were totaling US$ 37.1 billion in value. The industry accounted for 6.6 percent of Korea's total exports making it one of the country's largest export sectors (KOSHIPA, 2014, pp. 7-10).

Likewise, the Chinese government also considers shipbuilding as a strategic industry. Following the Korean model the Chinese State Council in the year 2000 officially declared shipbuilding as a key industry for the country's economic development. Consequently the State Commission for Science, Technology and Industry for National Defense set the target for Chinese shipbuilders to reach world number one position by 2015 (Krishnan, 2011, p. 76).

Success in shipbuilding can also bring with it technological spillover effects into other industries such as the electrical equipment industry, the automobile industry, and the aircraft industry (Odagiri & Goto, 1996, p. 233). Other heavy industrial sectors such as steel and related industries such as ship equipment manufacturing are also likely to benefit from investments and progress made in shipbuilding. For these reasons shipbuilding is regarded as a pillar industry in both South Korea and China (Collins & Grubb, 2008, p. 6). However, South Korean and Chinese government authorities not only promote their national shipbuilding industries out of economic considerations but also in order to safeguard their national defense interests. Support for this industry is to a certain extent politically motivated since a strong domestic shipbuilding industry facilitates the upgrading of a country's naval fleet and most likely brings with it positive spillover effects to the country's national defense industry as well (Bruno & Tenold, 2011, p. 209).

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[8] Clarkson Research is a subdivision of the Clarkson Group, the world's largest shipbroker and one of the world's leading providers of statistical and research services to the maritime industry. Clarkson Research provides comprehensive data on international shipping and shipbuilding markets through its Shipping Intelligence Network. However, access to Clarkson data is restricted to paying customers and only very few articles are freely accessible. Hence the information provided by Clarkson analysts used for the analysis of shipbuilding industries of China and South Korea in this thesis is sometimes obtained from secondary sources.

Given the strategic importance of shipbuilding as a pillar industry for both countries it appears to the author as a very interesting and relevant topic to conduct further research on. The thesis at hand therefore presents a comparative analysis of competitiveness of the world's leading shipbuilding industries, namely China and South Korea on the basis of Michael Porter's national diamond model. This model lends itself well to the study of industry competitiveness and is described in detail in Chapter 3.1 of this thesis. As discussed in the state of the art section of this paper (Chapter 2) the diamond model has been applied by renowned scholars to analyze competitiveness of nations or particular industries for numerous times and is also well suited to analyze competitiveness in shipbuilding. However, as to the knowledge of the author it has never been applied to the shipbuilding industry before in English scientific literature with the exception of Solesvik and Encheva (2007) who analyzed shipbuilding competitiveness of the Ukraine using diamond theory. Through basing the analysis carried out in this study on Porter's diamond model the author attempts to close this research gap. The analysis of the Chinese and South Korean shipbuilding industries is carried out in order to answer the guiding research question of this thesis which reads as follows:

1. How competitive are the national shipbuilding industries of China and South Korea and what constitutes their key success factors?

In addition to the main research question which will be the guiding theme of this thesis the author through conducting this research also aims at finding answers to the following questions:

2. In which aspects are the national environments relevant to Chinese and South Korean shipbuilders similar or different to each other?

3. Which role do the national governments of China and South Korea play for the success of their domestic shipbuilding industries?

Comparing the two countries' national shipbuilding industries, assessing their competitive advantages and analyzing their overall level of competitiveness is supposed to reveal insights that should be relevant and important for a number of reasons. First and foremost, the global shipbuilding industry is in a restructuring process due to a huge building overcapacity and a weak order situation. Therefore only the most competitive yards will survive and as of today it is rather unclear which nations' shipbuilders will be better able to cope with the present market downturn and emerge victorious from this crisis. The aim of this thesis is to shed some

light on this question even though its focus lies on analyzing the status quo rather than making predictions of future developments.

As has been argued both countries' shipbuilding industries are heavily supported by their national governments through both direct and indirect subsidies. In this thesis also the role played by both countries' governments for their national shipbuilding industries is analyzed which might foster an understanding for how policymakers of both countries act in order to support not only domestic shipyards but also other important industries. Through undertaking a comparison of national shipbuilding industries of South Korea and China the author wants to elaborate on the similarities and differences as well as on the strengths and weaknesses of both nations' shipbuilders. However, the analysis carried out in this thesis is also intended to reveal competitive advantages of both countries' shipbuilders on which they base on their dominant position in the global market.

Having an understanding for what constitutes the key success factors of these two nations is also relevant for international competitors as it allows them to direct their strategies accordingly. Last but not least there is also a certain amount of foreign investment into the two countries' national shipbuilding industries. For potential market entrants and investors it is also vital to know about special characteristics of the local environment, competitive context as well as potential future performance of main participants. Since South Korea has been the hegemon in global shipbuilding for more than a decade and China has risen as a strong challenger, the author decided to focuses with this analysis on these two nations.

1.2 Organization of Thesis

The thesis at hand is divided into five chapters. After this introduction Chapter 2 provides a review of the related literature on shipbuilding competitiveness in China and South Korea in order to set this study into a broader context. This overview of shipbuilding literature is followed by the presentation of the research design in Chapter 3. As has been argued Michael E. Porter's diamond model of national advantage serves as the underlying framework of this thesis. In this chapter the diamond model is presented and its five dimensions of national competiveness are extensively discussed. In addition a short review of scholarly literature in which diamond theory has been applied to measure national or industry competitiveness is provided in this section. This is followed by a summary of the main points of critique of Porter's diamond framework and a discussion of some modified versions of the original home-based national diamond model which have been proposed by other scholars. On this basis an extended and modified version of the original diamond model is presented as

analytical framework for the analysis of shipbuilding industries in China and South Korea. In addition also the methodology used to apply the single criteria from the analytical framework is specified in this section. Chapter 4 goes on to analyze shipbuilding competitiveness in China and South Korea according to the analytical criteria presented in the theoretical part of this thesis derived from the five dimensions of Porter's diamond model which are factor conditions, demand conditions, related and supporting industries, firm strategy, structure and rivalry, as well as the role of the government. The level of competitiveness for each of these dimensions is evaluated for China and South Korea and the findings are then compared to each other in brief concluding sections. In the final Chapter 5 the findings from the analysis conducted in the empirical part of this thesis are summarized and the contribution of each dimension of Porter's diamond model to the success of China's and South Korea's shipbuilding industry is assessed based on a framework adapted from Öz (2002) and Barragan (2005). Finally explicit answers to the research questions are provided on this basis. In addition the relevance and implications of the main findings of this study are discussed and some suggestions for further research are stated.

2 Literature Review on Shipbuilding Competitiveness and State of the Art

A review of the shipbuilding literature suggests that there exists a large body of scholarly work on this topic. Due to the complexity of the industry, most of this literature, however, focuses on particular areas such as port competitiveness, shipbuilding business or short sea shipping (Lee, Wan, Shi, & Li, 2014, p. 367). While several scholars focus with their research on shipbuilding competitiveness, comparative studies are less frequent. Major contributions to the field of shipbuilding competitiveness were made amongst others by Chou and Porter (1986), Storch and Lamb (1995), Bertram and Weiss (1997), Bertram (2003), Gebhardt and Jarvis (2003), Chou and Chang (2004), Rashwan and Naguib (2006), Pires, Lamb, and Souza (2009) and Zakaria, Rahaman, and Hossain (2010).

Studies focusing on the shipbuilding industries of South Korea and China came to the fore in the 1990s when Korea overtook Japan as market leader and China started to expand its domestic shipbuilding capabilities (Li, Bang, Lin, & Wang, 2012, p. 108). One of the first studies that centers on shipbuilding competitiveness in East Asia is the work by Song (1990) in which he focuses on shipping and shipbuilding policies of China. In this study it is argued that successful policy measures lead to the positive development of Chinese shipbuilding firms from the end of the 1970s onwards. Song projects further future growth of China's shipping and shipbuilding industry, and attests both industries to play a vital role for China's national economy. Lee (1990) analyzes the role of the Korean government for the domestic shipping industry's rapid development from 1962 to 1981. The study reveals that the Korean government through various policies including a state-financed shipbuilding program both directly and indirectly contributes to the growth of the Korean shipping and shipbuilding industry. Also Hong (1995) reviews South Korea's marine policy including issues such as shipping and shipbuilding and analyzes the industry's governance.

Sohal and Ferme (1996) analyze South Korea's shipbuilding industry based on direct observations during company visits to Hyundai Heavy Industries (HHI) in 1993 and 1994. While their study mainly describes company structure and policies of Hyundai Heavy Industries, Sohal and Ferme also find that South Korean shipbuilders enjoy a cost advantage over their at that time biggest rivals from Japan due to labor cost advantages and cheaper access to raw material such as steel. Their observations also reveal that Hyundai Heavy Industries is capable of producing highly sophisticated LNG carriers which indicates that Korean shipbuilders have caught up with Japanese firms in terms of engineering and manufacturing skills. In their study Sohal and Ferme conclude that the biggest future

challenge for South Korean shipbuilders comes from Chinese yards because of cost advantages and their rapidly expanding building capacity.

In another contribution to the study of shipbuilding in East Asia Nagatsuka (1999) analyzes the structure and future prospects of South Korea's shipbuilding industry, while King (1999) focuses on state aid in shipbuilding, assesses capabilities of South Korean and Chinese shipbuilding companies and predicts a rising market share for Chinese shipbuilders. Lu and Tang (2000) examine challenges of Chinese shipbuilding firms in the 1980s when they first tapped into international markets and distinguish broadly between external factors which are outside the control of shipbuilders and shipbuilding management. Dwivedi and Maffioli (2003) study the implementation of total quality management (TQM) in shipbuilding by comparing South Korean shipyards to European ones.

Hassink and Shin (2005) analyze the development of South Korea's shipbuilding industry to answer the question whether it can be considered a cluster according to the terminology by Porter (1990a). They carry out their research based on the analysis of secondary literature and conduct expert interviews with scholars, shipyard managers and government representatives. In their study it is argued that during the 1970s when modern shipbuilding started in Korea, funds were channeled heavily into a limited number of large shipyards in the province of Gyeongnam. These yards were controlled by chaebol companies which closely cooperated with the Korean national government. Hassink and Shin find that while the Korean shipbuilding industry was regionally concentrated, these yards worked in isolation from each other, focused on exports and had only little support from supplying industries, thus cannot be considered as an integrated cluster (Hassink & Shin, 2005, pp. 141-144).

As Hassink and Shin note, the situation changed by the mid-1980s when the domestic supply base for shipbuilding firms was heavily extended. In addition also the necessary infrastructure for research and development such as universities and special research programs had been established at that time. This lead to South Korean firms purchasing a high percentage of components from local suppliers. In addition they started to invest heavily in research and development themselves, benefited from cooperating with Korean universities specialized in ship engineering and had a constant supply of well-educated graduates from these institutions (Hassink & Shin, 2005, pp. 148-149). Hassink and Shin (2005) therefore conclude that the South Korean shipbuilding industry "developed from a couple of cathedrals in the desert, highly dependent on import for its main supply, towards an innovative cluster with much interaction between the large yards and their suppliers, as well as with universities and research institutes" (p. 152). However they do not forget to mention China as a potential

future challenger that due to its low cost advantage could pose a potential threat to the competitiveness of South Korea's shipbuilding cluster (Hassink & Shin 2005, p. 152). Shin and Hassink (2011) further elaborate on the South Korean shipbuilding cluster. In their follow-up study they examine the stages of the shipbuilding industry cluster lifecycle and argue that it is moving from a developmental to an expansion stage. They further note that the South Korean shipbuilding cluster has expanded in terms of geography with some firms also running shipyards abroad, but also in terms of production activities.

While earlier studies of shipbuilding in South Korea focus either on the role of the government for Korea's rise in international shipbuilding (Lee 1990; Hong 1995; King 1999), industry structure (Nagatsuka 1999; Hassink & Shin 2005; Shin & Hassink 2011) or competitiveness on the firm level (Sohal & Ferme 1996), the study by Pai (2006) can be considered as first attempt to identify and analyze the main sources of industry success of South Korean shipbuilding. In his paper Pai identifies technical progress, changes in technical and allocative efficiency, as well as scale effects as the main sources of total factor productivity in shipbuilding. Pai applies a stochastic production frontier model to Korea's shipbuilding industry and uses micro-level data from 1992 to 2004 for the analysis. His findings suggest that the productivity growth and hence, the success of South Korea's shipbuilding industry for the period studied was mainly due to technological progress. In addition Pai finds that total productivity growth has also been supported by the more efficient use of existing technology and to a minor degree by the utilization of scale effects, while allocative inefficiencies decelerated total productivity growth. In view of China's rise as a strong competitor in international shipbuilding mainly due to the country's labor cost advantage, Pai argues for a more efficient resource allocation based on the principles of free markets. In addition Pai emphasizes on the need for investments in research and development since according to the findings of his study technological innovation has been the main factor of productivity growth of shipbuilding in South Korea.

Another contribution to the body of literature on South Korea's shipbuilding industry has been made by Shin and Ciccantell (2009). In their study they analyze the role of the steel and shipbuilding industries for South Korea's economic ascent and argue that development in both industries heavily contributed to progress in other related sectors such as electronics and automobiles. As Song (1990), Hong (1995) and King (1999) also Shin and Ciccantell focus on the role of the Korean government in supporting industry success in shipbuilding. They argue that the shipbuilding industry strongly benefited from various government policies which were part of Korea's third and fourth national five-year plans for economic growth.

Shin and Ciccantell in their study also note that the greatest risk for Korean shipbuilders could come from Chinese yards with low-wage advantages working together in joint ventures with Japanese shipbuilders which command over expertise in leading-edge technologies.

While most contributions to the body of literature on shipbuilding in China and South Korea center on commercial shipbuilding, the study by Collins (2010) focuses on military shipbuilding instead. In his research Collins examines how progress and development in commercial shipbuilding could also benefit the military shipbuilding industry in China. Collins argues that components required for the production of commercial and military vessels are very different which is why he sees only limited potential for a technology transfer from one industry segment to the other. Collins nevertheless argues that the Chinese military shipbuilding industry benefits from the progress made by domestic firms in the commercial sector in some areas. He cites improvements in ship design and fuel efficiency as examples where technology advancements in the civil sector are likely to convert into gains and improvements in the production of military vessels (Collins, 2010, p. 2). In addition Collins also sees a dual-use potential for civil vessels in times of conflict. He argues that some types of civil vessels could be equipping with light arms so that they could be used to curtail smuggling, poaching and piracy as well as for laying mines in the scenario of naval warfare (Collins, 2010, p. 5).

In another study Collins (2013) analyzes developments in China's military shipbuilding industry. He finds that technical capabilities of Chinese yards have significantly improved and at the time of study matched those of their South Korean and Japanese counterparts. In addition Collins (2013) finds that Chinese shipyards enjoy a significant cost advantage over South Korean and Japanese yards mainly due to cheap labor. He concludes that China's military shipbuilding industry has developed to a point where it is capable of producing highly sophisticated military vessels in large numbers. At the time of study China's naval industry still relied on imports of some important components. However, Collins expects technical capabilities of the Chinese military shipbuilding industry to further improve so that by 2018 all key elements of modern military vessels could be produced domestically (Collins, 2013, pp. 1, 5).

Apart from the studies conducted by Collins most of the more recent scholarly literature on shipbuilding in China centers on commercial shipbuilding such as the study by Tsai (2011). In his analysis of the Chinese shipbuilding industry Tsai argues that the country's national advantage in shipbuilding is mainly based on factor advantages such as the availability of land and cheap labor and other inputs which are also due to the presence of supporting industries

such as the iron, steel and machinery manufacturing industry (Tsai, 2011, p. 42). He cites a strong and growing home demand for new vessels as well as government financial support and incentives for expansion as further reasons for China's rapid expansion in global shipbuilding (Tsai, 2011, p. 62). Moreover Tsai identifies the relative low productivity and a rather poor management as the main limiting factors of growth for the Chinese shipbuilding industry (Tsai, 2011, p. 57).

Another study on China's shipbuilding industry has been conducted by Krishnan (2011) who tries to derive recommendations for India from his analysis. Throughout his study Krishnan argues that the rise of China as a world leading shipbuilding nation has mainly been due to strong support of domestic shipbuilding firms and ancillary industries by the national government. Krishnan in particular traces the Chinese success in shipbuilding back to the government's decision to allow state-owned shipyards to work relatively autonomously based on market principals as well as to the government support of a limited amount of competition between these yards. His study also covers the various policy decisions through which the Chinese government tries to support its domestic shipbuilding industry with a special focus on subsidies. Besides government support Krishnan attributes China's leading role in shipbuilding to factor advantages such as cheap labor and shipbuilding steel as well as to the presence of supporting industries in shipbuilding equipment. He also emphasizes on the positive impact of technological advancements in commercial shipbuilding for China's navy and defense industry. Krishnan also sees potential for India to become a successful shipbuilding nation which in his view would require substantial industry support by the national government.

While the studies by Tsai (2011) and Krishnan (2011) focus on shipbuilding in China, there are also some more recent studies focusing on shipbuilding in South Korea such as the ones by Bruno and Tenold (2011) or Lee and Chang (2012). In their study Bruno and Tenold (2011) analyze the rise of South Korea as a leading shipbuilding nation and note that the rapid development of the country's shipbuilding industry received only little attention from scholars in the past. Bruno and Tenold in their study focus on the time period from 1970 to 1990 when the global shipbuilding industry was faced with a major crisis due to a tremendous increase of the oil price and a consequent decline in the demand for new ships. They argue that these unfavorable market conditions first lead to nationalization and subsidization but in a second step also to massive disinvestment which forced most of European yards to cease production (Bruno & Tenold, 2011, p. 202). According to Bruno and Tenold South Korea benefited from this trend and due to advantages such as low wages and cooperating unions as well as heavy

government support managed to gain significant market shares against Western competitors. In their work it is also noted that in the mid-1980s when Japan was South Korea's major competitor in global shipbuilding also currency fluctuations, specifically the appreciation of the yen, from which Japanese exporting firms had to suffer, helped South Korea to further improve its relative competitiveness (Bruno & Tenold, 2011, p. 205, 208). In addition Bruno and Tenold also find another reason for the rise of South Korea's shipbuilding industry. As has been mentioned Korean shipbuilding firms were heavily supported by the national government which had a strong interest in establishing a world leading domestic shipbuilding industry in order to enhance national security. As Bruno and Tenold note, the South Korean government had a strong incentive to upgrade its military at a time when the United States had withdrawn their troops from Korea and the military threat from Communist China was still present (Bruno & Tenold, 2011, p. 209).

Another contribution to the literature on shipbuilding in South Korea has been made by Lee and Chang (2012) who assess the work ability of workers in the Korean shipbuilding industry. For their study Lee and Chang make use of the so-called work ability index (WAI) developed by the Finish Institute of Occupational Health (FIOH). Through applying this index the work capacity of workers of different age groups is evaluated. According to the findings of Lee and Chang, Korean workers on average score relatively high which also indicates high working capacity. However, scores of people employed in shipbuilding are lower than those of workers in other industries. Lee and Chang also find that work ability in Korea does not decrease for aged people while research findings of other scholars suggest a decreasing work capacity of aged workers in Finland. Lee and Chang attribute this difference to the comparably poor social security for aging workers in Korea as well as to the role of patriarchy in Korean society.

Some of the most recent studies on shipbuilding in East Asia again center on the rising competitiveness of China and also draw comparisons between China and South Korea. Such a comparative study on shipbuilding competitiveness for China, Japan and South Korea has been conducted by Li et al. (2012). In this study Li et al. apply the Analytical Hierarchy Process (AHP) method to shipbuilding. They first compile a hierarchy of shipbuilding competitiveness consisting of eight dimensions (cost, vessel, capacity, efficiency, shipyard, workforce, expertise, policy) critical for success in shipbuilding and then analyze each country's performance according to these dimensions or critical success factors. The findings of this study suggest South Korea to rank first in terms of shipbuilding competitiveness due to advantages in technology and human resources, followed by China and Japan. While

according to Li et al. South Korea will keep its leading position in the shipbuilding market for the near future they also note China's rising competitiveness due to capacity built-up and cost-advantages.

In another study Jiang and Strandenes (2012) assess costs of Chinese, South Korean and Japanese yards and analyze how these costs influence the countries' competitiveness in the shipbuilding industry. Jiang and Strandenes use market shares and shipbuilding costs to evaluate China's competitiveness relative to that of South Korea and Japan. In their study Jiang and Strandenes exclusively focus on costs for labor, steel and ship equipment as they account for roughly ninety percent of overall costs in shipbuilding (Jiang & Strandenes, 2012, p. 482). They find that while wages of Chinese workers are significantly lower than those of workers in South Korea or Japan, this advantage is partly offset by low labor productivity. In addition their findings suggest that Chinese yards have the lowest costs for ship equipment and steel. They conclude that China kept a cost-leading position throughout the examined period from 2000 to 2009 which was mainly due to the country's advantage regarding labor costs. An analysis of shipbuilding costs and market shares also revealed that China's competitiveness has dramatically increased over the period studied (Jiang & Strandenes, 2012, p. 492).

Also Jiang, Bastiansen, and Strandenes (2013) evaluate the competitiveness of the Chinese shipbuilding industry during a period from 2000 to 2009. However, they limit their study to the tanker and bulk carrier sectors. Jiang et al. choose profit rate of shipyards as measurement for their competitiveness. In their study an increase in profit rate is associated with an increase in industry competitiveness. For their research Jiang et al. calculate profit rates of major shipbuilding contracts in China and compare them to those of Japanese and South Korean firms. Their findings suggest that over the analyzed time period profit rates of Chinese shipbuilding companies were on average higher than those of their Japanese or South Korean competitors. Jiang et al. explain the stronger competitiveness of Chinese shipbuilders in the bulk carrier and tanker sector by cost advantages in labor as well as materials (Jiang et al., 2013, pp. 43-44). Jiang et al. also consider market swings in their study. They find that China was 1.3 times more competitive than South Korea and 1.44 times more competitive than Japan in the tanker sector during boom periods. They further argue that in times of trough or unfavorable market conditions China's relative competitiveness against South Korea and Japan was even stronger for the sectors studied. In their work Jiang et al. also develop an econometric model to identify the sources of competitive advantage in shipbuilding as well as their relative importance and conclude that for China shipbuilding costs are the main source

of competitiveness while it is contract price deviation for South Korean and Japanese shipyards (Jiang et al., 2013, p. 46).

Another study by Ye et al. (2013) also evaluates the capability of China's shipbuilding industry. Ye et al. develop an evaluation system based on interviews conducted with fifteen experts in the realm of shipbuilding. Out of these interviews Ye et al. obtain sixteen elements which according to the experts demonstrate or affect a nation's shipbuilding capability. The elements are then divided into three categories, namely scientific research and development ability, shipbuilding ability and international cooperation ability (Ye et al., 2013, p. 1372). For their study Ye et al. make use of the expert argumentation method. With this method every single indicator is weighted individually by scholars and researchers based on their assessment and discussions of relevant studies in the field of shipbuilding. As a result of the study, China's shipbuilding industry capability scores 73 out of 100 points. Viewed in detail the study reveals higher scores for the dimension shipbuilding ability of China than for international cooperation capability and scientific research and development ability. Ye et al. interpret the findings of their study by saying that the Chinese shipbuilding industry at the time of study stood at a middle level. However, they also note a large gap compared to more advanced nations. Ye et al. conclude that in order to enhance the capability of China's shipbuilding industry improvements in areas such as organization structure, level of technology, ship equipment, management and policies are required (Ye et al., 2013, p. 1375).

In another study Zheng, Hu, Li, and Huang (2014) present a fuzzy expert system that could potentially evaluate competitiveness of Chinese shipbuilding companies. Their model consists of six factors namely company type, the area in which a shipbuilding company is located, the GDP of the city in which the company is headquartered, population, produced ship types, and the amount of capital invested by the company. According to Zheng et al. these six factors mainly influence the order situation of shipbuilding companies and hence their competitiveness. Zheng et al. conclude that their example system proofed to be a viable option for the analysis of shipbuilding competitiveness, but also note that there is still much room for improvement of their fuzzy expert system in the future.

Last but not least also He and Qian (2014) contribute to the competitiveness literature on Chinese shipbuilding. In their study they analyze the formation mechanisms of competitiveness in the shipbuilding industry with a focus on China. They first distinguish between dominant and potential competitiveness. Dominant competitiveness is measured by a nation's share in new ship orders. He and Qian analyze data from 2008 to 2013. According to their findings China surpassed South Korea in terms of new ship orders in 2009 and kept its

leading position from then on. Hence, they conclude that competitiveness of the Chinese shipbuilding industry has improved significantly. However, during a downturn in global demand for new ships from 2009 to 2013 China faced a stronger decline in market share than South Korea while Japan's new ship orders even increased. He and Qian therefore argue that in case of unfavorable market conditions or trough Chinese shipbuilding firms would suffer the most which is in sharp contrast to the findings of Jiang et al. (2013). For the measurement of potential competitiveness in shipbuilding He and Qian develop a competitiveness analysis index consisting of five dimensions which correspond to those of Porter's diamond and comprise of 23 indicators. According to the data derived from a questionnaire survey all five dimensions (production factors, demand conditions, auxiliary industries, industrial organization and government support) affect competitiveness in shipbuilding. The findings of He and Qian therefore suggest that the dimensions of Porter's diamond are the main formation mechanisms of competitiveness in the shipbuilding industry.

From this review of the literature on shipbuilding competitiveness in China and Korea several conclusions can be drawn. First, scholars have identified a multiplicity of critical success factors in shipbuilding and applied very different methods to analyze the Chinese and Korean shipbuilding industry. Second, out of the scholars that focus with their research on East Asian shipbuilding, many identify government support as critical to the success of a nation's shipbuilding industry. Therefore they analyze government policies of China and South Korea and their effects on domestic shipbuilding firms. As the findings of the reviewed literature suggest the shipbuilding industries of both countries, China as well as South Korea, owe much of their success to their national governments which strongly supported progress and development in shipbuilding through subsidies and other support measures. Third, besides the role of the government, also input factors such as labor and materials are identified as critical success factors. In a couple of studies it is mentioned that both China and Korea enjoy factor advantages over other shipbuilding nations. While South Korea's factor advantage is mainly due to labor productivity, China's competitiveness rests on its low-wage advantage and the countries cheap access to shipbuilding steel. The importance of having a strong supplier and supportive industry in close proximity has also been discussed in the reviewed literature. Fourth, from the literature discussed it seems that scholars basically agree on South Korea as the current leading nation in shipbuilding due to advantages in technology and human resources that lead to very high overall productivity. However, scholars also agree on China as the main challenger that is rapidly catching up on the back of a strong government support for the industry, a huge home demand for new ships as well as a significant wage-

advantage over South Korea. Last but not least, it can be drawn from this literature review that while different scholars have identified very different success factors in shipbuilding, most of them can be categorized into one of the dimensions of Porter's diamond model which will be presented and discussed in the next chapter of this thesis. This view is also supported by the findings of He and Qian (2014) who argue that the dimensions of Porter's diamond model constitute the main formation mechanisms of shipbuilding competitiveness. The diamond model has not yet been applied to shipbuilding by scholars with the exception of Solesvik and Encheva (2007) who analyze shipbuilding competitiveness of the Ukraine. However, it has attracted much attention from the scientific community and has been frequently used by scholars to assess and evaluate the competitiveness of nations, industries or firms as is discussed in Chapter 3.2 of this work. In the following chapter in which the author presents the research design and method for this thesis, Porter's diamond model is extensively discussed.

3 Research Design and Method

In order to answer the research questions the shipbuilding industries of China and South Korea are analyzed in this thesis based on the application of Porter's diamond theory. Porter's diamond model serves as the underlying framework of this thesis and is presented and extensively discussed in the following. The single determinants of national competitive advantage according to diamond theory are explained and the interlinkages between the individual factors and hence, the dynamism in the diamond model is discussed. In doing so it becomes clear what constitutes competitive advantage according to Porter's theory. As has been argued the diamond model has been applied by numerous scholars of various research fields and a short review of this literature is also presented in this chapter. In addition the author also discusses the attested flaws in Porter's theory by reviewing critical literature dealing with the diamond model and presents some of the modified versions of Porter's original diamond proposed by other scholars. Through this approach Porter's original diamond model is adjusted to shipbuilding based on the suggestions of other scholars. Finally the author presents an extended and modified version of the original diamond model which serves as analytical framework for the analysis of shipbuilding competitiveness in China and South Korea conducted in this thesis. In addition the methodology used to apply the single criteria from the analytical framework is specified in this chapter.

3.1 Porter's Diamond Model

In his book "The Competitive Advantage of Nations" Michael E. Porter introduces the diamond model as a framework according to which the competitiveness of a nation or a particular industry can be evaluated. According to Porter (1990a) applying this model should foster an understanding for why some nations manage to provide a favorable home base for domestic firms to create competitive advantage over their international competitors while others fail to do so. In other words the diamond approach seeks to explain why some nations or particular industries within a nation progress and prosper through achieving international success in global competition while other countries or its firms see their competitive position deteriorating (Porter, 1990a, p. 71).

Through conducting various studies of different nations and industries Porter finds that the world's leading firms of a particular industry are quite frequently all located in the same single country or geographic region. He therefore concludes that nations strongly influence the competitiveness of its firms through providing a domestic environment that either

facilitates or hinders the creation of competitive advantage. In his view it is therefore paramount when evaluating a nation's competitive position in a global context to ask why a country became home base for the world's leading companies of a particular industry (Porter, 1990a, p. 1). Through the diamond model Porter therefore seeks to explain what determines a favorable or unfavorable national environment and how nations can become home base for internationally competitive firms.

The introduction of the diamond model stems from the notion that older theories such as Adam Smith's absolute advantage or David Ricardo's comparative advantage which seek to explain export patterns of nations are no longer sufficient to analyze a country's competitive position within a global context. Porter attributes this to the changing nature of international competition (Porter, 1990a, p. 2). In his view the classical theories that explain national competitiveness either by favorable macroeconomic variables such as exchange rate depreciation or low interest rates, an abundance of cheap labor or a country's richness in natural resources are not fully satisfactory because they only focus on one out of many factors that contribute to competitive advantage. Porter argues that countries have been successful in raising the living standard of their citizens despite appreciating currencies, high interest rates, high labor costs or resource scarcity. Also theories according to which government policy shapes a nation's competitive position through protectionism or providing subsidies to its firms focus only on one aspect of a broader picture and are therefore by themselves insufficient to explain national competitiveness. The same applies to theories focusing on differences in management style since promising approaches to management vary from industry to industry (Porter, 1990a, pp. 3-5).

Porter contradicts the abovementioned classical theories and argues that national prosperity is created rather than inherited (Porter, 1990b, p. 73). He states that the prime goal of a nation is to improve the living standard of its citizens for which the most important determinant is national productivity. Keeping a high level of productivity requires a nation to constantly upgrade itself and its industry to improve productivity through innovation and technological advancement (Porter, 1990a, p. 6). In Porter's opinion it is therefore not only resource richness or an abundance of cheap labor, but also pressure and challenges that help firms to gain and sustain competitive advantage (Porter, 1990b, p. 73). Despite an increasingly globalized world economy, Porter describes the creation of competitive advantage as a "highly localized process" in which "the role of the home nation seems to be as strong as or stronger than ever" (Porter, 1990a, p. 19). Since the success of a nation's firms depends on their ability to upgrade and their level of innovation, what is most beneficial to them is having

fierce competition and strong rival companies in their home market, aggressive domestic suppliers and local customers with high demands (Porter, 1990b, p. 73).

Porter's hypotheses derive from a four-year study of ten leading trading nations and over hundred industries which he conducted in order to understand why countries gain competitive advantage in particular industries. The focus of this study was on relatively sophisticated industries and industry segments which often require advanced technology and skilled workers (Porter, 1990a, pp. 21-22). What Porter finds is that "the nature of competition and the sources of competitive advantage differ widely among industries and even industry segments" (Porter, 1990a, p. 69). According to Porter the domestic environment in which firms operate is shaped mainly by four attributes which determine whether a nation as a potential home base to firms of a particular industry provides favorable or rather unfavorable conditions for creating and maintaining competitive advantage (Porter, 1990a, p. 71). These four determinants of national advantage are:

1. *Factor conditions*: The availability and cost of workers and raw materials, but also infrastructure and know-how of workers and institutions which are necessary to compete in a given industry.

2. *Demand conditions*: The extent and nature of domestic customer preferences. Demanding customers pressure firms to invest in new technology and to improve product features such as price, quality or delivery which in turn forces companies to constantly innovate and upgrade.

3. *Related and supporting industries*: The existence of related and supporting industries in the home nation, their level of competitiveness in a global context, and the level of integration between firms and the respective supplier industry.

4. *Firm strategy, structure and rivalry*: The level of domestic competition in a given industry, the presence or absence of strong domestic rival firms and the general conditions in a nation that determine how companies are created and managed.

In Porter's model these four determinants of national advantage are arranged in the form of a diamond which is illustrated in Figure 1 on the next page.
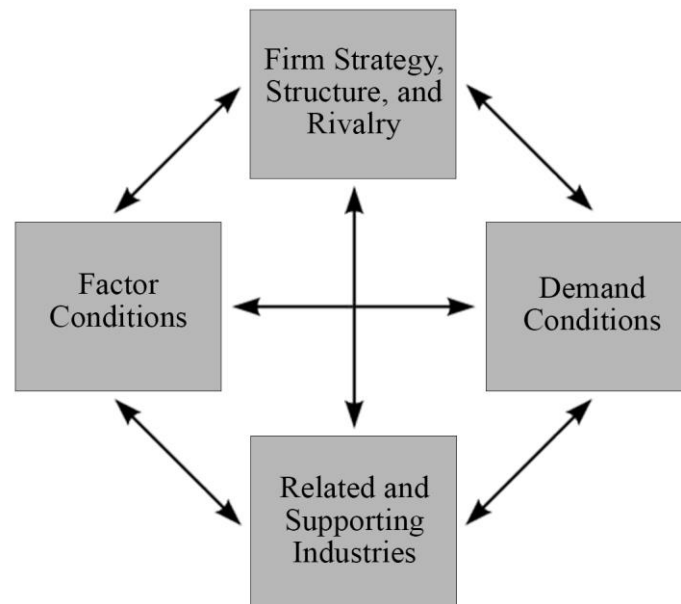
Figure 1: Determinants of national competitive advantage

Source: Porter, 1990b, p. 77

These four dimensions of the diamond model shape the environment in which a nation's firms operate and affect the ability of these companies to create and sustain competitive advantage in a given industry or industry segment. As Porter notes a nation cannot achieve international success in every industry but should instead focus on these industries for which its national diamond is the most favorable. In his model the single variables are interlinked, meaning that an advantage in one of the four dimensions can also positively influence others. In some industries it is possible to gain competitive advantage by utilizing favorable conditions in only one or two determinants of the diamond. However, this holds true only for particular industries in which success or failure are determined mainly by possession of or access to an abundance of natural resources or for industries in which the use of advanced technology and highly skilled or specialized workers are of little importance. For other industries and especially those which are knowledge-intensive competitive advantage which is based on only one or two determinants will be very difficult to sustain and favorable conditions for all four variables will be necessary to keep a leading position (Porter, 1990a, pp. 72-73).

In order to complete his theory Porter introduces two additional factors as "outside forces" to his diamond model, namely *Government* and *Chance*. The complete diamond model including all six factors of national advantage is presented in Figure 2 on the next page.

