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AN ANALYSIS OF MARKET-DISTORTING FACTORS IN SHIPBUILDING

THE ROLE OF GOVERNMENT INTERVENTIONS

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AN ANALYSIS OF MARKET-DISTORTING FACTORS IN SHIPBUILDING – THE ROLE OF GOVERNMENT INTERVENTIONS

Karin Gourdon

This report analyses market-distorting factors in the shipbuilding industry with a focus on government interventions. This paper argues that government interventions in this cyclical industry do more harm than good by exacerbating and prolonging economic downturns through two channels. First, it promotes an over-ordering of vessels through lower delivery time, distorting ship buyers' investment behaviour. Second, it may maintain unproductive capacity in the market that re-enters a new economic cycle, restarting the vicious circle of industrial excess capacity. Against the background of the global nature of this industry, these channels reinforce the case for effective international disciplines on government interventions. Overall, the mature nature of the shipbuilding industry undermines the need for an active industrial policy, beyond facilitating structural adjustment, and emphasizes the necessity for a horizontal policy approach. The work seeks to provide policy makers with a better understanding of how different factors can contribute to excess capacity.

The paper was authored by Karin Gourdon from the Structural Policy Division (SPD) at the OECD Directorate for Science, Technology and Innovation (STI). Special thanks goes to Professor Myrto Kalouptsidi (Harvard University), Paul Illicenco (Delegation of Romania to the OECD Working Party 6 on Shipbuilding) and Paul Stott (Newcastle University) for their valuable inputs and feedback. Laurent Daniel (OECD/STI) and Nick Johnstone (OECD/STI) contributed with essential insights and suggestions, and supervised the project. The paper has also benefitted from feedback from Sarah Box and Dirk Pilat (OECD/STI), Julien Gourdon (OECD) on government procurement policies, and Christian Steidl (OECD).

Keywords: Excess Capacity, Government Support, Shipbuilding

Executive Summary

This study discusses the features of the shipbuilding industry, particularly the determinants of newbuilding prices and production costs, and presents the concept and relevance of "time to delivery" of ship orders. Building upon this analysis the report discusses three examples of government interventions to illustrate through which channels these may impact the shipbuilding market. These three examples encompass preferential financing instruments, and two discretionary measures, notably government procurement policies and non-enforcement of national bankruptcy laws.

This paper argues that government interventions in the shipbuilding industry not only inhibit a level-playing field, but will do more harm than good by exacerbating economic downturns in this cyclical industry through two channels.

- First, it may lead to a larger extent of over-ordering of vessels through lower time to delivery, thereby distorting the investment behaviour of ship buyers and leading to a more pronounced cyclical downturn.
- Second, during "bust" times, excess capacity may lead to government support to failing ship yards with the goal to minimize social costs. Government support to these firms that are practically insolvent (so-called "zombie firms") – through the non-enforcement of national bankruptcy laws – will however prolong these economic bust periods. As such, unproductive capacity will re-enter the market in the new cycle and restart the vicious circle of industrial excess capacity.

Against the background of the global nature of the shipbuilding and shipping industries any market-distorting government intervention in one country will ultimately affect industry developments in third economies. These channels furthermore reinforce the case for effective international disciplines on government interventions in the shipbuilding industry.

In any case, the mature nature of the shipbuilding industry undermines the need for an active industrial policy, beyond facilitating structural adjustment. As a mature industry the sector requires a horizontal policy approach, particularly one focused on: i) allowing free market entry and more importantly exit of yards; ii) upgrading the general level of labour skills and human capital through strong training policies and education programs; iii) ensuring efficient capital markets rather than targeted financial interventions inconsistent with market conditions; and, iv) enabling resources (i.e. capital stock and labour) to move easily between sectors. With respect to the latter issue, policies supporting yards to re-orientate to other business would also be conducive to address the problem of natural excess capacity associated with cyclical downturns affecting the shipbuilding industry.

1. Introduction

Why are some industries more prone to excess capacity than others? And what determines the extent of such market imbalances? The shipbuilding industry along with other heavy industry sectors are prime examples of recurring overcapacity. While certain industry features, such as capital-intensity, irreversibility of capital stock and capital construction lags, have been shown to partly explain this phenomena, the role of government interventions is less well understood.

This paper argues that government measures can have tremendous effects by aggravating the extent of an industry's excess capacity. During cyclical downturns, government actions in the shipbuilding industry will artificially maintain unused and unproductive capacity. However, less attention is often paid to government interventions during economic upturns although such actions, as will be argued in the following, can exacerbate the cyclical downturn, thereby aggravating 'naturally occurring' market imbalances.

Shipbuilding is a capital-intensive industry. Despite the large amount of labour inputs, the major input factor for ship construction remains capital stock in the form of long-term assets, such as land area, building docks, quays, steel cutting machinery and cranes. However, **cyclical downturns** affecting capital-intensive industries do not result in excess capacity per se, as long as capacity quickly adapts to new market conditions. As has been shown, investment irreversibility and long construction lags often delay exit decisions of firms despite incurred financial losses.

On the one hand, capital investments of yards are not highly reversible as unused capital stock can hardly be reused or resold profitably (i.e. they are sunk costs). On the other hand, capital stock investments (or expansions) feature long construction lags (e.g. yards and docks are not built within one day) making capacity investments slow, and thereby rendering good times even more profitable for existing firms (Kalouptsidi, 2014[1]).[1] Hence, consistent with anecdotal evidence ship yards delay exit decisions and suffer losses in anticipation of better times (i.e. yards exhibit patterns of hysteresis). Such market behaviour may lead to chronic excess capacity (Pindyck, 1991[2]) and government actions preventing or delaying industrial restructuring can artificially prolong and worsen such structural imbalances.

During **cyclical upturns**, capacity is a competitive advantage of ship yards. The net production time of a vessel takes around nine to 18 months (depending on the ship type and features).[2] However, following a rise in orders for new ships (i.e. similar to the positive demand shock prior to the economic crisis of 2008), yards will face capacity constraints which are reflected in additional waiting time for each order. Hence, during cyclical upturns several months can pass until the actual ship production starts since yards need to wait until docks become available, and the time to delivery (TTD) of ships increases with the order book (i.e. yard backlog) – a special feature of the shipbuilding industry.

In 2008, the time from order to delivery date reached on average 3 ½ years (compared to 1 ½ years in the early 2000s), and in the same year 70% of the fleet was still scheduled for delivery by 2012. During this wait, uncertain demand for sea transport can substantially alter economic conditions for shipping firms; and indeed, the crisis of 2008 led to an idling of part of the existing fleet, freight rates for shipping firms plunged and thereby rendered new ships unnecessary (Kalouptsidi, 2014[1]). In other words, long waiting time amplifies the uncertainty ship buyers face with their investment decisions in new ships (i.e. a capital

good).[3] Ship buyers therefore prefer short waiting times for their orders to be able to exploit the prosperous boom phase in the form of increased freight rates. Large yard capacity shortens the delivery time of vessels as yards have more docks available. In turn, offering shorter delivery times to ship buyers strengthens the position of yards during contract negotiations, which in turn determine newbuilding prices.[4]

Public measures supporting directly or indirectly capacity expansion in the short or long-term influence the investment behaviour of shipping firms through a reduction in waiting time (i.e. TTD). The natural increase in waiting time during periods of high ship demand has however a smoothing effect on investment. Time to delivery constrains the supply of new vessels in the short-term due to slower and lower deliveries of vessels, and thereby reduces the extent of over-ordering of new vessels. In addition, since ships are capital goods, ship buyer's investment decisions are similar to those for financial products in the sense that such decisions are usually based on net present value calculations. Expectations about future demand for transportation services and profits are crucial for ship buyers' willingness to pay. Hence in the long-term, incentives of ship buyers to invest in new ships are dampened with long time to build delays since ships that are delivered late will not be able to take advantage of the temporarily increased demand for shipping services.

Simulations by Kalouptsidi (2014[1]) show that in the scenario under pure construction time for vessels of nine to 18 months (in contrast to an increased delivery time of up to 3 ½ years due to orders queuing at yards until a new dock becomes available as observed around the year 2008), ship supply becomes more elastic in the short-term (i.e. more responsive to demand). The greater responsiveness of production levels to demand results in higher order volumes of around 2%, a twice more volatile ship production, and significantly lower ship prices. As the paper will furthermore highlight, negative demand shocks – which will certainly arise due to the cyclical nature of the shipbuilding industry (see Annex A for an overview of ship production over time) – will lead to a more severe excess capacity situation in the shipbuilding industry. Similarly, the negative consequences for the shipping industry may be more pronounced than without an artificially reduced delivery time (e.g. through government supported capacity developments). The research results show that under pure construction time (i.e. no additional waiting time due to orders queuing at yards) the fleet is larger and 45% more volatile, and freight rates are lower although less volatile (by around 2%). Indeed, due to the reduced freight rates at least consumer surplus (i.e. of shippers) is higher under these shorter delivery times.

It is worth highlighting that the aforementioned effect of government interventions on the supply elasticity is a particular feature of the shipbuilding industry for several reasons. First, in the shipbuilding sector production starts only with a secured order and yards do not build up inventory of ships. Second, ships are capital goods, i.e. financial assets. Ship buyers apply portfolio theory and discounted cash flow models in general to assess the vessels' value. Asset prices and investment decisions thereby depend on expectations about the development of key exogenous variables, such as demand for transportation services, interest rates, bunker costs, exchange rates (Karakitsos and Varnavides, 2014[3]). Purchase decisions for ships are therefore inherently different to those for intermediate goods. Third, due to the time lag of several years between investment decisions and their realization (i.e. time to delivery) along with the nature of ships being capital assets, the time dimension is particularly important as economic conditions can drastically alter between the ordering and operation of ships to generate revenues.

In short, non-market based investments into yard capacity through government measures will not only make it difficult to restore a level-playing field in the global shipbuilding

industry, but may also exacerbate economic downturns in the shipping or shipbuilding industries through two channels: first, it may lead to a larger extent of over-ordering of vessels through lower time to delivery as explained above, and thereby to a more pronounced cyclical downturn; second, during bust times excess capacity may lead to government support to failing ship yards in order to minimize social costs. Given the global nature of the shipbuilding and shipping industries any market-distorting government intervention in one country will ultimately affect industry developments in third countries. These channels furthermore reinforce the case for effective international disciplines on government interventions in the shipbuilding industry.

It is important to note that this study does not define – much less attempts to measure – the extent of excess capacity present in the shipbuilding industry. The challenge in defining the term (and measuring) excess capacity lies in the fact that firms rarely employ capital stock and labour at maximum settings, since doing so would be economically inefficient. Firms rather operate at the maximum effective utilisation, which will however vary across firms and time, and is not observed directly. More generally, since excess capacity in the shipbuilding industry has a cyclical component it is virtually impossible to disentangle the part of these market imbalances arising from cyclical factors, from those arising from structural factors (i.e. the part resulting from government interventions).

Instead, this paper is a continuation of the work conducted by the Secretariat to analyse factors that affect supply and demand of ships, and thereby industrial capacity in the long term. OECD (2016[4]) analysed the causes of excess capacity with respect to the features of the shipbuilding industry and derived policy recommendations based on past-experience of a selection of shipbuilding economies. The objective of the following analysis is to provide a better understanding of the channels through which various public support measures can lead to market distortions[5] and affect industrial capacity.

To discuss these mechanisms in more detail, section 1 of the report first lays the basis for the subsequent analysis by describing the specificities of the shipbuilding industry in terms of supply and demand. Section 2 then describes the effect of a selection of government measures on supply primitives. The last section concludes on the results and provides further remarks.

2. Market dynamics in shipbuilding

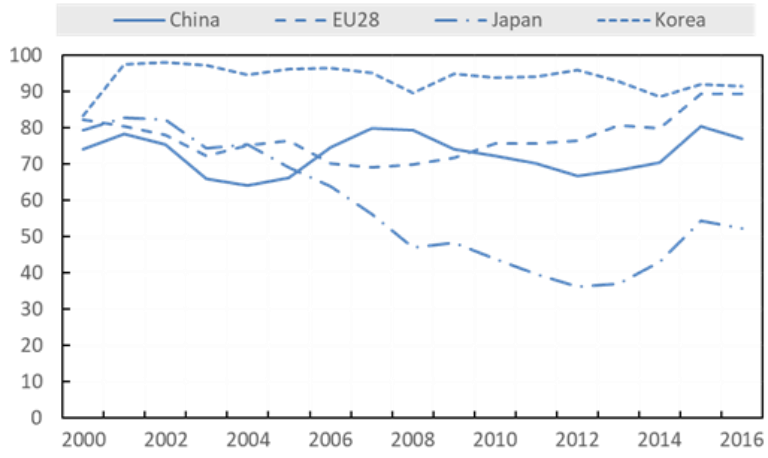
This section provides the basis for the subsequent discussion on government measures. The first part of this section describes the global character of the shipbuilding market, and discusses major determinants of newbuilding prices. The second part of this section has a focus on the supply side by describing the industry maturity of ship production, capital intensity, and presents the concept and the relevance of time to delivery. The section finishes with an analysis of determinants of production costs.

2.1. Global shipbuilding market and major determinants of newbuilding prices

Commercial shipbuilding operates in an integrated global market where ship yards usually compete for contracts outside their own countries. As Figure 1 shows, over the last two decades, the lion's share of ship production of major shipbuilding economies has been purchased by foreign owners (with the exception of Japan – a case which requires a separate explanation as outlined in Box 1). The fact that a new ocean-going vessel can load its first freight independent of the location where it has been built adds to the flexibility of ship buyers to order at their preferred yard around the world and leads at the same time to more competition across ship yards. In other words, provided that the ship order features the same conditions in terms of, among others, prices, time to delivery, quality aspects, financing, or post delivery services (see more on contract conditions below), there was no economic reason for buyers to prefer domestic over foreign built ships.

Figure 1. Export share of ship production (CGT) by region

In %



Note: Export shares are calculated as the shares of a given country's production sold to a foreign owner. EU28's export share is calculated as the share of EU28's production sold to non-EU28 countries.
Source: based on Clarkson World Fleet Register (2018).

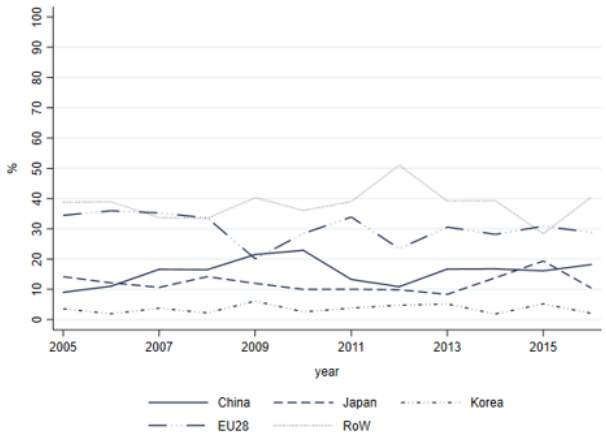
Box 1. Japan's decline in export share

Japan constitutes an exception; from 2005 its industry faced a continuous decline in export share and saw finally around 2009 a drop below 50%, indicating an increased dependence on domestic orders. This decline happened in a period when global competition intensified. As one example, around the year 2003 China entered the shipbuilding industry under a national government programme (see next section). The country's product mix most closely resembles the Japanese one with its largest exposure to bulker production. The average share of similar ship type orders amounts to around 80% between 2005 and 2015 (calculated on the basis of a similarity index that is often used in export basket analysis of two countries, see Annex B). In short, Japan's yards were seemingly confronted with increased direct competition from China for orders of similar ship types – this was the case to only a lower extent for other economies.

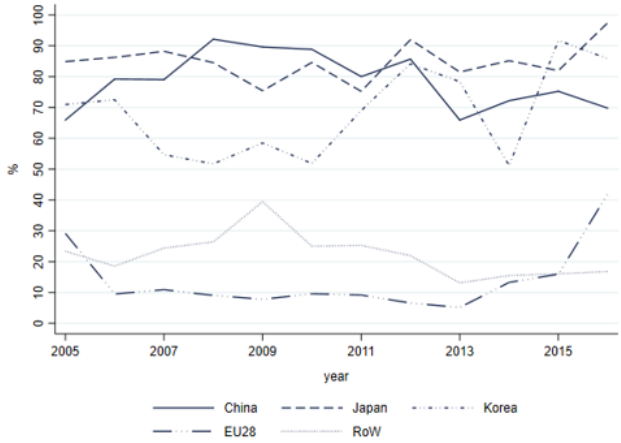
Yet, the global character of the shipbuilding industry certainly depends on the development of the country's downstream industry, i.e. shipping companies. Figure 2 (a) indicates a measure for the size of shipping industries across countries. Along with EU 28 states (in particular Greece), Japan and China represent the leading owner countries that ordered vessels at world shipyards during 2005 and 2016. For 2016, the owner countries' shares for new orders amount to around 30% for EU 28 countries and 20% for China and Japan each. In contrast, Korea holds only a share of about 5%, suggesting a relatively small commercial shipping industry. Irrespective of the size of the domestic shipping industry, shipping firms usually purchase vessels from domestic ship yards (Figure 2 (b)). Between 2005 and 2016, ship buyers placed the majority of orders at domestic yards; take the example of 2015 where around 90% of Korean owners ordered from Korean yards, 80% of Japanese buyers and 70% of Chinese owners did so at their respective national yards. The result for EU 28 countries requires a separate interpretation; although EU 28 countries, in particular Greece, have a strong shipping industry the majority of orders are placed outside of the EU. This may result from the fact that Greece is active in dry/bulk shipping while EU countries were initially mainly active in container and tanker production and subsequently specialised more on passenger ship production as well as offshore service vessels and platforms (OECD (2017[5]), OECD (2018[6]) and OECD (2015[7])). Lower transaction costs certainly play a role in the decision to order domestically, such as no language barriers, shorter distances to travel to meetings with the yard, in some cases cost advantages for purchases in local currency and public policies.

Figure 2. Orders by owner country and builder country

(a) Share of orders* by owner country



(b) Share of owners' orders* at domestic yards

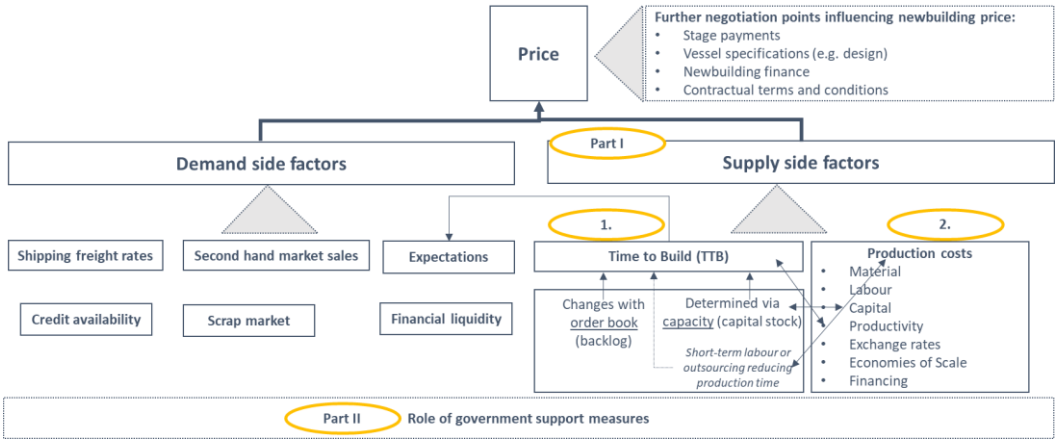


Note: *Orders are corrected for cancellations.
Source: based on Clarkson World Fleet Register (2018).

In such an international environment for vessel purchases, ship owners either contact ship brokers to facilitate the transaction, or they get directly in contact with some shipbuilders (often through yards sales' offices based in buyer countries). In both cases, a common procedure is to invite a selection of yards to submit tenders that set out a precise specification of the ship.[6] Buyers select the most competitive bids and make a final selection after a detailed discussion of the design, specifications and terms. Usually this process takes between six months to a year, in particular in a buyers' market. In contrast, in a sellers' market this approach is hardly possible since buyers compete fiercely for the few available berths, and yards set to a large extent their own terms and conditions (e.g. often yards take advantage of a firm market to insist upon the sale of a standard design) (Stopford, 2003[8]).

Major negotiation points of the contract are the price, stage payments, the "makers'list" (i.e. manufacturers of the main items of machinery and equipment), vessel design, newbuilding finance offered for the buyer, and other contractual terms and conditions. The vessel price is by far the most important aspect of the negotiations (Stopford, 2003[8]). In a weak market, buyers will seek to extract the maximum benefit from their negotiating position in each area. Conversely, in a strong market the shipbuilder will negotiate for the maximum price possible on a standard vessel, with favourable stage payments. Figure 3 outlines for the buyer's and supplier's side the major determinants of ship contracts, which in turn influence newbuilding prices.

Figure 3. Determinants of newbuilding prices



Note: Capacity drives capital costs but reduces time to build which is a competitive advantage of yards. Short term labour or outsourcing activities reduce production time and thereby time to build, however such short-term services are usually more expensive and therefore increase production costs (trade off: either increasing prices and weakening a yard's competitive advantage or reducing profit margins weighing on a yard's profitability). Higher yard productivity may decrease production time (and costs, or increase output while keeping production costs constant) and thereby reduces time to build. In turn, time to build influences expectations since with increased delivery time ship owners need to predict profits that are further in the future.
Source: based on Stopford (2003[8]).

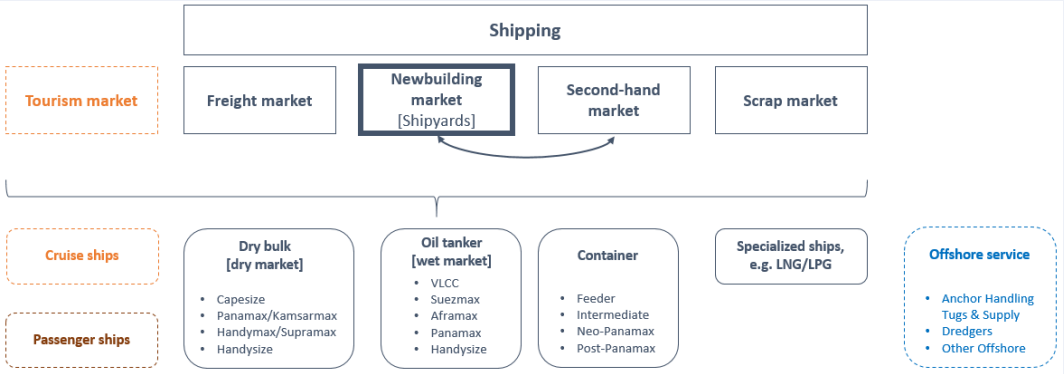
Demand side factors

According to Stopford (2003[8]), key factors on the demand side are current freight rates, the price of modern second-hand ships, financial liquidity of buyers, the availability of credit and, most importantly, expectations (Figure 3). *Expectations* about future profits (through freight rates, e.g. time charter or voyage charters) determine the willingness of ship owners to invest in a new vessel (i.e. a capital asset). The net present value (discounted cash flows less cash outflows) must be positive, otherwise there would be no economic reason for a ship owner to invest.[7] For more information on drivers of investment decisions of ship buyers see Box 2. Demand for shipping services is uncertain as well as highly volatile and cyclical, and driven by seaborne trade which in turn is tied to global economic growth as well as heavily affected by geographic trade patterns (influenced by trade barriers) and geopolitical events (Greenwood and Hanson, 2015[9]).

Box 2. Four distinct shipping markets

Shipping is organised in the form of four markets and investment decisions are the results of an interaction between them (Figure 4): freight, newbuilding (shipbuilding industry), second-hand and scrap. Increasing freight rates (i.e. earnings for ship owners) and a positive outlook of demand for maritime transport incentivise shipping firms to expand their fleet either through newbuilding or second-hand ships to exploit increasing profits. Demolishing a vessel is less attractive during these times since each owner aims to operate at the highest possible fleet capacity. In contrast, decreasing freight rates and a negative outlook of future demand incline owners to either sell their vessel at the second-hand market or collect the scrap values (i.e. mostly steel see Gourdon (2019[10])).

Figure 4. Distinct markets for ship demand



Source: based on Karakitsos and Varnavides (2014[3]).

While this structure pertains to the ship types for dry bulk, oil tanker, container and other specialized vessels (e.g. LNG/LPG carriers), the freight market is not applicable to cruise and passenger ships as well as offshore service vessels. The demand drivers are different. The cruise and passenger ship market is an exception and falls out of the scope of this paper. Demand drivers in the tourism market substantially differ from those of the market for water transportation of goods insofar as they are less volatile and depend directly on disposable income of cruise passengers.