23
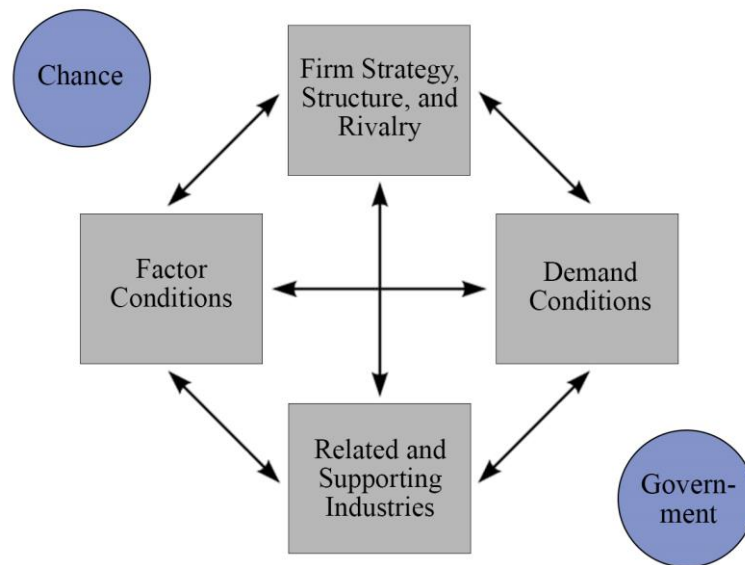
Figure 2: Porter's diamond model of national advantage

Source: Porter, 1990a, p. 127

Besides the four factors of a nation's diamond that have already been discussed also government can have a strong influence on domestic and foreign firms' competitive position within a global industry. It can through various policies affect all other determinants of national advantage. Chance summarizes events and happenings which are out of the control of firms and most of the time also governments, but still have the potential to shift competitive advantage in a given industry (Porter, 1990a, p. 73). In the following chapters the six factors that together constitute a nation's diamond are discussed in more detail also focusing on the interlinkages between the single factors.

3.1.1 Factor Conditions

Production factors such as human resources, physical resources, knowledge resources, capital resources and infrastructure are necessary to compete in every industry. All nations possess these, however, in different quantities and qualities. According to Porter's theory it is not the mere availability of factors, but the way they are employed that determines competitive advantage. Factor advantage by itself is seldom enough to be internationally successful, and it is paramount that these factors are deployed in a productive manner which is determined by the other variables of the diamond (Porter, 1990a, p. 76).

According to Porter there is also a hierarchy among factors. First, he distinguishes between *basic factors* and *advanced factors*. Basic factors are natural resources, climate, location, unskilled labor and debt capital, while modern infrastructure, highly skilled labor and special trained personnel and academic research institutes are examples of advanced factors (Porter,

1990a, p. 77). While basic factors are mostly inherited by a nation or demand only little investment to create them, this is quite the opposite for advanced factors. These factors are created rather than inherited and usually developing them involves a long process of investing heavily in human and physical capital. However, the importance of basic factors in international competition is diminishing since they tend to become easily available globally. In addition basic factor disadvantages can often be compensated through technological advancement. In most industries, firms which nevertheless base their success on basic factor advantages will have difficulties sustaining their competitive edge (Porter, 1990a, p. 77).

Following Porter's theory it is mainly the possession of or access to advanced factors that determines competitive advantage in most industries. Advantages in advanced factors help firms to achieve product differentiation or to upgrade production processes through proprietary technology, which both have the potential for companies to gain and sustain comparative advantage. Advanced factors are also scarcer because of the significant investment in human and physical resources they often require. In addition they are hardly available for purchase on global markets and also very difficult to access for subsidiaries of foreign owned companies because they are most vital to product design and development which usually takes place at a company's home base (Porter, 1990a, pp. 77-78).

Second, Porter also distinguishes between *generalized factors* and *specialized factors*. Generalized factors, such as a nation's highway system or a pool of motivated semi-skilled workers, can be deployed in many industries but the advantages which are derived from these factors are usually rather minor. Generalized factors are seldom exclusive to a small number of nations and corporate activities based on these factors do not need to be performed at the home base (Porter, 1990a, pp. 77-78). In contrast, specialized factors are only of value to a very limited number or even only a single industry. Examples of such factors are amongst others staff with knowledge and skills in a very narrow field or infrastructure that is only useful to a certain type of industry or industry segment. The creation of specialized factors usually requires sufficient supply of generalized factors to build on and also often involves private investment. For these reasons specialized factors are relatively scarce. However, company activities which are more complex or even proprietary often rest on the deployment of specialized factors at the home base. This is why most sophisticated competitive advantages are based on specialized factors (Porter, 1990a, p. 79).

According to Porter nations and their firms are most competitive in industries in which they are particularly good at creating and deploying advanced and specialized factors. This requires high and continuous investment in human and knowledge resources and also

infrastructure. In addition nations not only have to prevent its factors from depreciating but also need to continually upgrade them mostly through innovation (Porter, 1990a, p. 80).

As has already been discussed, it is mainly advanced and specialized factors that allow firms not only to create, but also to sustain competitive advantage. While firms' international success which rests on basic or generalized factor advantages is often short-lived because it is relatively easy for its competitors to match them, this does not apply to competitive advantage which is based on advanced and specialized factors. As has been argued these factors are created rather than inherited. Therefore it is not a country's current factor pool which is most important in determining competitive advantage, but a nation's ability to create and upgrade advanced and specialized factors relevant to particular industries (Porter, 1990a, pp. 77, 80).

Last but not least, Porter also argues that competitive advantage does not necessarily need to rest upon an abundance or low cost of factors, but can also grow out of selective factor disadvantages. While the former can result in an inefficient use of factors, the latter forces firms to level out their disadvantage through innovating around it. This often leads to more sustainable competitive advantages overall. However, which types of factors are created and upgraded in a country or which selective factor disadvantages are leveled out through innovation by its firms strongly depends on other dimensions of Porter's diamond such as the nature of home demand and domestic competition as well as on the existence of related and supporting industries and firm strategy (Porter, 1990a, p. 81).

3.1.2 Demand Conditions

Besides factor conditions also home demand conditions for an industry's products or services determine national competitive advantage. Strong home demand can give firms a competitive edge through realizing economies of scale, but what is even more is that sophisticated buyer needs force firms to continuously upgrade and improve their products. As Porter notes "the *quality* of home demand (…) is more important than the *quantity* of home demand in determining competitive advantage (Porter, 1990a, p. 86).

Domestic customers demanding sophisticated products challenge firms to innovate faster and to constantly question and improve product features and production processes. Over the long run this helps companies to achieve, upgrade and sustain competitive advantage over their foreign rival companies (Porter, 1990a, p. 86). Sophisticated home buyer demand is also important for companies for another reason. Firms also gain competitive advantage in industries where they have earlier or better knowledge about local and global buyer needs. In

industries where domestic demand is sophisticated firms can also gain such knowledge faster, thereby realizing competitive advantage over foreign competitors (Porter, 1990a, p. 86).

Porter argues that the characteristics of home demand are as important as or even more important than ever in times of globalization and internationalization of competition. In his view it is still a firm's domestic market in which it is best at perceiving and interpreting customer needs. Porter attributes this to various reasons. Usually companies pay their highest attention to home buyers' demand and are also sensitive to pressures from these customers to product improvements or adaption. In addition firms tend to have their pride in competing successfully in their home market which makes them draw much of their attention to domestic buyer needs instead of that of foreign customers. Last but not least, also product development and approval of new products usually takes place at a firm's home base (Porter, 1990a, p. 86).

Besides having sophisticated domestic customers, also the segment structure of this demand can help firms in creating and sustaining competitive advantage. In industries where demand is segmented firms tend to focus on the large segments or those which are deemed most profitable in their home market and pay less attention to smaller segments which are supposed to be less profitable. These segments are often also completely ignored by domestic firms and ceded to foreign companies. As a consequence firms are most likely to become good at segments which are important, large and/or profitable in their home market. These are also the segments where a nation's firms most likely achieve competitive advantage globally. This does not only apply to large countries, but also to smaller nations in which there is high local demand in a segment which, in relative terms, is less important in most other countries (Porter, 1990a, p. 87).

In addition to the composition and segment structure of home demand, also its size and growth pattern have the potential to influence competitive advantage. However, the question of how the size of the home market affects the creation of national advantage in an industry is controversially discussed in the literature. According to Porter a large home market is favorable in those industries which are characterized by high uncertainty, which require huge investments in research and development or technology or where economies of scale in production can be realized. Whenever a large home market spurs private or public investment it can be considered as a strength and supporting factor of competitive advantage (Porter, 1990a, pp. 93-94). On the other hand, a large home market can also be regarded as a disadvantage in developing competitive edge internationally. This is the case if firms decide not to tap into foreign markets and aim for selling globally because of sufficient demand for their products or services in their home market (Porter, 1990a, p. 94).

It is, however, not only the size of the home market that can influence the ability of a nation to gain competitive advantage in a particular industry, but also the growth rate of home demand. This is due to investment decisions which depend rather on the growth rate of a market or market segment than on its absolute size. As Porter argues, companies are more willing to adopt new technologies or invest in large and more efficient production facilities in markets that are characterized by high growth rates. Large investments in technological advancement or facility construction are more justifiable in growing markets because of high chances for these investments to pay off. In contrast, for firms which compete in markets with only moderate or little growth, the willingness to adopt new technologies or invest in innovative and more efficient facilities tends to be much lower (Porter, 1990a, p. 94).

As has already been discussed every factor in Porter's theory is at interplay with the other dimensions of the diamond. Therefore, also demand conditions cannot be viewed as an isolated determinant of competitive advantage. How the presence of sophisticated and demanding buyers in firms' home markets, as well as the level and growth rate of home demand affect a nation's firms' ability to gain and sustain competitive advantage also depends on other factors of the diamond. As Porter notes, in markets of large absolute size or with high growth rates, firms in the absence of fierce competition often wallow in their own success instead of constantly trying to improve and also fail to seek promising investment opportunities. Sophisticated domestic customers which demand companies for continual improvements of all product features are also only of minor value to these firms if their home market lacks appropriate related and supporting industries which allow companies to satisfy this demand (Porter, 1990a, p. 99).

3.1.3 Related and Supporting Industries

The third factor in Porter's national diamond is related and supporting industries. Their presence and level of sophistication also determines national advantage in a given industry (Porter, 1990a, p. 100). Porter argues that strong and internationally competitive home-based supporting industries can supply domestic firms efficiently with high quality and/or cost-effective machinery or inputs such as materials, parts and components. Due to good business relationships and geographical proximity home-based suppliers often treat domestic firms preferentially and also grant them earlier or faster supply. This is one reason why the existence of home-based supporting industries which are strong global players can also lead to competitive advantages in downstream industries (Porter, 1990a, p. 101).

However, the mere availability of inputs from domestic suppliers is not sufficient to gain competitive advantage. In an ever globalizing world, machinery, tools and other inputs are traded on global markets and companies are not reliant on home-based supplier industries to purchase them. Therefore Porter stresses that it is the effective utilization of inputs rather than their availability through which firms can gain competitive advantage over their rivals (Porter, 1990a, p. 103).

Having strong home-based suppliers also offers the possibility for intense cooperation between firms and their supporting industries. Establishing close working relationships with upstream and downstream industries can be beneficial to firms for various reasons. Supplier industries can grant domestic firms preferential access to important information and new technology. Working closely together also means benefiting from each other's research and development efforts and can also lead to faster and more efficient joint problem solving. Porter argues that it is also easier for firms to communicate with home-based suppliers due to geographical proximity and shared cultural values. This facilitates open communication and free flow of information and can reduce transaction costs. All in all close cooperation with home-based upstream and downstream industries allows firms to innovate and upgrade and also accelerates this process (Porter, 1990a, p. 103).

While the presence of an internationally competitive supporting industry in a nation can give its firms a competitive edge, so does the cooperation between related industries (Porter, 1990a, p. 105). According to Porter companies are related if they either have same or similar activities in their value chain or produce or sell complementing products such as computers and software. It can be beneficial for companies of related industries to form alliances and there is much potential for shared activities in fields such as technology development, manufacturing, marketing and distribution. According to Porter firms can also share know-how and use same technologies or distribution channels which can cut costs and increase productivity (Porter, 1990a, p. 105). As Porter notes, globally strong related industries in a nation have strong demand for sophisticated machinery and inputs such as materials and components which creates favorable conditions for domestic supplier industries to enter the market, but also pressures them to develop at a faster pace and to continually innovate and upgrade themselves (Porter, 1990a, p. 106).

All in all the presence of a globally strong supportive industry or related industries in a nation can help it to become internationally successful in a given industry. Firms benefit the most when cooperation with domestic suppliers or related industries spurs innovation or leads to shared activities that raise productivity (Porter, 1990a, p. 107). However, having the

world's best supplier industry or globally strong related industries in close proximity may be insufficient for a nation's firms to gain competitive advantage if the other factors of the diamond prevent this from happening. According to Porter the most favorable conditions regarding supporting and related industries are only of little value to firms if they do not have access to advanced factors they depend on, if home demand for their products or services is insufficient or unsophisticated, or if there is no pressure to innovate and improve due to a lack of domestic competition (Porter, 1990a, p. 107).

3.1.4 Firm Strategy, Structure and Rivalry

National performance in a given industry is also influenced by the structure of domestic firms as well as the strategies applied by these companies. The level of rivalry and the number of domestic competitors in an industry strongly affect the innovation process and therefore also determine domestic firms' position in international competition (Porter, 1990a, p. 107). In his book "Competitive Strategy: Techniques for Analyzing Industries and Competitors" Porter describes three generic strategies of how firms can pursue competitive advantage which are *overall cost leadership*, *differentiation* and *focus* (Porter, 1980, p. 35). Companies striving for cost leadership try to reduce and minimize costs so that they can market their products or services cheaper than their competitors. The ability to do so often requires having a high market share which allows for realizing economies of scale in purchasing, or having favorable access to basic factors such as raw materials or cheap labor. Companies following this strategy also try to minimize overhead costs as well as expenses for research and development, service or advertising. While other aspects such as product quality or after sales service are not completely ignored, managers pay most attention to cost cutting measures instead (Porter, 1980, pp. 35-36).

Companies applying the second generic strategy, differentiation, aim for the creation of something outstanding that is perceived as special and unique industry-wide instead of offering a standardized product or service for the cheapest price. Firms can achieve this through having a special product design, adapting new or proprietary technology, offering special product features, a high quality customer service or an exclusive dealer network. Applying this strategy also means that the focus is placed not primarily on cutting costs but more on offering products or services of higher quality or with special features that allow for charging a price premium (Porter, 1980, p. 37).

Besides cost leadership and differentiation, Porter describes a third strategy, namely focus. Firms applying this strategy concentrate their effort on a particular group of customers, a

segment of the product line or a particular geographic market. With this approach firms try to offer the best product or service for a particular target group. A successful focus strategy requires either holding a low cost position in the targeted segment or offering highly differentiated products or services (Porter, 1980, pp. 38-39).

Cho and Porter (1986) distinguish between five strategic alternatives for firms in the shipbuilding industry that aim to compete globally. These are global cost leadership, global differentiation, global segmentation, national responsiveness and protected markets (Cho & Porter, 1986, p. 548). While global cost leadership and global differentiation have already been discussed, the latter three strategies can be regarded as subversions of what Porter (1980) describes as the focus strategy.

According to Cho and Porter (1986) the cost leadership strategy is very popular among firms in the shipbuilding industry. With this approach, companies usually run large-scale facilities to reap scale economies and try to serve customers which do not look for differentiation but for price-efficient vessels. Firms which try to gain competitive advantage through differentiation can do so by offering extended or low-cost financing of ships or faster delivery. They can also add special features to their ships which include the use of advanced or proprietary technology or stand out from their competitors by producing vessels of very high quality. With this strategy firms still serve a global market which means selling ships of different categories to many nations (Cho & Porter, 1986, p. 548).

Applying a global segmentation strategy, however, means to focus on a particular ship category and only sell these particular vessels worldwide. This is often the case for ships such as passenger cruisers or specialty vessels that require sophisticated know-how in engineering to be constructed (Cho & Porter, 1986, p. 550). The forth strategy that Cho and Porter refer to is the so-called national responsiveness strategy. This strategy presupposes that there are differences in customer needs for a certain product in different nations or geographic regions, and that firms can gain strategic advantage by adapting their products accordingly. However, Cho and Porter argue that buyer needs regarding ships do not differ much between nations, which explains why this strategy is hardly ever employed in shipbuilding (Cho & Porter, 1986, p. 550). Last but not least, the protected market strategy can be applied by firms or nations respectively. With this strategy companies do not have economic advantages over foreign competitors, but benefit from a central or local government that is protecting their market position. This is quite common in the shipbuilding industry with many ships being bought locally and governments preferring to buy from domestic firms (Cho & Porter, 1986, p. 550).

Besides firm strategy the fourth dimension of Porter's diamond also looks into how companies are organized and structured. Porter argues that differences in management approaches which are influenced by the national environment also determine national competitiveness (Porter, 1990a, p. 109). According to Porter the national environment affects the willingness of firms to compete internationally. What causes firms to rise from competing nationally to globally is fierce domestic competition and a saturated home market which forces firms to export their products and services (Porter, 1990a, p. 110).

In addition also goals of companies, its managers and employees play an important role in the creation of competitive advantage in a given industry. As Porter notes, "nations will succeed in industries where these goals and motivations are aligned with the sources of competitive advantage" (Porter, 1990a, p. 110). Porter argues that company goals are strongly influenced by ownership structure and incentive processes for managers. However, according to his theory a given company structure can be beneficial for creating competitive advantage in some segments while being disadvantageous in others (Porter, 1990a, pp. 111-112).

Besides company goals matching industry needs, also managers' and employees' goals and motivations are crucial for firms to be internationally successful. Their effort and willingness to develop skills further strongly influences the creation and maintenance of competitive advantage (Porter, 1990a, pp. 113-114). The motivation of individuals is also affected by how prestigious or nationally important an industry is. As Porter notes, "where an industry becomes a notable occupation or takes on national importance, competitive advantage often results" (Porter, 1990a, p. 114). He attributes this to a very high commitment of employees working in workplaces that enjoy high prestige or national priority. In addition these industries often also attract the most talented people which supports the creation of national advantage in a given industry. However, while national important industries attract talented and skillful people, it is also possible that a segment only becomes prestigious after a nation achieves international success in that industry. Either way prestige is something that helps an industry to attract talented and highly committed people and therefore contributes to the creation of competitive advantage according to diamond theory (Porter, 1990a, p. 114).

Through his study Porter also identifies a strong correlation between the existence of fierce domestic competition and strong rivalry between firms and the creation of national advantage in an industry (Porter, 1990a, p. 117). He contradicts the notion that domestic competition hinders firms from growing strong and reaping economies of scale and thus, become internationally successful. Quite the opposite, Porter argues that domestic rival firms pressure each other to lower costs, improve the quality of their products or services, launch new

products, and constantly commit to innovate and raise productivity in their struggle to stay ahead of competition. The findings of his study suggest that a nation's industry which is characterized by a monopoly or cartel of few firms with large market shares seldom manages to achieve global leadership. These firms might reap economies of scale in their domestic market, but lack the pressure to constantly innovate and improve which is why over the long run companies that face a more competitive domestic environment take the leading position globally (Porter, 1990a, pp. 117-118).

Porter also finds that most so-called national champions, which are firms that hold large market shares in their home markets and usually face rather limited competition, often are reliant on government protection and subsidies and while dominating the domestic market are unable to compete internationally. In contrast to this, in industries in which a number of companies are almost equally strong in terms of market shares, they fight heavily for the most talented people and technological breakthroughs. Porter argues that in such scenarios often also pride is involved which causes managers and employees to commit themselves even stronger to outperform the domestic rival companies. These firms are also often directly compared to each other through the media which additionally fuels rivalry (Porter, 1990a, pp. 118-119). The presence of strong domestic competitors might also pressure firms to tap into foreign markets in order to realize economies of scale, sell their products or services in new markets and improve overall profitability. Companies which do not face competition in their home market might be less tempted to internationalize their business and instead decide to rely on the national market (Porter, 1990a, p. 119).

Besides the already discussed advantages of domestic rivalry for creating and sustaining national advantage there is another reason why fierce competition helps firms to stay on top of business internationally. While in a competitive environment companies are forced to constantly innovate and improve, they cannot solely base their success on advantages derived from a favorable home environment. Advantages in factor costs, a large home market with demanding customers or the presence of globally strong domestic supporting and related industries are factors from which all firms in a nation can benefit. Therefore sustainable competitive advantage needs to be based on other factors such as proprietary technology, the realization of economies of scale and/or scope or the more efficient use of national advantages. Thus, in a competitive environment firms in their attempt to outperform their domestic rivals not only innovate but also upgrade their competitive advantage, thereby constantly improving national performance in a given industry (Porter, 1990a, pp. 119-120).

However, as Porter argues it is not the sheer number of firms competing in an industry that determines national performance. In fact it is rather the level of competition among firms that forces them to introduce new and better products, raise quality of existing ones, implement cost cutting measures, develop and/or implement new and proprietary technology, or think about innovative distribution channels and creative ways of marketing. Porter also notes that facing fierce domestic rivalry in itself is seldom sufficient for a nation's firms to gain competitive edge internationally. In most cases these firms' global success will be based on other factors of the diamond as well (Porter, 1990a, p. 122).

3.1.5 Chance

In addition to the previously discussed factors of the diamond model, also so-called chance events can have an effect on national competitiveness in a given industry. These events are mostly unpredictable and outside the control of firms and usually also governments. However, they can severely impact national competitiveness in a given industry through creating discontinuities that can shift competitive advantage (Porter, 1990a, pp. 124-125). Examples of chance events as listed in Porter (1990a, p. 124) are:

- Acts of pure invention
- Major technological breakthroughs
- Dramatic changes in input costs (for example oil shocks)
- Significant shifts in global financial markets or exchange rates
- Surges in local, regional or global demand for certain products
- Political decisions of foreign governments
- Wars

As this list suggests, chance events are very different in nature but what all of them have in common is the potential to severely affect and lastingly impact and change industry structure. Throughout the course of history chance events have also played a role in the shipbuilding industry. Examples are major technical breakthroughs such as the introduction of the steam-engine and the change from timber to iron and steel as shipbuilding materials. At a time when wooden ships were the industry norm, the United States held a leading position because its firms had competitive advantage due to an abundant supply of easily accessible cheap timber. However, the introduction of steam-powered steel ships nullified US firms' competitive advantage and their leading position was soon taken away by British companies which were more familiar with the by then newest technologies (Cho & Porter, 1986, p. 539).

Industry structure in shipbuilding again changed partly due to the occurrence of chance events with Japan entering the global market in the 1950s. At that time the Korean War lead to a soaring demand for new ships. Western European shipyards had hard times satisfying this demand. Their order backlogs accumulated and delivery times lengthened significantly. In addition Egypt nationalized the Suez Canal in 1956. Foreign oil companies and commercial shippers were not allowed to pass through the Canal and had to go around Africa instead. This route took them way longer and they were in urgent need of additional ships. Japanese firms capitalized on this situation and satisfied the demand for oil tankers and cargo vessels and gained significant market shares (Cho & Porter, 1986, pp. 552-553). According to Porter (1990a, p. 124) the entry of Korea into the shipbuilding market was also facilitated by a chance event, namely a surge in global demand for ships.

For this thesis the author will, however, refrain from including the factor "chance" in his analysis. As has been argued, chance events are mostly unpredictable and usually out of the control of firms and governments. It is therefore not only virtually impossible to predict there occurrence but also rather speculative to analyze which nation will convert such happenings into competitive advantage since only time can tell.

3.1.6 The Role of the Government

A nation's government plays an important role in the diamond model, as it can through various policies influence all other determinants of national competitive advantage with the exception of chance. In turn government decisions can also be influenced by these determinants. However, the exact role of the government strongly depends on its policy decisions which can have positive as well as negative effects on the creation of national competitive advantage in a given industry. According to Porter governments should step away from heavily subsidizing, overregulating and protecting particular industries. While such policies might give a nation's firms a short term competitive edge over foreign competitors, they also create dependencies and promote the emergence of oligopolies, cartels or monopolies. In addition, heavily subsidizing an industry often implies an inefficient allocation of resources. Furthermore, a reduction of rivalry within a national industry might also prevent firms from pursuing innovation and upgrading which hurts national performance over the long run (Porter, 1990a, p. 117, 127).

Besides the aforementioned, Porter describes another way in which governments can negatively influence the national diamond. In order to help domestic firms to make up for high factor costs in the home market and promoting exports, a nation's government might also

be tempted to keep the value of its currency artificially low. However, for firms basing their competitive advantage on a favorable national exchange rate is risky. An undervalued currency might help firms to achieve international success but also slows down the upgrading of competitive advantage. Over the long run it is likely that these firms lose their competitive position to other companies which base their success on more sustainable and sophisticated sources of competitive advantage (Porter, 1990a, p. 128).

Overall Porter's theory holds that the government's role in influencing national competitiveness is only partial. It can through the right policies contribute to its firms' international success, but fails to do so if the other determinants of the national diamond are nonexistent or unfavorable. In other words, government as a variable in itself cannot create competitive advantage, but is reliant on other determinants of the diamond to promote industry success. Only in this case it has the power to reinforce existing strengths (Porter, 1990a, p. 128). Porter therefore describes government not as a "helper" or "supporter" of national industry but rather as a "catalyst" and "challenger". In his view a government should "encourage change, promote domestic rivalry, stimulate innovation" and push firms to constantly improve, seek productivity gains, and upgrade their competitive advantage (Porter, 1990b, p. 87). Porter views the role of the government as an indirect one (except for countries which are early in their development process) with the overall goal of creating an environment in which firms can gain and sustain competitive advantage. He also emphasizes governments' powerful role of "transmitting and amplifying the forces of the diamond" (Porter, 1990b, p. 87).

In the following some specific policy approaches through which governments can positively influence their national diamond and create an environment that promotes and facilitates the creation of national advantage in a given industry are listed. According to Porter (1990b, pp. 87-89) governments should:

- Focus on specialized factor creation
- Avoid intervening in factor and currency markets
- Enforce strict product, safety, and environmental standards
- Sharply limit direct cooperation among industry rivals
- Promote goals that lead to sustained investment
- Deregulate competition
- Enforce strong domestic antitrust policies
- Reject managed trade

As this list of policy approaches suggests, there are various ways through which a government can positively influence its national environment and promote and facilitate the creation of competitive advantage. However as Porter notes, it should not overplay its role in the diamond and in case it intervenes heavily in the national economy it might do more harm than good to the competitiveness of domestic firms (Porter, 1990a, p. 682).

3.1.7 The Diamond Model as a Dynamic System

While each of the determinants in Porter's diamond model has been discussed individually in the previous chapters the author focuses in this section on how these determinants and variables work together as a dynamic system. As has been argued the determinants in a national diamond are interlinked and can affect and reinforce each other (Porter, 1990a, p. 132). An example of the dynamism in Porter's model is factor creation, which is strongly influenced by other determinants of national advantage, most notably the level of rivalry in a domestic market. As Porter argues, fierce competition forces firms to invest in factor creation. In order to stay ahead of competition, companies intensify research and development (R&D) activities to develop new technologies and invest in specialized infrastructure or training for employees to improve their skills. In addition to strong rivalry in the home market also high and sophisticated demand for a certain product leads to higher investment into the creation of related factors (Porter, 1990a, pp. 134-135).

The nature of home demand, the second determinant of national competitiveness in Porter's model, is also influenced by other variables of the diamond. For instance strong rivalry in a market leads to firms investing in marketing and advertising which can stimulate and expand domestic demand for certain products. In addition in a constant struggle to maintain their competitive position and market share, companies are forced to introduce new and innovative products which can also spur domestic demand. Last but not least when domestic related and supporting industries enjoy a good reputation internationally, their image might have positive spillover effects to other national industries and enhance global demand for their products (Porter, 1990a, pp. 137-138).

Home demand for an industry's products or services, in turn, also affects the development of related and supporting industries in a nation. As Porter notes, strong and/or growing demand for certain products stimulates the emergence of domestic suppliers. When demand conditions create such a favorable national environment there is a strong incentive for supporting industries to develop and supply domestic companies with machinery, tools and other materials which have previously been produced in-house or purchased from foreign

firms. In addition also strong rivalry in a national industry can positively influence the competitive position of related and supporting industries. On the one hand internationally successful firms demand high quality and cost-efficiency from their suppliers. This forces domestic related and supporting industries to constantly innovate in order to meet these requirements and as a consequence they upgrade their competitive advantage. On the other hand a nation's supplier industry also benefits from globally strong domestic firms which sell their products on international markets, because these companies channel demand to their domestic suppliers (Porter, 1990a, p. 138).

The fourth determinant of national advantage, firm strategy, structure and rivalry, is also influenced by all other determinants in the diamond model. For instance a strong and growing demand for certain products stimulates the emergence of new businesses which want to satisfy this demand by selling their products. Also the abundance of factors or factor creating mechanisms as well as the presence of internationally competitive related and supporting industries in a country provides a favorable national environment that supports and encourages the entry of new firms into an industry (Porter, 1990a, pp. 141-142).

As has been argued throughout this chapter the determinants of national advantage in Porter's diamond model cannot be viewed solely in isolation, but work together as a dynamic system. Therefore the interrelationships between the single determinants also need to be taken into consideration when analyzing a nation's competitive position in a given industry. Porter's theory suggests that countries gain a competitive edge in international competition in those industries for which their national diamond is the most favorable (Porter, 1990a, p. 144). However, for some industries nations need not possess advantages throughout all variables of the diamond to be internationally competitive. This particularly applies to resource-intensive segments in which industry success is largely based on low factor costs, as well as to segments in which advanced technologies are not decisive. For industries which are more sophisticated though, basing success on advantages in only one or two determinants of the diamond is seldom sufficient for companies to keep a dominant position over the long run. Even though firms might manage to achieve a leading position in such a segment, they will have difficulties maintaining their competitive edge when their success only rests on advantage in a single determinant of Porter's diamond. While also in most advanced industries nations can become globally successful without having advantages in all determinants of the diamond, not only creating but also sustaining a leading position industry-wide usually requires firms to expand advantages to more than one or two determinants (Porter, 1990a, p. 145).

3.1.8 The Importance of Clusters

In his work Porter also argues that companies in a particular industry are often geographically concentrated within a nation. He refers to such agglomerations of interconnected firms in certain regions or cities as *industry clusters* (Porter, 1990a, p. 148). Usually such clusters are characterized by the presence of rival firms, related and supporting industries, sophisticated and demanding customers but also related research institutions and universities. Porter distinguishes between two types of relationships within an industry cluster. On the one hand clusters can have a horizontal dimension, meaning that they comprise of firms producing similar products and are therefore competing on same markets. On the other hand clusters can also be characterized by a vertical dimension, indicating that upstream, midstream and downstream sectors of one industry, responsible for different steps in the value chain, are working together in close geographical proximity (Porter, 1990a, p. 149).

According to Porter industry clusters develop because national success in one industry also triggers the emergence and development of other related or supporting industries. When a cluster is formed, the different groups of industries support each other in improving and upgrading their competitive advantage. Benefits in one industry are likely to spread to other downstream or upstream segments. Geographical proximity of firms facilitates communication and free flow of information. Companies of different segments within the cluster jointly or each for itself invest in the development of new technologies, specialized infrastructure or human resources. In general these efforts lead to accelerated creation of required factors and also draw attention from government and universities to the given industry. Such agglomerations of interconnected firms of one industry also attract talent and cities or regions might become well-known nationally or globally for a particular industry cluster which in turn raises local companies' reputation worldwide (Porter, 1990a, p. 151).

Porter also provides some examples of industry clusters. Amongst others he mentiones the Japanese keiretsu. These are loose business groups centered on a major bank and characterized by cross-shareholding relationships between the single member companies. These firms maintain close ties and often cooperate in fields such as technology development, but also stimulate innovation through various competing internal business units (Porter, 1990a, p. 153). Some other well-functioning industry clusters are found in Italy where interconnected firms are not only frequently geographically concentrated but also interlinked due to family ties. Last but not least also Silicon Valley in California which is home to many of the world's leading high-tech corporations is an example of agglomeration tendencies of interconnected companies within a nation (Porter, 1990a, pp. 151, 154).

In Porter's theory clusters are of vital importance for the creation and maintenance of national advantage in a given industry. Porter argues that the geographic concentration of competing firms, their supplier companies, related industries and important and demanding customers positively influences the mutual reinforcing character of the single determinants of the national diamond (Porter, 1990a, p. 157). In his view the close geographic proximity of competing firms can further intensify rivalry, which in turn fuels innovation and improvement. Having supplier companies in the area also facilitates the coordination of joint research and technology development efforts. Firms also benefit from the presence of important and demanding customers in an industry cluster because for them it is the fastest way to learn about emerging needs according to which they can adapt their products. Finally, when an industry cluster becomes important or prestigious within a region or nation also nearby located research institutes and universities might react to its existence by adapting or creating new curricula which teach their students the skills required for working in this field (Porter, 1990a, p. 157).

Now that the dimensions of Porter's diamond model and the interlinkages between the individual factors have been presented and discussed in this chapter, the subsequent section provides a short review of scholarly literature in which diamond theory has been applied to measure national or industry competitiveness.

3.2 Application of Porter's Diamond Model in Scholarly Literature

As has been discussed in the previous sections of this thesis, Porter's diamond model lends itself well for the analysis of competitiveness on a national, industry, and firm level. Porter (1990a) uses his diamond theory to analyze the competitiveness of Denmark, Germany, Italy, Japan, Singapore, South Korea, Sweden, Switzerland, the United Kingdom and the United States. Since its introduction in 1990 Porter's diamond model has also attracted much attention from other scholars. Bellak and Weiss (1993) apply diamond theory to Austria, analyzing the country's international competitiveness. Liu and Song (1997) utilize Porter's framework for an analysis of China's competitive advantage. Öz (2002) analyzes the competitive structure of the Turkish industry using Porter's diamond framework. Kincaid (2005) utilizes an extended diamond model to analyze competitive advantage of three South Pacific island nations, namely Fiji, Papua New Guinea, and Tonga. Stone and Ranchhod (2006) analyze national competitiveness of Brazil, Russia, India, China, the United Kingdom and the United States. The approach developed for this analysis is also based on diamond theory. Also Chobanyan and Leigh (2006) in their study utilize Porter's national diamond to

assess international competitiveness of Armenia. Cassidy, Barry, and van Egeraat (2009) apply Porter's diamond theory to explain international competitiveness of Ireland while Herciu (2013) evaluates national advantages and disadvantages of Romania using the Porter framework. Porter's home-based national diamond has also been extended and modified by scholars in their studies of national competitiveness. Cartwright (1993) applies Porter's diamond theory to New Zealand and proposes the multi-linked diamond as a revised model. Rugman and D'Cruz (1993) also use a modified version of the original Porter diamond, the so-called double diamond framework, to analyze international competitiveness of Canada. In addition Moon, Rugman, and Verbeke (1995, 1998) make use of a generalized double diamond model that offers some extensions to Porter's home-based national diamond to assess international competitiveness of South Korea and Singapore.