In other words, the shipping industry is closely linked to boom and bust cycles. Recent empirical findings suggest that overinvestment in booms usually occur because of two recurring forecasting errors of firms. Firstly, firms mistakenly believe that abnormally high profits will persist into the future. Secondly, firms underestimate the investment response of their competitors (i.e. so-called "competition neglect").[8] As a result, shipping firms overinvest during booms and are predictably disappointed by low future earnings (Greenwood and Hanson, 2015[9]).[9]

Time to delivery, which varies with order book (i.e. the higher the order book the longer the waiting time from order to delivery and vice versa), has a smoothing effect on investment (new orders of ships). Time to delivery constraints the supply of new vessels in the short-term due to slower and lower deliveries of vessels. In addition, incentives of ship owners to invest in new ships are dampened with long time to build delays as ships that are delivered late will not be able to take advantage of the temporarily increased demand for shipping services.[10] Since longer time to build renders ship buyers less likely to respond to demand shocks, it will lead to a smoother investment process into new ships and in turn less volatility in the fleet (Kalouptsidi, 2014[1]).

These time lags between order and delivery make it far riskier for ship owners to invest in new ships in booms than it was in busts. During prosperous periods when ship buyers prefer to take advantage of the profitable market conditions immediately they favour the purchase of second hand vessels to avoid the time lag in the construction of newbuilt ships.

Supply side factors

From the viewpoint of shipyard supply the key issues are the production costs and the time to delivery (Figure 3). Time to delivery is determined in the short-term[11] by capital stock (e.g. the number of docks and berths available) and the size of the order book (i.e. backlog). A yard with three years' work cannot offer a realistic delivery, while another yard constructing their last ship on order will be desperately keen to find new business. This

balance is what drives shipyard prices. During booms when the yards have built up long order books and many owners are competing for the few berths available, prices rise sharply. In a recession the opposite happens. Shipyards are short of work and there are fewer buyers, so the yards have to drop their prices to tempt in buyers (Stopford, 2003[8]).

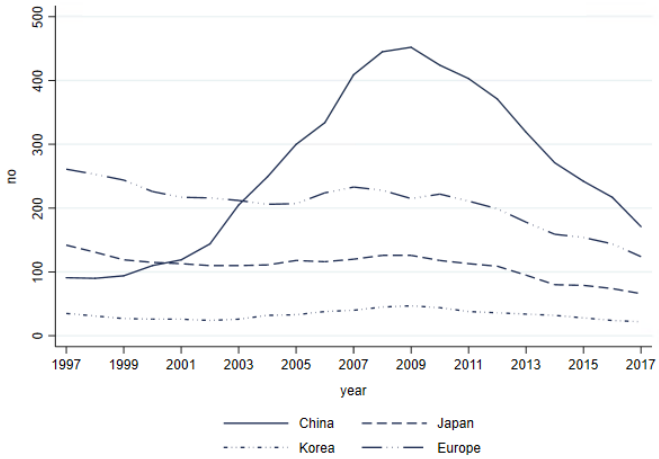
The trade-offs ship builders face are (Figure 3): either increase capacity to decrease time to delivery but face increased production costs (i.e. variable capital costs), or use short-term services such as temporary workforce or outsourcing that reduce production time (and in turn time to delivery) but increases production costs. Finally, increased productivity reduces delivery time and influences production costs (i.e. a firm can produce the same output with lower input costs). As described above, time to delivery determined on the supply side impacts the demand side as it influences expectations and thereby investment decisions (i.e. new orders) and newbuilding prices.[12] As Adland and Jia (2015[11]) state there exists a term structure of newbuilding prices, describing the combinations of cost and time to delivery between which ship owners would be indifferent. If ship buyers have an opportunity cost through waiting time for a ship (i.e. missed profits through freight contracts), time to delivery will be a downward sloping function with respect to prices such that early delivery slots command a premium over deliveries further into the future.

2.2. Supply side – Features of the shipbuilding industry

2.2.1. Industry maturity

In the early 2000s the shipbuilding industry was characterised by a large wave of new ship yards (Figure 5), specifically from China. Indeed, Europe and Japan showed a decline in the number of active yards in the same period. The expansion of China's shipbuilding industry is mainly a result of its industrial development plans starting in the early 2000s (Box 3). Historically, Japan and Korea entered the shipbuilding industry already in the 1950s and 1970s, respectively.[13]

Figure 5. Number of active firms



Note: China includes Hong Kong. Europe includes: Albania, Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bulgaria Croatia, Cyprus[14], Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Kazakhstan, Kosovo, Latvia, Lithuania, Liechtenstein, Luxembourg, Macedonia, Malta, Moldova, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom. Active yards include all yards that either receive a new order or are currently working on the production of existing orders.

Source: based on Clarkson World Fleet Register (2018).

Box 3. Chinese development plans involving the shipbuilding industry

- 2003 National Marine Economic Development Plan
- 2006 The 11th Five-Year Plan for National Economic and Social Development
- 2006 The Medium and Long Term Development Plan of Shipbuilding Industry
- 2007 The 11th Five-Year Plan for the Development of Shipbuilding Industry
- 2007 The 11th Five-Year Plan for the Development of Shipbuilding Technology
- 2007 The 11th Five-Year Plan for the Development of Ship Equipment Industry
- 2007 Guideline for Comprehensive Establishment of Modern Shipbuilding (2006-10)
- 2007 Shipbuilding Operation Standards
- 2009 Plan on the Adjusting and Revitalizing the Shipbuilding Industry
- 2010 The 12th Five-Year Plan for National Economic and Social Development
- 2012 The 12th Five-Year Plan for the Development of the Shipbuilding Industry
- 2013 Plan on Accelerating Structural Adjustment and Promoting Transformation and Upgrading of the Shipbuilding Industry
- 2013 Shipbuilding Industry Standard and Conditions
- 2015 Made in China 2025

Source: Kalouptsidi and Barwick (Fall 2017[12]).

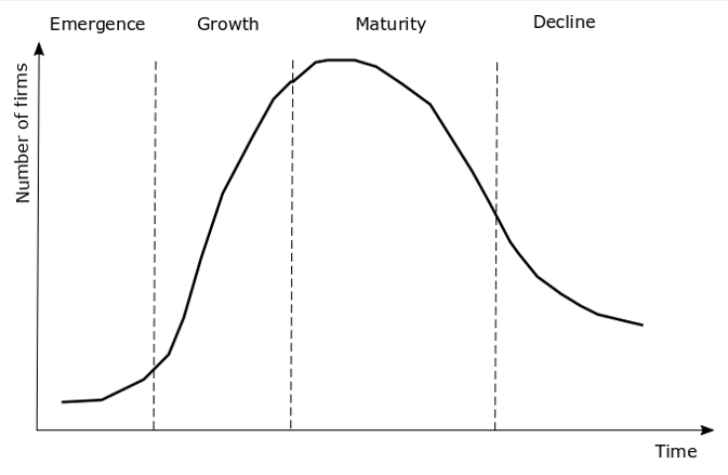
Relating the development of the number of active yards to a life-cycle analysis indicates that the shipbuilding industry in the major shipbuilding economies seems to be in a declining stage and China entered the declining part of the mature life-cycle stage (see Box 4 and Figure 6). These models are based on the observed tendency for the number of firms in an industry to be relatively low and stable in the initial years, followed by a period of rapid growth, before the number peaks and subsequently declines as the market for the industry eventually decays.

Livesey (2012[13]) introduces the idea of relative industry maturity by contrasting a country's position in the industry life cycle with the position of the industry abroad.[15] For Europe, Japan, Korea and China in 2018, the domestic shipbuilding industry most closely relates to sectors that are either in the mature or declining stage at home and where the same is true on a world scale. According to Warwick (2013[14]) this is the area where the need for selective industrial policy is least urgent and a horizontal approach is best – particularly one focused on allowing free entry and exit, upgrading the general level of labour skills and other capabilities, and enabling resources (i.e. capital stock and labour) to move easily between sectors.

Box 4. Life Cycle Analysis

Livesey (2012[13]) first discusses the concept of phases of industrial maturity based on industry life-cycle models. Figure 6 illustrates a typical pattern of emergence, growth, maturity and decline for a sector, using the number of firms as an indicator, although the concept could be generalised to include other indicators of the stage of an industry's development (Warwick, 2013[14]).

Figure 6. Stages of industry life-cycle



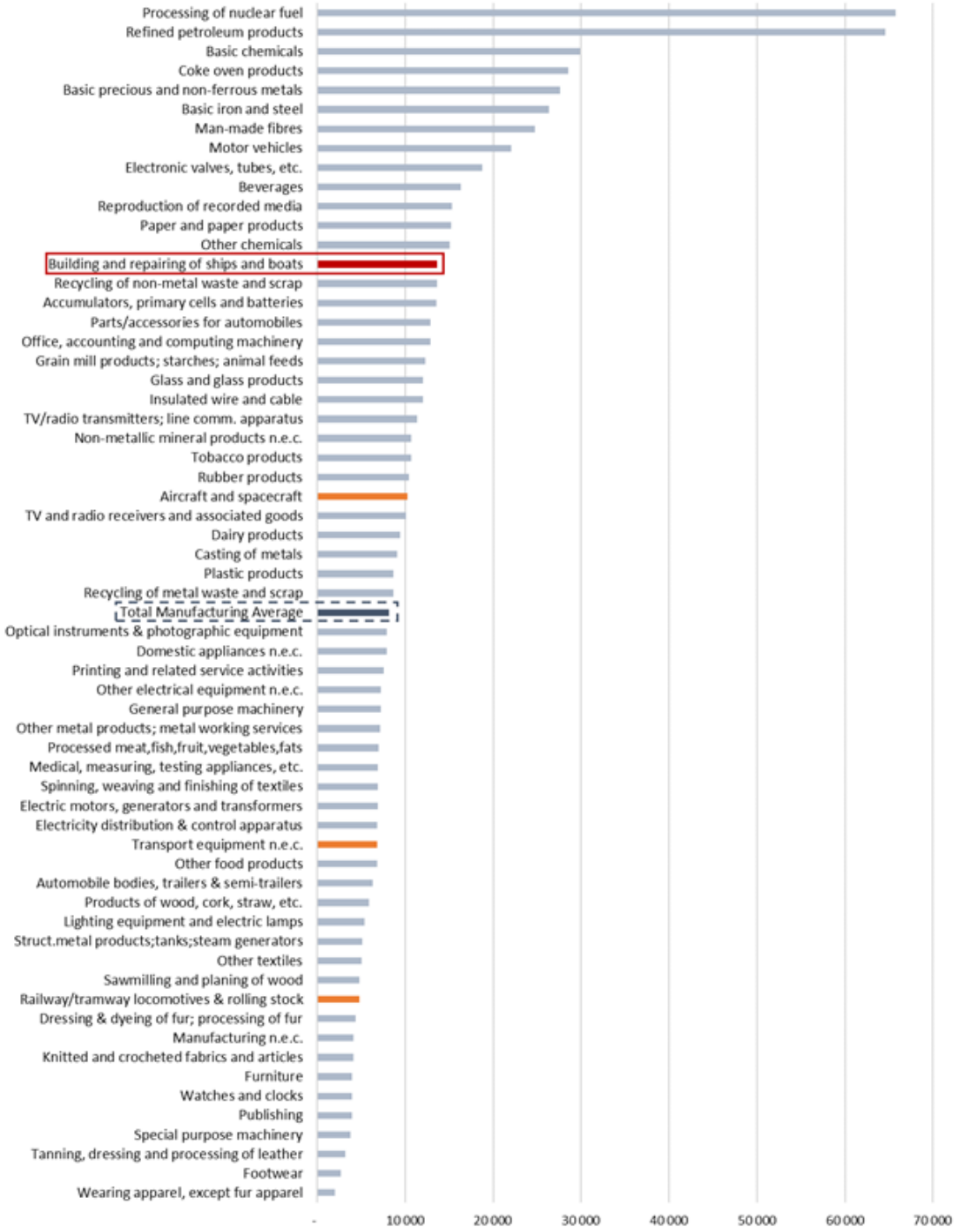
Source: based on Livesey (2012[13]).