The major points of critique on Porter's original home-based diamond framework as well as some extensions to this model are discussed in the next chapter of this thesis. In addition to the presented studies which focus on competitiveness on a national level, scholars have also applied Porter's diamond model to all kinds of industries. Curran (2001) applies the diamond model to geography departments in the United Kingdom to assess the level of competition in the country's higher education system. Jin and Moon (2006) focus with their research on South Korea's apparel industry. Jin and Moon not only apply Porter's home-based diamond model but also the so-called generalized diamond model by Moon et al. (1998) to identify factors of competitive advantage in the Korean textile and apparel industry. Karácsony (2008) assesses the competitiveness of the Hungarian wheat sector using the Porter framework. Tavoletti and te Velde (2008) present a case study of the Dutch flower industry and evaluate whether the country's global success in the flower business can be explained by Porter's diamond theory. Sun, Fan, Zhou, and Shi (2010) in their study compare competitiveness of real estate industry of Beijing and Tianjin using the diamond model while Liu, Zhang, and Xu (2010) utilize diamond theory to analyze international competitiveness of the Chinese medicine industry also evaluating its competitive advantages and disadvantages. Sterns and Spreen (2010) focus with their research on processed citrus industries in Brazil and the United States and used diamond theory for their comparison. Mann and Byun (2011) in their study also employ Porter's diamond model as a theoretical framework to evaluate the competitiveness of the Indian apparel industry. Aghdaie, Seidi, and Riasi (2012) use diamond theory to identify the barriers to Iran's saffron export and Özer, Latif, Sarışık, and Ergün (2012) compare and analyze the tourism industries of Turkey and Spain based on this model. In addition Bakan and Dogan (2012) utilize Porter's model to examine which factors affect

competitiveness of basic industries in the Turkish city Kahramanmaras. Porter's diamond framework is also applied in Hamad and Duman (2013) to identify the competitive advantage of microcredit industry in Bosnia and Herzegovina as well as in the work by Mohd and Zulkornain (2014) which centers on the Malaysian food processing industry. Also the study by Márkus (2008) in which he introduces a framework to measure firm level competitiveness is based on Porter's diamond theory. Naserbakht, Asgharizadeh, Mohaghar, and Naserbakht (2008) merge the diamond model with SWOT method in order to analyze Iranian technology park competitiveness. Dögl and Holtbrügge (2010) base their analysis of competitive advantage of German renewable energy firms in Russia on Porter's diamond. In a follow-up study Dögl, Holtbrügge, and Schuster (2012) apply the same framework to analyze competitiveness of German renewable energy firms in China and India. The diamond model is also used for a competitive analysis at the firm level in a study by Zhang and Zhao (2012). In their work Zhang and Zhao assess the competitiveness of coal enterprises in the Chinese Shanxi province and try to explain mergers and acquisitions between these companies using diamond theory. Last but not least also Liu and Pan (2012) apply Porter's diamond model to analyze competitiveness of construction companies in Taiwan. As this review of literature on diamond theory reveals, Porter's diamond model has been used by numerous scholars for the analysis of competitive advantage of nations, industries and firms and has also been criticized, extended and modified in various ways. In the following chapter the author presents a summary of the main points of critique of Porter's framework and also discusses some of the extended and modified versions of the original home-based national diamond which have been proposed by other scholars.

3.3 Criticism and Modifications of Porter's Diamond Model

As has been demonstrated in the previous section, Porter's diamond model has been applied by renowned scholars of different fields to analyze and compare the competitiveness of nations, particular industries or firms within a nation. However, it has not only been extensively discussed in the management literature but has also been criticized for several reasons and modified in various ways. In the following chapters the attested flaws in Porter's theory are discussed by reviewing critical literature dealing with the diamond model.

3.3.1 Criticism by Grant (1991)

In his work Grant (1991) questions the notion that intense rivalry stimulates innovation and as a consequence leads to the upgrading of competitive advantage. He refers to prior research on

the relationship between industry structure and the level of innovation and argues that findings have been inconsistent. While Grant acknowledges the "breadth and depth" of Porter's theory, he does not fail to mention that it has come at high costs. In his view definitions of key concepts such as the upgrading of competitive advantage are imprecise and used inconsistently throughout Porter's research (Grant, 1991, p. 541).

Grant further questions whether upgrading of competitive advantage achieved through the use of more advanced technology or more sophisticated skills really is a prerequisite for maintaining industry success. Grant contradicts Porter's theory in this regard, arguing that in certain industries long-lasting competitive edge can also be based on basic advantages such as cheap access to an abundance of natural resources, as the example of Saudi Arabia as a leading supplier of crude oil demonstrates. He further argues that in contrast, also competitive advantage which rests on complex technology and sophisticated skills can often be rendered insignificant by other firms which manage to imitate them quickly (Grant, 1991, p. 541).

Grant mainly criticizes the original Porter framework for its lack of precision. He argues that the single dimensions of national advantage are highly overlapping which makes the differentiation between four determinants plus two outside factors questionable. Grant makes the cynical remark that the same theory could have also been introduced using a triangle or a pentagon instead of a diamond. In his view variables classified under one determinant of the diamond are sometimes too diverse and their effects on competitive advantage too different from each other as that they could be grouped together (Grant, 1991, p. 542).

In addition Grant addresses the relationships between the individual determinants of national advantage, which in his opinion, are often unclear. He argues that some variables in the national diamond have an ambiguous effect on the creation of competitive advantage. As an example Grant cites factor conditions. In Porter's theory having an abundance of highly productive factors at one's disposal is regarded as beneficial for creating and sustaining industry success. However, Porter also describes how basic factor disadvantages can force firms to find their way around these obstacles by upgrading their competitive advantage. Grant therefore criticizes Porter for not defining under which conditions national advantages in the supply of basic factors are benefiting or hindering firms to become internationally successful (Grant, 1991, p. 542).

Furthermore, in Porter's diamond model the determinants of national advantage are connected and can influence each other. Industry success is explained by a favorable national diamond for a given industry. However, Grant argues that not only a favorable national diamond can lead to industry success, but cause and effect relationships can turn. In his

opinion national success in a particular segment can also spur additional investments to upgrade competitive advantage, and helps to create an environment that promotes entry of new suppliers, related firms and competitors which in turn also raise the level of sophistication of home demand (Grant, 1991, p. 542).

According to Grant the strong side of the original diamond model lies in explaining industry success and patterns of national competitive advantage in particular industries for which it is well suited. The weak side of Porter's diamond approach, according to Grant, lies in predicting how industry patterns of nations will evolve over time. This is due to Grant's points of critique regarding the model which have been discussed throughout this chapter. Overall Grant describes Porter's theory as "gloriously rich but hopelessly intractable" (Grant, 1991, p. 542).

3.3.2 Criticism and Modification by Dunning (1993)

Dunning (1993) argues that rising globalization affects the competitive advantage of nations and its industries and criticizes Porter for underestimating the role of multinational enterprises in global competition in his diamond model. According to Dunning in an intertwined world economy large proportions of firms' assets are either purchased on global markets or located in countries other than the companies' home nations. He therefore contradicts the notion that the competitive position of multinational enterprises first and foremost depends on the nature of the diamond of their home countries (Dunning, 1993, pp. 9-10). In Dunning's view more and more firms engage in international networks either through forming strategic alliances, international subcontracting or other cooperative arrangements which renders the concept of national diamonds insignificant or at least requires substantial reappraisal of the underlying assumptions. Therefore he argues in favor of replacing Porter's national diamond with a global or supranational diamond, or at least one that includes those countries within which a nation's firms keep close relations (Dunning, 1993, pp. 10-12).

Dunning further elaborates on the role of inward and outward foreign investment for creating and sustaining international competitiveness. He concludes that in a globalized world economy firms' competitive advantage often does not only rest on domestic resources and capabilities, but also on assets acquired outside of their home nation. In his opinion it is becoming increasingly common for companies which attempt to upgrade their competitive advantage to make use of favorable conditions of other countries' national diamonds. Thus, networks of national diamonds are created and further strengthened by the presence of multinational enterprises. Dunning therefore suggests not only modifying but extending

Porter's national diamond framework. He argues that the nature of national diamond networks and the position of nations within these networks determine its firms' international success at least as much as the other determinants of the original diamond framework. Hence, Dunning suggests adding multinational activity as an additional outside factor to the Porter model (Dunning, 1993, p. 14).

3.3.3 The Double Diamond Model by Rugman & D'Cruz (1993)

In one of their previous studies Rugman and D'Cruz (1991) analyze Canada's international competitiveness using Porter's diamond approach. In doing so they claim that the original national diamond model cannot explain the county's industry success. Rugman and D'Cruz (1993) argue that while Porter's diamond model works for analyzing competitiveness of larger nations it has some major flaws and without adaption does not work for explaining industry success of smaller, open trading nations (Rugman & D'Cruz, 1993, p. 17).

Rugman and D'Cruz mainly criticize Porter's theory of national advantage for three reasons. They argue that in comparison to large nations, most small, open trading economies will find weaknesses in their national diamonds, for example in the extent and sophistication of home demand for their products or services. In order to compensate for such disadvantages these firms tap into foreign markets, usually larger neighboring countries, to make use of advantages in their national diamonds. Two ways for companies to achieve this are through foreign direct investment (FDI) or the establishing of foreign subsidiaries. This directly leads to their first point of criticism of Porter's national diamond framework, which is the relationship between FDI and the creation of competitive advantage. In Porter's theory only outward FDI is defined as source for creating industry success while inward FDI is viewed rather critical in this regard. In addition the presence of foreign subsidiaries in a nation's home market is viewed as disadvantageous for creating national competitive advantage. However, Rugman and D'Cruz contradict this view and argue that research and development efforts of foreign-owned firms benefit the host country in almost the same way as those undertaken by domestic firms. In their analysis of national competitiveness of Canada they argue that foreign-owned firms and inward FDI also contribute to the nation's economic success (Rugman & D'Cruz, 1993, pp. 24-25, 28).

However, Rugman and D'Cruz' criticism of Porter's theory is not limited to the role of foreign direct investment for creating competitive advantage. In addition they also disagree with Porter on the potential of natural resources for developing and sustaining industry success. While Porter argues that relying on basic factor advantages such as an abundance of

natural resources, cheap labor or basic technology is deemed to be unsustainable, Rugman and D'Cruz partly contradict this view. They argue that Canadian firms have managed to turn the country's wealth in natural resources into more sophisticated and sustainable competitive advantages such as proprietary resource processing technologies or complex refining techniques (Rugman & D'Cruz, 1993, p. 25).

As their main point of criticism of Porter's diamond model Rugman and D'Cruz argue that international competitiveness of small and open trading nations cannot be explained by the nature of their home country diamond alone. Instead such countries usually are highly interdependent with larger and often neighboring states. These nations often provide a more favorable environment for firms to achieve international success which is why many companies establish foreign subsidiaries or tap into such markets via foreign direct investment. As Rugman and D'Cruz demonstrate this is particularly true for many Canadian-owned multinational enterprises which rely on the United States as a key market for selling their products. They argue that to these companies the United States' national diamond is at least as relevant as the Canadian one. However, according to Rugman and D'Cruz this does not only apply to Canada but to many other nations with a small home diamond. Due to a small domestic market firms in such countries are forced to tap into larger markets of other nations and when countries are integrating in this way, competitive advantage of these multinational enterprises not only depends on the nature of their home country's national diamond, but also on that of the larger nation they are operating in or selling to (Rugman & D'Cruz, 1993, pp. 19, 26).

For this reason Rugman and D'Cruz put forward the idea of a double diamond model in which competitive advantage not only rests on the nature of a nation's home diamond but also on that of the so-called international diamond. In their example of Canada this international diamond relevant to Canadian firms would be the one of the United States, which is why they suggest a North American diamond to analyze competitiveness of Canadian firms instead of only a home-based Canadian one (Rugman & D'Cruz, 1993, pp. 18, 29).

3.3.4 The Generalized Double Diamond Approach by Moon et al. (1995, 1998)

Moon et al. (1995) agree with Rugman and D'Cruz (1993) in saying that the original diamond model introduced by Porter (1990a) works for analyzing competitiveness of large nations, but cannot be applied to smaller economies without major adaptation and modification. In their view a double diamond framework is better suited to explain industry success of smaller countries. While Rugman and D'Cruz (1993) suggest Canadian managers to think of an

integrated North American diamond which includes the United States' and the Canadian one, Moon et al. (1995) argue that this double diamond framework might not work for other small economies. Therefore they develop a generalized double diamond framework which according to them should be suitable to analyze competitiveness of all small economies and their industries (Moon et al., 1995, p. 99).

As Dunning (1993) and Rugman and D'Cruz (1993) also Moon et al. (1995, 1998) criticize Porter for not including multinational activity in his framework. They contradict Porter's theory in two important points. The first is that not only domestic but also foreign owned firms can contribute to the progress of a nation's industry and facilitate the creation and upgrading of national advantage. Second, they argue that sustaining competitive advantage often requires firms to not only base their success on a favorable national diamond, but also to make use of advantageous conditions in other nations' diamonds (Moon et al., 1995, p. 99). In their study Moon et al. (1998) analyze the competitiveness of South Korea and Singapore by applying Porter's original home-based diamond model as well as the generalized double diamond model introduced by Moon et al. (1995). They come to the conclusion that the generalized double diamond model is better suited to explain the two countries' economic progress and competitive position in global business (Moon et al., 1998, p. 135).

The generalized double diamond framework is based on the underlying assumption that smaller economies and their firms try to compensate for disadvantages in their national diamonds through tapping into other nations' markets. Therefore their level of competitiveness not only depends on the nature of their national diamonds, but also on that of their major trading partners. Figure 3 on the next page illustrates the generalized double diamond framework consisting of a global diamond (the outer square), an international diamond (the dotted line) and a domestic diamond (the inner square). The global diamond is characterized by its fixed size while that of the domestic diamond depends on country size and level of competitiveness and therefore varies from nation to nation. The international diamond which is placed in between the global and the domestic diamond represents a nation's competitiveness. However, as opposed to the original Porter framework, competitiveness in this model is not only determined by domestic but also by international parameters. In this model the difference between the domestic diamond (inner square) and the international diamond (dotted line) represents multinational activity such as inbound and outbound foreign direct investment (Moon et al., 1998, p. 138).
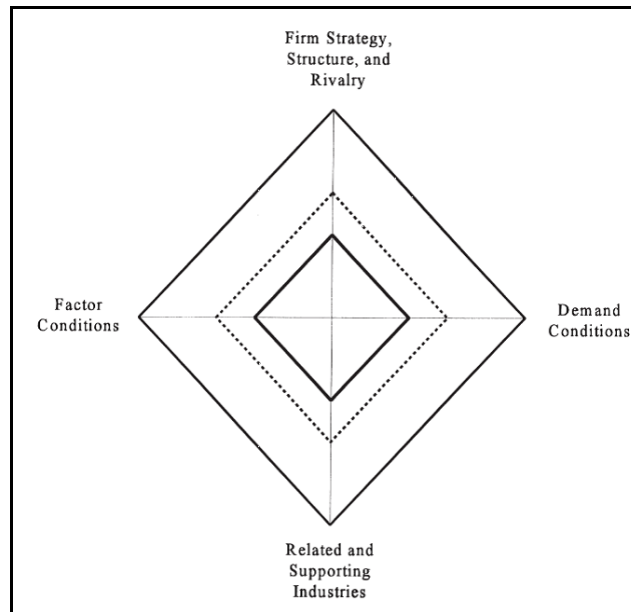
Figure 3: The generalized double diamond model

Source: Moon et al., 1998, p. 138

Moon et al. (1998) describe two methodological differences between their framework and the home-based national diamond framework by Porter (1990a, 1990b). First, not only domestic firms but also foreign owned companies operating in a nation can contribute to creating and sustaining competitive advantage on the national, industry or firm level. Therefore in this model inbound foreign direct investment in an economy is viewed as a potential contribution to improvements in a nation's competitiveness rather than a risk factor. Second, they argue that in times of globalization maintaining competitive advantage often requires firms to source some activities to other nations where conditions are more favorable instead of solely relying on advantages in their home nation's domestic diamond. This also stands in stark contrast to Porter's theory according to which firms should focus on their home base and concentrate as many activities as possible there (Moon et al., 1998, p. 139). In addition to the already mentioned adaptations and modifications of the original diamond framework Moon et al. (1995, 1998) also comment on the role of government as a determinant of national advantage. While Porter treats government as one of two exogenous factors in his framework (the second being chance), Moon et al. regard it as a very important variable, not comparable to chance events, which is why they suggest integrating it as a fifth endogenous factor in the generalized double diamond framework (Moon et al., 1995, pp. 110-111; 1998, p. 148).

All in all Dunning (1993), Rugman and D'Cruz (1993) as well as Moon et al. (1995, 1998) mainly criticize Porter for not including multinational activity in his original home-based diamond model. Moon et al. (1998) also demonstrate that using their generalized double

diamond framework instead of Porter's original one also leads to very different results. Therefore they question the validity of the single diamond model and suggest extending and modifying it. For the analysis of the Chinese and Korean shipbuilding industry the author will therefore also include multinational activity into his framework. Hence, not only domestic but also international demand for Chinese and Korean built ships will be evaluated. In Chapter 4.5 of this thesis the role of the government for the success of the Chinese and South Korean shipbuilding industry is discussed. This analysis also emphasizes on government policy regarding foreign investment. The role of inbound and outbound foreign investment for both countries' shipbuilding industries is evaluated in this chapter. This includes analyzing whether Korean and Chinese shipbuilding firms make use of advantages in other nations' home diamonds for instance through running production facilities abroad. In addition the author investigates whether foreign-owned firms are operating in both countries' shipbuilding industries and tries to answer how they contribute to Korean and Chinese industry success in shipbuilding. Moon et al. (1995, 1998) also emphasize on the role of the government for creating and sustaining national advantage in a given industry and argue that its influence on competitiveness of a nation's firms should not be underestimated. The author agrees with this view and therefore follows their suggestion to include government as a fifth endogenous variable in the framework instead of considering it as an outside factor. In this thesis he therefore makes use of an extended and modified version of Porter's diamond model to analyze the competitiveness of the Korean and Chinese shipbuilding industry. The model has been adapted based on the suggestions by Grant (1991), Dunning (1993), Rugman and D'Cruz (1993) as well as Moon et al. (1995, 1998) and is presented in the following chapter.

3.4 Analytical Framework and Methodology

In this chapter the actual analytical framework, that is the structure to answer the research questions, and the analytical criteria according to which the analysis of shipbuilding competitiveness in China and South Korea is conducted are presented. In addition the methodology used to apply the single criteria from the analytical framework is specified.

3.4.1 Extended and Modified Diamond Model

As has been argued throughout the theoretical part of this thesis the author makes use of an extended and modified version of Michael E. Porter's diamond model of national advantage for the analysis of shipbuilding competitiveness in China and South Korea. It has been demonstrated in the preceding chapters that the original diamond model requires some

adjustments to be made in order to be applicable for the analysis of shipbuilding industries of these two nations. Therefore the major points of critique of various scholars that have been working with diamond theory are incorporated in this extended and modified version of Porter's diamond model. This model serves as the analytical framework for the analysis conducted in this thesis and is depicted in Figure 4 below:
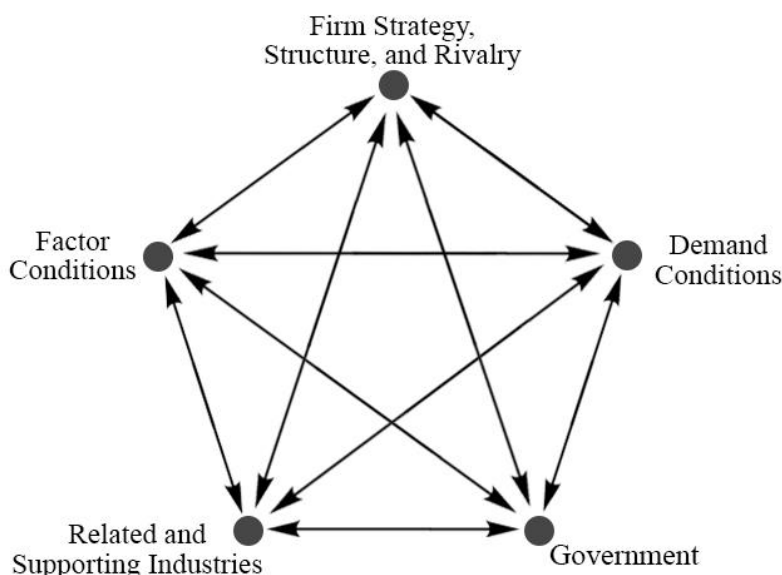
Figure 4: Extended and modified version of Porter's diamond model

Source: Authors own figure based on Porter (1990a)

As can be seen from Figure 4 our extended and modified version of Porter's diamond model consists of five dimensions which together constitute the national environment in which a nation's companies operate. These dimensions determine whether a nation provides rather favorable or unfavorable conditions for the international competitiveness of domestic shipbuilding companies. The five determinants of national competitive advantage are factor conditions, demand conditions, related and supporting industries, firm strategy, structure and rivalry, and government. For each of the five determinants of national competitive advantage specific analytical criteria will be applied for the analysis of shipbuilding competitiveness of China and South Korea which are derived from the original diamond theory by Porter (1990a, 1990b) and adjusted to shipbuilding. According to Porter (1990a) an analysis of factor conditions should mainly include the availability and cost of workers and industry relevant raw materials, but also infrastructure as well as skills and know-how of workers (p. 71). From Porter's theory the author has derived analytical criteria for the analysis of factor conditions in Chinese and South Korean shipbuilding which will be applied in the empirical part of this thesis. They are divided into three different subcategories and are listed on the next page.

Analytical criteria for an analysis of shipbuilding workforce in China and South Korea
- Availability of shipbuilding workers
- Current number of employees in shipbuilding
- Skill level of employees measured by the highest educational level completed
- Wages and labor costs
- Labor productivity

Analytical criteria for an analysis of shipbuilding infrastructure
- Educational infrastructure (existence and number of universities offering programs in shipbuilding or research institutes focusing on maritime activities)
- Number of active shipyards[9]
- National shipbuilding capacity measured in terms of total production output in CGT

Analytical criteria for an analysis of relevant raw materials and components such as steel and ship equipment[10]
- Availability and cost of shipbuilding steel (localization rate[11] for shipbuilding steel, cost of shipbuilding steel per metric ton)
- Availability and cost of ship equipment (localization rate for ship equipment and cost of ship equipment per CGT)

For demand conditions the extent and nature of domestic customer preferences or in other words the quantity and quality of home demand needs to be analyzed (Porter, 1990a, p. 71). Hence, the author has derived the following analytical criteria for the analysis of demand conditions in Chinese and South Korean shipbuilding from Porter's diamond theory:

Analytical criteria for the analysis of domestic demand conditions
- Size of the domestic shipbuilding market (measured in terms of domestic shipowners' total order volume in CGT)
- Total domestic order volume in CGT and number of domestic orders placed at domestic shipyards
- Share of total Chinese and South Korean orders placed at domestic shipyards
- Share of domestic contracting at Chinese and South Korean shipyards[12]
- Growth rate of home demand

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[9] In this thesis the author follows the definition by Springer (2015a) according to which an active shipyard is defined as one with at least one vessel of 1,000 GT and above on its orderbook.

[10] According to Cho and Porter (1986) the most relevant input factors in shipbuilding besides labor are shipbuilding steel and ship equipment or marine subcomponents (p. 545).

[11] In this thesis localization rate describes the share of total demand for shipbuilding steel or ship equipment that can be supplied domestically.

[12] This criterion measures the share of ships that are built for domestic customers out of total ship production.

According to Cho and Porter (1986) the shipbuilding industry is a "global industry in which a firm's competitive position in one country is strongly impacted by its position in other countries" (p. 540). Given the global nature of shipbuilding industries the author has also integrated some criteria for the analysis of global demand conditions for Chinese and South Korean built ships into the analytical framework.

Analytical criteria for the analysis of global demand conditions for Chinese and Korean shipbuilders
- Total global demand for Chinese and South Korean built ships in terms of total CGT as well as total number of contracts
- Main global customers by number of orders placed at Chinese and South Korean shipyards as well as in terms of total CGT
- Segment structure of demand for Chinese and South Korean built ships[13]

Regarding the third dimension of the extended and modified diamond model, related and supporting industries, Porter (1990a) finds that their existence in a company's home nation, their level of competitiveness in a global context, as well as the level of integration between firms and their supplier industries should be part of an analysis of national or industry competitiveness (p. 71). In shipbuilding the main related and supportive industries are the steel industry as well as the ship equipment and marine subcomponent industry which function as the main suppliers to shipbuilding companies besides the labor market (Cho and Porter, 1986, p. 545). For this reason the analysis of related and supporting industries for shipbuilders in China and South Korea also focuses on these two industries. The analytical criteria relevant for the analysis of related and supporting industries of shipbuilders in this thesis derived from Porter's diamond theory read as follows:

Analytical criteria for the analysis of the marine equipment industry in China and South Korea
- Size of the domestic marine equipment industry in terms of total production volume
- Number of domestic firms active in the manufacturing of ship equipment
- Localization rate for ship equipment and marine subcomponents

Analytical criteria for the analysis of the steel industry in China and South Korea
- Size of the domestic steel industry measured in terms of total steel output
- Development of total steel output and steel consumption
- Domestic share of global steel production
- Localization rate for shipbuilding steel

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[13] The segment structure of ship demand is an indicator for the types of ships produced in both countries.

For the fourth dimension of the analytical framework that is firm strategy, structure and rivalry the author will focus with his research on industry structure, the number of shipbuilding companies, the level of competition in Chinese and South Korean shipbuilding, as well as the strategies applied by these firms which is in accordance with Porter's original diamond theory.

Analytical criteria for the analysis of firm structure, strategy and rivalry
- Number of domestic shipbuilding companies and active yards in the home market
- Ownership structure of major shipbuilding companies
- Industry structure in terms of market shares of shipbuilding companies
- Strategies applied by domestic shipbuilding companies[14]
- The level of competition in the domestic shipbuilding market and the degree of rivalry between domestic shipbuilding companies

The fifth and last dimension of the analytical framework is government. Porter (1990a) regards it as one of two exogenous factors in his original diamond model. However, an extensive review of shipbuilding literature presented in Chapter 2 of this thesis has revealed that the role of the government is a very important variable for the success of a nation's shipbuilding industry. Hence, the author follows the suggestion by Moon et al. (1998) to integrate government as a fifth endogenous variable in the framework. In addition to the role of the government also multinational activity is incorporated into the framework. Therefore the author also analyzes government policy toward foreign investment in domestic shipbuilding and the role of inbound and outbound foreign investment for the competitiveness of shipbuilding industries in China and South Korea in this section.

Analytical criteria for the analysis of the role of the government in Chinese and Korean shipbuilding
- Level of government intervention in the domestic shipbuilding industry
- General government policies affecting shipbuilding
- Extent and nature of industry regulations, shipbuilding subsidies and other supportive measures
- Government policy toward foreign investment in domestic shipbuilding
- Role of inbound and outbound foreign investment for industry success

In this section the analytical framework which is based on Porter's original diamond model of national advantage and according to which the analysis of shipbuilding competitiveness in

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[14] For company strategy the author distinguishes between cost leadership, differentiation and focus as described in Porter (1980) and in chapter 3.1.4 of this thesis.

China and South Korea will be carried out in the following chapters has been presented. In addition the author has listed the actual analytical criteria for this analysis which are derived from Porter's diamond theory and adapted to shipbuilding. In the following section the data collection method that has been applied by the author in order to obtain the relevant data for the actual analysis conducted in the empirical part of this thesis is presented.

3.4.2 Data Collection Method

After having presented an extended and modified version of Porter's diamond model which serves as the analytical framework according to which the competitiveness of shipbuilding industries in China and South Korea is analyzed in this thesis, the method used to apply the single analytical criteria specified in the previous chapter is explained. The analysis of shipbuilding competitiveness of China and South Korea is done using data obtained from various types of documents which are listed below:

- Academic papers and books
- Reports and websites of official bodies of the Chinese, South Korean or international shipbuilding industry such as the Korean Offshore and Shipbuilding Association (KOSHIPA), the China Association of the National Shipbuilding Industry (CANSI), the Shipbuilders' Association of Japan (SAJ), and the Ships and Marine Equipment Association Europe (SEA)
- Reports and databanks of international institutions such as the Organisation for Economic Co-operation and Development (OECD) or the World Bank
- Shipbuilding newspapers and journals such as World Maritime News or Marine Link
- Websites of shipbuilding companies and corporate reports
- Reports and websites of shipbrokers, consulting companies and research institutes focusing on shipbuilding information such as Clarkson Research, IHS Fairplay, ECORYS and KPMG
- Reports from government bodies where available in English language

Shipbuilding industries in China and South Korea have also strong interlinkages to the countries' national defense industries. As Collins (2010) argues, "the development of maritime industry human capital, indigenous industrial innovation, and the ability to rapidly build merchant-type ships all have important defense implications" (p. 1). Therefore information regarding national shipbuilding capabilities can be regarded as rather confidential (Ye, Zeng & Wang, 2013, p. 1372). This made obtaining reliable data for each of the analytical criteria of the presented framework difficult which is why the author sometimes had to rely on secondary sources to obtain crucial information.

4 Comparison of Shipbuilding Industries in China and South Korea

In this chapter the competitiveness of the Chinese and South Korean shipbuilding industry is analyzed according to the extended and modified diamond model presented in the theoretical part of this thesis. This includes an analysis of the determinants of national competitive advantage which are factor conditions, demand conditions, related and supporting industries, firm strategy, structure, and rivalry, as well as the role of the government according to the analytical criteria specified in Chapter 3.4.1. As has been argued in the theoretical part of this thesis also multinational activity is included in the analysis of shipbuilding industries in China and South Korea. For this reason the author also analyzes international demand for Chinese and South Korean built ships as well as government policy regarding foreign investment and the role of inbound and outbound foreign investment for both countries' shipbuilding industries in this chapter.

4.1 Factor Conditions

In this chapter factor conditions for the shipbuilding industries of China and South Korea are analyzed and compared to each other. This analysis includes the availability of workers, but also the current number of employees in shipbuilding and their skill level, wages or labor cost and labor productivity. In addition to employment and labor the author also examines shipbuilding infrastructure in this section. This includes educational infrastructure as well as the national shipbuilding capacity and the number of active shipyards. Furthermore the availability and cost of main resources or materials relevant to shipbuilding such as steel and ship equipment are also assessed in this chapter.

4.1.1 Factor Conditions in China

With a population of more than 1.37 billion people China is the most populous country in the world. By the end of 2014 the total Chinese labor force stood at 806 million (World Bank, 2016). As these numbers demonstrate Chinese firms have a huge labor pool at their disposal and availability of workers does not seem to be a big issue to them. This is particularly the case for low- or semi-skilled workers which account for the majority of employees in shipbuilding. Chinese shipyards often make use of an abundant supply of migrant workers coming from rural areas. Migrant workers not only tend to be cheaper, but are also easier to lay off when firms want to downsize their workforce (ECORYS Research and Consulting [ECORYS], 2009, p. 117). That having access to this huge labor pool is one of the reasons for Chinese shipbuilders' status as global industry leaders is also acknowledged by other

researchers. According to Collins and Grubbs (2008, p. 8) Chinese shipbuilders owe much of their success to a "seemingly endless supply of inexpensive labor", and also Tsai (2011, p. 50) cites the "abundant supply of skilled, low cost labor" as a major advantage of Chinese shipbuilders.

In addition to the availability of potential future workers in Chinese shipbuilding also the number of people currently employed in this industry is assessed. However, due to limitations in data availability the author refers to the most recent data that is publicly available. Statistics compiled by the Commission of Science, Technology and Industry for National Defense (COSTIND) suggest that in 2005 roughly 400.000 people were employed in Chinese shipbuilding, with 315.000 working for the 480 largest firms (COSTIND, 2005[15] as cited in Tsai, 2011, p. 42). According to the China Association of the National Shipbuilding Industry (CANSI) the total shipbuilding workforce stood at 440.000 in 2008 (CANSI, 2008[16] as cited in ECORYS, 2009, p. 112). While there is a shift towards higher-skilled workers in China the majority of people currently employed in Chinese shipbuilding has only completed basic education (OECD, 2009, p. 116). However, even though there are no exact figures on education levels of the Chinese shipbuilding workforce, Tsai (2011) points out that there is also no lack of skilled and well-trained people working in Chinese shipyards (Tsai, 2011, p. 50). As has been argued the shipbuilding industry is very labor intensive. Therefore labor cost is one determining factor of industry success. Consequently the relatively cheap labor force of Chinese shipbuilders can be regarded as a significant advantage towards foreign firms. Wage costs strongly differ between Asian countries. According to a CARE research report from 2008 Chinese labor cost stood at US$ 2 per day. This is only a fraction of the South Korean labor cost which was reported to average US$ 19 per day (CARE Research, 2008[17] as cited in ECORYS, 2009, p. 119). This price advantage resulting from an abundant supply of relatively cheap labor compared to other shipbuilding nations can be regarded as one of the main reasons for China's rise in shipbuilding. In 2002 Chinese shipyard workers on average earned US$ 325 per month, while wages of South Korean employees in shipbuilding were estimated to equal US$ 1400 (Collins & Grubb, 2008, p. 8). However, wages in China have significantly increased over the past decade and also Chinese shipbuilders are struggling with rising labor costs. In 2001 the average Chinese wage was one twentieth of that of South

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[15] The original COSTIND report has only been published in Chinese language.

[16] The China Association of the National Shipbuilding Industry (CANSI) almost exclusively publishes in Chinese language. Therefore whenever CANSI data is used for the analysis of shipbuilding competitiveness of China and South Korea in this thesis it is obtained from secondary sources.

[17] The original CARE Research report has not been freely published and access is restricted to paying companies and institutions.

Korea. In 2009 Chinese labor cost measured in US$ per man-hour was roughly one tenth of that of South Korea (Jiang & Strandenes, 2012, pp. 481-482). As these figures suggest China still enjoys a significant cost advantage over other major shipbuilding nations when it comes to labor cost. The availability of cheap labor has been and still is one of the main reasons for the country's status as a global leading nation in shipbuilding (Krishnan, 2011, p. 81). The latest data that is available to the author suggests that labor costs for Chinese yards are only twelve percent of that of South Korea or fourteen percent of that of Japan (Tsai, 2011, p. 57).

Besides wages also labor productivity is a critical factor that determines industry success. In shipbuilding the two relevant types of labor productivity are labor productivity in terms of value-added per person employed and labor productivity in terms of production value per person employed (ECORYS, 2009, p. 98). Figure 5 below compares labor productivity in the Chinese shipbuilding industry to that in South Korea, Japan and the European Union:
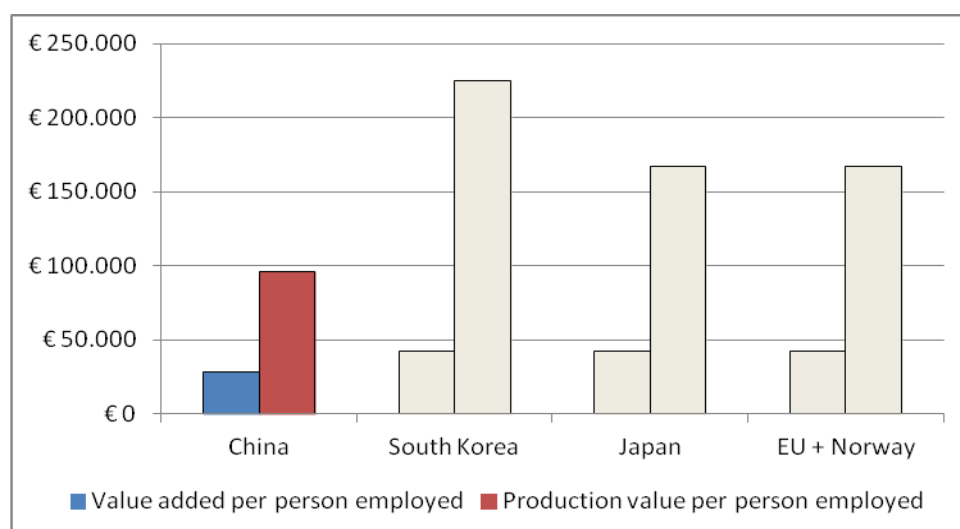
Figure 5: Labor productivity of Chinese shipyard workers in 2006
Source: ECORYS, 2009, p. 99

As illustrated in Figure 5 labor productivity in terms of value added per person employed was about € 28.000 for Chinese shipyards in 2006. Compared to the € 40.000 value-added per person employed for South Korea, Japan and the European Union plus Norway this suggests lower labor productivity for Chinese yards. From the second productivity indicator it becomes even more evident that Chinese shipbuilders suffer from relatively low labor productivity. Chinese yards' production output per employee equaled € 96.000 in 2006. However, China clearly lagged behind in this regard and South Korea's production output with € 220.000 per person employed was more than twice as high as that of China. Chinese yards also have to catch up in terms of production efficiency measured in annual CGT output per worker. While the country's main competitors South Korea and Japan produced 90 CGT per employee in

2006, Chinese output per worker was only 20 CGT in this year (ECORYS, 2009, pp. 98-99). Also Jiang and Strandenes (2012) analyze labor productivity of Chinese and South Korean shipbuilders. Their findings also suggest that Chinese shipbuilders are lagging behind their Korean counterparts in this regard. According to their findings labor productivity is 0.07 CGT per man-hour in South Korea, but only 0.016 CGT per man-hour for China. Jiang and Strandenes conclude that Chinese shipbuilders' advantage in wages which are only one tenth of that of South Korea are therefore partly offset by low labor productivity. Finally they come to the conclusion that unit labor costs for Chinese shipbuilders are roughly one third of that of South Korean workers and therefore still relatively low by international comparison (Jiang & Strandenes, 2012, p. 484). Also Collins and Grubb (2008) as well as Tsai (2011) describe China's productivity in shipbuilding as relatively low by international standards and estimate the country's overall shipbuilding productivity at roughly on fourth to one sixth of that of South Korea and Japan (Collins & Grubb, 2008, p. 37; Tsai, 2011, p. 50).

As has been argued, another important factor that determines industry success of Chinese shipbuilding is infrastructure. First educational infrastructure and in particular Chinese universities and research institutes that offer programs related to shipbuilding are discussed in this section. In China the two large state-owned conglomerates China Shipbuilding Industry Corporation (CSIC) and China State Shipbuilding Corporation (CSSC) run their own research institutes and training centers. In addition universities such as the Jiangsu University of Science and Technology, the Ocean University of China, the Harbin Engineering University, as well as the Shanghai Jiao Tong University are well-known for offering programs in shipbuilding and marine engineering. These universities are also part of the China Shipbuilding and Marine Engineering Industry Intellectual Property Alliance which was founded in 2015 and aims for promoting the creation, management and protection of intellectual property relevant for the development of the domestic shipbuilding industry (Wang, 2015). While the Chinese shipbuilding industry in the past mainly relied on its low cost advantage, it is now increasingly developing its human capital. More and more universities are offering programs for shipbuilding engineering and roughly 1.500 students are graduating from these programs every year (Collins & Grubb, 2008, p. 2).

Besides the educational infrastructure also the number of yards as well as China's shipyard production capacity is analyzed in this section. In 2007 the Commission for Science, Technology and Industry for National Defense (COSTIND) estimated the number of Chinese yards to be higher than 2.000 (COSTIND, 2007[18] as cited in Tsai, 2011, p. 39). However, the

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[18] The original COSTIND report has only been published in Chinese language.

reliability of this information needs to be questioned given the latest data on the number of active Chinese shipyards published by the shipping intelligence network Clarkson, which is also a world leading provider of shipbuilding information. According to Clarkson Research the number of active Chinese yards has almost halved from over 300 at the beginning of 2012 to around 150 in 2015 (Springer, 2015a). In 2014 the Chinese shipbuilding industry was still the largest globally if measured in tonnage terms. 148 yards had at least one vessel of 1.000 GT and above on order. Hence, Chinese yards accounted for roughly one third of all yards worldwide which had at least one vessel on their orderbook (Barnwell, 2014). In 2015 the number of active Chinese yards fluctuated between 160 at the beginning of the year and 151 by the end of May. What these numbers clearly indicate is that the Chinese shipbuilding industry has also been affected by the fall in demand for new ships and as a result many Chinese yards could not secure orders or even went out of business (Springer, 2015a). This trend is also reflected in Chinese shipyards production capacity which is the next point of analysis. Following the suggestion by ECORYS (2009) the author uses production levels as a proxy for shipbuilding capacity. Figure 6 below depicts the development of shipbuilding capacity in China:
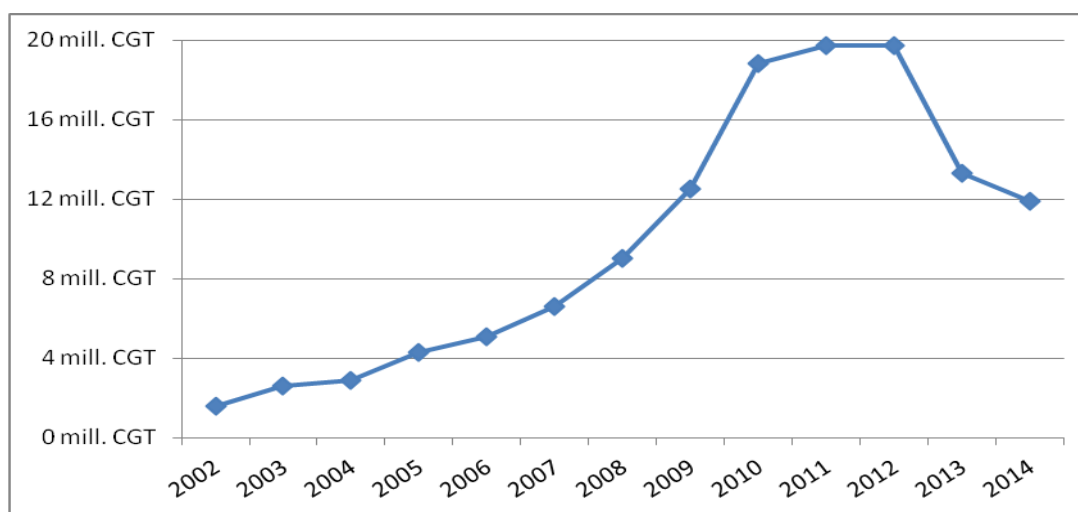
Figure 6: Development of total Chinese shipbuilding capacity

Source: IHS Fairplay[19] as cited in SEA Europe, 2015, p. 29

As shown in Figure 6 China's shipbuilding capacity standing at 1.5 million CGT in 2002 grew rapidly over the next years and increased more than tenfold until 2010 where it reached

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[19] IHS is a global enterprise providing analysis and information for various industry segments including shipping and shipbuilding. Its platform IHS Fairplay is one of the most extensive sources for maritime information. However, access to IHS Fairplay data is restricted to paying customers such as shipping and shipbuilding companies or government agencies. Therefore, the IHS Fairplay data that is used for the analysis of shipbuilding industries in China and South Korea in this thesis is obtained from secondary sources.

18.8 million CGT. It remained constant at a level slightly below 20 million CGT from 2010 to 2012 but significantly declined afterwards standing at roughly 12 million CGT by the end of 2014. This trend also reflects developments in global shipbuilding capacity. Similar to the development in China also global shipbuilding capacity rose steadily from 21 million CGT in 2002 to 51 million CGT in 2010, remained rather constant at this high level for three consecutive years and dropped to 36 million CGT in 2014. China's share of global shipbuilding capacity grew constantly from 9 percent in 2002 to 43 percent in 2012 and has since then declined to 33 percent in 2014 (authors own calculations based on IHS Fairplay data obtained from SEA Europe, 2015, pp. 28-29).

Last but not least also the availability and cost of major resources and materials relevant for shipbuilding of which the most important are steel and ship equipment are analyzed in this section. China's competitive position in global shipbuilding is also due to the country's favorable conditions regarding the supply of steel. China is the number one steel producing country in the world. It produced 810 million metric tons of crude steel in 2014. By comparison the second largest steel producing country Japan produced 110 million metric tons of crude steel in the same year which is roughly 14 percent of the Chinese production volume (World Steel Association, 2015a, p. 8). However, China is not only the by far largest steel producer, but also one of the cheapest suppliers of shipbuilding steel (Krishnan, 2011, p. 75). At the end of 2015 the price for a metric ton of hot rolled plate, the type of steel mostly used for the construction of hulls and platforms, stood at US$ 250 in China. In comparison a metric ton of hot rolled plate was traded at US$ 550 in the United States, US$ 580 in Japan and US$ 470 in South Korea at the same time (Steel Business Briefing, 2016). Large Chinese shipyards usually work in close cooperation with major steel producing firms that are often located in close geographic proximity. These companies usually keep close and longstanding relationships and work on the basis of fixed-price agreements through which Chinese yards are provided with a relatively cheap supply of large quantities of steel. Given the huge production volume of Chinese steel companies as well as their competitive pricing, the demand for shipbuilding steel of Chinese shipbuilders is almost entirely met by domestic steel manufacturers (Jiang & Strandenes, 2012, p. 484).

While Chinese shipbuilders are provided with favorable conditions regarding the domestic supply of huge quantities of cheap shipbuilding steel, they heavily depend on imports when it comes to ship equipment. Currently some 60 to 70 percent of total demand for ship equipment is imported. For this reason it is a government goal to support the domestic ship equipment industry and to boost the domestic loading rate (Jiang & Strandenes, 2012, p. 485). However,

domestic prices at which Chinese shipbuilders purchase ship equipment are still relatively low when compared to that for South Korean or Japanese yards. In Japan for instance there is very limited price competition among suppliers of ship equipment and the industry is protected by the government which puts high tariffs on imported ship equipment. In China, however, there is more competition among suppliers of ship equipment which also leads to price reduction. Nevertheless the Chinese ship equipment industry is still in a developmental phase and for more sophisticated components shipbuilders rely on imports. Due to tariffs that are imposed on imported ship equipment overall equipment costs of Chinese shipbuilders are only slightly lower than that of their Japanese or South Korean counterparts. In the year 2000 Chinese shipbuilders had ship equipment costs of US$ 350 per CGT compared to equipment costs of US$ 500 per CGT for South Korean shipbuilders. In 2009, the latest date for which data is available ship equipment costs for Chinese shipbuilders had increased by 15 percent since 2000 amounting to US$ 500 per CGT. However equipment costs were still lower than those for Japanese or South Korean shipbuilders which had equipment costs of US$ 650 and US$ 700 per CGT respectively in 2009 (Jiang & Strandenes, 2012, p. 486).

4.1.2 Factor Conditions in South Korea

South Korea has a population of 50.4 million people out of which 26.4 million represent the nation's workforce (World Bank, 2016). However, while shipbuilding is an important strategic industry in South Korea, it is challenging for the country's shipbuilders to attract new talent. South Korea is faced with a rapidly aging population and the proportion of people entering the workforce is shrinking. Hence, industries are competing for skilled young people and the country's shipbuilding companies have created tailored training programs and offer competitive salaries to lure potential employees. However, most of Korea's young talent aims for living in the large dynamic cities and shipyards are usually located far from these areas. In addition shipbuilding is often considered as a dirty job and the majority of young Koreans prefers to work in other industries such as electronics or gaming (OECD, 2014, p. 54). The difficulty of attracting young skilled workers to join the shipbuilding industry is also documented by the shipbroking company Lorentzen and Stemoco (2006)[20]. According to a company report wage levels in Korean shipbuilding are increasing, but attracting new talent is challenging for shipyards and especially skilled welding workers are lacking (Lorentzen & Stemoco, 2006).

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[20] Lorentzen & Stemoco is a leading provider of shipbroking and consulting services headquartered in Oslo, Norway.

At the end of 2013 roughly 154.000 people were employed in South Korea's shipbuilding industry. Even though it has become more and more challenging for shipyards to attract young skilled workers, the total manpower in shipbuilding has constantly increased over the last 15 years. The shipbuilding workforce can be divided into four different groups, namely management and administration, engineers, technical and skilled workers as well as subcontractors (KOSHIPA, 2014, p. 7). Figure 7 below depicts the composition of the South Korean shipbuilding workforce:
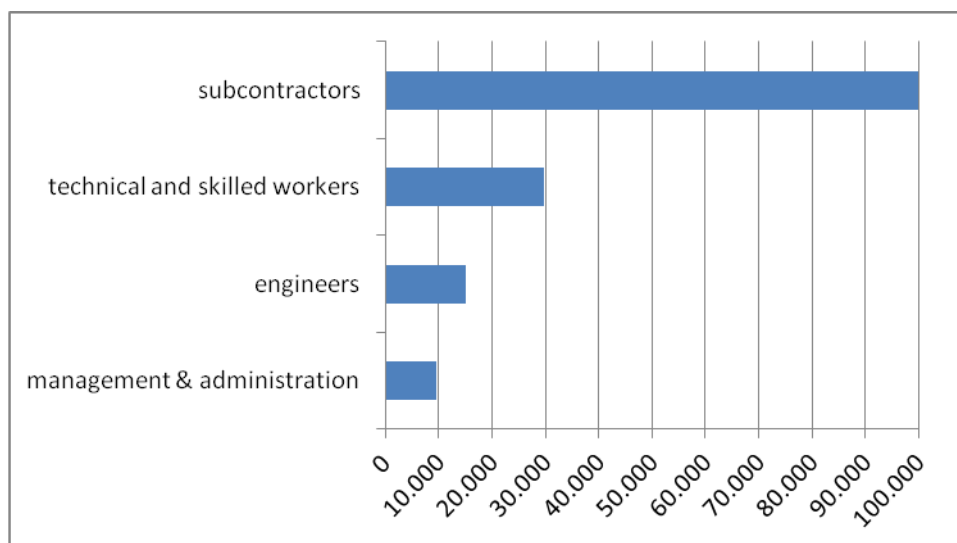
Figure 7: Composition of the South Korean shipbuilding workforce

Source: KOSHIPA, 2014, p. 7

As Figure 7 illustrates roughly 9.500 people or some 6.2 percent of the total shipbuilding workforce in Korea worked in management and administration at the end of 2013. Some 15.000 engineers worked in Korean shipbuilding which amounted to to 9.8 percent of the total workforce. The 29.600 technical and skilled workers constituted 19.2 percent of total shipbuilding manpower in South Korea. The vast majority of employees in shipbuilding, almost 100.000 people worked as subcontractors. This group represented 64.8 percent of the total shipbuilding workforce (KOSHIPA, 2014, p. 7). Interestingly South Korean shipbuilders are hiring more and more subcontractors which also explains the constant growth of total shipbuilding workforce. Over the past fifteen years total manpower in shipbuilding almost tripled from roughly 55.000 people in the year 2000 to 154.000 at the end of 2013. While in 2000 some 20.000 subcontractors worked for Korean shipyards, their number grew fivefold to roughly 100.000 in 2013. Hence, subcontractors were responsible for the majority of this growth trend in the South Korean shipbuilding workforce (KOSHIPA, 2014, p. 7).

Regarding educational levels of the South Korean shipbuilding workforce there is not much reliable data available. According to KOSHIPA some 74 percent and hence the vast majority of engineers holds a university degree with the rest being high school and college graduates. While 64.2 percent have a bachelor's degree, 6.4 percent hold a master's degree and 3.4 percent have a PhD. Unfortunately there are no actual figures on education levels of research and development workforce in Korean shipbuilding. However, the KOSHIPA report suggests that also for this category the proportion of employees holding a master's degree or PhD is high and rising (KOSHIPA, 2014[21] as cited in OECD, 2014, p. 21).

As has been argued, attracting young skilled employees has become a major challenge for South Korean shipbuilders, even though wage levels in the industry have steadily increased. Currently labor costs account for roughly one third of total costs in Korean shipbuilding (ECORYS, 2009, p. 111). While in the past South Korean yards enjoyed labor cost advantages over other major shipbuilding nations this has dramatically changed in recent years. In 1998 hourly payment of shipyard workers in Korea was only 43 percent of that of the Japanese shipbuilding workforce and only 32 percent of that of Germany. However, due to the appreciation of the Korean won and a rapid salary increase over the last decade, the annual salary of employees of Korean shipbuilding companies is now higher than that of their Japanese colleagues. In 2006 the average annual salary of a Korean shipyard worker was between US$ 44.000 and US$ 54.000, while casual workers earned US$ 30.000 annually on average. This is eight to nine times higher than the average Chinese salary for shipyard workers (Lorentzen & Stemoco, 2006). This huge gap in wages between South Korean and Chinese shipyard workers is also acknowledged by other scholars such as Tsai (2011, p. 57) who also estimates the Korean shipbuilding wage to be seven to eight times that of the Chinese one. However, salaries of Korean shipyard workers are not only high by international comparison but also when compared to wages paid in other major Korean industries. In 2009 the Japan Ship Technology Research Association (JSTRA) estimated the average annual salary of Korean shipyard workers at 46 million Korean won which is around US$ 36.000. Thereby shipbuilding ranked fourth in terms of annual salary only behind the refining-, rail- and petro-chemical industry (JSTRA, 2012 as cited in OECD, 2014, p. 20).

While labor costs are relatively high for South Korean shipbuilders this also applies to labor productivity. South Korean shipyard workers are highly productive in terms of value-added per person employed and also lead in terms of production value per shipyard worker as can be seen from Figure 8 on the next page.

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[21] Data on education levels of the Korean shipbuilding workforce were directly reported to the OECD by KOSHIPA.
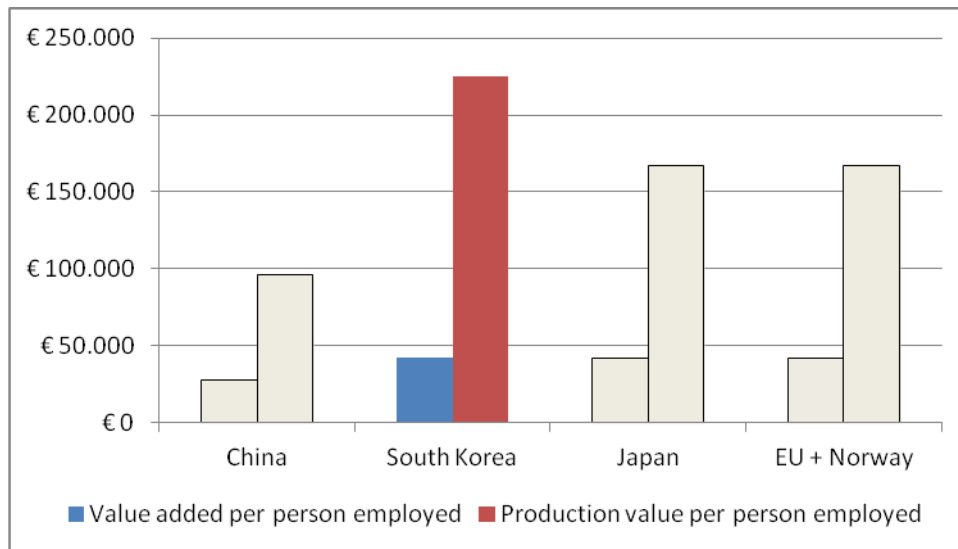
Figure 8: Labor productivity of South Korean shipyard workers in 2006

Source: ECORYS, 2009, p. 99

For 2006, the last year for which data is available, South Korean labor productivity in shipbuilding was about € 40.000 value added per shipyard worker and therefore as high as that of Japanese or European yards. However it was significantly higher that the € 28.000 value added per person employed for Chinese shipyard workers. The second indicator shows the Korean dominance in terms of labor productivity even more clearly. The Korean production value per shipyard worker amounted to € 220.000 in 2006. It was roughly 30 percent higher than that of Japanese and European shipyard workers whose production value reached € 170.000 per person. Compared to Chinese employees in shipbuilding whose production value was € 96.000 per worker, South Korean workers were more than twice as productive in this regard (ECORYS, 2009, p. 99). South Korean workers also clearly outperform their Chinese colleagues in terms of production efficiency. The average output per worker measured in terms of CGT was roughly 90 CGT for Korean shipyard workers and therefore rather high by international comparison. While Japanese workers could keep up with their Korean colleagues in this regard and also had an output of 90 CGT per worker, production efficiency of European and Chinese workers was much lower with an average output of 20 CGT per worker. Hence, production efficiency of South Korean shipyard workers was more than four times the one of their Chinese colleagues (ECORYS, 2009, p. 99). These figures are also partly confirmed by the findings of Jiang and Strandenes (2012) who also analyze labor productivity of South Korean, Japanese and Chinese shipyards. According to their findings labor productivity in terms of output measured as CGT per man-hour (MH) is significantly higher for South Korean yards than for Chinese ones, but lower than that of Japanese yards. While South Korean workers had an average output of 0.074 CGT/MH in

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2009, it was 0.016 CGT/MH for Chinese and 0.121 CGT/MH for Japanese yards (Jiang & Strandenes, 2012, p. 494). While these findings are not fully consistent with those in ECORYS (2009) they do acknowledge the productivity gap between South Korean and Chinese shipyard workers.

After having discussed the availability, cost and productivity of labor in Korean shipbuilding the author now focuses on shipbuilding educational infrastructure, the number of yards as well as shipbuilding capacity. In South Korea currently 21 universities, 18 colleges and 16 graduate schools offer programs in shipbuilding engineering. In 2012 more than 2.100 students were newly enrolled in these university and college programs and some additional 230 students signed up for shipbuilding or marine engineering programs at graduate schools (OECD, 2014, p. 32). Many of these universities have established close relationships with the country's large shipbuilding companies which also results in jointly conducted initiatives or company sponsored research programs. Samsung Heavy Industries (SHI) was the first shipbuilding company that together with the Pusan National University launched an official diploma course for naval architecture and ocean engineering. Through this course shipyard workers can participate in an official academic program and obtain a bachelor's degree while still working at Samsung's Geoje Shipyard (Samsung Heavy Industries, 2006).

Besides these joint initiatives between shipbuilding corporations and state universities there are also so-called corporate universities which require the official permission of the Korean Ministry of Education, Science and Technology. Corporate universities are research entities run by companies that aim for training employees or potential future employees with job specific skills. One of these corporate universities, the Heavy Industry Academy was established by Daewoo Shipbuilding and Marine Engineering (DSME) in 2012. It recruits hundred high school graduates ever year and guarantees employment at DSME after graduation (Kim, 2012). Most of the other large Korean shipbuilding companies also run their own training centers or corporate universities and more than 4.400 employees were trained at these institutes in 2012 (KOSHIPA, 2013 as cited in OECD, 2014, p. 22).

The number of South Korean yards is rather small compared to other major shipbuilding nations such as China or Japan. This is due to the structure of the industry which is dominated by three large chaebol conglomerates, namely Daewoo, Samsung and Hyundai. Together these three largest Korean shipbuilders accounted for 58.4 percent and hence more than half of the total Korean output in shipbuilding in 2013. The Korean shipbuilding industry is therefore rather concentrated with only few large companies participating in international competition. All in all only eight large companies accounted for almost 98 percent of Korea's

shipbuilding output in 2013 (OECD, 2014, p. 12). Given Korea's shipbuilding output the number of companies is relatively small by international comparison and so is the number of active Korean shipyards. According to the most recent data which is of August 2015 only 20 yards had a vessel of 1.000 GT and above on order compared to 53 active yards in Japan and 146 in China (Springer, 2015b).

In the next step of this analysis total shipyard capacity of South Korean shipbuilders is evaluated. In order to do so production levels are used as a proxy by the author. Figure 9 below depicts the development of shipbuilding capacity in South Korea from 2002 to 2014:
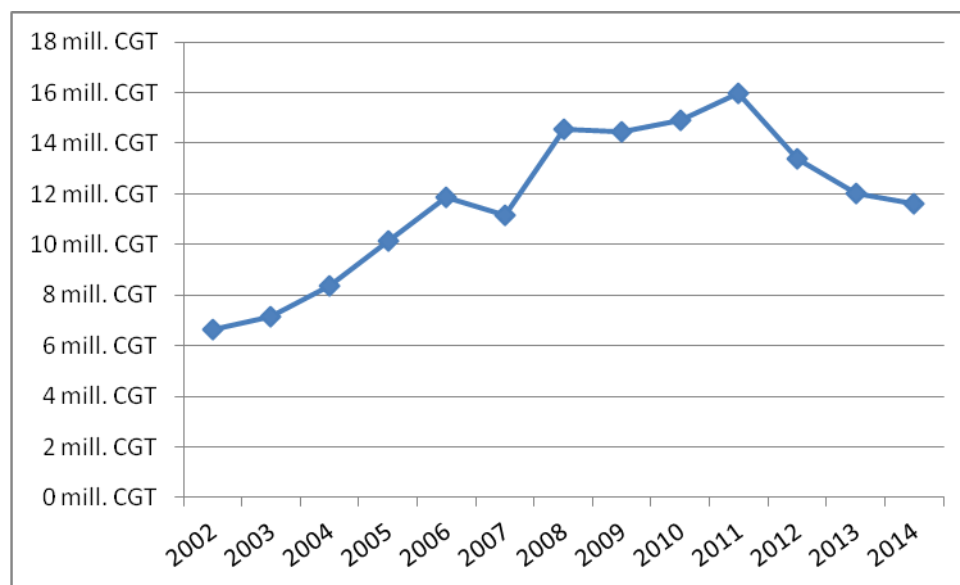
Figure 9: Development of total South Korean shipbuilding capacity
Source: IHS Fairplay as cited in SEA Europe, 2015, p. 30

As can be seen from Figure 9 South Korea's shipbuilding capacity standing at 6.6 million CGT in 2002 almost doubled over a short period of four years to reach 11.8 million CGT in 2006. After a minor decline in 2007 total building capacity grew by 30 percent to 14.5 million CGT in 2008. It remained fairly constant for the next two years and reached a peak of 16 million CGT in 2011. However, the global economic and financial crisis and the resulting slump in global demand for new ships also lead to capacity reduction in South Korea. Building capacity declined for three consecutive years and stood at 11.6 million CGT by the end of 2014. Over the reviewed period from 2002 to 2014 South Korea's total building capacity grew by roughly 75 percent which also reflects the global development in shipbuilding capacity. South Korea's share of global shipbuilding capacity remained fairly stable over the reviewed period oscillating between 28 and 34 percent. By the end of 2014 South Korea's shipbuilding capacity of 11.6 million CGT accounted for 31 percent of the total

global capacity and almost equaled that of China which stood at 11.9 million CGT. These two countries command over the by far highest shipbuilding capacities with Japan ranking third in this regard with a building capacity of 6.7 million CGT (IHS Fairplay as cited in SEA Europe, 2015, pp. 28-31).

After having discussed availability, cost and productivity of labor as well as educational and physical infrastructure relevant for South Korean shipbuilders, the author now focuses on the availability and cost of steel and ship equipment, the two most important input factors in this industry besides labor. Regarding steel, South Korea produced 71.5 million metric tons of crude steel in 2014 thereby ranking fifth in global steel production only behind China, Japan, the United States and India (World Steel Association, 2015, p. 8). However, for shipbuilding mostly medium and heavy steel plate is used for the construction of hulls and platforms (Jiang & Strandenes, 2012, p. 484). While South Korea produces large quantities of steel plate, domestic steel companies cannot compete with the market leader China in terms of steel price due to higher production costs. Therefore South Korean steel mills rather focus on the production of higher-quality steel plate or specialized grades of steel which are used for the construction of LPG or LNG carriers (Brooks, 2015). The Korean transaction price of hot rolled plate stood at US$ 470 per ton at the end of 2015. In comparison a metric ton of hot rolled plate was traded at US$ 250 in China at the same time (Steel Business Briefing, 2016). In Korea shipbuilding is the main consumer of plate products. However, the domestic demand for steel plate cannot be fully met by domestic suppliers and Korean shipbuilders also due to price advantages import a significant proportion of their steel demand (Brooks, 2015).

While Korean shipbuilders have to import a significant amount of steel mainly from China, the localization rate for ship equipment and marine subcomponents is relatively high. Most large South Korean shipbuilding companies are vertically integrated and function as their own producers of ship equipment and marine subcomponents (OECD, 2014, p. 23). However, the South Korean ship equipment industry is also an important business segment on its own, and more than 700 companies are active in this field. Roughly 180 of these companies are members of the Korean Ship Equipment Association (KOMEA) and account for more than 80 percent of Korea's total ship equipment output (KOMEA, 2016). Availability of domestically supplied ship equipment is therefore less of an issue for South Korean shipbuilders. In 2014 almost 90 percent of Korean shipbuilders' demand for ship equipment and marine subcomponents was met by domestic suppliers (KOSHIPA, 2014, p. 10). Regarding ship equipment costs there is no information available except for the calculations done by Jiang and Strandenes (2012). According to this study competition in South Korea's ship equipment

industry is only moderate, and some firms have large production capacities which allow them to realize economies of scale. For their evaluation of ship equipment costs Jiang and Strandenes use data from KOMEA which unfortunately is not available to the author. Based on this information they estimate ship equipment costs for Korean shipbuilders at US$ 500 per CGT in 2000. According to their calculations, costs for marine subcomponents and ship equipment remained at US$ 500 per CGT until 2005 and increased by 40 percent to US$ 700 per CGT until 2009. They also compare ship equipment costs for South Korean, Chinese and Japanese shipbuilders and conclude that South Korean yards at US$ 700 per CGT compared to US$ 650 per CGT in Japan and US$ 500 per CGT in China had the highest equipment costs (Jiang & Strandenes, 2012, p. 486).

Conclusion

From the comparison of factor conditions in China and South Korea several conclusions can be drawn. It became clear that Chinese shipbuilders enjoy several factor advantages such as easy access to an abundant supply of workers, significantly lower labor costs, a favorable educational and physical infrastructure as well as a large supply of cheap domestic steel. However, some of these advantages such as the extremely low labor costs of Chinese shipyard workers are at least partly offset by low labor productivity. While Chinese shipbuilders also enjoy cost advantages for ship equipment, they heavily rely on imports of some key components. This poses the risk of delays in ship delivery if components cannot be delivered on time. In South Korea on the other hand, the large chaebol companies Samsung, Hyundai and Daewoo which dominate the national shipbuilding industry are vertically integrated and the lion's share of the demand for ship components is supplied domestically. In addition Korean shipyards usually train their employees in corporate universities or training centers. The well-trained South Korean labor force might also partly explain the very high labor productivity of shipyard workers which is one of the major competitive advantages of South Korean shipbuilders.

4.2 Demand Conditions

After comparing factor conditions relevant to South Korean and Chinese shipbuilders, this chapter focuses on demand conditions for the two countries' shipyards. The analysis includes the size of the two nations' home markets (Chinese and South Korean shipowners' total order volume), the number and volume of domestic orders placed at Chinese or South Korean yards, the share of total Chinese and South Korean orders placed at domestic yards, the share

of domestic contracting at Chinese and South Korean yards, as well as the growth rate of home demand. Since shipbuilding is a global industry also global demand for Chinese and South Korean vessels as well as growth patterns of this demand are analyzed. In addition the main global customers for both shipbuilding nations as well as the segment structure of demand for Chinese and South Korean ships are discussed in the following.

4.2.1 Demand Conditions in China

Over the last decades China has seen an unprecedented economic development and growth. After opening up its economy also international trade accelerated and China emerged as a leading export nation. Much of this trade was and remains to be carried by sea and hence, China started to expand its merchant fleet. The rise in domestic demand for new ships together with strong government support represented a rather favorable home environment for Chinese shipbuilders to develop and progress which also enabled them to tap into the international shipbuilding market later on (Collins & Grubb, 2008, p. 8). At present the Chinese fleet is the third largest globally in terms of tonnage only behind Greece and Japan. Chinese shipowners also account for the largest orderbook which makes the domestic shipbuilding market the largest in the world (Cheng, 2014). In the first half year of 2015 Chinese shipowners had placed orders for new ships totaling roughly nine million CGT thereby making the country the largest buyer of ships worldwide followed by Singapore and Japan. With global orders placed at the world's shipyards totaling 106.4 million CGT, Chinese shipowners' demand for new vessels accounted for roughly eight percent of total global demand in tonnage terms. The global orderbook for new ships stood at US$ 290 billion in the first half year of 2015. Some nine percent of total global orders worth US$ 26.1 billion were placed by Chinese shipowners (IHS Fairplay data obtained from SEA Europe, 2015, p. 40).

The Chinese shipbuilding industry is also strongly benefiting from the high order volume of domestic shipowners of which the lion's share is placed at Chinese yards. Out of the total ship orders of 9 million CGT ordered by Chinese shipowners, orders of around 7.5 million CGT were placed at domestic yards. This amounts to more than 80 percent of the total order volume of Chinese shipowners. Regarding the number of ordered ships, Chinese shipowners had 420 ships of 1.000 CGT and above on their orderbook in the first half year of 2015 out of which 380 or some 90 percent were placed at domestic yards (IHS Fairplay as cited in SEA Europe, 2015, p. 40). Nevertheless, while Chinese shipowners account for the largest proportion of ship orders at domestic yards of any owner nation, the major share of Chinese shipbuilding output is still destined for export. At the end of 2014 Chinese shipowners had

orders for 363 ships of 1.000 CGT and above placed at domestic yards which were totaling 9.3 million CGT and hence accounted for 26.2 percent of the total Chinese orderbook (SAJ, 2015, p. 31). This implies that the remaining 73.8 percent of the Chinese orderbook were slated for export.