2.2.2. Capital intensity

Shipbuilding is a capital-intensive industry. The production of ships requires long-term assets, especially land area, building docks, quays, machines for steel preparation and cutting, cranes.[16] As an illustrative example of capital intensity across sectors, the ratio of capital stock (i.e. gross fixed capital formation) to employment is much higher than the average ratio of the manufacturing sector (Figure 7). Most capital-intensive industries are nuclear fuel processing, petroleum refining, chemicals, iron and steel while at the lower end of industrial capital intensity are textiles and publishing.

Figure 7. Illustrative capital intensity across sectors

Ratio of Gross Fixed Capital Formation (GFCF) over Employment

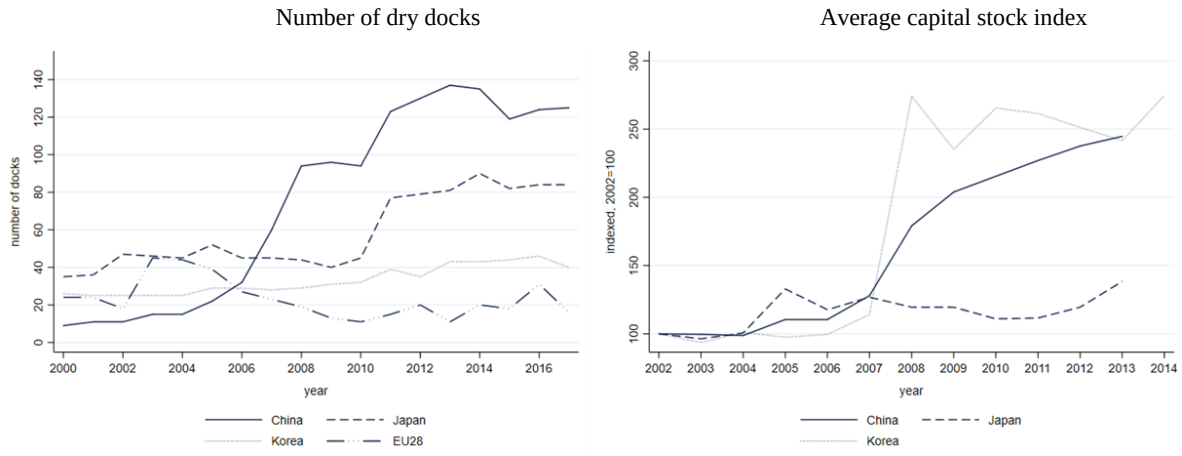


Note: Ratio of average GFCF and average employment (does not include short-term labour) by sector across country and year.
Source: based on United Nations Industrial Development Organization (UNIDO) 3 Digit-level industry classification of ISIC Rev. 3.

Shipyard capacity steadily increased for the majority of shipbuilding countries over the last two decades. The number of dry docks per country as a capacity measure illustrates that in particular China and Japan expanded its production ability (Figure 8 lhs). At a broader level, ship yard capacity can be approximated by a yard's deflated capital stock[17] representing fixed assets, such as. docks, quays, cranes, buildings, land area, machinery for steel cutting and welding and so on (Figure 8 rhs). Average capital stock increased in particular in China and Korea from 2006/07 onwards while for Japan the increase in capital stock started around 2010 – which is in line with the development of Japan's number of dry docks. Strikingly, despite the cyclical downturn as a result of the economic crisis of 2008 both capacity measures continued increasing rather than adapting to the new market conditions.

The observation that capacity adapts only sluggishly is reminiscent of the discussion on investment irreversibility and long construction lags of new capacity that often delay exit decisions of firms. On the one hand, capital investments of yards are barely irreversible as unused capital stock represents sunk costs, hence, it can hardly be reused or resold profitably. On the other hand, capital stock investments (or expansions) feature long construction lags (e.g. yards, docks, cranes are not built within one day) making capacity investments slow, and thereby rendering good times even more profitable for existing firms (Kalouptsidi, 2014[1]).[18] Hence, consistent with anecdotal evidence ship yards delay exit decisions and suffer losses in anticipation of better times (i.e. yards exhibit patterns of hysteresis).

Figure 8. Shipbuilding capacity indicators by country

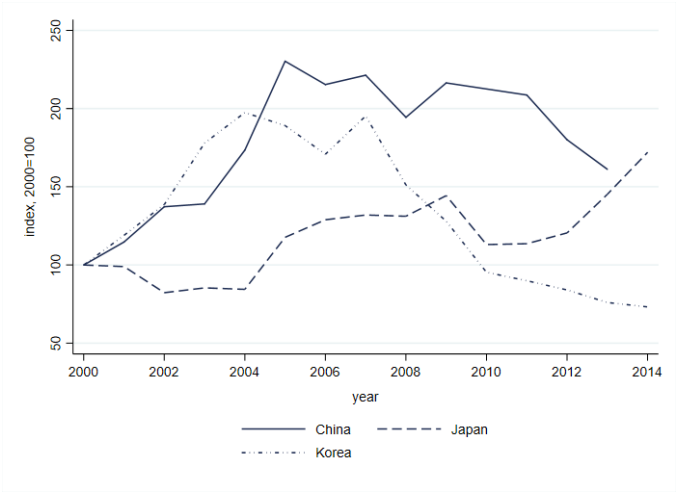


Source: lhs based on monthly publication of Clarkson Shipyard Monitor.; rhs based on ORBIS 2016-1 and 2016-2, and Kalouptsidi and Barwick (Fall 2017[12]).

This is also reflected in the decline in capacity utilisation rates since capacity does not adapt rapidly to the drop in demand. Figure 9 shows an approximation of utilisation rates of plant and equipment (i.e. capital stock utilisation) for the three major shipbuilding economies calculated on the basis of real gross output over real capital stock. In China, capital stock utilisation increased since 2000 and stabilized thereafter until it declined around 2010. In contrast, Korea saw a major drop in 2007/08 and Japan seems to have been able to increase its utilisation levels of the year 2000. It seems that at least in China and Korea capital utilisation is below its potential, i.e. at the country-specific peak.

Figure 9. Median yard utilisation rates of capital stock

Indexed at 2000=100



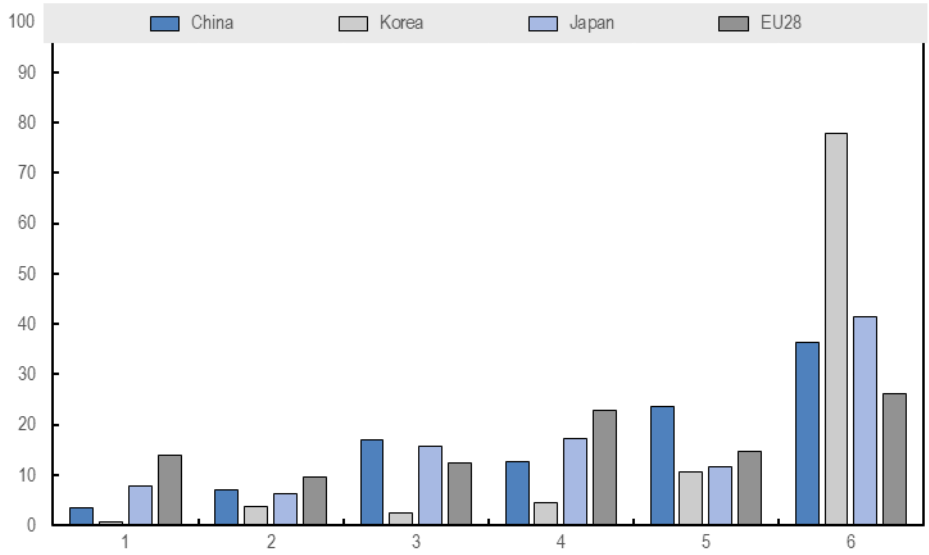
Note: For another approach estimating yard capacity see the report by the OECD on Imbalances in the Shipbuilding industry (OECD, 2016[15]).
Source: based on ORBIS 2016-1 and 2016-2, and Kalouptsidi and Barwick (Fall 2017[12]).

In contrast to the shipping industry (demand side) which features several distinct markets (i.e. container, tanker, bulker etc.), there is a large supply substitutability of ship yards. In other words, yards can more easily switch the production from one to another standardized ship type – at least to some extent.[19] Therefore, yard capacity cannot be subdivided by ship type and must be seen as an aggregate production capacity since most of the yards produce a certain number of ship categories.

Figure 10 highlights that ship yards are multi-product firms, in particular the largest yards are able to produce six or more types, such as in Korea. Strikingly, the single product yards (i.e. producing only one ship type) observed in the data are yards which likely produce cruise ships only, which indicates that the cruise ship production is not frictionless. In this case shipbuilders may not be able to move easily from one market to another as their facilities may be unsuited for this vessel type or more importantly due to entry barriers in the form of experience in cruise ship production and a well-connected supplier base. For further discussion about the cruise ship market see OECD (2015[7]). This observation is also supported by Stopford (2003[8]), stating that most yards are extremely flexible and will bid for a wide range of business. In adverse markets major shipyards have been known to bid for anything from floating production platforms to research vessels. Moreover, Adland and Jia (2015[11]) highlight that since different ship types will compete for the same slots available the delivery lag for bulkers, for instance, will be influenced by the demand for other ship types, such as tankers and gas carriers. Any government intervention in a ship yard will affect all ship types. Even if it is targeted at only one ship type in principle, it will be difficult in practice to derive the effect of the public intervention on this specific market.

Figure 10. Share of yard's output by number of ship types

During contract years 1990-2016

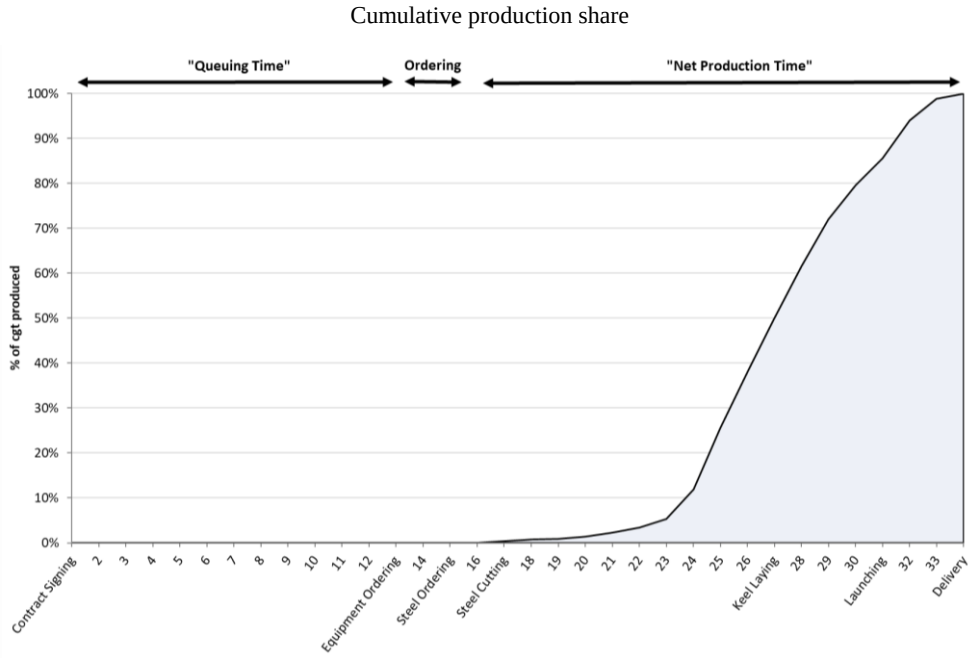


Note: 13 product categories: bulker, cruise ships, containerships, gas carrier, offshore services, pure car carriers, passenger, reefer, ro-ro, tankers, other dry cargo, other non-cargo, miscellaneous.
Source: based on Clarkson World Fleet Register (2018).

2.2.3. Time to Delivery

Figure 11 illustrates an example of a ship production process. Several years can elapse between contract signing and the ordering of equipment and material, during which the order essentially is queuing for a dock to become available. Typically the net production time of a vessel takes around nine to 18 months (depending on the ship type and features).[20] However, following a rise in orders for new ships (i.e. similar to the positive demand shock prior to the economic crisis of 2008), yards will face capacity constraints which are reflected in additional waiting time for each order. Hence, during cyclical upturns several months can pass until the actual ship production starts since yards need to wait until docks become available, and the time to delivery of ships increases with the order book (i.e. yard backlog) – a special feature of the shipbuilding industry.