Unfortunately there is no time series data available regarding the domestic demand for new vessels. Nevertheless due to China's role as a leading trading nation, home demand for ships has significantly increased over the last decades. In the 1990s the majority of Chinese merchant ships was foreign built, because the domestic shipbuilding industry was still in a developmental phase and did not have the capacity and capability to build tankers and containerships in large numbers. However, this has changed dramatically and now the strong home demand for ships is to a large extent domestically supplied (Collins & Grubb, 2008, p. 8). The Chinese orderbook also due to strong home demand grew rapidly and constantly until 2008 when the global financial and economic crisis had severe impacts on the global shipping and shipbuilding industries and demand for new vessels plummeted (KOSHIPA, 2016). Figure 10 below depicts the development of domestic orders placed at Chinese yards from 2008 onwards measured in terms of deadweight tonnage (DWT)[22]:
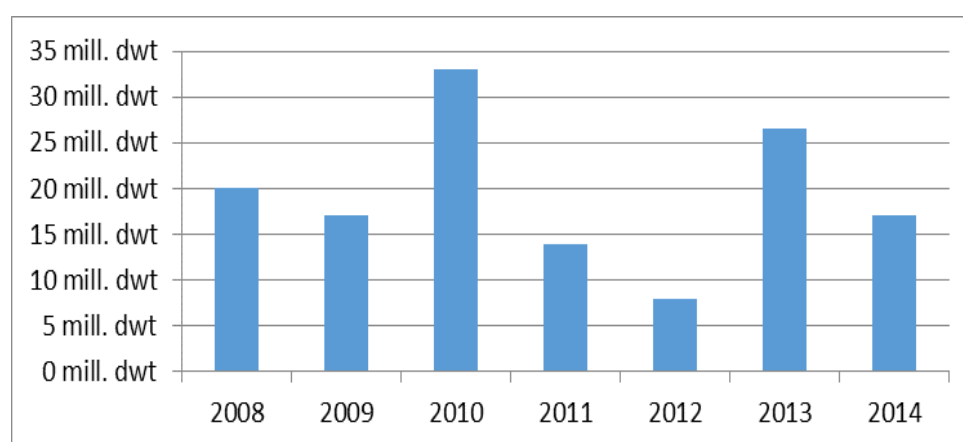
Figure 10: Development of domestic orders placed at Chinese yards

Source: Cheng, 2014 (Clarkson Research)

As Figure 10 depicts domestic orders placed at Chinese yards strongly fluctuated within the reviewed period. Starting from new domestic orders amounting to 20 million DWT in 2008, domestic demand reached a peak of new contracted vessels of 33 million DWT in 2010, and a low of new ship orders of 8 million DWT in 2012. For the years 2013 and 2014 domestic demand recovered amounting to orders of 26.5 million DWT and 21 million DWT

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[22] Deadweight tonnage is a measure expressed in metric tons for the maximum carrying capacity of a ship including cargo, fuel, fresh water, crew and provisions (Clarkson, 2016).

respectively (Cheng, 2014). The development of Chinese orders placed at domestic yards also corresponds to that of global new shipbuilding contracts concluded with Chinese and foreign shipbuilding firms and hence pictures the global shipbuilding trend (KOSHIPA, 2016).

In addition to domestic demand for Chinese ships, also global demand for Chinese vessels is analyzed in this section. As has been argued the shipbuilding industry is a global industry by its nature and the majority of ships is constructed for foreign customers. Figure 11 depicts the development of global new orders placed at Chinese shipyards. As a comparison value also figures for total global new orders are shown.
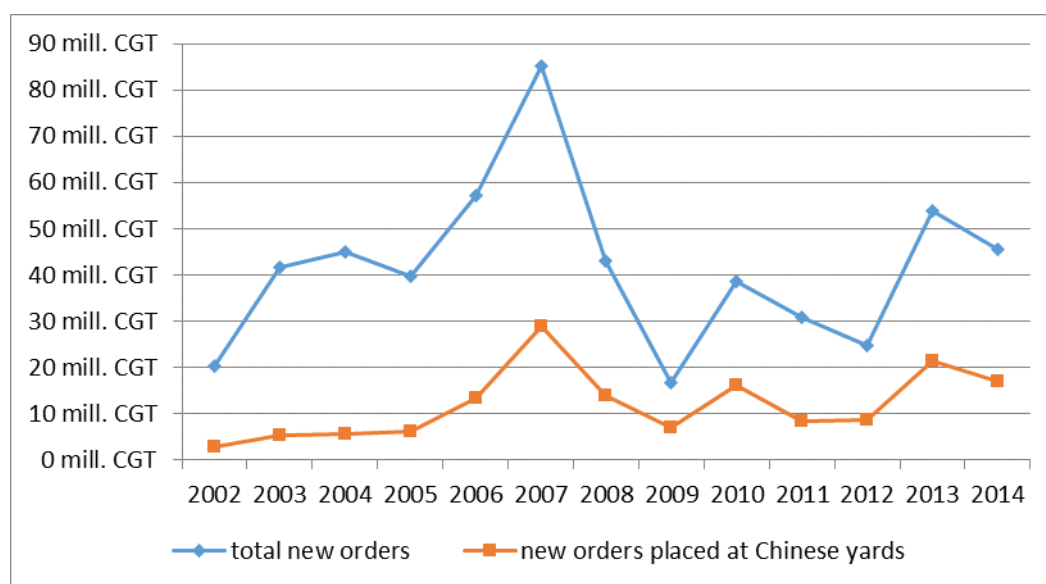
Figure 11: Development of global demand for foreign and Chinese built ships
Source: IHS Fairplay as cited in SEA Europe, 2015, pp. 28-29

As displayed in Figure 11 global new orders placed at Chinese shipyards starting at 2.7 million CGT in 2002 significantly increased for five consecutive years and reached a record high of 28.9 million CGT in 2007. Newly placed orders declined to 13.6 million CGT and 7.1 million CGT for 2008 and 2009 respectively. While they slightly recovered to 16.1 million CGT in 2010 demand for Chinese ships again dropped and new orders amounted to roughly 8.5 million CGT in 2011 and 2012. Since then also the global shipbuilding industry has partly recovered and new orders again increased also for Chinese yards accounting for 21.4 million CGT and 16.9 million CGT in 2013 and 2014. While in 2002 global orders placed at Chinese yards made up 13.2 percent of total new orders, this percentage has grown over the reviewed period to 37.1 percent in 2014 (IHS Fairplay as cited in SEA Europe, 2015, pp. 28-29).

While Chinese shipowners account for the largest proportion of contracting at domestic yards of any owner nation, the vast majority of orders still comes from other nations. The

author therefore also wants to analyze which countries are responsible for the bulk of demand for Chinese built vessels. Table 1 depicts the main customers of Chinese built ships in terms of number of orders placed as well as orderbook volume in CGT terms:

Owner's nationality	No. of vessels ordered	CGT in million	CGT owner %
China	363	9,3	26,2
Greece	150	3,1	8,7
Germany	174	2,9	8,1
Bermuda	75	2,0	5,6
Singapore	83	2,0	5,6
Hong Kong, China	62	1,6	4,4
Norway	62	1,5	4,3
USA	44	1,1	3,1
Monaco	57	1,1	3,0
Italy	29	0,7	1,9

Table 1: Major buyer nations of Chinese built ships

Source: SAJ, 2015, p. 31

As can be seen from Table 1 Chinese shipowners had newbuilding orders for 363 vessels placed at domestic yards in 2015 totaling 9.3 million CGT. Thereby domestic shipowners (excluding the Special Administrative Regions Hong Kong and Macao) accounted for 26.2 percent of all newbuilding orders placed at Chinese shipyards. The major buyer nations of Chinese built vessels besides China were Greece and Germany which both accounted for more than eight percent of the Chinese shipbuilders' orderbook. In this list Bermuda is ranked as fourth largest buyer of Chinese built vessels. However, most of these ships are so-called flag of convenience ships which are only registered in Bermuda by shipowners of different nationalities in order to circumvent regulations in their home countries. International demand for Chinese built ships is also strong in Singapore, Norway, the United States, Monaco and Italy. The Special Administrative Region Hong Kong is listed separately accounting for 4.4 percent of orders placed at Chinese yards (SAJ, 2015, p. 31).

Last but not least also the segment structure of demand for Chinese built ships is analyzed in this section. While the number of domestic and foreign orders placed at Chinese shipyards as well as the total tonnage in CGT terms are indicators for the "quantity" of home and foreign demand, the analysis of segment structure of this demand is intended to reveal the preferences of customers as well as the sophistication of buyer needs and hence, serves as an indicator for the "quality" of this demand. In order to interpret this segment structure of demand for Chinese built ships, the different types of ships are first ranked according to their level of complexity. According to Krishnan (2011) the different types of ships are classified

based on their level of complexity in construction and divided into three different groups namely low complexity ships (LCS), medium complexity ships (MCS) and high complexity ships (HCS). Low complexity ships are relatively easy to construct as they do not require the integration of complex systems on board. General cargo ships, bulk carriers and tankers fall into this category. Medium complexity ships are more difficult to construct as they require the integration of some complex system on board of the ship. Very large tankers such as very large crude carriers (VLCCs) and ultra large crude carriers (ULCCs) [23] as well as containerships are classified as medium complexity ships. Last but not least high complexity ships have several complex systems on board. Vessels considered as high complexity ships are amongst others liquefied natural gas (LNG) carriers as well as liquefied petroleum gas (LPG) carriers (Krishnan, 2011, p. 83). Figure 12 below again shows the different ship types according to their level of complexity in construction:

Figure 12: Ship types by their level of complexity in construction
Source: Collins & Grubb, 2008, p. 2

In order to analyze the segment structure of demand for Chinese built ships the Chinese orderbook by vessel type is depicted in Figure 13 on the next page. Only cargo carrying ships were considered which accounted for 88.7 percent of total ships ordered.

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[23] Ultra large crude carriers (ULCCs) are tankers of more than 320,000 dwt (Clarkson, 2016).
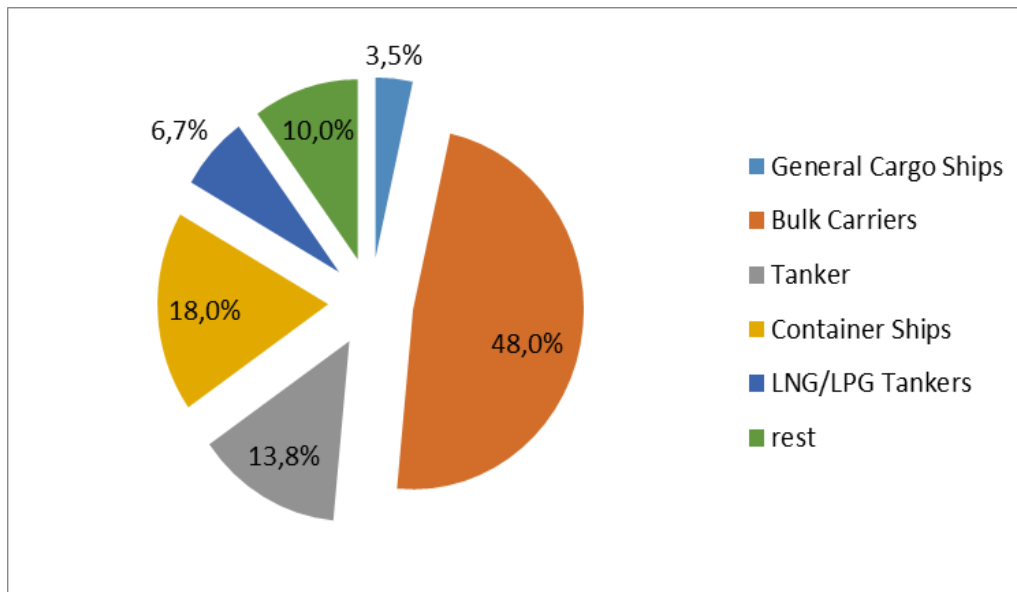
Figure 13: Orderbook of Chinese shipyards by vessel type (June 2015)

Source: Authors own calculations based on SAJ, 2015, p. 32

As Figure 13 illustrates, demand for Chinese built ships is particularly strong in the bulk carrier segment. These low complexity ships account for 48 percent of the total Chinese orderbook and hence, constitute the by far largest segment of vessels produced at Chinese shipyards of any ship type. In addition also general cargo ships and tankers which are also considered as low complexity ships make up 3.5 and 13.8 percent of the Chinese orderbook respectively. Together orders of low complexity ships amount to 65.3 percent of the total orderbook. Also orders of containerships which are classified as medium complexity ships make up 18 percent of total orders placed at Chinese yards (SAJ, 2015, p. 32). From the analysis of segment structure of demand for Chinese built ships several conclusions can be drawn. First, the Chinese shipbuilding industry is heavily weighted toward the construction of low and medium complexity ships. Second, within these segments there is a strong focus on bulk carriers which account for almost half of total orders. Third, while Chinese shipbuilders are capable of producing high complexity ships their presence in these market segments is not very strong and construction of LNG and LPG carriers only accounts for a minor proportion of total orders.

4.2.2 Demand Conditions in South Korea

The South Korean home market for ships is smaller than that of China. In 2015 South Korean shipowners had 103 orders for new ships totaling 2.5 million CGT placed at domestic and foreign shipyards. In comparison Chinese shipowners had ordered 420 ships totaling 9 million CGT. Hence, the South Korean home market for ships was only 27.8 percent of the Chinese

one if measured in CGT terms. In 2015 the global shipbuilding orderbook stood at 106.4 million CGT. South Korean shipbuilding orders therefore accounted for 2.3 percent of total global demand for new ships if measured on a CGT basis. However, if market share is measured in terms of total order value, global market share of Korean shipowners is much higher. While the total global orderbook for new ships stood at US$ 290 billion in the first half year of 2015, South Korean shipowners' order volume was US$ 20.3 billion and hence amounted to roughly seven percent of total global orders in terms of value. This is not much less than Chinese shipowners' newbuilding orders which totaled US$ 26.1 billion (authors own calculations based on IHS Fairplay data obtained from SEA Europe, 2015, p. 40).

Almost 90 percent of South Korean shipbuilding orders in tonnage terms were also placed at domestic yards. In 2015 out of newbuilding orders totaling 2.5 million CGT, orders of 2.2 million CGT were also placed at South Korean companies. In terms of number of vessels, 75 out of 103 building orders were given to domestic shipyards. As the Chinese shipbuilding industry, also the South Korean one is heavily focused towards export. Domestic newbuilding orders of 2.2 million CGT accounted for 7.3 percent of total orders placed at South Korean shipyards. Hence, the rest of 92.7 percent of total contracting at South Korean shipyards, ships of roughly 29.8 million CGT were ordered from other nations and destined for export (IHS Fairplay as cited in SEA Europe, 2015, p. 40).

In this section also the development of domestic demand for South Korean ships is analyzed. Unfortunately the author lacks time series data for South Korean newbuilding orders placed at domestic shipyards. Therefore the development of domestic demand for South Korean vessels is analyzed by looking at ship deliveries to domestic customers. For the past decades the South Korean shipbuilding industry has always focused on exports which accounted for roughly 85 percent of total production value in 1990. By the mid-1990s the share of production destined for export had climbed to almost 99 percent (ECORYS, 2009, p. 12). Figure 14 on the next page depicts the development of ship deliveries to domestic customers from 2000 to 2013.
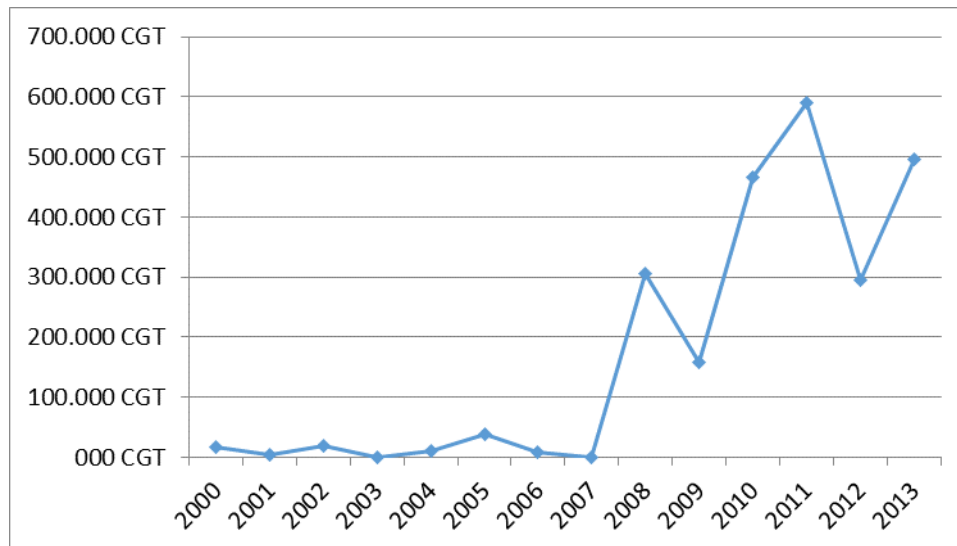
Figure 14: Development of South Korean ship deliveries to domestic buyers

Source: KOSHIPA[24] as cited in OECD, 2014, p. 42

As can be seen from Figure 14 ship deliveries to domestic buyers were almost negligible from 2000 until 2007. During this eight year period a total of only 10 ships with 1.000 CGT and above was delivered to South Korean buyers. Over this period domestic vessel deliveries averaged only 12.200 CGT annually. In 2008 eight vessels were delivered to domestic customers accounting for roughly 300.000 CGT or 2.5 percent of total deliveries. Since then 83 ships of 1.000 CGT and above were delivered to domestic buyers. In tonnage terms ship deliveries fluctuated between delivery volumes of 157.000 CGT in 2009 and 591.000 CGT in 2011. On average ships of roughly 385.000 CGT were annually delivered to domestic customers over the period from 2008 to 2013. In 2013, the last year for which data is available, domestic deliveries made up 5.2 percent of total deliveries. From this study of ship deliveries to domestic buyers it can be derived that domestic demand for new vessels only accounts for a minor portion of total demand for South Korean ships. However, as Figure 14 demonstrates, domestic demand for Korean built vessels has nevertheless grown significantly over the researched period (KOSHIPA as cited in OECD, 2014, p. 42).

In addition to domestic demand for South Korean ships also global demand for South Korean vessels is analyzed in this section. The development of global new orders placed at South Korean shipyards is depicted in Figure 15 on the next page. As a comparison value also figures for total global new orders are shown.

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[24] KOSHIPA data has been directly provided to the OECD.
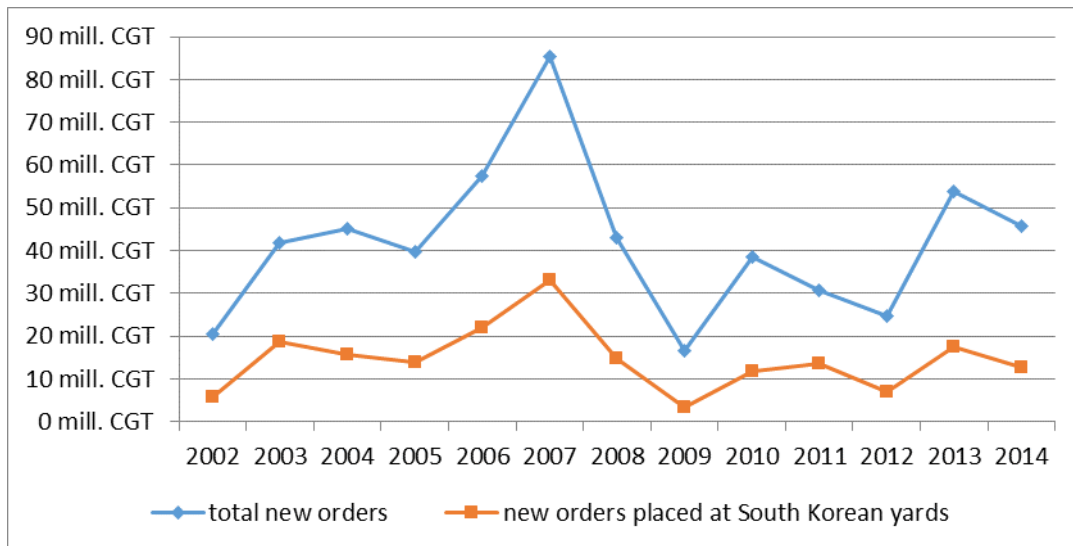
Figure 15: Development of global demand for foreign and South Korean built ships

Source: IHS Fairplay as cited in SEA Europe, 2015, pp. 28-30

As displayed in Figure 15 global new orders placed at South Korean shipyards starting at 5.7 million CGT in 2002 rose more than threefold in only one year to 18.7 million CGT in 2003. After a slight decrease of newbuilding orders for the next two years, new orders climbed again to 21.9 million CGT in 2006 and reached an all-time high of 33 million CGT in 2007. However in 2008 new orders only totaled 14.8 million CGT and reached a low of 3.4 million CGT in 2009. From 2010 on newbuilding orders slightly recovered and fluctuated between 7.1 million CGT and 17.4 million CGT from 2010 to 2014. While in 2002 global orders placed at South Korean yards made up 28.5 percent of total global new orders, this percentage fluctuated between 20 and 44 percent over the reviewed period. In 2014 orders placed at South Korean yards accounted for 27.3 percent of total global newbuilding orders (IHS Fairplay as cited in SEA Europe, 2015, pp. 28-30).

In addition to the development of total global demand for South Korean built ships the author also wants to analyze where this demand is coming from, and hence, which nations are the main customers of South Korean shipyards. The single largest buyer of South Korean built ships is Greece, which accounts for more than 20 percent of the South Korean orderbook. Greece is followed by South Korean shipowners who account for the second largest proportion of contracting at domestic yards. Besides Greece and South Korea, many other nations order South Korean built vessels. Table 2 on the next page depicts the main customers of South Korean built ships in terms of both, number of vessels ordered as well as orderbook volume in terms of total CGT.

Owner's nationality	No. of vessels	CGT in million	CGT owner %
Greece	156	6,1	20,4
South Korea	70	2,2	7,3
Monaco	48	1,9	6,4
United Kingdom	42	1,6	5,4
Canada	20	1,6	5,4
Bermuda	50	1,5	5,1
Singapore	49	1,2	3,9
Japan	15	1,1	3,8
China	23	1,1	3,7
Norway	31	1,1	3,6

Table 2: Major buyer nations of South Korean built ships

Source: SAJ, 2015, p. 31

As can be seen from Table 2 South Korean shipowners had newbuilding orders for 70 vessels placed at domestic yards in 2015 amounting to 2.2 million CGT. Thereby domestic shipowners accounted for 7.3 percent of all newbuilding orders placed at South Korean shipyards. However, the major buyer nation of South Korean built vessels is Greece with open orders totaling 6.1 million CGT. Other major customers of South Korean vessels are Monaco, the United Kingdom, and Canada. A large number of flag of convenience ships to be registered in Bermuda has also been ordered from South Korea. Finally, also Singapore, Japan, China and Norway are major buyers of South Korean ships with orders above one million CGT placed at Korean shipyards (SAJ, 2015, p. 31).

Last but not least also the segment structure of demand for South Korean built ships is analyzed in this section. In Chapter 4.2.1 a classification scheme according to which the different types of ships are categorized based on their level of complexity into low complexity ships (LCS), medium complexity ships (MCS), as well as high complexity ships (HCS) has been presented. Figure 16 below displays the segment structure of demand for Korean ships:
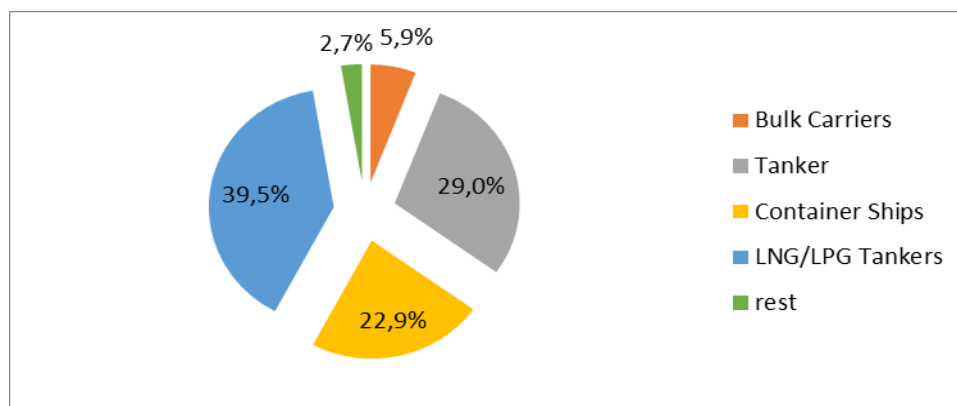
Figure 16: South Korean orderbook by type of vessel (June 2015)

Source: Authors own calculations based on SAJ, 2015, p. 32

As Figure 16 illustrates demand for South Korean built ships is particularly strong in the LNG/LPG tanker segment as well as in the tanker and container ship segment. Orders of LNG and LPG tankers accounted for 39.5 percent of total orders if measured in CGT terms. These ship types are classified as high complexity ships which require the integration of several complex systems on board (Krishnan, 2011, p. 83). South Korean shipbuilders' dominance in this market segment becomes even clearer if the South Korean and Chinese orderbooks are compared to each other. While orders for LNG and LPG ships placed at South Korean shipyards totaled 11.8 million CGT, the Chinese orderbook included orders for LNG and LPG tankers of only 2.4 million CGT. Besides LNG and LPG tankers, containerships which are classified as medium complexity ships made up 22.9 percent of total demand for Korean ships. Together high complexity and medium complexity ships accounted for 62.4 percent of total global demand for South Korean vessels. This is in stark contrast to Chinese shipbuilders for which these market segments play a minor role and only account for 24.7 percent of their orderbook. South Korean shipbuilders also produce low complexity ships of which tankers made up 29 percent and bulk carriers 5.9 percent of their total orderbook (SAJ, 2015, p. 32).

However, in contrast to their Chinese rivals South Korean shipbuilders are much more diversified with a strong presence in all three market segments. Therefore they are less dependent on demand for ships of a particular market segment as they are capable of producing very different types of ships. This is opposed to Chinese shipbuilding companies which rely on a strong demand for bulk carriers which account for almost half of their total orders. The comparison of segment structure of the Chinese and South Korean orderbook first and foremost reveals that while global demand for Chinese built vessels is particularly strong for low complexity ships, South Korean shipbuilders focus on other market segments and demand for Korean ships is particularly strong for medium and high complexity ships. They dominate the global market for LNG and LPG tankers and do not compete too much with China in the bulk carrier segment as Japanese shipbuilders do.

Conclusion

The analysis of demand conditions for Chinese and South Korean shipbuilders has yielded several results. Chinese shipbuilders benefit from a particularly strong home demand for new vessels. Chinese shipowners account for the largest orderbook of any nation and more than 80 percent of this demand is supplied domestically. Also South Korean home demand for ships is to a large extent met by domestic shipyards. However, total demand for new ships is stronger in China than in South Korea. As the shipbuilding industry is a global industry by its nature,

both countries' shipbuilders are heavily focused towards export. Global demand is strong for both, Chinese as well as South Korean built vessels. However, the analysis of demand segment structure has shown that very different types of vessels are ordered from Chinese and South Korean shipbuilders. While the former mainly focus on the construction of low complexity ships, the latter are much more diversified with a strong presence in different sectors and a focus on high complexity ships.

4.3 Related and Supporting Industries

In this chapter Chinese and South Korean related and supporting industries regarding shipbuilding are analyzed and compared according to their characteristics and international competitiveness. The focus of this analysis is on the ship subcomponent or marine equipment sector which can be defined as "the supply industry to the shipyards" (ECORYS, 2009, p. 36). This analysis includes the size of domestic marine equipment industries in terms of production volume and number of firms as well as the localization rate for marine subcomponents. Besides the ship subcomponent and marine equipment sector also the steel industry is a major ancillary industry to shipbuilding as the construction of hulls requires large quantities of shipbuilding steel. For this reason also the size and international competitiveness of the Chinese and South Korean steel industry is analyzed in this chapter.

4.3.1 Related and Supporting Industries in China

In China most large shipbuilders and especially the two large state-owned conglomerates China State Shipbuilding Corporation (CSSC) and China Shipbuilding Industry Corporation (CSIC) are vertically integrated and also act as their own suppliers of ship subcomponents and marine equipment. However, demand for marine equipment and ship subcomponents cannot be fully met by in-house production (ECORYS, 2009, p. 76). While there is a lack in data regarding the exact number of Chinese marine equipment companies it can be said that the industry is still in a developmental phase and immature by international comparison (Collins & Grubb, 2008, p. 2). In 2005 also Wang Rongsheng, the then President of the China Association of the Shipbuilding Trade (CAST) and later President of the China Association of the National Shipbuilding Industry (CANSI), stated that the "low level of the ship component industry has become the bottleneck for the future development of China's shipbuilding industry" (Shun, 2005). Also the Chinese Commission for Science, Technology and Industry for National Defense (COSTIND) identified the weakness of the domestic marine equipment industry as a major hurdle for Chinese shipbuilders to achieve global leadership in

shipbuilding. COSTIND therefore considered development and progress in the domestic marine equipment industry as indispensable for further growth in the shipbuilding sector and accorded it very high priority. As a result China's marine equipment industry featured prominently in the 11th National Five-Year Economic Plan with the key objective to optimize the shipbuilding supply chain by improving domestic supply capability and increasing the technological level of ship subcomponents and marine equipment (Tsai, 2011, p. 42).

Nevertheless, the Chinese ship subcomponent and marine equipment industry is still lagging behind the country's shipbuilding industry. In 2012, the latest year for which data is available, total industry output was estimated at CNY 94.9 billion (US$ 15.2 billion) which is only a fraction of total shipbuilding output (Huidian Research, 2013). Chinese shipbuilders heavily rely on licensing of foreign technology as well as on imports of ship subcomponents and marine equipment. Even though the State Administration for Science, Technology and Industry for National Defense (SASTIND), the successor institution of COSTIND, has set the objective to achieve a 80 percent localization rate for marine equipment by 2015, the real figures show a very different trend (Krishnan, 2011, p. 74).

According to Feng, Guangwu, and Yu (2013) the development of the Chinese marine equipment industry is backward, lacking the ability to self-develop and produce subcomponents and marine equipment without relying on foreign technology. Therefore imported marine equipment is often superior in quality to domestically produced components and the localization rate of ship components and marine equipment is even in decline (Feng et al., 2013, p. 1374). The share of indigenous components and equipment also varies depending on ship types. While for low complexity ships such as general cargo ships and bulk carriers some 58 percent of components come from domestic suppliers, this figure is significantly lower for more complex ship types such as container ships for which Chinese fabricated components account for 15 to 41 percent of total components. Overall, the localization rate of marine equipment for all ship types stood at 40 percent in 2007 (Krishnan, 2011, p. 74). Collins and Grubb (2008) also estimate the average Chinese localization rate of marine equipment at 40 percent and note that it is significantly lower for some medium and most high complexity ships. The weakness of the Chinese marine equipment industry entails several disadvantages for the country's shipbuilders. The resulting dependency of shipbuilders on imports of ship subcomponents offsets hard-currency profits and exposes them to monetary exchange-rate fluctuations. In addition delivery delays of imported components can slow down the production flow of shipyards which reduces production efficiency and can also endanger the timely delivery of ships (Collins & Grubb, 2008, p. 30).

While Chinese shipbuilders suffer from the relative weakness of the domestic marine equipment industry and rely on imports of some types of ship subcomponents, the demand for steel is almost entirely domestically supplied. This is not surprising given China's dominant position as the world's largest steel producing country. With a total output of 822.4 million metric tons of crude steel in 2014 Chinese steel companies accounted for 49.4 percent of total global steel production. As a comparison value Japan, the second largest steel producer, had a total output of 110.7 million metric tons which is equivalent to only 13.5 percent of the Chinese total output. The development of total Chinese steel production and consumption from 2008 to 2014 is depicted in Figure 17 below:
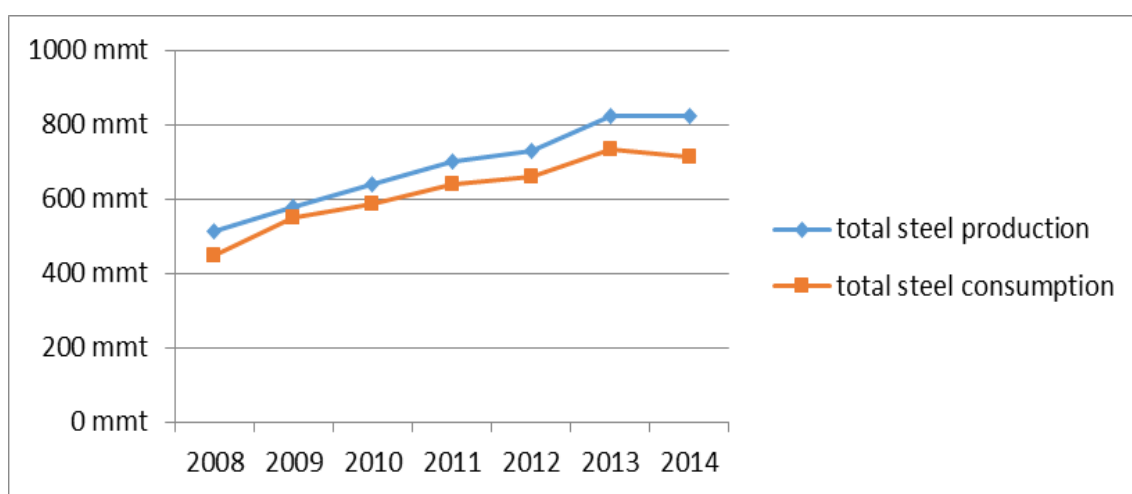
Figure 17: Development of Chinese crude steel production and consumption
Sources: World Steel Association, 2014 and World Steel Association, 2015a, p. 16

As shown in Figure 17 total Chinese steel production stood at 512 million metric tons in 2008 and has constantly increased ever since. Steel production reached a record high of 823 million metric tons in 2014. However, China is also the by far largest consumer of steel products. Demand for crude steel standing at 447 million metric tons in 2008 also rose steadily over the reviewed period and peaked at 735 million metric tons in 2013. Steel consumption only slightly decreased to 711 million metric tons in 2014 and hence, China accounted for 46.2 percent of global steel consumption. As Figure 17 illustrates, China had a production surplus of crude steel for every year from 2008 to 2014. While both output and domestic consumption of steel grew rapidly over the reviewed period also the production surplus increased from 65 million metric tons in 2008 to 112 million metric tons in 2014 (World Steel Association, 2015a, pp. 15-16).

Regarding the total number of Chinese steel companies the author could not find reliable data. However, it can be said that the Chinese steel industry is dominated by a number of large state-owned companies. Table 3 lists the world's largest steel producing companies as well as the top ten Chinese steel companies:

Rank	Company	Headquarter	Output 2014 (mmt)
1	ArcelorMittal	Luxembourg	98.088
2	Nippon Steel Corporation	Japan	49.300
3	Hebei Steel Group	China	47.094
4	Baosteel Group	China	43.347
5	POSCO	South Korea	41.428
6	Shagang Group	China	35.332
7	Ansteel Group	China	34.348
8	Wuhan Steel Group	China	33.053
9	JFE Steel Corporation	Japan	31.406
10	Shougang Group	China	30.777
12	Shandong Steel Group	China	23.336
17	Maashan Steel	China	18.903
18	Tianjin Bohai Steel	China	18.488
20	Benxi Steel	China	16.261

Table 3: Global top ten steel-producing companies and largest Chinese firms

Source: World Steel Association, 2015b, p. 1

As Table 3 illustrates six Chinese steel companies namely Hebei Steel, Baosteel, Shagang, Ansteel, Wuhan Steel and Shougang were among the ten largest steel producers in 2014. The largest ten Chinese steel companies had a cumulative output of 300.9 million metric tons in 2014 which made up 36.6 percent of the total Chinese output and corresponds to more than the combined output of the world's second, third and fourth largest steel producers Japan, the United States and India. In total 27 Chinese companies were ranked among the global top 50 steel producers measured by output in 2014 (World Steel Association, 2015b, p. 1).

However, China is not only the by far largest producer and consumer of crude steel, but also the largest steel exporter. In 2014 Chinese steel companies exported 92.9 million metric tons of steel which is more than double the export volume of the second largest steel exporter Japan. In the same year some 14.9 million metric tons of mainly higher grade steel were also imported. This resulted in a trade surplus of 78 million metric tons of steel which makes China the largest net exporter of steel followed at a respectful distance by Japan and Russia (World Steel Association, 2015a, p. 27). The huge production output and competitive position of China's steel industry is definitely an advantage for Chinese shipbuilders as they have access to a large supply of cheap shipbuilding steel. According to the China Metallurgic

Industry Planning and Research Institute Chinese shipbuilders consumed 13 million metric tons of steel in 2014 which was almost entirely supplied by domestic companies. Therefore the Chinese shipbuilding industry accounted for 1.8 percent of total domestic steel consumption. The domestic demand for shipbuilding steel is also expected to rise to 13.5 million metric tons in 2015 (Xinhua Finance, 2015).

4.3.2 Related and Supporting Industries in South Korea

In South Korea the shipbuilding industry is part of a sophisticated maritime cluster which includes well established upstream and downstream industries. This maritime cluster is also connected to other clusters such as logistics and electronics. The Korean ship subcomponent and marine equipment industry constitutes a major part in the shipbuilding supply chain and therefore also forms part in the South Korean maritime cluster (OECD, 2014, p. 11). In South Korea the production of ship subcomponents and marine equipment has become more important over the last decades. While in the past most shipbuilding work including the manufacturing of many ship subcomponents was carried out directly at the shipyards, the production of marine equipment has become more and more technologically advanced and nowadays requires highly sophisticated and specialized manufacturing hubs. Therefore many South Korean firms are specialized in the manufacturing of ship subcomponents and marine equipment and supply the shipyards with high quality finished products. Marine equipment also makes up for a large share of a ship's total value with estimates ranging from 50 to 70 percent for low or medium complexity ships and up to 80 percent for high complexity ships (ECORYS, 2009, pp. 7-8).

In South Korea the ship subcomponent and marine equipment industry is an important industry on its own, comprising of some 700 companies which employ a total workforce of roughly 65.000 people. Some 180 of these marine equipment manufacturing firms are also active members of the South Korean Marine Equipment Association (KOMEA). These KOMEA member firms account for roughly 80 percent of total ship subcomponent and marine equipment output in South Korea (KOMEA, 2016). The development of ship subcomponent and marine equipment output in South Korea is depicted in Figure 18 on the next page.

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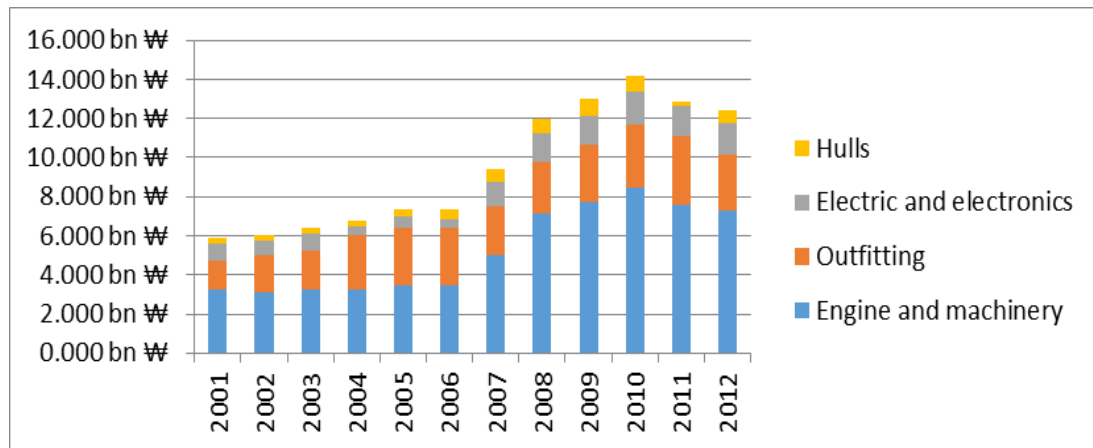
Figure 18: Development of total South Korean marine equipment output

Source: KOMEA as cited in KOSHIPA, 2014, p. 7

As can be seen from Figure 18 total output of marine equipment in terms of production value rose steadily starting from KRW 5.8 trillion (US$ 5.2 billion) in 2001 to KRW 14.2 trillion (US$ 12.5 billion) in 2010 and only slightly declined to KRW 12.4 trillion (US$ 10.9 billion) in 2012. Over the reviewed period total production output in terms of value has therefore more than doubled. In 2012, the last year for which data is available, 56.4 percent and hence more than half of production output with KRW 6.8 trillion (US$ 6.0 billion) was in the engine and machinery segment. Outfitting with a production value of KRW 3 trillion (US$ 2.7 billion) made up 25.4 percent of total marine equipment output. Electric and electronics accounted for KRW 1.6 trillion (US$ 1.4 billion) or 13.2 percent of total output and the hull sector reported a total production value of KRW 600 billion (US$ 530 million) which amounted to 5 percent of total South Korean marine equipment output (KOMEA as cited in KOSHIPA, 2014, p. 7).

Due to the strong increase in South Korea's production output of marine equipment over the past decades the country's shipbuilders source most of components domestically and are much less dependent on equipment imports than their Chinese rivals. In 2011 South Korean shipbuilders purchased ship components and marine equipment worth a total of US$ 10.1 billion of which only 15.3 percent or components worth US$ 1.55 billion were imported. Hence some 84,7 percent of South Korean shipbuilders' demand for ship components and marine equipment, worth a total of US$ 8.55 billion, was domestically supplied in 2011 (authors own calculations based on KOSHIPA, 2014, p. 7 and KOMEA, 2013[25] as cited in OECD, 2014, p. 23). Compared to the 40 percent localization rate of ship components and marine equipment in China, the South Korean rate for domestic subcomponent sourcing of

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[25] KOMEA data has been directly provided to the OECD.

84.5 percent is very high. This also shows the relative strengths of South Korea's marine equipment industry by international comparison which is a major advantage for the country's shipbuilders.

In addition to the ship equipment and marine subcomponent industry, the South Korean shipbuilding industry keeps also close ties with the domestic steel industry which supplies Korean shipyards with important raw materials for hull construction. In South Korea the domestic steel industry is considered as strategic. It supplies not only domestic shipyards with steel but also the automobile and construction industry with important raw materials. In 2009 roughly 78.000 people worked for South Korean steel manufacturers (Korea Iron and Steel Association [KOSA], 2016). While there is no reliable data on the number of steel manufacturing companies in South Korea it can be said that the industry is dominated by only two large conglomerates namely the Pohang Iron and Steel Company (POSCO) as well as the Hyundai Steel Company. Figure 19 below depicts the development of total steel production and consumption in South Korea from 2005 to 2014:
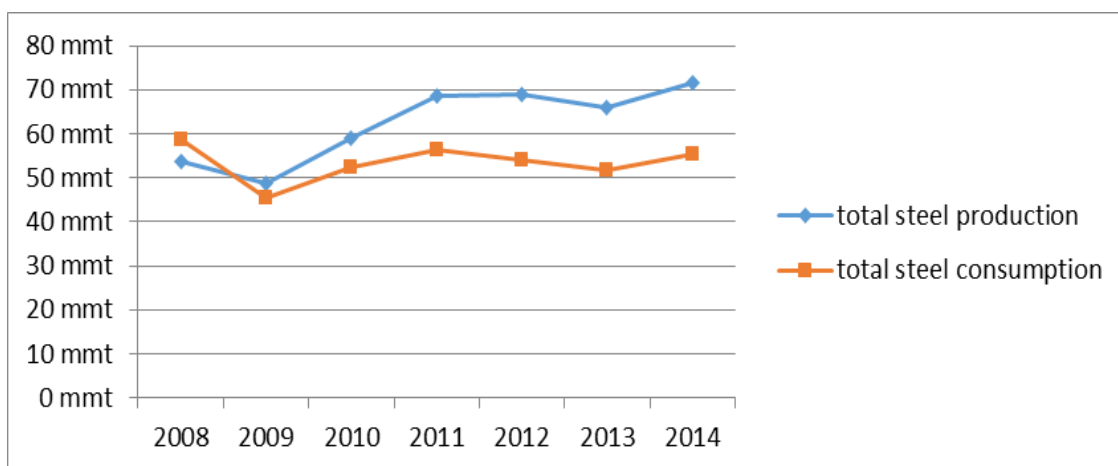
Figure 19: Development of South Korean crude steel production and consumption

Source: Korea Iron and Steel Association, 2016 and World Steel Association, 2015a, p. 16

As can be seen from Figure 19 total South Korean steel output stood at 53.6 million metric tons in 2008 and rose over the reviewed period to a peak of 71.5 million metric tons in 2014. In 2008 total South Korean steel consumption was higher than total domestic production (58.6 million metric tons of steel consumed to 53.6 million metric tons produced). However, from 2009 on steel production exceeded consumption in South Korea and this gap between supply and demand in crude steel rose steadily to a production surplus of 16.1 million metric tons in 2014 (World Steel Association, 2015a, p. 9). The two dominating steel companies POSCO and Hyundai together produced 62 million metric tons of steel in 2014 and hence accounted for roughly 87 percent of total South Korean steel output. POSCO with a production output of

41.1 million metric tons of steel was ranked as the fifth largest steel manufacturer worldwide. The Hyundai Steel Company had a total steel output of 20.6 million metric tons and was ranked as the fourteenth largest steel producer in 2014 (World Steel Association, 2015b, p. 1).

South Korea also surpassed Russia in terms of total steel output in 2014 and is now ranked as the fifth largest producer of crude steel worldwide only behind China, Japan, the United States and India. The Korean total steel output of 71.5 million metric tons made up 4.3 percent of total global steel production in 2014 (World Steel Association, 2015a, p. 9). Even though production of crude steel exceeds domestic consumption, South Korea not only exports but also imports significant amounts of steel. In 2014 South Korea ranked fourth in both, total steel exports as well as total steel imports. While 31.9 million metric tons of crude steel were exported also 22.4 million metric tons of steel were imported. With a trade surplus of 9.5 million metric tons of crude steel South Korea therefore also ranked as the fifth largest net exporter of steel products worldwide (World Steel Association, 2015a, p. 27).

In South Korea shipbuilding accounts for a significant portion of the total domestic steel consumption. In 2012 some 20.8 percent of total Korean demand for steel came from the shipbuilding industry. Shipbuilding therefore ranks third only behind the construction and automobile industry in terms of steel demand in South Korea. In shipbuilding mainly steel plate is required for the construction of hulls and a total of 5.6 million metric tons of steel or some 77.6 percent of domestically produced plate products were supplied to Korea's shipbuilding industry (KOSA, 2013 as cited in OECD, 2014, p. 11). However, South Korean shipbuilders demand for plate products is only partially domestically supplied. In addition to domestic supply Korean shipyards rely on imports of steel plate to meet demand. As has been discussed in Chapter 4.1.2 of this thesis, South Korean steel producers are faced with higher production costs compared to their Chinese rivals. Therefore it is not feasible for them to produce and sell steel products as cheaply as Chinese manufacturers do. Instead South Korean steel mills focus on the production of high quality steel products with more advanced properties. Especially high complexity ships such as LNG and LPG tankers are constructed with a double hull. For their construction specialized grades of steel with advanced anti-corrosion and lightweight properties are required. The South Korean steel industry is specialized in the production of such high grades of steel and supplies domestic shipbuilders with high quality steel plate while a significant portion of demand for lower grades of steel is imported from Japan and China (Brooks, 2015).

Conclusion

From the analysis of related and supporting industries in China and South Korea several conclusions can be drawn. Chinese shipbuilders suffer from a relatively weak domestic marine equipment industry which is still immature and lags international standards in some areas. For this reason they heavily rely on imports of some key components. In contrast, the South Korean marine equipment industry is very competitive by international comparison. Hence, more than 80 percent of South Korean shipbuilders demand for ship components and marine equipment is sourced domestically. In addition China's steel industry which is the largest in the world is definitely an advantage for Chinese shipbuilders as they have access to a large supply of cheap shipbuilding steel. South Korea also has a strong steel industry which supplies the domestic shipbuilding industry, but a significant portion of demand for plate steel is also imported. Due to higher production costs South Korean steel companies cannot compete on price with their Chinese rivals and therefore focus on the production of higher grades of steel. Domestic shipbuilders utilize the benefits of these high quality steel products for the construction of high complexity ships such as LNG and LPG tankers.

4.4 Firm Strategy, Structure and Rivalry

In this chapter the industry structure of shipbuilding sectors in China and South Korea is analyzed and discussed. This includes the number of firms and active yards in the home markets, as well as their ownership structure and market shares. In addition domestic shipbuilding companies' strategies are analyzed and the level of competition in the domestic shipbuilding market is evaluated.

4.4.1 Firm Strategy, Structure and Rivalry in China

In China most of the major state owned shipbuilding enterprises are incorporated into either the China State Shipbuilding Corporation (CSSC) or the China Shipbuilding Industry Corporation (CSIC) depending on their location. Both, CSSC and CSIC serve as umbrella organizations for state-owned shipbuilding related businesses and report to the State Council through the State Owned Assets Supervision and Administration Commission. While shipbuilding enterprises located in the northern half of China are controlled by the CSIC, most shipyards in Shanghai and south of the Yangtze fall under the umbrella of the CSSC (Collins & Grubb, 2008, p. 9). Besides major shipyards integrated into either CSSC or CSIC the Chinese State Council has also control over numerous smaller yards which are administered by local governments. In addition also the large state-owned shipping conglomerates such as

the China Ocean Shipping Group Company (COSCO), Sinotrans & CSC as well as the China Shipping Group run their own shipyards (Collins & Grubb, 2008, pp. 13-14).

Beyond state-owned shipyards also independent private companies run shipyards in China. Among the largest private shipbuilding companies in China are the Yangzijiang Shipbuilding Group which runs the largest Chinese shipyard Jiangsu YZJ with a total orderbook of 2.5 million CGT in 2015, the New Century Shipbuilding Group, the Yangfan Group, the Sinopacif Group, the Jiangsu Hanton Ship Heavy Industry Corporation and many more. While the abovementioned private enterprises rank among China's ten largest shipbuilding companies by orderbook volume in 2015 there are also numerous other independent shipyards most of which engage in the construction of small tankers and bulk carriers. Before the shipbuilding industry has been hit by the consequences of the international economic and financial crisis more than 300 private independent shipyards were operating in China. However, their number has decreased to 97 active yards in 2015 with a combined total orderbook of 17.3 million CGT as of March 2015 (Xing, 2015). Table 4 lists the top ten Chinese shipbuilding companies according to their orderbook volume as of October 2015:

Rank	Company	Type	No. of yards	Orderbook volume
1	China State Shipbuilding Corporation (CSSC)	state-owned	12	10 million CGT
2	China Shipbuilding Industry Corporation (CSIC)	state-owned	8	4 million CGT
3	Yangzijiang Shipbuilding Group	private	4	2.7 million CGT
4	China Ocean Shipping Group Company (COSCO)	state-owned	6	2.5 million CGT
5	Sinotrans & CSC	state-owned	4	1.5 million CGT
6	New Century Shipbuilding Group	private	2	1.5 million CGT
7	Yangfan Group	private	2	1.4 million CGT
8	China Shipping Group	state-owned	2	1.2 million CGT
9	Sinopacific Group	private	2	1.1 million CGT
10	Jiangsu Hantong Ship Heavy Industry Corporation	private	2	1.1 million CGT

Table 4: Top ten Chinese shipbuilding companies (October 2015)

Source: Li, 2015 (Clarkson Research)

As can be seen from Table 4 the China State Shipbuilding Corporation (CSSC) is the by far largest Chinese shipbuilding conglomerate in terms of total orderbook volume. The shipyards operating under the wing of CSSC are further subdivided into large shipyard group companies such as the Shanghai Waigaoqiao Shipbuilding Corporation, the Hudong-Zhonghua Group, the Guangzhou-Huangpu Group and the Jaingnan Shipyard Group (China State Shipbuilding

Corporation, 2016). These affiliated enterprises manage subsidiary shipyards and mainly function as independent corporate enterprises (Collins & Grubb, 2008, p. 9). Together the CSSC shipyards had a combined orderbook volume of roughly 10 million CGT in 2015 (Li, 2015). The second largest Chinese shipbuilding conglomerate is the state-owned China Shipbuilding Industry Corporation (CSIC) which controls shipyards in northern China. Just like CSSC also CSIC consists of several affiliated enterprises such as the Dalian Shipbuilding Industry Group, the Bohai Shipbuilding Heavy Industry Group or the Wuchang Shipbuilding Industry Group (China Shipbuilding Industry Corporation, 2016). In total eight large shipyards with a combined orderbook of 4 million CGT were operating under the CSIC in 2015 (Li, 2015). Also the three largest state-owned shipping conglomerates namely the China Ocean Shipping Group Company (COSCO), Sinotrans & CSC, and the China Shipping Group rank as the fourth, fifth and eighth largest Chinese shipbuilding companies in terms of orderbook volume. As can be seen from Table 4 the Yangzijiang Shipbuilding Group is the largest independent private Chinese shipbuilding company. With a total orderbook of 2.7 million CGT it was ranked as the third largest Chinese shipbuilding corporation, right behind the large state-owned conglomerates CSSC and CSIC. In addition to the Yangzijiang Shipbuilding Group four other private shipbuilding companies had orderbooks above one million CGT in 2015. These were the New Century Shipbuilding Group, the Yangfan Group, the Sinopacific Group as well as the Jiangsu Hantong Ship Heavy Industry Corporation which were also ranked among the ten largest Chinese shipbuilding companies in terms of orderbook volume in 2015 (Li, 2015).

As has been argued, the two large state-owned conglomerates CSSC and CSIC are the by far largest shipbuilding companies in China and account for a significant share of total shipbuilding orders and completions. However, also shipyards of the major state-owned shipping conglomerates as well as numerous private yards operate in China and hold significant market shares. Figure 20 on the next page depicts market shares of state-owned and independent private shipbuilding companies measured by orderbook volume in CGT terms as of October 2015.
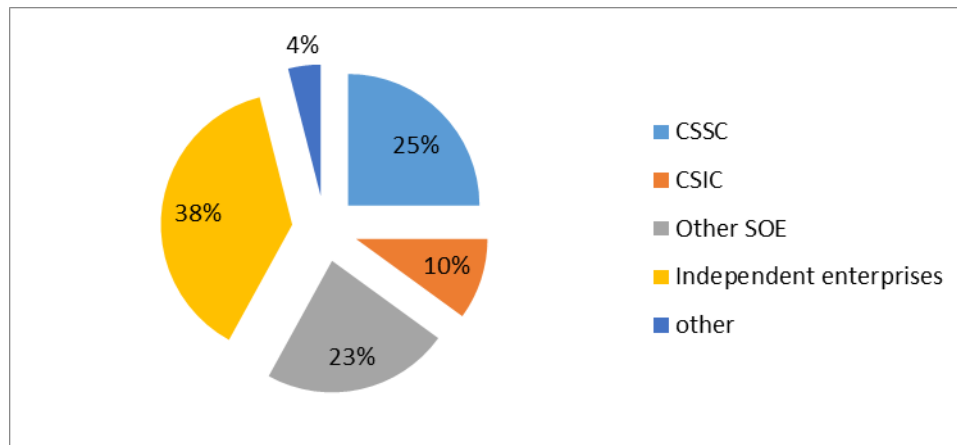
Figure 20: Market shares of Chinese yards in terms of orderbook volume (October 2015)

Source: Li, 2015 (Clarkson Research)

As Figure 20 depicts total shipbuilding orders placed at CSSC shipyards totaling 10 million CGT accounted for 25 percent of the total Chinese orderbook. Orders placed at CSIC shipyards made up 10 percent of total demand for Chinese built vessels. Shipyards of other state-owned enterprises had a combined orderbook of 9.2 million CGT and hence, held a combined market share of 23 percent. Shipbuilding orders of 15.3 million CGT were also placed at independent private shipbuilding companies. Therefore private firms accounted for 38 percent of the total Chinese orderbook, and their combined orderbook even exceeded the joint orderbook of the two giant state-owned conglomerates CSSC and CSIC. Other Chinese shipyards with no clear government background but significant overseas investment had a combined orderbook of 1.6 million CGT and held a market share of 4 percent (Li, 2015).

China's shipbuilding industry is also subject to constant change and some new shipyards have opened while many others, especially smaller ones, went out of business, merged with others or were renamed (Collins & Grubb, 2008, p. 14). Therefore also the number of Chinese shipbuilding companies or shipyards changes frequently. According to Clarkson Research data some 146 Chinese yards had at least one vessel of 1.000 CGT or above on order as of August 2015. Hence, the number of active Chinese yards is relatively high compared to 53 active yards in Japan and only 20 active South Korean shipyards (Springer, 2015b).

Regarding the strategy of Chinese shipbuilders it can be said that most companies make use of labor cost advantages towards foreign competitors and focus on the production of low complexity ships and especially on bulk carriers. In this segment Chinese shipbuilders are highly competitive as they produce standardized ship types in relatively large quantities which allows them to realize economies of scale. Hence, they can offer very competitive prices and clearly follow a cost leadership strategy in this market segment (ECORYS, 2009, p. 177).

However, Chinese shipbuilders are also diversifying into other market segments as they want to compete with their international rivals for lucrative orders of high complexity ships such as LNG and LPG carriers, very large crude carriers (VLCCs) or offshore platforms (Tsai, 2011, p. 50). Nevertheless the strong focus on the bulk carrier and tanker sector remains for most Chinese shipbuilders as can be seen from Figure 21 below which shows the orderbooks of the ten leading Chinese shipbuilding companies by vessel type. As this figure also clearly demonstrates only CSSC shipyards have significant orders of high complexity ships on their orderbooks which reflects their endeavor to break into this higher market segments.
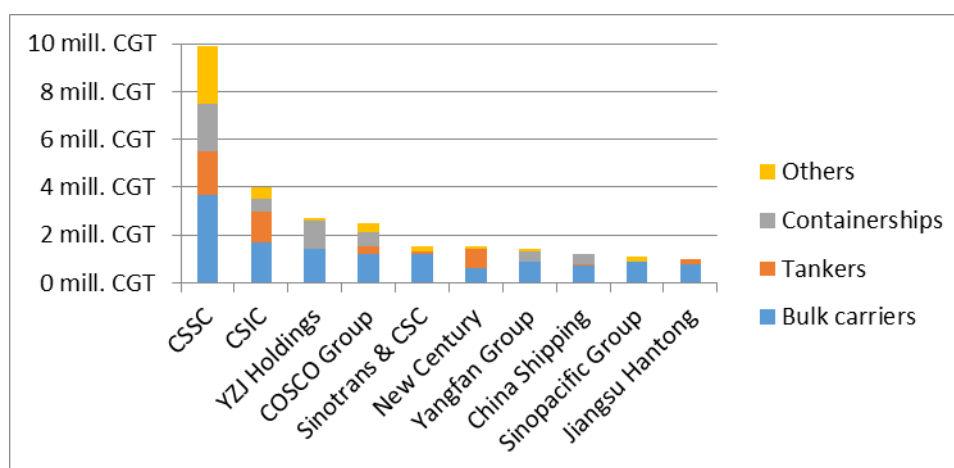
Figure 21: Orderbooks of China's top ten shipbuilding groups by vessel type

Source: Li, 2015 (Clarkson Research)

Last but not least also the level of competition among domestic shipbuilders is analyzed in this section. It can be said that while the Chinese shipbuilding industry has been and to some extent still is dominated by state-owned companies, a certain level of free-market competition has been introduced by the ruling authorities to promote development and technological progress in this strategic industry. Before 1999 Chinese shipbuilding enterprises with few exceptions were all operating under the umbrella of the CSSC which functioned as a state-owned monopoly for shipbuilding at that time. As a result of an antimonopoly initiative by the Chinese leadership shipyards in the north and west of China were spun off from CSSC and integrated into the newly formed CSIC. Regarding investment and capital management decisions both, CSSC as well as CSIC shipyards are allowed to act relatively autonomous from the state. Both conglomerates also directly compete for government contracts and on the international shipbuilding market (Collins & Grubb, 2008, p. 9).

However, in recent years the active promotion of competition within the domestic shipbuilding industry has been replaced by a government attempt to reduce shipbuilding overcapacity through the support of yard mergers. Through various policies the Chinese

ruling authorities try to encourage ordering at CSSC and CSIC yards and market conditions for private independent yards have deteriorated. Many of the smaller yards went out of business in the aftermath of the global economic and financial crisis which also resulted in reduced competition among the remaining shipyards (Li, 2015). Nevertheless the "presence of healthy competition between state-owned shipbuilders is remarkable and noteworthy within China's defense industrial establishment" (Collins & Grubb, 2008, p. 9).

4.4.2 Firm Strategy, Structure and Rivalry in South Korea

The South Korean shipbuilding industry is dominated by a few chaebol companies. Chaebol are huge family-owned business conglomerates which keep close relationships with the government and exercise control over a large number of subsidiaries operating in various industries. These business conglomerates are characterized by a complex system of cross-unit equity investment and are controlled by very powerful chairmen who exert power over all business operations (Jung, 2004, pp. 299-300). Due to the dominance of these chaebol, South Korea's shipbuilding industry is heavily concentrated. According to KOSHIPA some 80 shipbuilding companies were operating in South Korea at the end of 2013 out of which nine were large and the remaining 71 small and medium sized enterprises (KOSHIPA, 2013 as cited in OECD, 2014, p. 6). However, as of August 2015 only 20 yards had a vessel of 1.000 CGT and above on order. Compared to 146 and 53 active shipyards in China and Japan, this is a relatively small number (Springer, 2015b). In the past decade many small and medium sized Korean shipbuilders went out of business due to the slump in demand for new ships, and few very large conglomerates divide the market between themselves. Figure 22 below presents market shares of Korean shipbuilding companies in terms of completions in 2013:
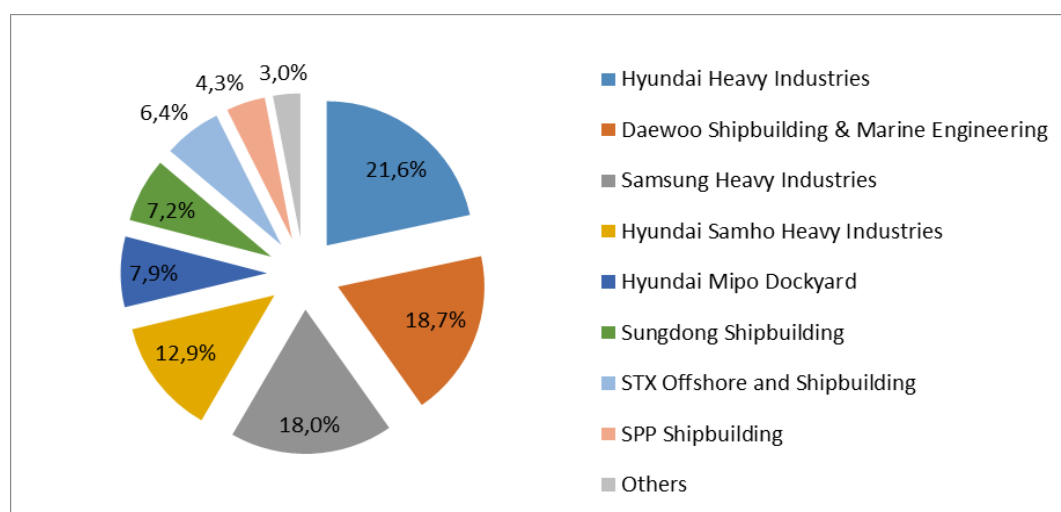

Figure 22: Market shares of South Korean shipbuilding groups in terms of completion

Source: IHS, 2013 as cited in OECD, 2014, p. 13

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As Figure 22 illustrates the top three South Korean shipbuilders Hyundai Heavy Industries (HHI), Daewoo Shipbuilding and Marine Engineering (DSME) and Samsung Heavy Industries (SHI) dominate the South Korean market in terms of completions. Their joint production output made up 58.3 percent of total South Korean output in 2013. Figure 22 also demonstrates the high level of concentration of the Korean shipbuilding industry in which the eight largest companies together accounted for 97 percent of total shipbuilding output (IHS, 2013 as cited in OECD, 2014, p. 13). The dominating South Korean shipbuilding companies are also the largest in the world in terms of orderbook volume as is depicted in Table 5 below:

Rank	Company	Country	No. of yards	Orderbook
1	Hyundai Heavy Industries	South Korea	3	11.02 million CGT
2	Daewoo Shipbuilding and Marine Engineering	South Korea	2	5.96 million CGT
3	Samsung Heavy Industries	South Korea	2	5.50 million CGT
4	Hyundai Mipo Dockyard	South Korea	2	4.82 million CGT
5	Imabari Shipbuilding	Japan	8	4.18 million CGT
6	STX Offshore and Shipbuilding	South Korea	7	3.88 million CGT
7	Japan Marine United	Japan	6	3.36 million CGT
8	Shanghai Waigaoqiao Shipbuilding (CSSC)	China	2	2.84 million CGT
9	Yangzijiang Shipbuilding	China	2	2.60 million CGT
10	Hudong Zhonghua Shipbuilding (CSSC)	China	2	2.38 million CGT

Table 5: World's ten largest shipbuilding companies by orderbook volume (July 2014)[26]

Source: Korean Shipping Messenger, 2014

As shown in Table 5 the Korean chaebol Hyundai, Daewoo and Samsung are the largest shipbuilding companies in the world. Hyundai Heavy Industries is the largest shipbuilder worldwide if measured by orderbook volume in CGT terms followed by Daewoo Shipbuilding and Marine Engineering, Samsung Heavy Industries and Hyundai Mipo Dockyard. Also STX Offshore and Shipbuilding is ranked among the ten largest shipbuilders worldwide on sixth position. With an orderbook amounting to roughly 11 million CGT in 2014 Hyundai Heavy Industries accounted for 33.4 percent of the South Korean and 9.8 percent of the total global orderbook. Daewoo Shipbuilding and Marine Engineering had an order backlog of ships totaling 5.96 million CGT which made up 18.1 percent of the domestic and 5.3 percent of the global shipbuilding market. The orderbook of the third largest Korean shipbuilding company Samsung Heavy Industries stood at 5.5 million CGT and hence accounted for 16.7 percent of

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[26] In this ranking the shipyards incorporated into the CSSC and CSIC are regarded as individual business enterprises.

the South Korean and 4.9 percent of the total global orderbook (Korean Shipping Messenger, 2014). Together the three largest South Korean shipbuilding companies had an order backlog of vessels totaling 22.5 million CGT in 2014. Thus, they jointly held 68.1 percent of the South Korean and 19.9 percent of the total global orderbook (authors own calculations based on Korean Shipping Messenger, 2014).

In contrast to China where shipbuilding is dominated by state-owned enterprises, this is quite the opposite in South Korea where most shipbuilding companies are privately held (OECD, 2014, p. 15). Only five out of 80 are listed on the Korean stock exchange (Korea Exchange, 2016). The Korean government does not run its own state-owned shipbuilding enterprises, but state-owned entities function as shareholders of those shipbuilding companies that are public listed. In Table 6 below the five largest shareholders of the publicly listed South Korean shipbuilding companies are presented:

	Shareholder 1	Shareholder 2	Shareholder 3	Shareholder 4	Shareholder 5
HHI	Hyundai Heavy Industries	Mong-joon Chung	Hyundai Mipo Dockyard	KCC Corporation	National Pension Service of Korea
% share	**15.6 %**	**10.2 %**	**7.98 %**	**7.01 %**	**5.03 %**
DSME	Government of South Korea	Financial Service Commission	National Pension Service of Korea	Templeton Asset Management	APG Asset Management
% share	**49.7 %**	**8.51 %**	**4.96 %**	**4.31 %**	**1.26 %**
SHI	Samsung Electronics	Samsung Heavy Industries	National Pension Service of Korea	Samsung Life Insurance	Samsung Electro-Mechanics
% share	**17.6 %**	**11.2 %**	**4.04 %**	**3.38 %**	**2.39 %**
Hanjin HI	Hanjin Heavy Industries Holdings	Hanjin Heavy Industries	National Pension Service of Korea	Dimensional Fund Advisor	The Vanguard Group
% share	**32.1 %**	**6.76 %**	**4.00 %**	**1.65 %**	**0.70 %**
Hyundai Mipo	Hyundai Heavy Industries	Government of Saudi Arabia	National Pension Service Korea	Templeton Investment Counsel	The Vanguard Group
% share	**42.3 %**	**4.47 %**	**3.86 %**	**0.88 %**	**0.82 %**

Table 6: Top five shareholders of listed South Korean shipbuilding companies

Source: Korea Exchange, 2016 and Surperformance, 2016

As depicted in Table 6 the shipbuilding companies listed on the Korean stock exchange are Hyundai Heavy Industries, Daewoo Shipbuilding and Marine Engineering, Samsung Heavy Industries, Hanjin Heavy Industries as well as Hyundai Mipo Dockyard. The depiction of major shareholders also illustrates the chaebol typical method of cross holdings through subsidiaries and affiliated enterprises which is especially the case for Samsung Heavy Industries. The Korean government through the National Pension Service acts as a shareholder in all five companies. In addition it is the major shareholder of Daewoo Shipbuilding and Marine Engineering which came under severe financial pressure during the global economic and financial crisis. The Korean government and government-related agencies such as the Korean Development Bank and the Export-Import Bank of Korea acted as main creditors and after a government bailout debt was covered into equity (Business News Korea, 2015; OECD, 2014, p. 15).

Regarding the strategy of South Korean shipbuilders, two groups of companies which operate in different market segments and cover different product mixes need to be distinguished (Springer, 2015b). Figure 23 below depicts the joint orderbook of the big three South Korean shipbuilding companies Hyundai Heavy Industries, Daewoo Shipbuilding and Marine Engineering and Samsung Heavy Industries by vessel type as of August 2015 and compares it to the joint orderbook of the remaining South Korean shipyards:
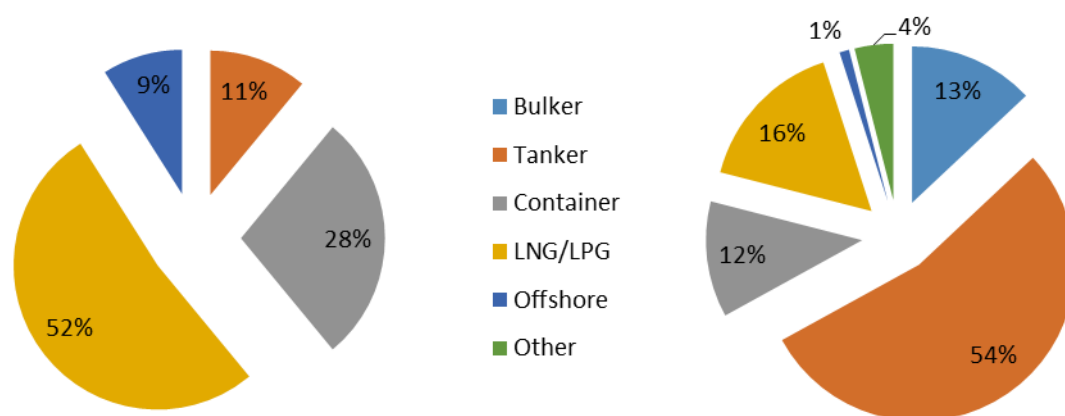
Figure 23: Orderbook at the big 3 Korean yards (left) and at remaining yards (right) by vessel type
Source: Springer, 2015b (Clarkson Research)

As can be seen from Figure 23 the big three South Korean shipbuilding companies are heavily focused toward the construction of medium and high complexity ships. While containerships accounted for 28 percent of their joint orderbook, liquefied natural gas (LNG) carriers and liquefied petroleum gas (LPG) carriers made up 52 percent of their order backlog. In addition orders for offshore vessels which are also classified as high complexity ships made up 9

percent of their joint orderbook. As Figure 23 illustrates the joint orderbook of the big three companies did not include orders of bulkers and those of tankers only accounted for 11 percent of total orders in CGT terms. In contrast the remaining South Korean shipbuilders are more focused on the market for lower complexity ships such as bulkers and tankers with the latter accounting for more than half of their combined orderbook in CGT terms. While medium and high complexity ships made up 89 percent of the joint orderbook of the big three HHI, DSME and SHI, these ship types accounted for only one third of the order backlog of the remaining Korean shipbuilders (Springer, 2015b).