Figure 11. Illustrative example of a ship production process



Note: Ship yards may organize their production processes differently. This graph aims to show only an illustrative example of the delivery time comprising "queuing time" and "net production time". The production shares do not reflect actual numbers.
Source: Author's elaboration based on information obtained through interviews with ship yards.

Figure 12 shows the increase in delivery time during periods of high demand (i.e. around 2006-08) as a consequence of yard capacity constraints. While in the early 2000s the delivery time amounted to around 18 months, on average, during the peak ship buyers were required to wait up to 3 ½ years.

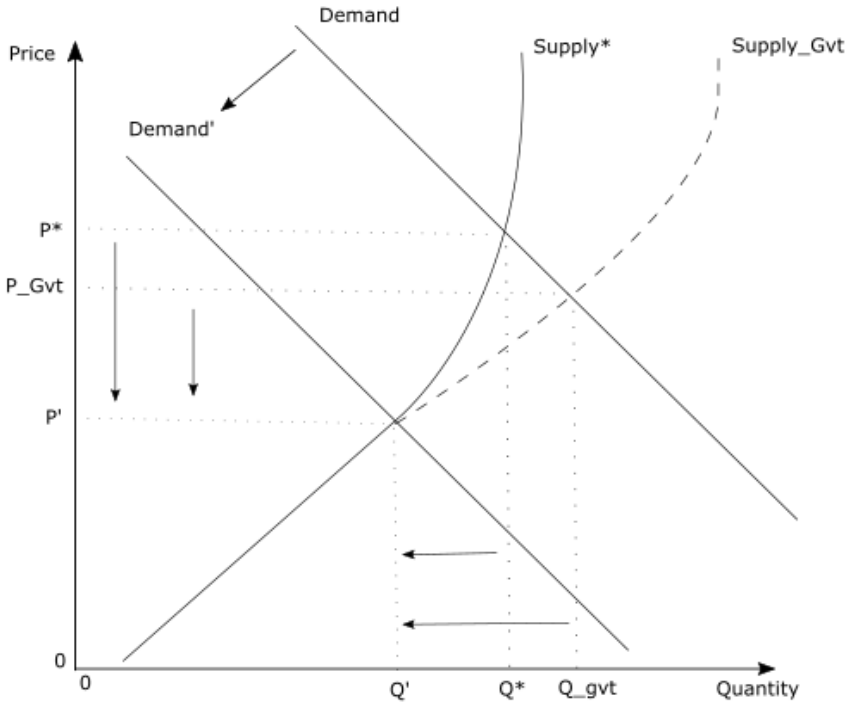
Figure 12. Average Time to Delivery

Source: based on Clarkson World Fleet Register (2017).

Artificially stimulated capacity expansions through government measures make the supply of vessels more elastic (i.e. more reactive to demand). As Figure 13 shows, the solid supply line (i.e. solid line for *Supply** indicating ship supply without government intervention) indicates that once ship yards reach their capacity constraint they are not able anymore to produce ships in the short-term. Hence, the supply curve becomes very inelastic, i.e. even if a ship buyer would accept to pay an extraordinarily high price the yard will not be able to produce the ship in the short-term by virtue of unavailable docks. In this situation prices are higher (*P**) und production (*Q**) is lower than in the case of government interventions stimulating directly or indirectly capacity increases (i.e. dotted line for *Supply_Gvt* representing ship supply with government involvement). In the latter case, with artificially increased capacity the supply curve becomes more elastic (i.e. more reactive to increased demand), so that ship yards are able to supply their ships faster than in the first case under capacity constraints. Following a negative demand shock (i.e. downward shift of the demand curve to *Demand'*), such as it was the case following the economic crisis of 2008, the extent of a drop in production will be more severe in the case of elastic supply than it would be in the case of inelastic supply. Formally, the decline from *Q_Gvt* to *Q'* is much larger than the drop from *Q* to *Q'*, indicating the extent of unused capacity following a cyclical downturn. Indeed, the drop in ship prices due to a cyclical downturn is smaller in the case of government intervention, but only since ship prices were already much lower compared to the natural market price (under *Supply**), making the decline less pronounced. This highlights the market distorting effect of government interventions on ship prices.

In conclusion, the natural increase in waiting time during periods of high ship demand has a smoothing effect on investment. Time to delivery constrains the supply of new vessels in the short-term due to slower and lower deliveries (i.e. inelastic supply curve *Supply**), and thereby reduces the extent of over-ordering of new vessels. In addition, since ships are capital goods, ship buyers' investment decisions are similar to those for financial products in the sense that such decisions are usually based on net present value calculations. Expectations about future demand for transportation services and profits are crucial for ship buyers' willingness to pay. Hence, incentives of ship buyers to invest in new ships are dampened with long time to build delays since ships that are delivered late will not be able to take advantage of the temporarily increased demand for water transportation. In addition, since production is less responsive to demand shocks the extent of excess capacity as a result of a cyclical downturn will be less severe in the absence of any government intervention in the shipbuilding industry.

Figure 13. Negative demand shock: Effect of elastic supply on production



Note: This reasoning would not change when the *Supply_Gvt* curve would additional shift downards (implying reductions in production costs reflected in lower prices).
Source: Author's elaboration.

2.2.4. Production costs

Lower prices can be a result of a(n) (unexpected) decline in production costs. This section discusses the impact of several factors on production costs.[21] Our empirical results on a data sample of European and Asian shipbuilding companies shows that Chinese firms have on average significantly lower costs compared to German, Finnish, French, Italian, Korean and Norwegian firms while Romanian and Russian ones have on average lower costs than Chinese ones (Annex E for an overview of the data sample and Annex F for results).

The most interesting findings are probably that:

i. Costs increase in a convex manner[22]: by reaching a yard's capacity constraint, costs increase per unit produced since the firm needs to hire more expensive short-term labour and/or existing workers need to work extra hours as well as maintenance costs for machines increase due to the increased workload.

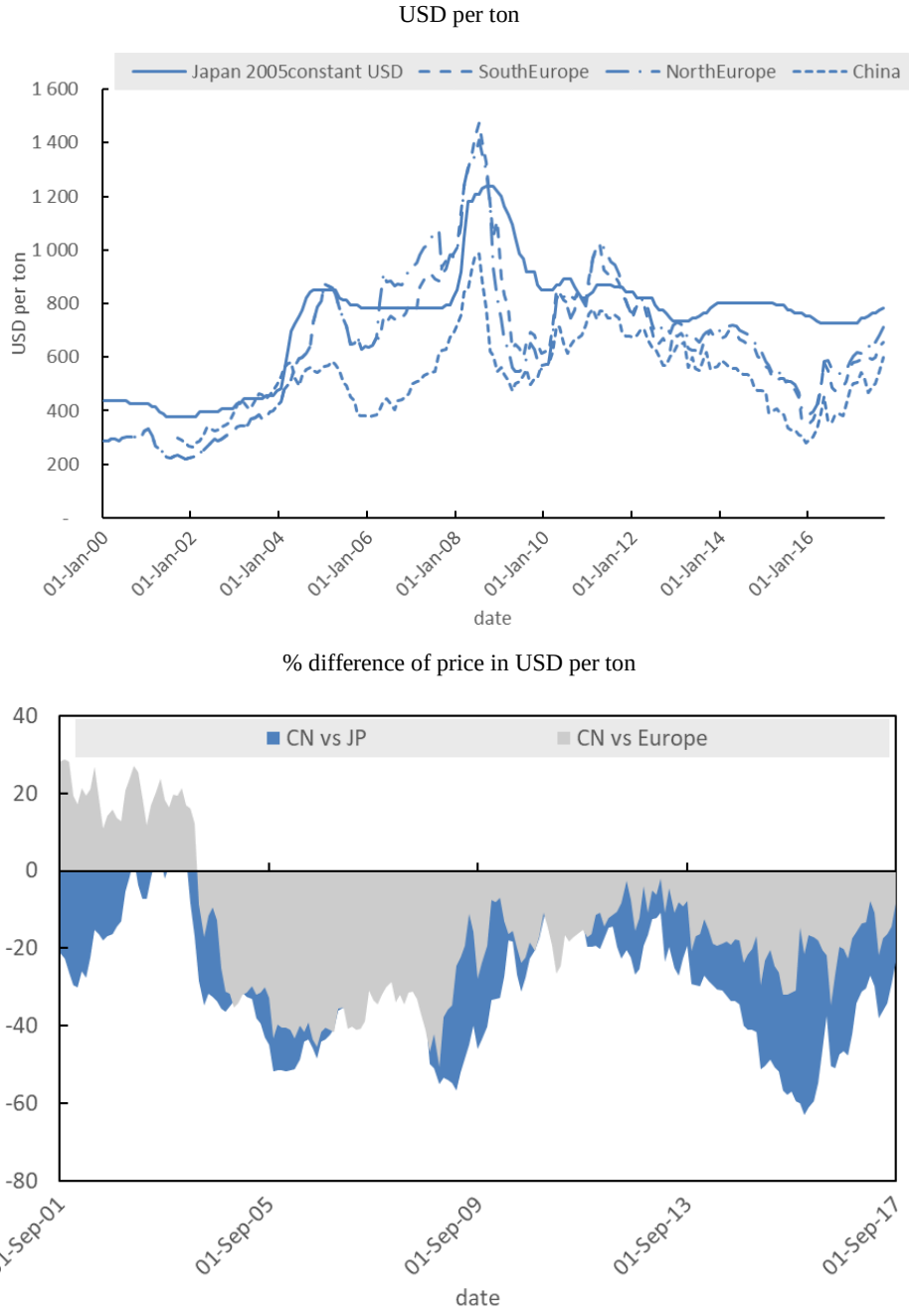
ii. Firms with large capital stock can benefit from efficiencies by producing the same quantity (i.e. CGT) at significantly lower marginal costs compared to firms with smaller capital stock. An increase of firm capital stock by 1% decreases on average firms' costs by around 0.01%.

iii. Prices for steel, ship's main input factor, have a significant impact on production costs and are considered to be very volatile (Figure 14, upper graph). A 1% increase in steel prices increases production costs by on average 0.5%.[23] Chinese steel prices are significantly lower than Japanese and European ones (Figure 14, lower graph) – in some periods up to 50% compared to (South) European prices

and 60% lower than Japanese prices. Although the figures compare the same steel category there may be differences in quality across countries.

iv. Productivity plays an important role in cost developments. More productive firms can decrease their production costs. An increase in total factor productivity decreases production costs by on average 0.7% (all other factors constant).

Figure 14. Steel plate prices (upper) and price difference to Chinese steel prices (bottom)

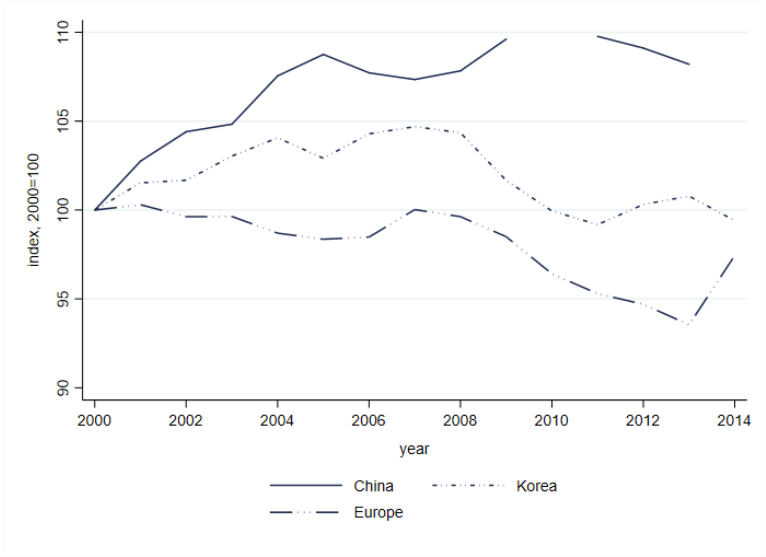


Note: Steel plates are major input factor for ship construction. Chinese and European prices are traded in USD per ton, while Japanese prices are converted from Yen to 2005 constant USD.
Source: S&P Platts (2017[16]) and Japan Metal Daily (2017[17]) for Japanese prices.

Total factor productivity (TFP) provides a good indication of how efficiently firms can convert inputs into outputs (see Box 5) and plays a role in changes in production costs.

Figure 15. Total Factor Productivity

Index of country average firm-level productivity, 2000=100



Note: There are no observations for Japan's material costs. Therefore, for Japan it is not possible to derive reliable total factor productivity estimates.
Source: based on ORBIS 2016-1 and 2016-2, and Kalouptsidi and Barwick (Fall 2017[12]).

Box 5. Total Factor Productivity

Total Factor Productivity (or also called multi-factor productivity) reflects the overall efficiency with which labour and capital inputs are used together in the production process. Changes in TFP reflect the effects of changes in management practices, technological advancements, organizational change, general knowledge, network effects, spill-over effects from production factors, adjustment costs, economies of scale or the effects of imperfect competition.

Since TFP measures the change in output relative to changes in labour and capital and thereby assessing the efficiency with which both inputs are used, it is a better measure of productivity than labour productivity or capital efficiency alone.

For example, instances where one company generates more output with the same amount of labour and capital inputs than one of its competitors, may reflect changes in TFP. Growth in TFP is measured as a residual, i.e. that part of production growth that cannot be explained by changes in labour and capital inputs (including material). This indicator is usually measured as an index and in annual growth rates.

Source: OECD Productivity Statistics (2018[18])

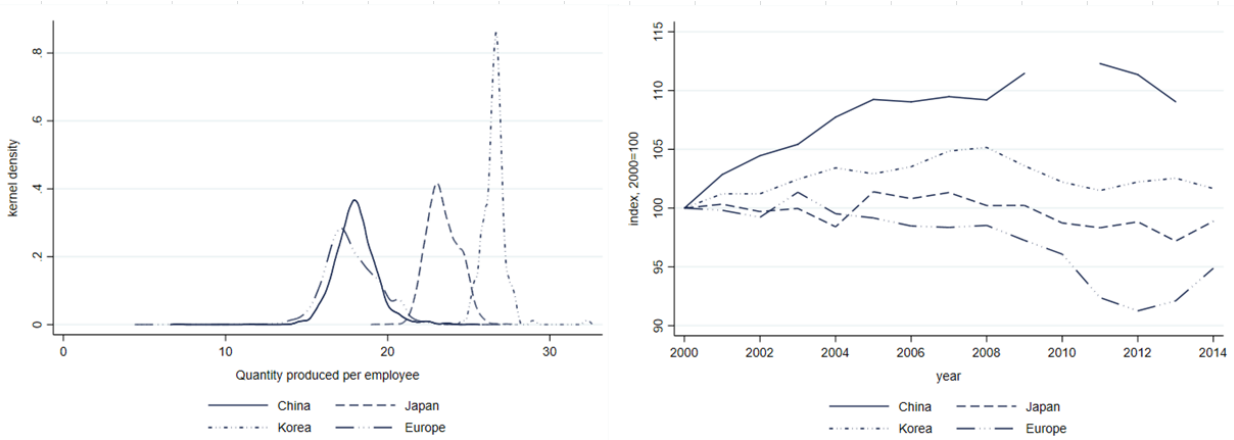
The results indicate that China's shipbuilding industry experienced a strong increase in TFP compared to its levels in the year 2000, while European countries faced a decline during the same period. Similar to China, Korean ship yards showed an increase in TFP until 2009 that subsequently declined below its level in 2000 (Figure 15).

Still China's TFP levels are on average lower than those of Korean and European firms, but they grow more rapidly.[24] In our sample for the period from 2000 to 2013, the weighted annual growth for China's shipbuilding firms amounts to 7% while for European ones it amounted to only about 0.9% and for Korea to approximately 2.1%. TFP growth of China's shipbuilding industry is significantly higher than for the total Chinese manufacturing industry as found by Brandt et al. (2012[19]).[25] The authors derived TFP developments of China's manufacturing industry as a whole and showed a weighted average annual productivity growth of 2.8%. In addition, China targeted the shipbuilding industry as one of its strategic sectors for which it aimed to dedicate resources for industrial development during several development plans (Box 3). Such industrial policy measures may have supported investments in the (targeted) industry that in turn boosted productivity growth.

The same pattern is observed for growth of labour productivity and the fact that labour productivity of China's yards are on average lower than of Korean and Japanese ones (Figure 16). All estimation results for TFP and labour productivity are listed in Annex G.

Figure 16. Average firm-level labour productivity

2000-14



Note: China does not cover the year 2010. Labour productivity is defined as quantity produced per worker.
Source: based on ORBIS 2016-1 and 2016-2, and Kalouptsidi and Barwick (Fall 2017[12]).

3. The Role of Government Support Measures in Explaining Market Distortions

Governments and other public institutions can implement various measures to support their domestic industries and firms specifically or indirectly (i.e. horizontal policies that do not target any specific industry). The significant challenge in analysing the effect of government interventions in the shipbuilding industry and in general lies in the fact that systematic data (at the firm-level) is virtually non-existent, and thus the presence and extent of public interventions are often unknown.

The objective of the following work is to provide a better understanding of the channels through which various public support measures can lead to market distortions and affect industrial capacity. The previous section details the features of the shipbuilding industry and along these lines the following section will discuss three government interventions as examples to illustrate through which channels these may impact the shipbuilding market. These three examples encompass preferential financing instruments, and two discretionary measures, notably government procurement policies and non-enforcement of national bankruptcy laws.

To illustrate the potential market-distorting effects of the selected public measures on supply side primitives, this study differentiates between their impact on firm output (i.e. mainly production), earned income, cost of intermediate goods and services (i.e. inputs from upstream sectors, such as steel, marine equipment and so on), labour (i.e. employment and salaries), land area and natural resources (renewable and non-renewable), physical (e.g. machinery, buildings, other equipment) and financial capital (i.e. in general debt and equity), and knowledge (i.e. research and development capacity, (acquisition) of skills, education, etc.) (Table 1). This structure is derived from the OECD taxonomy used in the areas of fossil fuel and agriculture (OECD, 2018[20]).[26]

Table 1. Effect of governmental transfer on supply side primitives

Supply						
Direct	Indirect	Through cost factors				
A: Output	B: Company income	C: Cost of intermediate inputs	D: Labour	E: Land and natural resources	F: Capital	G: Knowledge
					physical financial	

Source: based on OECD (2018[20]).

3.1. Preferential financing inconsistent with market-based conditions

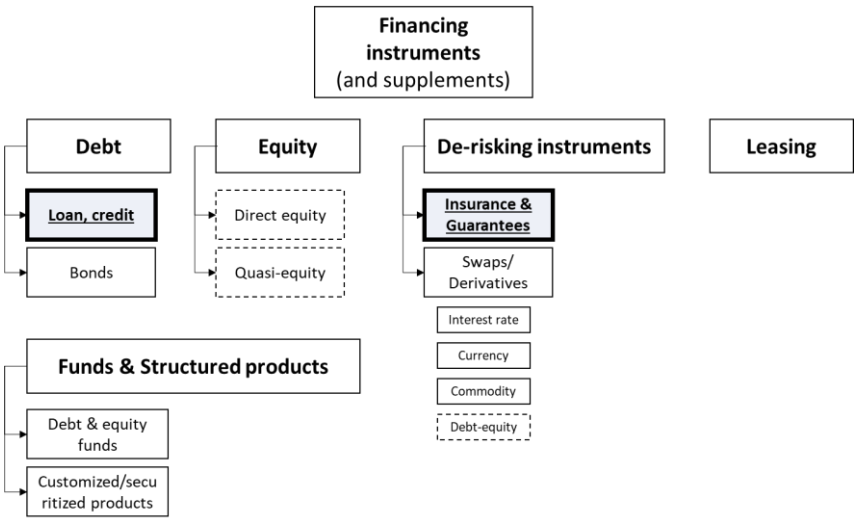
Background

Firms can use various forms of financing instruments (Figure 17). The basic ones include debt (loans, credits or bonds) and equity (direct and quasi-direct[27]). Beyond those, there

exists also funds, such as debt or equity funds, and structured products that are customized, such as options or indices. As part of financing solutions there are also so-called *de-risking instruments* that help firms reduce or manage financing risks, such as insurance and guarantees as well as swaps on interest rates, currency, commodities or debt-equity. Guarantees lower the risk of a transaction and enable lenders to enter into a financing contract which might not be possible otherwise (e.g. due to credit or jurisdictional issues). Swaps and derivatives are typically financial agreements that supplement other financing instruments to help manage different types of risk faced by an investor or borrower (World Resources Institute, 2012[21]). Alternatively, there are leasing options whereby the lessor purchases an asset on behalf of the lessee in return for a contractually agreed series of payments with interest rate (Deloitte, 2018[22]).

Governments or public institutions in general can provide financing solutions to firms. The most widely discussed financing alternatives are probably loans and credits, as well as equity instruments along with insurance and guarantees (as part of financing solutions) (Figure 17).

Figure 17. Indicative glossary of financing instruments



Note: Financing instruments highlighted in blue and bold frame are discussed in this report. Items in a dashed frame will be discussed as part of an upcoming report on state-ownership. The remaining items can be included in a revised version of this report should their analysis be of interest to the delegates.
Source: based on World Resources Institute (2012[21]).

The analysis will focus on debt financing in the form of loans/credits and supplement financing solutions, particularly guarantees (highlighted in bold in Figure 17). The analysis discusses these financing solutions for both parties, the ship yard and the ship buyer. Equity solutions provided by the government (i.e. equity financing and debt-equity swaps)[28] enter essentially the discussion of state-ownership – a topic which will be addressed in an upcoming report. For more information about financing instruments used in the shipbuilding industry see the OECD report on ship finance which also discusses financial leasing.

Potential effects

Through the public provision of preferential financing instruments that are inconsistent with market-based conditions, governments may indirectly understate their cost of capital

because they treat risk-bearing as costless. Still it is important to highlight that governments may allocate through preferential financing a significant share of societies' capital and risk to support a country's domestic industry (Lucas (2018[23]) and (2014[24])). Beyond that, such government interventions can distort the shipbuilding and shipping markets in the long-term and make it difficult to achieve a global level-playing field. In the following the analysis discusses the effect of preferential financing provided by the government inconsistent with market conditions to ship suppliers and ship buyers.

Supplier side

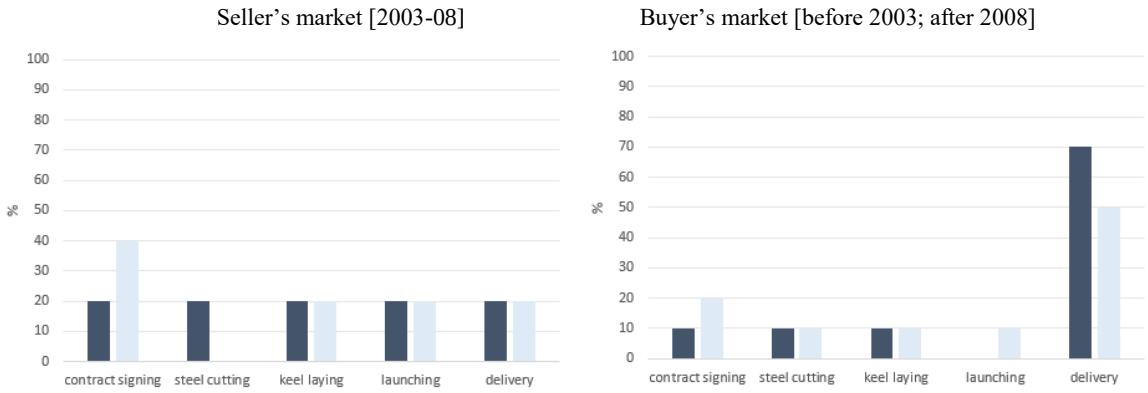
Preferential (concessional) **loans** often feature extended terms that are substantially more generous than financing instruments available in the market. The concessionality is achieved either through interest rates below those available on the market or by longer grace periods, or a combination of these (OECD (2006[25]), IMF (2003[26])).

Measuring the "concessionality level" of financing instruments provided by governments or government-affiliated authorities is a challenging task: first, there is the difficulty to identify the interest rates charged as well as other contractual terms, which are hardly disclosed by public institutions; second, a counterfactual analysis needs to be conducted in order to derive the interest rate (and financing costs in general) the firm would have paid in private markets. For the latter aspect, usually a benchmark interest rate is derived by constructing the firm specific risk profile plus the risk free interest rate. Useful information sources to estimate those capital costs are financial statements to derive, for instance, the interest rates paid on other debt or the firm leverage (in order to assess the firm risk), or credit ratings to project loan cash flows and derive credit spreads for the estimation of discount rates (Lucas, 2018[23]). Alternatively, the risk premium can be derived on the basis of the Capital Asset Pricing Model (CAPM) introduced by Sharpe (1964[27]), Lintner (1965[28]) and Mossin (1966[29]). This model allows the determination of the firm specific *beta-factor* which represents the non-diversifiable (systematic) risk of the firm.