The orderbook composition of South Korean shipbuilding companies and especially that of the big three shipbuilders reflects the trend to move from lower to higher market segments. While South Korean shipbuilders try to compete with Chinese and Japanese rivals over ship prices, this is becoming more and more difficult as they are faced with rising labor costs. Hence, South Korean shipbuilders are shifting operations to low cost countries in order to stay competitive. Examples are Hyundai Heavy Industries which has established three joint ventures in China or Daewoo Shipbuilding and Marine Engineering which runs its second yard in China (ECORYS, 2009, p. 176). In addition the major South Korean shipbuilders try to avoid pure cost-based competition in lower-end market segments by focusing on the construction of more sophisticated high-value-added products such as LNG and LPG carriers but also eco-ships and other specialty vessels (KOSHIPA, 2014, p. 4).

Due to the slump in newbuilding orders after the global economic and financial crisis from which the shipbuilding industry has not yet fully recovered, South Korean shipbuilders also try to diversify revenue streams by breaking into new markets. Therefore the offshore oil and gas sector has been given high priority by shipbuilders in recent years and all major Korean shipbuilding companies now also specialize in the production of offshore equipment, drill ships and offshore plants (OECD, 2014, p. 50). Reflecting this trend the Korea Shipbuilders' Association was renamed into Korea Offshore and Shipbuilding Association in 2013 and its member companies follow the vision for diversification into the offshore sector under the slogan "from shipbuilders to ocean builders" (KOSHIPA, 2014, p. 3).

More generally it can be said that South Korean shipbuilders pursue an ambidextrous strategy. On the one hand they try to realize further gains in production efficiency and cost savings which suggests they follow a cost leadership strategy for some market segments. On the other hand, however, they also pursue a differentiation strategy by diversifying into higher market segments through investing in technological innovation and focusing on the construction

of high-value-added products which require advanced technology for construction and for which higher prices can be charged (ECORYS, 2009, p. 175).

Despite the general market downturn in global shipbuilding due to a slump in demand for new vessels and the growing competition coming from Chinese shipbuilders which drives down prices of most vessel types, the biggest problem that Korean shipbuilders face is hyper-competition in their home market. The main reason for this excessive competition among domestic players is the longstanding rivalry between the chaebol Hyundai and Samsung. According to industry watchers these two conglomerates would do anything to gain advantage over the other. This is also reflected in their press statements which usually emphasize on the own superiority or success over the other in winning a tender (Hellenic Shipping News, 2015). As a consequence of this intense rivalry companies sacrifice margins to outbid others and win orders. This has resulted in depressed prices for most ship types which has additionally worsened the financial situation of major Korean shipbuilders (Park, 2012).

Conclusion

In this chapter the structure and strategies of Chinese and South Korean shipbuilding companies have been analyzed and the intensity of rivalry or the level of competition between domestic shipbuilders has been assessed. From this analysis several conclusions can be drawn. In China, the shipbuilding industry comprises of state-owned as well as independent private shipbuilding companies. State-owned enterprises account for more than half of the total shipbuilding output and many of them are incorporated into one of the two large state conglomerates CSSC and CSIC. In South Korea the shipbuilding industry is dominated by large chaebol companies. Most shipbuilding companies are privately held and only five are listed on the Korean stock exchange. These include the chaebol Hyundai Heavy Industries (HHI), Daewoo Shipbuilding and Marine Engineering (DSME) and Samsung Heavy Industries (SHI) which are the largest shipbuilding companies in the world and together account for more than two thirds of the Korean shipbuilding market. In South Korea eight shipbuilders account for 97 percent of the total shipbuilding output which makes the Korean shipbuilding industry much more concentrated than the Chinese one. This is also reflected in the number of shipyards which is significantly higher in China than in South Korea. Chinese shipbuilders are heavily focused toward the production of low complexity ships, especially bulk carriers, which they produce in large quantities. They make use of labor cost advantages toward their Korean competitors and follow a cost leadership strategy. In Korea there are two groups of shipbuilding companies which focus on different market segments. The big three

shipbuilders mainly serve higher market segments for medium and high complexity ships while for the remaining companies low complexity ships such as bulkers and tankers account for roughly two thirds of the order volume. South Korean shipbuilders pursue an ambidextrous strategy. While they follow a cost leadership strategy for some market segments especially the big chaebol companies try to diversify revenue streams through investing in technological innovation and breaking into new markets such as the offshore oil and gas sector where they can charge higher prices for premium products. While in China there is a certain level of free-market competition also among state-owned companies, South Korean shipbuilders are faced with excessive competition in their home market mainly due to the longstanding rivalry between Hyundai and Samsung which has resulted in depressed prices for most ship types.

4.5 The Role of the Government

In this chapter the role of the government in China and South Korea for the success of the national shipbuilding industry is discussed. This includes an analysis of the level of government intervention in both countries' marine industries. Therefore government policies affecting shipbuilding are reviewed and discussed and the different types of subsidies provided to domestic shipbuilding companies are analyzed. This chapter also includes an assessment of industry regulations and further supportive measures put forward by the two countries' governments. In addition also the role of foreign investment in the Chinese and South Korean shipbuilding industry is discussed in this chapter.

4.5.1 The Role of the Government in China

In the long history of shipbuilding, global market leadership has shifted several times and shipbuilders of different nations have only managed to become internationally competitive when they were supported by their national governments. This also applies to China were the success and growth of domestic shipbuilders can to a large extent be attributed to the strong government support for the industry (Krishnan, 2011, p. 76). The Chinese shipbuilding industry has greatly benefited from government reforms of the manufacturing and industrial sector and especially from the defense conversion program introduced under Deng Xiaoping in 1982 (Collins & Grubb, 2008, p. 1). In the 1990s at a time when China was transforming from a centrally planned to a market based economy the defense conversion process was "primarily concerned with transforming former military-oriented enterprises into organizations that could compete effectively and profitably in the commercial marketplace" (Cheung, 2009, p. 60). As

part of this defense conversion program the fifth National Congress eliminated the Sixth Ministry of Machine Building and established the China State Shipbuilding Corporation (CSSC). All state-owned entities performing shipbuilding activities were corporatized under the wing of the CSSC which enjoyed a high degree of market-based economic autonomy and bureaucratic freedom that was previously unknown in the Chinese communist system (Collins & Grubb, 2009, p. 350).

In 1999 the Chinese leadership decided to establish the China Shipbuilding Industry Corporation (CSIC) and to integrate shipyards operating in the northern half of the country which were former controlled by the CSSC into this new conglomerate. This decision by the Chinese government to break up the shipbuilding monopoly formerly held by the CSSC and to allow a certain level of competition among domestic shipbuilders also contributed to the rise of the industry as a global market leader (Collins & Grubb, 2008, p. 9).

As has been argued the Chinese government provided state-owned shipbuilding companies with a high degree of bureaucratic freedom and firms were given the right to hire and fire workers freely which greatly benefited shipyards' production efficiency. Chinese shipbuilding companies enjoyed this leeway because of government plans to make shipbuilding a strategic industry. The domestic shipbuilding industry was identified as key sector for the economic development of China in the year 2000 and two years later the State Commission of Science, Technology and Industry for National Defense (COSTIND) set the target for China to replace South Korea as market leader in global shipbuilding by 2015 (Krishnan, 2011, p. 76). In order to reach this goal a program for the development of the domestic shipbuilding industry was formulated as part of China's eleventh five-year economic plan. This program included the promotion of foreign investment and the creation of Sino-foreign joint ventures in the maritime sector and supported the construction of major shipbuilding facilities. In addition it also targeted a significant increase in annual production output of domestically produced ship subcomponents, marine equipment, diesel engines and ships (Tsai, 2011, p. 43).

In order to achieve this leading position in global shipbuilding the Chinese government has also introduced numerous types of subsidies and other policies to support the domestic shipbuilding industry. First and foremost the Chinese government supports its domestic shipbuilding companies financially. Instead of direct state financing the Chinese government makes use of the banking sector to provide funding to its state-owned shipbuilding enterprises and has encouraged state-owned and private banks to give cheap loans to domestic shipbuilders (Tsai, 2011, p. 45). In some provinces such as Jiangsu province the local

government also provides a debt guarantee scheme to investors and shipbuilders. Land acquisitions of Chinese shipbuilding companies are also subsidized through the State. Usually land is offered at preferential rates, in some provinces at only 30 percent of the valued price and the government also provides a capital tax subsidy for the purchase of land (KPMG, 2007[27] as cited in Krishnan, 2011, pp. 77-78). In China the domestic shipbuilding market is heavily protected and the Ministry of Finance has placed tariffs on the import of ships. The rates charged on imported ships vary depending on the ship type and range from 3 to 10.5 percent of the contract value. As has been argued the Chinese shipbuilding industry also benefits from a strong home demand for new ships which is for the most part domestically supplied. Chinese ship owners mainly buy domestically built vessels because they profit from a direct government subsidy of 17 percent of the contract price for Chinese built ships. In addition major state institutions such as the State Oceanic Administration are required to purchase domestically built vessels when these are cost-effective (OECD, 2007 as cited in Tsai, 2011, p. 44).

Chinese shipbuilding companies also enjoy government support regarding the export of ships. The Export-Import Bank of China provides export seller credits to domestic shipbuilding companies and export buyer credits to foreign buyers of Chinese built ships at preferential interest rates (Export-Import Bank of China, 2016). In addition losses of state-owned shipyards made while working on foreign orders are reimbursed by the government if the shipyard has made a high contribution to China through constructing a vessel for export. The purchase of Chinese built ships is also made more attractive to foreign customers by the government which gives a full refund of valued-added tax (VAT) which is 17 percent in China to foreign ship buyers. In shipbuilding it is common that parts of the contract value for larger orders need to be paid in advance in order for the shipyard to cover running costs. To further attract foreign customers and support the export of domestically built vessels the Chinese central government gives refund guarantees on advance payments made by foreign customers (KPMG, 2007 as cited in Krishnan, 2011, p. 77).

In addition to the already mentioned subsidies and support measures Chinese shipbuilders also benefit from a bunch of other government policies geared toward the success of the domestic shipbuilding industry. Domestic shipbuilders enjoy exemption from the enterprise income tax under certain circumstances. Shipyards which invested in new infrastructure

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[27] In 2007 the Shipyard Association of India on behalf of the Indian Ministry of Finance commissioned the consulting company KPMG to conduct a study on shipbuilding subsidies given by other major shipbuilding nations. The KPMG report called "Shipbuilding Sector: Economic Benefits and Benchmarking Government Support across Countries" was submitted to the Indian Ministry of Shipping (Manoj, 2007). However, it is not freely accessible and hence extracts from this report are cited from Krishnan (2011) in this thesis.

before 2010 were exempted from income tax for a maximum of five years (Ludwig & Tholen, 2006, p. 22). Also shipbuilding companies located in the shipbuilding industrial zones in the Zhejiang and Liaoning provinces enjoy a reduction of enterprise income tax. Besides exemption from income tax shipbuilding companies also import most key ship subcomponents at zero customs duty and get a refund of value-added tax paid on these imports. The Chinese government is also providing assistance for poorly performing state yards which need to modernize or undergo financial restructuring. Such yards can apply for a debt to equity swap to the central government (KPMG, 2007 as cited in Krishnan, 2011, p. 78). In order to foster innovation in the domestic shipbuilding industry China is also promoting scientific research in the shipbuilding realm and has established maritime universities and also financially supports the research and development efforts undertaken by shipbuilding companies (Tsai, 2011, p. 44).

While the scarce information on policy measures regarding shipbuilding that is publicly available has been used for the analysis of government influence on Chinese shipbuilding in this section, the author had to refrain from including subsidy volume in this analysis due to a lack in data availability. As the World Trade Organization (WTO) points out, "reliable sources of information on industrial subsidies are scarce and mostly incomplete (and) systematic data are non-existent" (WTO, 2006, p. 34). Also Kalouptsidi (2014) in his study of industrial subsidies in global shipbuilding notes that "because of institutional and strategic reasons, the information on subsidies that the Chinese government provides has rampant missing and misreported data" (Kalouptsidi, 2014, pp. 5-6).

As has been argued the Chinese government also tries to close the gap in technology between its domestic shipbuilding companies and their international rivals through promoting foreign investment. Therefore it allows foreign investors to enter the domestic market and cooperate with Chinese shipbuilding companies. Domestic shipbuilders are also allowed to set up joint ventures with foreign partners and international investors can buy shares of Chinese owned shipbuilding firms. However, shareholdings of foreign investors are limited to 49 percent and shipbuilders of other nations are not allowed to set up wholly-owned foreign subsidiaries in China (Ludwig & Tholen, 2006, p. 23). Unfortunately, there is no reliable information regarding the total amount of foreign investment into the Chinese shipbuilding industry available to the author and also the actual number of joint ventures between Chinese and foreign shipbuilding companies is unclear. However, while only two Sino-foreign joint ventures participating in shipbuilding activities existed in 1999, a rising trend toward more foreign investment into the Chinese shipbuilding industry can be observed. In recent years

some large Sino-foreign joint ventures have been created. Foreign shipbuilders participating in such joint ventures are amongst others the Japanese conglomerate Tsuji Heavy Industries and the Tsuneishi Group as well as the South Korean chaebol Samsung Heavy Industries and Daewoo Shipbuilding and Marine Engineering (Collins & Grubb, 2008, pp. 16-17). The Chinese government requires such joint-ventures to also establish technical centers in China to absorb technological know-how from foreign investors. The opening of the Chinese shipbuilding industry, the establishing of joint ventures with foreign partners and the resulting knowledge transfer has benefited domestic companies. As Tsai (2011) argues, "the entry of large, foreign shipbuilding enterprises reflects this opening of the market and has resulted in a significant expansion of production capability, which in turn has strengthened the competitiveness of the Chinese shipbuilding industry" (p. 49).

All in all the analysis of government policy regarding shipbuilding has revealed that the Chinese shipbuilding industry is heavily supported by the national government and owes much of its international success to various government support measures. Domestic shipbuilders operate in a protected market and benefit from a number of different types of government subsidies. This analysis has also demonstrate that the Chinese government strongly intervenes in the domestic shipbuilding industry which is further backed by the findings of Kalouptsidi (2014) who tried to detect the presence and magnitude of government subsidies in global shipbuilding. Most large Chinese shipyards are also state-owned as has been discussed in Chapter 4.4.1 of this thesis and hence the state also exerts considerable influence over the domestic shipbuilding industry.

4.5.2 The Role of the Government in South Korea

The origin of shipbuilding industry policy in South Korea can be traced back to 1958 when the central government passed the act on the encouragement of shipbuilding. From this time on shipbuilding featured in the five-year economic plans which aimed for the promotion of South Korea's industry (OECD, 2014, p. 23). In the 1970s the South Korean government focused on the promotion of heavy industries including steel-making, machinery and shipbuilding. At a time when the international shipping market was rapidly expanding the Korean government made shipbuilding a strategic industry and heavily supported domestic shipbuilding companies through political, financial and educational activities. Korean shipbuilders were encouraged by the government to build very large vessel types. The chaebol Hyundai, Samsung and Daewoo made use of this favorable market conditions and rapidly

expanded their shipbuilding capacity through the construction of large shipyards (Shin & Hassink, 2011, p. 1393).

Besides investing in capacity built up, the government also provided information on shipbuilding know-how and heavily supported market expansion in this early stage of Korean shipbuilding. After the promulgation of a law to promote domestic shipbuilders in 1976 the domestic shipbuilding industry had a double digit annual growth rate until the mid-1980s (Shin & Hassink, 2011, p. 1399). However, while a strong government policy during the 1960s and 1970s has initially helped South Korean shipbuilders to establish themselves as global market leaders, the level of government intervention in the domestic shipbuilding industry significantly decreased when Korean shipbuilders had established themselves as major global players. The Korean government noted that "government support is not a critical engine for industry success" and argued that domestic shipbuilders were treated unfavorably compared to rival companies in other countries where governments actively promote shipbuilding and therefore provide strong support to domestic shipbuilders (OECD, 2014, p. 32). Nevertheless, the South Korean government still supports the domestic shipbuilding industry through a number of subsidies and other support measures. In order to protect the domestic shipbuilding market the Korean government has implemented specific controls on the purchase of foreign built vessels which provide a non-tariff barrier to foreign shipbuilding companies competing for Korean shipbuilding contracts. In South Korea there are also strong financial linkages between shipping companies demanding for new vessels, banks, and shipbuilders and as a result the overwhelming majority of domestic shipbuilding orders is also placed at South Korean shipyards (Bruce & Garrard, 2013, p. 39).

Besides establishing trade barriers that restrict the import of ships, South Korean shipbuilders benefit from some other government measures. Domestic shipbuilding companies as well as South Korean ship buyers traditionally enjoy preferential access to funds from state related export credit agencies and state-owned banks. Major providers of shipbuilding financing are the export credit agency Korea Trade Insurance Corporation (K-Sure) and the Export-Import Bank of Korea (KEXIM). In addition also policy banks such as the Korea Development Bank (KDB), the Korea Exchange Bank (KEB), and the Korea Finance Corporation (KFC) financially support domestic shipbuilding companies (Global Trade Review, 2014, p. 31). The Korea Trade Insurance Corporation (K-Sure) operating under the Ministry of Trade, Industry and Energy (MOTIE) mainly provides working capital supports as well as export credit insurance to domestic shipbuilding companies but also assumes pre-shipment export credit guarantees. The Export-Import Bank of Korea (KEXIM)

under the Ministry of Strategy and Finance (MOSF) provides loans to support working capital of Korean shipbuilders and also handles export credit loans (OECD, 2014, p. 26). Figure 24 below depicts financial support from export credit agencies and state-owned banks to Korean shipbuilders in terms of monies committed each year from 2004 to 2013:
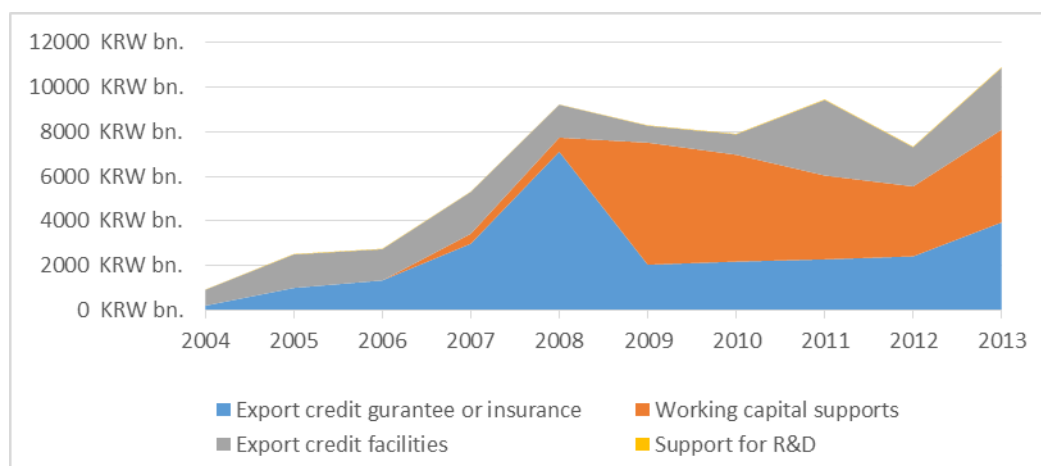
Figure 24: Monies committed to Korean shipbuilders by state agencies 2004 – 2013
Source: OECD, 2014, p. 31

As Figure 24 illustrates monies committed to South Korean shipbuilders have significantly increased over the reviewed period from 2004 to 2013. In 2004 financial support from Korean export credit agencies and state-owned banks to domestic shipbuilders amounted to KRW 925 billion (US$ 806 million). Export credits totaling KRW 713 billion accounted for the bulk of financial support followed by export credit guarantees or insurance amounting to KRW 201 billion and KRW 11 billion committed for the support of research and development (R&D). Until 2008 monies committed to Korean shipbuilding companies have increased almost tenfold from KRW 925 billion in 2004 to KRW 9.2 trillion in 2008. This development was mainly due to a significant increase in the provision of export credit guarantees and insurance as can be seen from Figure 24 (OECD, 2014, p. 31).

In 2008 the financial and economic crisis also severely affected the global shipbuilding industry. The ship finance market almost collapsed, demand for new ships plummeted and many already placed orders were cancelled or postponed. South Korean shipbuilding companies suffered from liquidity problems due to the lack of new building orders and difficulties in obtaining loans. The South Korean government therefore reshaped its policy toward shipbuilding and announced the "Shipbuilding Industry Restructuring and Competitiveness Plan" in 2009 (OECD, 2014, p. 24). As part of this plan the South Korean government through its export credit agencies provided funding and working capital support to domestic shipbuilders and ship equipment manufacturers which faced liquidity problems.

The increase in financial support from the Korean government to domestic shipbuilders as a countermeasure to cash-flow problems caused by the financial crisis can also be seen in Figure 24. Within only one year working capital support in the form of pre-shipment loans given to Korean shipbuilding companies rose more than eightfold from KRW 640 billion in 2008 to KRW 5.5 trillion in 2009. Also export credits increased significantly and by 2013 total financial support from Korean state agencies to domestic shipbuilding companies totaled KRW 10.9 trillion (USD 9.9 billion). Hence, the total finance volume of state agencies to Korean shipbuilders has increased more than tenfold within only ten years from 2004 to 2013 (OECD, 2014, p. 31). As a result of the stronger financial support from state agencies for South Korean shipbuilding companies also their financial exposure at year-end has significantly increased over the reviewed period. As Figure 25 illustrates the financial exposure of South Korean shipbuilders at year-end of which the bulk stems from export credit guarantees and insurances increased from KRW 9.0 trillion (USD 9.6 billion) in 2007 to KRW 26.7 trillion (USD 25.0 billion) in 2013.
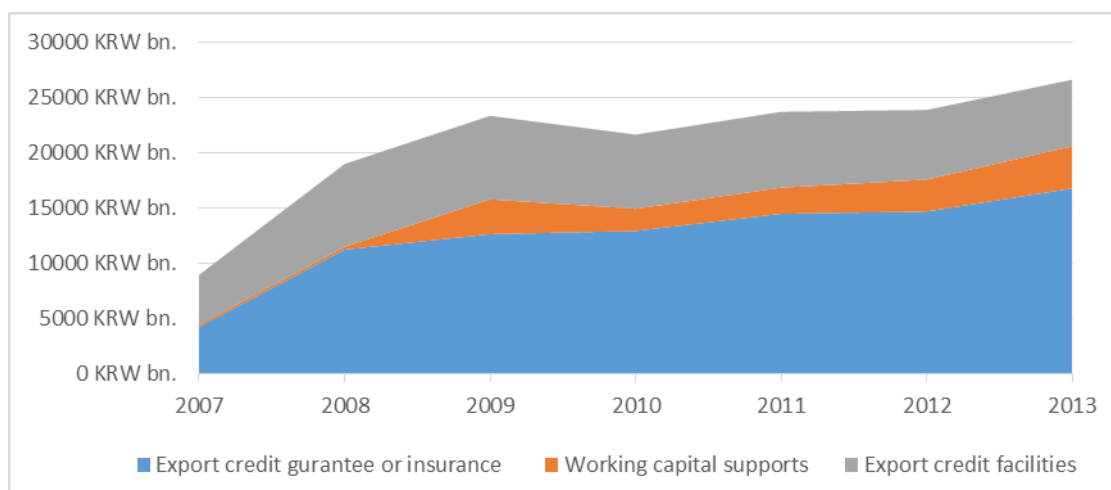
Figure 25: South Korean shipbuilders' maximum financial exposure at year-end

Source: OECD, 2014, p. 31

As has been argued the South Korean government has reshaped its policy towards shipbuilding as a consequence of the recent market downturn and the resulting financial difficulties of domestic shipbuilders. As part of the "Shipbuilding Industry Restructuring and Competitiveness Reinforcement Plan" the Korean government provided a financial support package worth KRW 32 trillion (approximately 18 billion Euro) to domestic shipbuilders to solve liquidity problems. This included loans and guarantees to shipbuilding companies and ship component manufacturers worth 12 billion Euro and additional 6.7 billion Euro in direct loans and debt guarantees to domestic and foreign purchasers of Korean built ships. In

addition the Export-Import Bank of Korea has been encouraged to give loans to small domestic shipbuilders and guarantee for overseas contracts of Korean shipbuilding companies (ECORYS, 2009, p. 50).

In addition to state funding Korean shipbuilders also benefit from the Special Tax Treatment Control Law which provides tax concessions to shipbuilders under corporate restructuring. One large Korean shipbuilder which has strongly benefitted from tax concessions in recent years is Daewoo Shipbuilding and Marine Engineering. For struggling domestic shipbuilding companies the Korean government also provides various restructuring subsidies. These range from debt and interest relief to debt forgiveness or debt-to-equity swaps provided by government controlled banks (WTO, 2016). As a result of such debt-to-equity swaps the Korean government through its government-related agencies has become a major shareholder in two of Korea's largest shipbuilding conglomerates namely Daewoo Shipbuilding and Marine Engineering as well as STX Offshore and Shipbuilding in recent years (OECD, 2014, p. 52).

Despite the efforts undertaken by the Korean government to promote the domestic shipbuilding industry and to help Korean shipbuilders to overcome the recent crisis, most large Korean shipyards are still heavily indebted and have officially requested stronger government support. In their view international rivals from China and Japan enjoy a very favorable home environment due to the strong government policy regarding shipbuilding and hence improve on the back of this government support. In order to stay competitive in the global shipbuilding market the Korean shipbuilding companies have requested for higher financial support from the government in order to level the playing field (Park, 2014).

In this chapter the author also briefly analyzes the role of inward and outward foreign investment for South Korea's shipbuilding industry. In contrast to China where the national government also successfully supports the domestic shipbuilding industry through the active promotion of foreign investment resulting in the establishment of Sino-foreign joint ventures, there has been only little foreign investment into Korea's shipbuilding industry in the past decade. However, most of the large South Korean shipbuilding conglomerates have established foreign subsidiaries or invested in foreign companies to get access to lower cost labor supply (ECORYS, 2009, p. 34). Table 7 on the next page gives an overview of overseas investments of large South Korean shipbuilding companies.

Company	Overseas investment
Hyundai Heavy Industries (HHI)	Hyundai Vinashin Shipyard (Vietnam)
	Hyundai Qingdao Shipyard (China)
Samsung Heavy Industries (SHI)	Samsung Heavy Industries Ningbo Company (China)
Daewoo Shipbuilding & Marine Engineering (DSME)	Daewoo Mangalia Heavy Industries (Romania)
STX Offshore & Shipbuilding	STX Europe Aker Yards (Norway)
	The Dalian complex (China)
Hanjin Heavy Industries & Construction	Subic Shipyard (Philippines)

Table 7: Overseas investments by South Korean shipbuilding companies

Source: Shin & Hassink, 2011, p. 1399

As can be seen from Table 7 the large South Korean shipbuilding conglomerates have invested in foreign companies and run shipyards outside Korea. Hyundai Heavy Industries for instance runs a shipyard in Vietnam where the company mainly produces product chemical tankers. At the Hyundai Qingdao Shipyard in China the focus lies on the construction of price effective bulk carriers and cargo ships. Daewoo Shipbuilding and Marine Engineering runs a subsidiary shipyard in Romania where it could secure 18 orders for various types of ships with a combined contract value exceeding one billion US dollars in 2013. The STX Offshore and Shipbuilding Group acquired the Norwegian Aker Yard to diversify its product line and runs the Dalian complex in China which is a large offshore production facility. Hanjin Heavy Industries and Construction runs a shipyard in the Subic Bay Freeport Zone in the Philippines. The company could secure new orders for ships totaling US$ 2.2 billion in 2013 at its subsidiary shipyard which had 43 ships on its orderbook at the end of 2013 (KOSHIPA, 2014, p. 18). Also Samsung Heavy Industries held a stake in a foreign shipyard, namely at the EAS shipyard in Brazil, but sold its shares in 2012 (Thomson Reuters, 2012). In addition the company runs a subsidiary in Ningbo (China) located in the Ningbo Economic and Technological Development Zone. It mainly focuses on the dismantling of ships as well as on the manufacturing of offshore steel structures and ship equipment (Samsung Heavy Industries, 2016).

Conclusion

The analysis conducted in this chapter has revealed that the Chinese as well as the South Korean government both play a strong role for the success of their national shipbuilding industries. Both governments support domestic shipbuilding companies through a number of subsidies and other support measures. However, the level of government intervention is much

higher in China were shipbuilding companies operate in a protected market. The Chinese central government also promotes foreign investment into the domestic shipbuilding industry and aims for a knowledge transfer from foreign investors to domestic shipbuilders engaging in Sino-foreign joint ventures. In contrast to China there is only limited government intervention in South Korea and state support has increased only after the outbreak of the global financial crisis. As a result of the global market downturn most Korean shipbuilding companies faced liquidity problems and the Korean government has reshaped its policy regarding shipbuilding resulting in the provision of more financial support to domestic shipbuilders of which many are still heavily indebted. While there is only little inward foreign investment in South Korea's shipbuilding industry, all large Korean shipbuilders run foreign subsidiaries mainly to make use of lower labor costs in the host countries.

5 Analysis

The aim of this thesis was to analyze the competitiveness of the Chinese and South Korean shipbuilding industries based on Michael Porter's diamond model of national advantage. Porter's diamond framework has been a useful tool to understand the sources of competitiveness in China's and South Korea's shipbuilding industry. However, some adjustments of the original Porter model had to be made, such as the integration of multinational activity into the framework or the treatment of government as an endogenous instead of an exogenous factor in the model, in order to cover the major support areas to shipbuilding as completely as possible. The analysis of shipbuilding competitiveness in China and South Korea based on Porter's diamond model has revealed not only the key success factors of both countries' shipbuilders, but also some weak points which need to be tackled in order to further increase industry competitiveness. In this chapter each of the dimensions of the extended and modified diamond model is assessed for China and South Korea using a framework adapted from Öz (2002) and Barragan (2005). In doing so each of the sources of competitive advantage in shipbuilding is rated at one out of five possible levels ranging from Low (L), and Low to Medium (L-M), to Medium (M), Medium to High (M-H), and High (H). The ratings were made according to the author's judgment based on the analysis conducted in the empirical part of this thesis. The results are also summarized in Table 8 at the end of this chapter.

As has been argued throughout this thesis, China and South Korea dominate the global shipbuilding market. As of June 2015, the latest date for which data is available, Chinese shipbuilders held 38.6 percent of the total global orderbook. At the same time shipbuilding orders placed at South Korean yards equaled 31.5 percent of total global orders measured in CGT terms. Therefore the two countries together held 70.1 percent of market share in terms of order backlogs which makes them the undisputed industry leaders. According to the findings of this study, both countries' shipbuilding industries are highly competitive. However, Chinese and South Korean shipbuilders operate in very different national environments and base their success on some very different factors. In the following the level of shipbuilding competitiveness for each dimension of Porter's diamond model is assessed based on the results derived from the analysis conducted in Chapter 4 of this thesis.

5.1 Assessment of Factor Conditions

As the results from the empirical part of this thesis suggest, both countries' shipbuilders enjoy a favorable home environment regarding factor conditions. Chinese shipbuilders have a huge

labor pool at their disposal and benefit from an abundant supply of low- or semi-skilled migrant workers coming from rural areas which are not only cheaper, but also easier to lay off at times when shipyards are faced with a weak order situation. In contrast Korean shipbuilding companies have difficulties attracting new talent as shipbuilding is regarded as dirty job in Korea and young people prefer working in other industries which are closer to city areas. In South Korea some 154.000 people work in shipbuilding while the Chinese shipbuilding workforce is much larger and comprises over 440.000 people. Most people working in Chinese shipbuilding have only completed basic education but there is also a sufficient supply of well-trained workers and shipbuilding engineers holding university degrees. Traditionally South Korean shipbuilders command over a highly skilled workforce and the majority of engineers is holding university degrees.

As has been argued shipbuilding is a very labor intensive industry. While in the past Korean shipbuilders enjoyed labor cost advantages over other major shipbuilding nations this has changed over the last decade. Wage levels in Korean shipbuilding have steadily increased and account for roughly one third of total shipbuilding costs. The average annual salary of a Korean shipyard worker is between US$ 30.000 and US$ 54.000 and therefore roughly nine to ten times higher than the annual Chinese salary in shipbuilding. This significant cost advantage of Chinese shipbuilders resulting from a relatively cheap labor force can be regarded as a major competitive advantage and key success factor. However, the advantage in labor cost is partly offset by labor productivity which is relatively low for Chinese shipbuilders and estimated at roughly one fourth to one sixth of that of South Korea and other major shipbuilding nations. In contrast South Korean shipbuilders benefit from a very high labor and overall productivity which is one of their main competitive advantages. The high productivity levels of South Korean shipbuilders might also be due to the well-established educational and physical infrastructure. Korea's shipbuilding industry is integrated into a highly sophisticated maritime cluster were major shipbuilding companies run their own corporate universities and keep close relationships to the 21 state universities and 16 grade schools that offer programs in shipbuilding engineering.

While China's shipbuilding industry has mainly relied on its low cost advantage in the past the country is now also actively developing its human capital. The largest shipbuilding conglomerates CSSC and CSIC are running their own research and training centers and numerous state universities are offering programs in shipbuilding engineering and maritime studies. Regarding physical infrastructure both countries are highly competitive and together they command over more than 60 percent of total global production capacity. China is the

global leader in terms of total shipbuilding production capacity with 11.9 million CGT in 2014 followed by South Korea with 11.6 million CGT. The number of active shipyards is much higher in China with 150 compared to only 20 in South Korea. However, this is mainly due to industry structure in South Korea where shipbuilding is dominated by a few very large chaebol such as Hyundai, Samsung and Daewoo which run the by far largest shipyards in the world.

Chinese shipbuilders also benefit from the competitiveness of the domestic steel industry which is the global number one in terms of total production output and supplies domestic shipbuilders with huge quantities of shipbuilding steel. The steel demand of Chinese shipbuilders is almost entirely domestically supplied and steel prices in China are significantly lower than in other shipbuilding nations. While South Korea's steel industry is also the fifth largest globally in terms of production output, Korean steel mills cannot compete with their Chinese rivals on price and therefore focus on the production of higher-quality steel products which are used by Korean shipbuilders for the construction of high complexity ships such as LNG and LPG carriers. Nevertheless South Korean shipbuilders still import large quantities of steel from China for cost reasons. Regarding the supply of ship equipment and marine subcomponents South Korean shipbuilders benefit from a highly competitive domestic supplier industry which results in a localization rate for ship equipment of almost 90 percent with only very few components being imported. While prices of ship subcomponents and marine equipment are slightly lower in China than in South Korea or other major shipbuilding nations, Chinese shipbuilders rely on imports of some key components which poses the risk of delays in ship delivery if components cannot be delivered on time.