A shipbuilding firm may use the loan for different purposes. For instance, it may invest in physical capital goods, such as additional docks, machinery or equipment, or expand its land area ("investment loans"). It can also pay back an old loan for refinancing purposes, affecting the company's financial capital position.

Alternatively, the company may use the loan to cover its working capital requirements ("working capital loans"), which are usually very high in ship production. Ships are typically contracted for a fixed price, payable in a series of 'stage payments' that spread payments over the period of vessel construction, which can take several years (Stopford, 2003[8]). The shipyard's aim is to be paid as the ship is built, so that working capital is not needed. Hence, the shipyard will aim for stage payments along the lines shown in Figure 18 (lhs) in a seller's market (i.e. periods in which demand for ships is very high and the yard has a stronger negotiation power). In a buyer's market (Figure 18, rhs), however, the up-front payments are rather low with for instance 10-20% of the ship price at contract signing and 10% for each milestone of steel cutting, keel laying and launching, while the major payment of up to 70% of the ship price will be paid by the ship buyer only at delivery.

Figure 18. Common stage payment terms of newbuilding contracts



Note: Dark and light lines highlight in each market the two possibilities of stage payments. For instance, in a seller's market, payment profiles with 5x20% stage payments at contract signing, steel cutting, keel laying, launching and delivery were observed, as well as payments of 40% at contract signing and 3x20% at keel laying, launching and delivery.
Source: based on information obtained from shipbrokers.

Stage payments determine the financing needs and thereby financing costs as illustrated in the example in Table 2. Let's assume cash expenditures of around 87% of newbuilding price, accruing during the construction period as follows: 10% at four months prior to steel cutting in order to pay the required steel ordered, 30% at steel cutting, 40% at keel laying and 7% at launching. In a buyer's market the stage payments will not cover the cash expenditures accruing during the steel cutting, keel laying and launching phases (highlighted in red). In this example, the yard needs to finance the entire cash expenditures of 87% of newbuilding price. In contrast, in the example of a seller's market with more favourable stage payments for the builder, the financing volume with 27% is much lower. Keeping in mind that ships cost several million USD (e.g. a gas carrier around USD 350 million, and cruise ships almost USD 1 billion) variances in stages payments can lead to large differences in financing costs, hence, production costs. Indeed, yards usually have several ships on order, each providing stage payments at different times, which may compensate working capital requirements across orders. However, it requires organizational skills and a good timing to avoid any financing to cover cash expenditures.

Table 2. Illustrative example of stage payments and cash expenditures

In %

		Contract signing	Contract signing + 3M	Steel cutting - 4M	Steel cutting	Keel laying	Launch	Delivery	SUM
Cash expenditures (%)				**10**	**30**	**40**	**7**		**87**
Stage/Advanced payments (%)	Buyer's market	20			10	10	10	50	100
	Seller's market	40				20	20	20	100
Accumulated advanced payments (%)	Buyer's market	20	20	20	30	40	50	100	
	Seller's market	40	40	40	40	60	80	100	
Sufficient/ insufficient cash (%)	Buyer's market	20	20	10	**-10**	**-40**	**-37**		
	Seller's market	40	40	30	0	**-20**	**-7**		

Note: The numbers are made up for illustrating the example only.
Source: derived from exchanges with shipbuilding contacts.

The potential effects of preferential financing instruments inconsistent with market-based conditions arise through various channels (Table 3). First, cheaper financing options in the form of investment loans may provoke firms to invest in capital stock and land, hence, to increase capacity. Depending on the degree of the preferential terms and the amount of free money associated with it for the purchase of new capital stock, the government intervention in question may lead to increased productivity levels for the firm. Essentially, the firm would get a generous capacity expansion without the need to cover (part of) its capital costs enabling it to produce more output at same costs (or the same output at lower costs). As discussed in the previous section, increased productivity levels can decrease production costs by on average 0.7% (*ceteris paribus*). Besides, as outlined previously firms with large capital stock can benefit from efficiencies by producing the same quantity at significantly lower marginal costs compared to firms with smaller capital stock. An increase of a firm's capital stock by 1% decreases firm's costs by on average 0.01%. These are potential cost reductions of not negligible magnitude.

Second, if the loan is used to cover the working capital requirements during ship construction it can decrease production costs. Such indirect support lowering production costs can either lead to reduced ship prices offered by the yard (in case of cost-pass-through to the buyer, hence, by keeping the profit margin constant), which in turn can lead to increased demand (i.e. firm output), or higher company income if the firm increases its profit margin instead of passing on the cost reduction to its buyers (no cost-pass-through).[29] Both effects depend on the price sensitivity of ship buyers. If this sensitivity is high (i.e. rather elastic demand) a firm may opt for the first case as it tries to capture the increased demand following price reductions. If this sensitivity is weak (i.e. rather inelastic demand) the firm may opt for the second case as the costs associated with the decline in demand (as a consequence of increased prices) will outweigh the gains (resulting from reduced production costs).

In view of the fact that in practice ship prices are typically determined at contract signing (and there is only a narrow leeway for ship yards to adjust prices post-order date) and the actual financing costs become only known with certainty during ship production, it is more likely that gains from cost reductions are reflected in increased enterprise income rather than output.

Table 3. Potential effect of preferential financing on supply primitives

Supply							
Direct	Indirect	Through cost factors					
A: Output	B: Company income	C: Cost of intermediate inputs	D: Labour	E: Land and natural resources	F: Capital		G: Knowledge
					physical	financial	
x	x			x	x	x	

Source: based on OECD (2018[20]).

Finally, **guarantees** provided by the government to shipbuilders (with or without preferential terms, such as reduced fees) would essentially enter the discussion above on estimating the extent of the subsidy-equivalent to the reduced risk premium provided by the bank. In other words, if the presence of a government guarantee or insurance will change the assessment of the bank about the firm's (default) risk (e.g. non-payment of the loan) and thereby reducing the risk premium for the loan charged by the bank, this

government intervention would essentially lead to reduced financing costs for the firm (i.e. at non-market conditions) and would imply a subsidy-equivalent. Otherwise, if the pure presence of the government as a guarantor is a necessary and sufficient condition for the firm in order to get a bank loan at all, and this is not accompanied by a change in the risk assessment of the bank (i.e. the risk premium charged is consistent with market conditions), then there would not be any concern about an implied subsidy.

Buyer side

Ship transactions are typically international as ship buyers and producers are located in different jurisdictions. As shown in the previous section, over the last two decades the lion's share of ship production of major shipbuilding economies has been purchased by foreign owners. In the light of the global character of the shipbuilding and shipping industry, "governments provide official export credits support through Export Credit Agencies (ECAs)[30] for national exporters competing for overseas sales" (OECD, 2018[30]). Such support can take the form either of (i) "official financing support", i.e. direct credits/loans, refinancing or interest-rate support to foreign buyers, (ii) "pure cover support", i.e. insurance or guarantees for credits provided by private financial institutions, or (iii) any combination of the two (OECD, 2017[31]).[31] While guarantees usually protect the lenders financing the purchase of the ship (or any export good) against repayment of their loan in certain circumstances, an insurance protects a shipbuilder (or exporter in general) against non-payment by the overseas purchaser of its products (Thomson Reuters, 2018[32]).

Ill-designed export credit practices that are inconsistent with market conditions can artificially stimulate demand for new vessels (Table 4). This reasoning complements the discussion presented above, but from a demand side perspective. If a public financing support measure (i.e. direct credits/financing, refinancing or interest-rate support along with guarantees to foreign buyers) implies cost advantages in the form of a subsidy-equivalent to the ship buyer, it will indirectly reduce the costs of ship purchases. With a large enough subsidy-equivalent, such publicly supported financing forms may stimulate ship purchases from buyers not willing to invest in newbuilt vessels in the absence of the indirect support, and may thereby indirectly aggravate the cyclical downturn as elaborated in the beginning of the paper. Only a framework for the orderly use of officially supported export credits can ensure a global level-playing field and eliminate trade distortions and subsidies. The role of the OECD Arrangement on Officially Supported Export Credits is precisely to provide a healthy market environment where exporters compete on the basis of the price and quality of their products rather than on the financial terms provided. The role of the OECD in export credits first and foremost involves the maintenance and developments of the international disciplines of the Arrangement which stipulate the financial terms and conditions for official export credits (OECD, 2018[30]).

Table 4. Potential effect of preferential financing on demand primitives

Supply							Demand
Direct	Indirect	Through cost factors					
A: Output	B: Company income	C: Cost of intermediate inputs	D: Labour	E: Land and natural resources	F: Capital	G: Knowledge	
					physical financial		
x							x

Source: based on OECD (2018[20]).

3.2. Discretionary policy measures

This category encompasses horizontal policy measures including the non-application of market based policy measures. This section neither discusses state-owned enterprises (as it will be analysed in an upcoming report) nor local content requirements (as this measure is analysed in Gourdon and Guilhoto (2019[33])).

3.2.1. Government procurement

Background

Government procurement (GP) encompasses the purchase of goods and services with public funds for public purposes by government institutions. In these transactions, 'value for money' plays a primary goal since public money is involved. In order to achieve this objective the World Trade Organisation (WTO) considers an open, transparent and non-discriminatory procurement process as the best tool since this approach optimises competition among suppliers.

Nonetheless governments may use government procurement transactions to achieve other domestic policy goals, such as supporting the development of specific local industries or social groups. The provision of preferential treatment for domestic goods, services and suppliers acts as a discriminatory barrier (Gourdon and Guilhoto, 2019[33]).

Government procurement falls in a wide range of instances. The OECD developed a taxonomy classifying government procurement policies in order to better understand whether and how such measures may impact foreign suppliers. The classification is structured in nine different sets of measures, whereof the first four are usually explicitly mentioned in a law and openly give preference to domestic suppliers. The remaining group of measures or practices are rather implicit in the sense that they do not expressly target foreign bidders but may, indirectly or potentially, affect cross-border procurement (Gourdon, Bastien and Folliot-Lalliot, 2017[34]):

Taxonomy of GP group or practices

1. Market access restrictions,
2. Domestic price preferences,
3. Local content requirement (LCR),
4. Collateral restriction/restrictive effects,
5. Conduct of procurement,
6. Qualification criteria,
7. Evaluation criteria,
8. Review/complaint system and
9. Transparency and information.

For the scope of this paper the analysis concentrates on the explicit measures, especially market access restrictions, domestic price preferences, and LCR. A description of the remaining GP groups of the taxonomy are displayed in Annex H.

Market access restrictions

Market access restrictions shown in Table 5 encompass all practices that intentionally restrict access to government procurement only to domestic suppliers, or which oblige joint ventures with a national/local entity (**M11-M13**). Reciprocity access provisions include provisions which allow foreign suppliers to bid only if the domestic supplier grants reciprocal access (**M14**) (i.e. following the WTO GP agreement). As an example of the latter, national treatment in GP is only granted to foreign firms if the same treatment is offered by the country of the foreign firm. Under the commercial presence requirement (**M15**), a supplier can participate in a bid only if its business is established locally in the procuring country (either through a subsidiary (ownership) or lease of premises (franchise, etc.). **M16** captures the occurrence observed where countries use national security reasons to exclude foreign firms from projects which are not directly linked to security matters. Measures pertaining to thresholds (**M17**) entitle foreign firms to bid in the country only for contracts above or below a given threshold (Gourdon, Bastien and Folliot-Lalliot, 2017[34]).

Table 5. Market access restrictions

Subgroup	Sub-category
M1: Market access restriction	**M11**: To national supplier
	M12: To local supplier
	M13: To joint ventures with national supplier
	M14: Access based on reciprocity
	M15: Commercial presence required
	M16: Exclusion for national security or safety reasons
	M17: Thresholds

Note: The taxonomy distinguishes between national and local suppliers. The term "national" is broadly understood as including any domestic suppliers, anywhere within the country where the procurement takes place. The term "local" refers to a particular group of domestic suppliers within a specific region or locality within the country. This distinction applies to M1 but also to M2 and M3.
Source: Gourdon, Bastien and Folliot-Lalliot (2017[34]).