Overall both Chinese as well as South Korean shipbuilders benefit from favorable factor conditions in their home markets. Competitive advantage of Chinese shipbuilders for this dimension of Porter's diamond mainly rests on an abundant supply of very cheap labor. In addition they also enjoy cost advantages for other major input factors such as steel and ship equipment which allows them to produce cheaper than their international rivals. The key success factor of South Korean shipbuilders that is based on favorable factor conditions is the very high labor productivity which results from a well-established educational and physical infrastructure. For the reasons mentioned above the contribution of factor conditions to the competitiveness of the Chinese shipbuilding industry has been assessed as high (H) by the author and as medium to high (M-H) for South Korea.

5.2 Assessment of Demand Conditions

As the analysis conducted in the empirical part of this thesis has revealed the Chinese shipbuilding market is much larger than the South Korean one if measured in tonnage terms. China is the largest buyer of ships worldwide with total orders amounting to roughly 9 million CGT. In comparison the South Korean demand for new ships is much smaller with orders totaling 2.5 million CGT as of June 2015. However, if measured by total contract value South Korean demand worth US$ 20.3 billion is not lagging far behind the Chinese one totaling US$ 26.1 billion. The share of total orders placed at domestic shipyards is very high for both countries. Out of Chinese ship orders totaling 9 million CGT some 7.5 million CGT or more than 80 percent were also placed at domestic shipyards. In South Korea ships totaling 2.2 million CGT and hence more than 90 percent of total demand were ordered from domestic shipbuilders. Even though both countries' shipbuilders but especially Chinese yards benefit from the strong home demand for new ships, the major proportion of shipbuilding output is destined for export in both countries. Nevertheless, Chinese shipowners account for the largest share of ship orders at domestic yards of any owner nation and the share of domestic contracting of 26.2 percent for 2014 is very high compared to the 7.3 percent in South Korea. Home demand for ships has dramatically increased in China over the past decades and strongly fluctuated after the outbreak of the global financial and economic crisis in 2007. In contrast South Korean home demand was almost negligible from 2000 to 2007 but has grown significantly from 2008 onwards.

Since shipbuilding is a global industry by its nature, also global demand for Chinese and South Korean built ships has been analyzed in this thesis. In absolute terms it has strongly increased for both Chinese as well as South Korean vessels. While newbuilding orders placed at South Korean shipyards were totaling 5.7 million CGT in 2002, they climbed to an all-time high of 33 million CGT in 2007 and with the general slump in demand after the global financial and economic crisis decreased to 12.6 million CGT in 2014. Global demand for Chinese built ships was much lower than that for South Korean ones in 2002 standing at 2.7 million CGT. However, it has strongly increased over the reviewed period and with orders totaling 16.9 million CGT in 2014 global demand for Chinese built ships was even stronger than that for South Korean ones if measured in CGT terms. Besides the strong home demand the major buyer nations of Chinese built ships are Greece, Germany and Singapore while the largest foreign customers of Korean built ships are Greece, Monaco and the United Kingdom.

What is also interesting is the very different segment structure of demand for Chinese and South Korean ships. While demand for Chinese built vessels is heavily weighted toward low

and medium complexity ships and especially bulk carriers, demand for Korean built ships is particularly strong in high complexity segments such as LNG and LPG carriers. In China bulk carriers which are categorized as low complexity ships account for almost half of total orders and high complexity ships such as LNG and LPG tankers only account for a minor portion of total orders. In contrast to Chinese shipbuilders their South Korean competitors are much more diversified with a strong presence in very different market segments and are therefore also less dependent on demand for particular ship types. Following Porter's theory the analysis of segment structure of demand is an indicator for the sophistication of buyer needs. In this regard the Chinese shipbuilding industry has potential to improve and the large corporations CSSC and CSIC are already breaking into higher market segments. In contrast to China global demand for South Korean built ships has a strong focus on high complexity LNG and LPG carriers. This is an indicator for the high sophistication of this demand from which South Korean shipbuilders strongly benefit.

While domestic demand volume is lower in South Korea than in China this is at least partly offset by the high sophistication of this demand which is a major competitive advantage of Korean shipbuilders. For this reasons the contribution of demand conditions to the competitiveness of the South Korean shipbuilding industry has been assessed as medium to high (M-H) by the author. The single most important characteristic of demand conditions for Chinese shipbuilders and one of their key success factors is the very strong home demand for their vessels on which they can rely on especially when there is a decline in global demand for new ships. Only the strong focus of this demand on low and medium complexity ships is a weak point in this dimension. Therefore the contribution of demand conditions to the competitiveness of China's shipbuilding industry has been assessed as medium to high (M-H).

5.3 Assessment of Related and Supporting Industries

For the dimension related and supporting industries of Porter's diamond framework the ship equipment and marine subcomponent industries in China and South Korea as well as the countries' domestic steel industries have been analyzed in the empirical part of this thesis. From the results of this analysis several conclusions can be drawn. In South Korea shipbuilding companies are integrated in a sophisticated maritime cluster which also includes well established upstream and downstream industries. The Korean ship equipment industry is an important industry on its own and highly competitive by international comparison. It comprises of some 700 companies specialized in the manufacturing of high quality ship subcomponents and marine equipment. The total output of Korea's marine equipment industry

more than doubled from US$ 5.2 billion in 2001 to US$ 10.9 billion in 2012. Due to the well-established domestic ship equipment industry South Korean shipbuilding companies source most of the required components domestically. This also shows in a very high localization rate for ship equipment which is above 80 percent in South Korea. In contrast to South Korea the ship equipment industry in China is still in a developmental phase and relatively weak by international comparison. While industry output reached US$ 14.5 billion in 2012 and hence exceeded that of South Korea, domestic equipment and subcomponent manufacturers rely heavily on licensing of foreign technology and imported marine equipment is often superior in quality to domestically produced components. As a result Chinese shipbuilding companies import most key components. This also shows in a relatively low localization rate for ship equipment which is estimated at 40 percent on average but might be significantly lower for some medium and high complexity ships types. The low level of China's ship equipment and marine subcomponent industry is probably the greatest weakness and competitive disadvantage of the countries shipbuilding companies. The strong reliance on imports of key components can slow down the production flow of Chinese yards and also poses the risk of delivery delays if components cannot be delivered on time.

While Chinese shipbuilders suffer from a relatively weak domestic ship equipment industry, the domestic steel industry is highly competitive and holding a dominant position as global number one in terms of production output. Six Chinese steel companies rank among the ten largest steel producers in the world and with a total output of 822 million metric tons of crude steel the industry accounted for almost half of global steel production in 2014. Given this huge production output and low labor costs also prices for steel are significantly lower in China than in other major shipbuilding countries and the demand for steel from Chinese shipbuilding companies is almost entirely met by domestic production. Also South Korea has a large domestic steel industry which is dominated by the Pohang Iron and Steel Company (POSCO) and the Hyundai Steel Company. South Korea had a total steel output of 71.5 million metric tons in 2014 and thereby replaced Russia as the fifth largest producer of crude steel worldwide. The Korean shipbuilding companies keep close ties with the domestic steel industry and the bulk of domestically produced plate products is supplied to Korean shipyards. However, South Korean steel producers cannot compete with their Chinese rivals on steel price due to higher production costs, and therefore focus on the production of high quality steel products with more advanced properties. These types of steel are utilized by domestic shipbuilders for the construction of high complexity ships such as LNG and LPG carriers which require a double hull. Nevertheless Korean shipbuilders demand for steel plate

can only be partially supplied domestically. While most high quality steel products are purchased domestically a significant portion of demand for lower grades of steel is imported from China.

As has been argued Chinese shipbuilders suffer from a relatively weak domestic ship equipment and marine subcomponent industry and therefore rely on imports of major components. This is a weak point in their national environment which is also undermining their international competitiveness. On the other hand China is the largest producer of crude steel worldwide and domestic shipbuilders enjoy a significant cost advantage over other shipbuilding nations regarding the supply of shipbuilding steel. For this reasons the contribution of related and supporting industries to the competitiveness of the Chinese shipbuilding industry has been assessed as medium (M) by the author. In contrast to China the South Korean ship equipment industry is highly competitive by international comparison and domestic shipbuilders draw competitive advantage from the supply of domestically manufactured high quality equipment and ship components. In addition its domestic steel industry is the fifth largest globally in terms of total steel output with a focus on high quality steel products. South Korean shipbuilders therefore source higher grades of steel domestically but also import large quantities of steel plate from China for cost reasons. Nevertheless the contribution of related and supporting industries to the competitiveness of the South Korean shipbuilding industry has been assessed as high (H) mainly due to the well-established and highly competitive domestic marine equipment industry.

5.4 Assessment of Firm Strategy, Structure and Rivalry

The analysis of this dimension of the diamond framework has revealed that industry structure of shipbuilding in China is very different from that in South Korea. Even though the number of shipbuilding companies changes frequently in both countries due to new openings, mergers and shut downs, it is much higher in China than in South Korea where the industry is highly concentrated. In South Korea the top three shipbuilding companies Hyundai Heavy Industries (HHI), Samsung Heavy Industries (SHI), and Daewoo Shipbuilding and Marine Engineering (DSME) together account for more than half of the domestic shipbuilding output and some 97 percent of the country's shipbuilding output is produced by only eight companies.

Most of South Korean shipbuilding companies are privately held and only five are listed on the Korean stock exchange. While the Korean government does not run its own shipbuilding enterprises it functions as a shareholder in those publicly listed through some state-related agencies. In contrast to South Korea most of the large shipbuilding companies in China are

state-owned enterprises incorporated into either the China State Shipbuilding Corporation (CSSC) or the China Shipbuilding Industry Corporation (CSIC) depending on their location. Both CSSC and CSIC serve as umbrella organizations and report to the State Council. Besides shipyards incorporated into either CSSC or CSIC there exist also numerous smaller yards which are administered by local governments. In addition there are also shipyards managed by large state-owned shipping conglomerates but also independent private companies run shipyards in China. As the analysis conducted in the empirical part has revealed enterprises incorporated under the wing of CSSC account for roughly a quarter of total newbuilding orders placed at Chinese shipyards. CSIC enterprises held a joint market share of roughly 10 percent while other state-owned enterprises secured 23 percent of total orders for Chinese built ships. Also private firms play an important role in Chinese shipbuilding and held a combined market share of 38 percent in terms of order backlogs.

Chinese and South Korean shipbuilders also follow very different strategies in order to stay competitive. Chinese shipbuilders mainly focus on the production of low complexity ships and especially on bulk carriers. They are highly competitive in this market segment as they produce standardized ship types in large quantities which allows them to realize economies of scale. Given their cost advantage toward most foreign shipbuilding companies regarding labor as well as shipbuilding steel, they can also offer very competitive prices and clearly follow a cost leadership strategy in this market segment. Some CSSC and CSIC enterprises also push into higher market segments and try to compete with international rivals for lucrative orders of LNG and LPG carriers. For South Korea two groups of shipbuilding companies need to be distinguished when analyzing strategy. The big three companies HHI, SHI, and DSME together dominate the global market for medium and especially high complexity ships and are heavily focused toward the production of high quality LNG and LPG carriers. The remaining South Korean shipbuilders are more focused on lower market segments and are highly competitive in the tanker sector with this ship type accounting for more than half of their joint output in CGT terms. For South Korean shipbuilders it is very difficult to compete with their Chinese rivals over price mainly due to their significantly higher labor costs. Therefore they try to avoid pure cost-based competition in lower-end markets and focus on the construction of higher complexity ships where they have competitive advantage over Chinese competitors due to their high level of innovation and technological know-how. Generally their strategy can be described as ambidextrous. While Korean shipbuilders on the one hand try to realize further gains in efficiency and cost savings which suggests they aim for cost leadership, they also try to differentiate by diversifying into higher market segments were premium prices can

be charged for high complexity or specialty vessels. This is also illustrated by the recent push of South Korean shipbuilders into the offshore oil and gas sector where they hold a leading position in the construction of drill ships and offshore plants.

Last but not least also the level of competition in Chinese and South Korean shipbuilding as well as the degree of rivalry between existing shipbuilding companies has been analyzed in the empirical chapter of this thesis. As has been argued fierce competition in the home market and intense rivalry between firms pressures them to improve product quality and to raise productivity in order to maintain a leading position and therefore helps them to increase their level of competitiveness in the long run according to Porter's theory. However, the longstanding rivalry between South Korean shipbuilding companies has lead to hyper-competition in their home market which is not only beneficial to them. While they are constantly challenged to innovate and upgrade their competitive advantages the intense rivalry between the large chaebol Hyundai and Samsung has also lead them to sacrifice margins to outbid the other and win orders. This has resulted in depressed prices for most ship types from which all South Korean shipbuilding companies are suffering. While Chinese shipbuilding is still dominated to some extent by state-owned enterprises there is a certain level of free-market competition and CSSC and CSIC enterprises directly compete for government contracts and on the international shipbuilding market. For the reasons mentioned above the contribution of firm strategy, structure and rivalry to the competitiveness of the Chinese shipbuilding industry has been assessed as medium (M) and as medium to high (M-H) for South Korea.

5.5 Assessment of the Role of the Government

As has been argued in this thesis shipbuilders of different nations have only then managed to become internationally competitive when they were supported by their national governments. However, the role of the government for the creation of national competitive advantage in shipbuilding strongly depends on its policy decisions which can have positive as well as negative effects on the performance of domestic shipbuilding companies. As the analysis of government policies affecting shipbuilding has revealed both Chinese as well as South Korean shipbuilders at least partly owe their position as global leaders in international shipbuilding to their national governments which decided to make shipbuilding a strategic industry and heavily supported the capacity built up of domestic shipbuilders. As has been argued the Chinese central government decided to transform former military-oriented companies into profit-oriented commercial shipbuilding enterprises in the 1990s. Chinese shipyards were

provided with a high degree of bureaucratic freedom and have the right to hire and fire workers freely. In addition Chinese shipbuilders benefit from numerous types of government subsidies and other policies which aim for supporting the national shipbuilding industry. The Chinese government not only supports its domestic shipbuilders financially through the provision of cheap funding, but also exempts shipyards from paying enterprise income tax under certain conditions and subsidizes land acquisitions of shipbuilding companies. In addition it heavily protects the domestic shipbuilding market through the imposition of tariffs on the import of foreign built ships and the provision of a direct subsidy of 17 percent of the contract price on the purchase of a Chinese built ship to domestic shipowners. Furthermore Chinese shipbuilders enjoy government support regarding the export of ships through the provision of export seller and export buyer credits from state-owned banks at preferential interest rates. The Chinese government is also actively promoting foreign investment into the domestic shipbuilding industry and allows foreign investors to set up joint ventures with Chinese partners as long as their shareholdings are limited to 49 percent. Investors participating in Sino-foreign joint ventures are also required to set up technical centers in China through which the government wants to provide for a knowledge transfer from foreign partners to domestic shipbuilders. All in all the central government of China plays a very important role for the success of domestic shipbuilding companies and the heavy government support can be regarded as one of their key success factors. For this reasons the contribution of the government for the competitiveness of Chinese shipbuilders has been assessed as high (H) by the author.

According to the findings of this study the South Korean government also heavily supported its domestic shipbuilding industry in its early stage through investing in capacity built up and providing information on shipbuilding know-how. However, when South Korean shipbuilders had established themselves as global market leaders the level of government intervention significantly decreased. Nevertheless South Korean shipbuilders still benefit from a number of government subsidies and trade barriers established by the Korean government which restrict the import of foreign built ships. As has been argued the recent global financial and economic crisis has hit the shipbuilding industry hard and Korean shipyards suffered from liquidity problems due to a lack in newbuilding orders. The South Korean government has therefore reshaped its policy toward shipbuilding and announced the "Shipbuilding Industry Restructuring and Competitiveness Plan" as part of which it provided a financial support package of KRW 32 trillion (US$ 27.8 billion) to domestic shipbuilders. As a result of the financial support to the struggling companies Daewoo Shipbuilding and

Marine Engineering and STX Offshore and Shipbuilding which resulted in debt-to-equity swaps the South Korean government at present also functions as the largest shareholder of these two shipbuilding enterprises. In addition the Korean government is also making efforts to attract and promote foreign investment into the domestic shipbuilding industry which role has been very limited over the past decade. However, almost all companies have established foreign subsidiaries or invested in foreign companies to get access to lower cost labor supply. As the analysis of government policy regarding shipbuilding has revealed South Korean shipbuilding companies would not have been able to establish themselves as industry leaders without the support of their national government. However, compared to the Chinese shipbuilding industry South Korean shipbuilders receive less government support and hence face a competitive disadvantage in this regard. For this reason they have officially requested for stronger government intervention in the domestic market and more financial support in order to level the playing field. For the reasons mentioned above the contribution of the government for the competitiveness of South Korean shipbuilders has been assessed as medium (M).

Country		Factor conditions	Demand conditions	Related and supporting industries	Firm strategy, structure and rivalry	The role of the government
China	Assessment	High	Medium to High	Medium	Medium	High
	Source of competitiveness	- Access to a huge labor pool - High availability of skilled and well-trained workers - Very low labor costs compared to other shipbuilding nations - High quality educational infrastructure - Highest number of active shipyards worldwide - Largest shipbuilding capacity worldwide with 11.9 million CGT in 2014 - Favorable conditions regarding the supply of shipbuilding steel and ship equipment	- Strong domestic demand for new ships - Roughly 90 percent of this demand is also placed at Chinese yards - Strong and growing global demand for Chinese built ships (37.1 % of total newbuilding orders placed at Chinese yards in 2014) - Demand is particularly strong for low to medium complexity ships and especially for bulk carriers	- Slow development of the domestic marine equipment industry which is still in a developmental phase - China's steel industry is the by far largest producer of steel products globally and hence, in a very competitive position - Shipbuilders demand for steel is almost entirely supplied by domestic companies at very competitive prices	- Dominance of state conglomerates CSSC and CSIC - Certain level of free market competition between state-owned shipbuilders - Companies mainly produce standardized low to medium complexity ships in large quantities and follow a cost leadership strategy - CSSC and CSIC enterprises also attempt to diversify into higher market segments such as LNG and LPG ships	- Shipbuilding regarded as strategic industry - Protective government - Numerous different types of government subsidies - Firms are given relatively high degree of economic autonomy and bureaucratic freedom - Promotion of foreign investment - Foreign shareholdings limited to 49% and regulations to provide for a knowledge-transfer to benefit the domestic industry

Table 8a: Assessment of the extended and modified diamond model for China

Country		Factor conditions	Demand conditions	Related and supporting industries	Firm strategy, structure and rivalry	The role of the government
South Korea	**Assessment**	**Medium to High**	**Medium to High**	**High**	**Medium to High**	**Medium**
	Source of competitiveness	- Very high labor productivity - High quality educational infrastructure - Close cooperation between universities and shipbuilding companies - Highly skilled and well-educated shipbuilding workforce - Second largest shipbuilding capacity with 11.6 million CGT in 2014 - Preferential access to specialized grades of steel used for the construction of high complexity ships - Very high localization rate for ship equipment	- Moderate but growing and highly sophisticated domestic demand for new ships - Roughly 90 percent of this demand is also placed at South Korean yards - Strong global demand for South Korean built ships (27.3 % of total newbuilding orders placed at South Korean yards in 2014) - Demand for South Korean built ships is particularly strong in high complexity segments such as LNG/LPG tankers (Indicator for high sophistication of demand)	- Existence of a sophisticated marine cluster with well established upstream and downstream industries - Ship subcomponent industry supplies shipyards with high quality finished products - Localization rate for ship equipment is very high (> 80%) - Korea's steel industry is the fifth largest worldwide - Focus on the production of high quality steel products	- Industry dominated by the "big three" Samsung (SHH), Hyundai (HHI) and Daewoo (DSME) - HHI, SHI, and DSME are the largest shipbuilding companies globally - Fierce competition in home market and very strong rivalry between the "big three" chaebol - Big three dominate the global market for medium & high complexity ships - Other firms highly competitive in the tanker sector - Leading position in the offshore oil and gas sector	- Shipbuilding regarded as strategic industry - Strong government support for market expansion in the past - Level of government intervention has significantly decreased - Relatively low level of market protectionism - Several subsidies for domestic shipbuilders - Government reshaped its shipbuilding policy after global financial crisis - State-related agencies provide financial support for struggling shipbuilders - Limited inbound foreign investment, but all major shipbuilders run production facilities abroad

Table 8b: Assessment of the extended and modified diamond model for South Korea

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5.6 Summary of Findings

In this section the results of this thesis are briefly summarized and explicit answers to the research questions are provided on this basis. In addition the author states the relevance of these findings and also provides suggestions for further research.

The purpose of this thesis was to analyze the competitiveness of shipbuilding industries in China and South Korea and find out what constitutes their key success factors. In order to answer the main research questions both countries' shipbuilding industries were analyzed using an extended and modified version of Michael Porter's diamond model. As the results of this analysis suggest, both countries' shipbuilding industries are highly competitive by international comparison and are likely to maintain their leading position in global shipbuilding for the near future. While both Chinese as well as South Korean shipbuilding companies enjoy a very favorable home environment for industry success they base their competitive advantages on very different factors.

Chinese shipbuilders owe much of their international success to very favorable factor conditions in their home market. In China labor costs are significantly lower than in most other shipbuilding nations which is one of the key success factors of Chinese shipbuilders. In addition they also benefit from a very strong home demand for new ships as well as from the well-established domestic steel industry which supplies domestic shipyards with large quantities of shipbuilding steel at exceptionally low prices. The analysis conducted in this thesis has also revealed a major weak point in Chinese shipbuilding which is the low level of the domestic ship equipment industry. For this reason Chinese shipbuilders heavily rely on imports of major components which poses several risks such as the slow-down of production or costly delivery delays. In China the large state-owned shipbuilding conglomerates China State Shipbuilding Corporation (CSSC) and China Shipbuilding Industry Corporation (CSIC), shipyards run by large state-owned shipping conglomerates and private shipyards are competing for domestic and global orders and there is a healthy level of competition between these companies. Most Chinese shipbuilders focus on the production of standardized low to medium complexity ships and follow a low cost strategy. Due to cost advantages towards South Korean or Japanese competitors Chinese shipbuilders are highly competitive in these market segments and with a strong focus on the production of bulk carriers they dominate the global market for this ship type.

In contrast to China the South Korean shipbuilding industry is dominated by a few very large chaebol companies such as Hyundai, Samsung and Daewoo which run the largest shipyards in the world and together account for the bulk of Korean shipbuilding output. South

Korean shipbuilders' disadvantage regarding labor costs is at least partly offset by very high productivity levels of employees. The very high productivity of Korean shipyards is one of their key success factors and might be due to the countries well-developed educational and physical infrastructure regarding shipbuilding. In South Korea shipbuilding is integrated into a highly sophisticated maritime cluster with well-established upstream and downstream industries. The South Korean ship equipment and marine subcomponent industry which is the major supply industry to domestic shipbuilders is highly competitive by international comparison. Korean shipbuilding companies can source almost all major components domestically which gives them competitive advantage in the construction of higher complexity ships. While the fierce competition in the domestic market not only challenges firms to invest in new technology, improve product quality and raise productivity in order to stay ahead of competition it has also resulted in a price war between major shipyards from which the whole industry is suffering. Due to advantages in shipyard infrastructure, technical know-how and the quality of ship equipment the major South Korean shipbuilders Hyundai, Samsung and Daewoo mainly serve higher market segments and focus on the construction of high complexity ships such as LNG and LPG carriers for which they dominate the global market. Some other Korean shipbuilders are highly competitive in the global tanker market. In recent years almost all major Korean shipbuilders have also entered the offshore oil and gas sector where they hold a leading position in the construction of drill ships and offshore platforms.

In addition to factor conditions, demand conditions, related and supporting industries, as well as firm strategy, structure and rivalry, also the role of the national governments for the success of the Chinese and South Korean shipbuilding industries has been analyzed and assessed in this thesis. As the findings of this study suggest, Chinese as well as South Korean shipbuilders owe much of their success to the supportive role of their national government which regard shipbuilding as strategic industry. Especially the Chinese government is heavily supporting the domestic shipbuilding industry through the provision of cheap funding to domestic shipyards as well as numerous other types of subsidies. It is also protecting the domestic market through the imposition of tariffs on imports of foreign built ships and the provision of direct subsidies for the purchase of Chinese built vessels. In addition it actively promotes foreign investment into the domestic shipbuilding industry and allows foreign investors to set up joint ventures with Chinese partners as long as their shareholdings are limited to 49 percent. These foreign partners are also required to set up technical centers in

China to provide for a knowledge transfer to their Chinese partners from which domestic shipbuilders have greatly benefited.

South Korean shipbuilders' market expansion from the 1970s to the 1990s was also strongly supported by the Korean government. However, when Korean shipbuilding companies had established themselves as global market leaders the level of government intervention in the domestic shipbuilding industry significantly decreased. While there is a relative low level of market protectionism in South Korean shipbuilding, the government also provides various subsidies to domestic shipbuilders. After the global economic and financial crisis the Korean government has reshaped its shipbuilding policy and now provides financial support for struggling shipbuilders. While government support for the industry plays an important role for the competitiveness of shipbuilding companies in both China as well as South Korea, the level of government intervention and support for domestic shipbuilding is much higher in China than in South Korea.

5.7 Relevance of Findings and Suggestions for Further Research

The results of this thesis are relevant for several reasons. As has been argued shipbuilding is a multi-billion dollar industry and the global market is highly competitive. Currently nations such as India and Bangladesh but also the Southeast Asian nations Vietnam, Malaysia, Singapore and the Philippines are trying to break into the international shipbuilding market while Japanese shipbuilders are trying to regain market shares. Through conducting this research the author has fostered an understanding for what constitutes the key success factors of the two major shipbuilding nations. This might be of interest to their international competitors as it allows them to direct their strategies accordingly. As has also been discussed the recent global economic and financial crisis has lead to a slump in demand for new ships from which major shipbuilding nations are only slowly recovering. For this reason the global shipbuilding industry is in a restructuring process and only the most competitive yards will be able to survive. Even though it cannot be reliably predicted whether South Korean or Chinese shipyards will evolve victorious from this crisis the findings of this analysis have nevertheless revealed important insights into both countries' shipbuilding industries which might contribute to the clarification of this question. In this thesis also the connection between shipbuilding and national defense industries has been discussed. As has been argued domestic shipbuilding companies might provide for a knowledge transfer to military shipbuilders and progress made in commercial shipbuilding might also facilitate the upgrading of a nation's naval fleet. Given the rising tensions in the South China Sea where China disputes over territorial claims with

other Southeast Asian nations the assessment of its shipbuilding capabilities might also be of interest to parties involved or interest in this conflict. Finally there is also a certain amount of foreign investment into the Chinese and South Korean shipbuilding industries. For potential market entrants and foreign investors it is vital to know about special characteristics of the local environment and competitive context. The results of this thesis might also contribute to foster such an understanding.

Needless to say this thesis has also certain limitations which could be addressed through further research. First, competitiveness of shipbuilding in China and South Korea has been analyzed at the average national level. However, it may vary between different geographical regions or provinces or between different sized shipyards. Therefore studies on the shipbuilding competitiveness on a regional level would be interesting as well as research focusing on the competitiveness of individual shipbuilding companies or shipyards. While the author tried to present a comprehensive picture of both countries' shipbuilding industries in this thesis and analyzed their level of competitiveness for the general market, further research might also assess shipbuilding competitiveness of Chinese and South Korean shipyards for particular market segments or ship types. While competitiveness in shipbuilding has been analyzed based on the dimensions of Porter's diamond model in this thesis there might also be additional or alternative criteria according to which the competitiveness of shipbuilding industries can be assessed. Finally, further research could also analyze the implications of the market entries of India, Bangladesh or the Philippines into the global shipbuilding market for China and South Korea. The research conducted in this thesis has demonstrated that there is still much to be explored and topics for further research are therefore plentiful.

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APPENDIX

Zusammenfassung

In dieser Arbeit wurde ein analytischer Ansatz verwendet um die Wettbewerbsfähigkeit der beiden führenden Schiffsbaunationen China und Südkorea zu beurteilen. Der globale Schiffbau ist ein Multi-Milliarden-Dollar-Markt und eine starke heimische Schiffbauindustrie kann somit als Katalysator für die wirtschaftliche Entwicklung und das wirtschaftliche Wachstum der betroffenen Länder wirken. Überdies kann eine starke heimische Schiffbauindustrie auch positive Auswirkungen auf die nationale Verteidigungsindustrie eines Landes haben. Etwa Mitte der 1990er Jahre konnten sich Südkoreanische Schiffbauunternehmen als Marktführer im globalen Schiffbau etablieren und haben seither ihre starke Position in diesem Markt gehalten. Im Jahr 2005 verkündete die chinesische Zentralregierung ihren Plan das Land bis zum Jahr 2015 als führende Nation im Schiffbau zu etablieren. Seitdem haben chinesische Werften kontinuierlich Marktanteile gewonnen und sind nun zu einem starken Herausforderer für südkoreanische Schiffbauer geworden, welche die südkoreanische Vorherschaft im Weltschiffbau angreifen. Die globale Schiffbauindustrie wurde durch die jüngste Weltwirtschafts- und Finanzkrise stark getroffen. Dies führte zu einem Einbruch an neuen Aufträgen und einer dadurch entstandenen Überkapazität bei den Schiffswerften. Dies brachte einen Umstrukturierungsprozess in Gang von dem alle großen Schiffbaunationen betroffen sind. Durch die nach wie vor eher mäßige Auftragslage werden nur die wettbewerbsfähigsten Werften als Sieger aus der globalen Schiffbaukrise hervorgehen.

Aus den angeführten Gründen versucht der Autor daher durch seine Forschungsarbeit die Frage zu beantworten welche Schiffbauunternehmen dies sein könnten, indem er die Wettbewerbsfähigkeit der beiden größten Schiffbaunationen China und Südkorea analysiert. Aus der durchgeführten Sichtung relevanter Literatur wurde deutlich, dass Wissenschaftler sehr unterschiedliche Erfolgsfaktoren für Wettbewerbsfähigkeit im globalen Schiffbau identifiziert haben. Die meisten davon können jedoch in eine der Dimensionen von Michael E. Porters Diamantenmodell der nationalen Wettbewerbsvorteile kategorisiert werden. Für diese Arbeit wurde das ursprüngliche Diamantenmodell anhand einiger wichtiger Kritikpunkte von Wissenschaftlern, welche sich intensiv mit Porters Theorie beschäftigt haben für den Schiffbau angepasst. Eine erweiterte und modifizierte Version von Porters Diamantenmodell dient daher als Analyserahmen anhand welchem die Wettbewerbsfähigkeit der Schiffbauindustrie in China und Südkorea in dieser Arbeit analysiert wurde.

Die Ergebnisse dieser Arbeit deuten darauf hin, dass sowohl chinesische als auch südkoreanische Werften im internationalen Wettbewerb als sehr konkurrenzfähig einzustufen sind. Ihr Erfolg basiert jedoch auf sehr unterschiedlichen Faktoren. Zudem verfolgen sie unterschiedliche Strategien und bedienen größtenteils unterschiedliche Marktsegmente. Den Ergebnissen dieser Arbeit zufolge haben chinesische Werften vor allem Wettbewerbsvorteile gegenüber internationalen Wettbewerbern aufgrund von vergleichsweise niedrigen Arbeitskosten. Zudem profitieren sie von einer starken Inlandsnachfrage nach neuen Schiffen sowie von der gut etablierten heimischen Stahlindustrie, welche chinesische Werften mit großen Mengen an Stahl zu vergleichsweise sehr günstigen Preisen beliefert. Aufgrund des vergleichsweise niedrigen Niveaus der heimischen Schiffsausrüstungsindustrie sind chinesische Werften auf die Einfuhr von wichtigen Schiffskomponenten aus dem Ausland angewiesen, was gleich mehrere Nachteile gegenüber internationalen Mitbewerbern zur Folge hat. Aus diesem Grund wurde in dieser Arbeit die Schwäche der heimischen Schiffsausrüstungsindustrie als größter Wettbewerbsnachteil der chinesischen Schiffsbauer identifiziert. Insgesamt konzentrieren sich die meisten chinesischen Werften auf die standardisierte Produktion von Schiffstypen, welche in ihrer Herstellung als wenig bis mittel komplex einzustufen sind. In diesen Marktsegmenten sind chinesische Werften aufgrund ihrer Niedrigkostenstrategie sehr wettbewerbsfähig und nehmen insbesondere im Segment für Massengutfrachter eine vorherrschende Stellung am internationalen Markt ein.

Einer der wichtigsten Erfolgsfaktoren südkoreanischer Werften ist die sehr hohe Produktivität. Diese gleicht zumindest teilweise ihren Nachteil im Bezug auf höhere Arbeitskosten aus. Die südkoreanische Schiffbauindustrie ist in einen komplexen maritimen Cluster integriert und heimische Werften profitieren von hochentwickelten, verwandten und unterstützenden Branchen, insbesondere von der heimischen Schiffsausrüstungsindustrie. Koreanische Werften beziehen beinahe sämtliche wichtige, sowie technologisch hochwertige Komponenten von heimischen Zulieferbetrieben, was ihnen einen Wettbewerbsvorteil in der Konstruktion von in der Herstellung als mittel bis sehr komplex einzustufenden Schiffen verschafft. Aufgrund von Vorteilen bezüglich der Werftinfrastruktur, einem überlegen technischen Know-how, sowie der sehr hohen Qualität der zugelieferten Schiffskomponenten konzentrieren sich die größten koreanischen Schiffsbauunternehmen Hyundai, Samsung und Daewoo auf den Bau von hochkomplexen LNG-Tankern (Flüssigerdgastankern) und LPG-Tankern (Flüssiggastankern) für welche sie den globalen Markt dominieren. In den letzten Jahren haben zudem beinahe alle großen südkoreanischen Schiffbauunternehmen den Offshore Öl- und Gassektor für sich entdeckt, in welchem sie nun eine führende Rolle im Bau von Bohrschiffen und Bohrplattformen innehaben.

In dieser Arbeit werden die wichtigsten und entscheidenden Erfolgsfaktoren der beiden großen Schiffbaunationen China und Südkorea aufgezeigt. Dies könnte von Interesse für ihre internationalen Mitbewerber sein, da diese Kenntnisse es ermöglichen, ihre Strategien im Wettbewerb entsprechend anzupassen. Nicht zuletzt überlappen sich die territorialen Ansprüche Chinas im Südchinesischen Meer mit einigen anderen südostasiatischen Ländern was zu einem immer heftiger geführten diplomatischen Konflikt zwischen den involvierten Parteien führt. Wie in dieser Arbeit erläutert, erleichtern bestimmte Fähigkeiten und Fortschritte im kommerziellen Schiffbau auch die Modernisierung der nationalen Militärflotte. Aus diesem Grund könnten die Erkenntnisse dieser Arbeit auch für all jene von Bedeutung sein, welche sich in welcher Art auch immer mit dem Konflikt im Südchinesischen Meer auseinandersetzen. Zu guter Letzt ist es auch für potentielle neue Marktteilnehmer sowie ausländische Investoren von entscheidender Bedeutung über Kenntnisse bezüglich der Besonderheiten der lokalen Umgebung sowie des nationalen Wettbewerbs zu verfügen. Die Ergebnisse dieser Arbeit könnten nicht zuletzt auch dazu beitragen ein solches Verständnis zu fördern.