The potential effect of such market restrictions are primarily reflected in a protection of the domestic industry against international competition in the context of orders placed by the government or government-related authorities. Although public procurement policies do not stimulate ship production at the aggregate level *per se* (i.e. the order would have been placed in any case) it may stimulate ship production for the domestic shipbuilding industry. Since the tender process includes preferential access for national firms, those national firms may not have won the order in the absence of the GP policy. In other words, national firms increase their production and thereby income not on the basis of market principles but of government intervention.

Table 6. Potential effect of market access restrictions on supply primitives

Supply						
Direct	Indirect	Through cost factors				
A: Output	B: Company income	C: Cost of intermediate inputs	D: Labour	E: Land and natural resources	F: Capital	G: Knowledge
					physical financial	
x	x					

Source: based on OECD (2018[20]).

Domestic price preferences

The second set of measures covers provisions that explicitly favour domestic firms by allocating a price preference (M2) to national suppliers (M21), local suppliers (M22) and joint ventures with national companies (M23). As an example for such policies, governments prefer national bids to foreign ones that are of equal quality where national bids' price does not exceed an additional 10% of the price quoted in the foreign one.

Table 7. Domestic Price Preferences

Subgroup	Sub-category
M2: Domestic price preferences	**M21**: For national supplier
	M22: For local supplier
	M23: For joint ventures with national entity

Source: Gourdon, Bastien and Folliot-Lalliot (2017[34]).

Similarly to the previous case, such government interventions increase the production and income of national shipbuilding firms although cheaper offers of equal quality would have been available to the government. In this case, a less competitive producer won the project and the government acts against the 'value for money' principle. In the long-term, if less competitive firms repeatedly win orders (at higher prices), those firms will be more likely to expand their capacity in the market, crowding out more productive firms.

Table 8. Potential effect of domestic price preferences on supply primitives

Supply						
Direct	Indirect	Through cost factors				
A: Output	B: Company income	C: Cost of intermediate inputs	D: Labour	E: Land and natural resources	F: Capital	G: Knowledge
					physical financial	
x	x			x	x	

Source: based on OECD (2018[20]).

Local Content Requirements

Local Content Requirements in the context of government procurement transactions require bidders to purchase domestically manufactured goods or domestically supplied services, for instance as a percentage of value added or as intermediate inputs. The requirements could be to use inputs or to store data locally (**M31**), use local services (**M32**), hire staff

from the country (**M33**), or subcontract national firms/experts (**M34**). Offsets requirements (M35) are generally measures that require or encourage suppliers to provide additional economic benefits to the local economy, such as in-country investments, transfers of technology, production under license, or marketing/exporting assistance. Under the WTO GPA, offsets are only authorized for developing countries as transitional provisions.

Table 9. Local Content Requirement

Subgroup	Sub-category
M3: Local content requirement	**M31**: Inputs and data storage
	M32: Services
	M33: Staff requirement
	M34: Subcontract requirement
	M35: Offsets

Source: Gourdon, Bastien and Folliot-Lalliot (2017[34]).

The knowledge about existing measures in the shipbuilding industry related to government procurement with a local content clause is rather scarce. The probably most widely known GP measure with a local content provision is Brazil's localisation based policy in its oil and gas sector, affecting ship production. As Gourdon and Guilhoto (2019[33]) show Brazil's proposed policy reform reflected in a significant reduction of local content rates can result in long-term benefits for the total economy and for different sectors in particular.

Research results on LCR policies in general highlight the long-run inefficiencies associated with these measures (Stone, Messent and Flaig (2015[35]); Gourdon and Guilhoto (2019[33])). With the LCR policy in place, firms are obliged to purchase less competitive and more expensive intermediate inputs domestically than those they could acquire on the international market. The policy results in the intended increase in output of the local upstream sector, increasing welfare, but only in the short-term. In the long-term, the higher prices of domestically procured components will increase the price of the final good and, as a result, the quantity sold will decline as will domestic welfare (in case the government is sensitive to increased price changes and will subsequently reduce its orders).

The potential effects of GP policies with a local content condition are less obvious. The need to source domestically may lead to increased intermediate input prices, lowering the firm's profit margin in case it is not able to increase its prices accordingly. In the long-term such policies can weigh on firms' financial health.

Table 10. Potential effect of local content requirements on supply primitives

Supply							
Direct	Indirect	Through cost factors					
A: Output	B: Company income	C: Cost of intermediate inputs	D: Labour	E: Land and natural resources	F: Capital		G: Knowledge
					physical	financial	
x	x	x		x	x	x	

Source: based on OECD (2018[20]).

3.2.2. Weak national bankruptcy laws or their non-enforcement

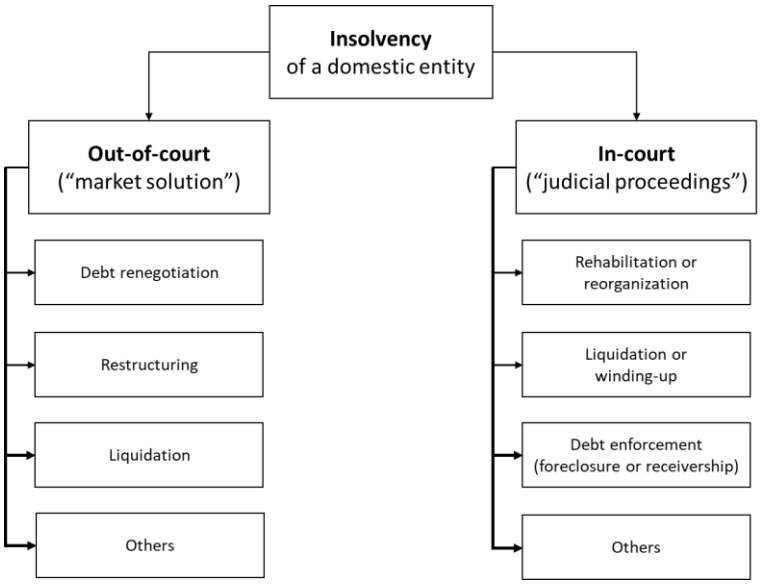
This section starts with a general outline of informal and formal insolvency proceedings, whereof the latter one is primarily guided by national bankruptcy laws. Subsequently the section describes which difficulties may arise through weak insolvency regimes or the non-enforcement of (even well-designed) bankruptcy laws in the form of government-designed rescue systems (i.e. bail-outs). Ultimately, the section analyses the potential effects of both instances in the context of the shipbuilding industry.

Background

Financially distressed firms need to find solutions with their stakeholders about how to fully repay corporate debts. In these situations, there are generally informal and formal insolvency proceedings available to companies (Figure 19). In an informal approach, the insolvent company negotiates and finds an agreement with its creditors out-of-court ("market-solution"), for instance by renegotiating the loan terms, firm restructuring or out-of-court liquidation. Since informal agreements do not involve a contract that legally binds the creditors to the agreement, there is the risk that stakeholders may back out of the agreement at any time. As an example, creditors may pursue legal actions against the company. It may be furthermore the case that an independently proposed arrangement will be less likely accepted by the firm's creditors.

Official proceedings may, however, be more likely to be approved. Besides, if there are too many creditors to negotiate an informal out-of-court workout or the stakeholders cannot agree on certain arrangements, a judicial proceeding may be more appropriate to determine the entity's future. In these cases, negotiations among stakeholders take place in-court and resolutions are backed by legal actions. In-court proceedings generally result in rehabilitation or reorganization of the business, liquidation or winding-up, or debt-enforcement (foreclosure or receivership).

Figure 19. Illustrative overview of insolvency proceedings



Note: This overview is not comprehensive and does not represent the complex structure of insolvency proceedings. It rather provides a general structure to insolvency proceedings resulting in negotiations among stakeholders either out-of-court (i.e. market-solution) or in-court (i.e. judicial solution").
Source: Author's compilation partly based on World Bank (2017[36]).

Efficient insolvency procedures to restructure financially distressed businesses are important to protect creditors' rights. Court rulings (i.e. formal proceedings) are a particularly powerful tool to enforce an agreement among stakeholders. On the one hand, bankruptcy regulations need to prevent the premature liquidation of sustainable businesses, and discourage lenders from issuing high-risk loans to the company along with managers from taking imprudent loans and making risky financial decisions. Through business reorganization, creditors can recover a part of their investment, more employees may be able to keep their jobs, and supplier and customer networks are preserved. On the other hand, well-functioning bankruptcy regimes need to correctly classify unsustainable businesses and enforce liquidation processes to protect creditor rights. By contrast, ineffective mechanisms for business exit will likely maintain unprofitable and unproductive capacity in the market, create a higher cost of capital and heightened risk perception among investors and financial institutions. Hence, only a systematic approach and coherent framework to insolvency and debt resolution can strengthen the investment climate, lead to economic growth and a healthy business environment (World Bank, 2017[37]).

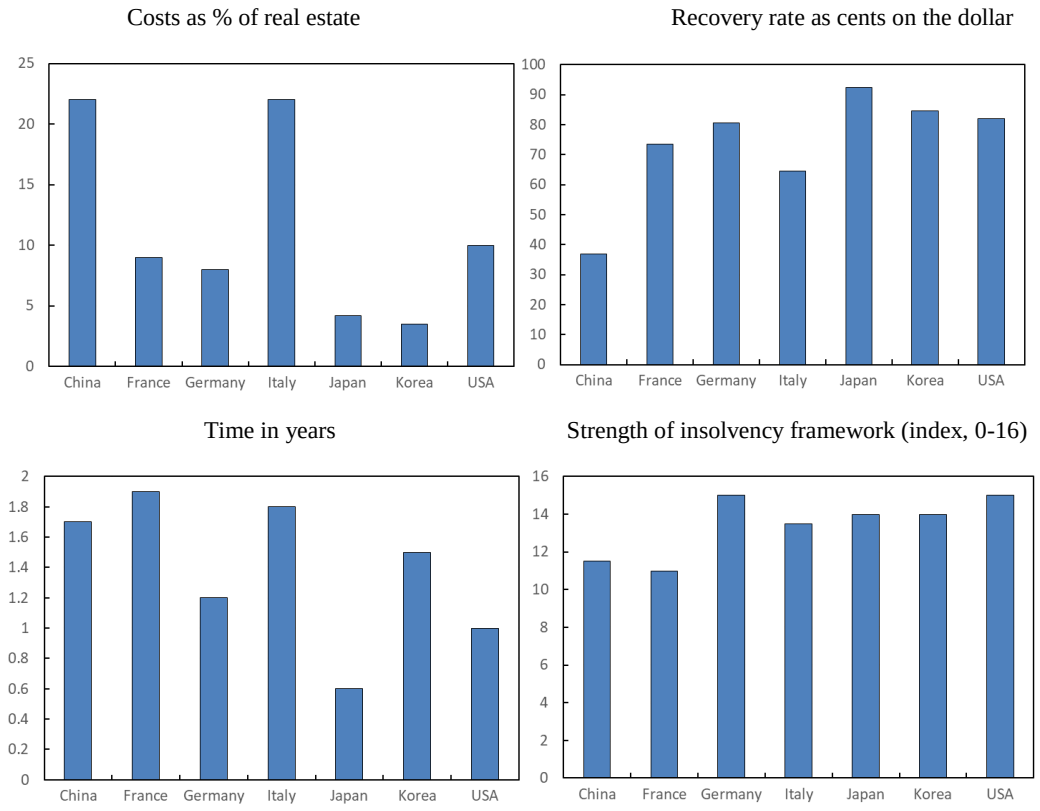
National insolvency laws along with institutions executing the law (i.e. judicial systems) differ across jurisdictions, and thereby may result in different decisions made for similar insolvency cases. The World Bank (2018[38]) publishes every year a comparison of insolvency regime indicators (see Figure 19 for a selection of four of these indicators) illustrating the average outcomes of comparable insolvency cases.[32] The results show that China's insolvency regime is the one with highest costs (more than 20% of real estate value) and the lowest recovery rate (below 40%) compared to other major shipbuilding economies. It is one of the regimes taking the longest time (more than 1 ½ years) and one with the lowest strength (next to France) in terms of commencement of proceedings, management of debtors' assets, reorganization proceedings and creditor participation. Korea's insolvency framework appears better than China's: Admittedly, resolving bankruptcy also takes relatively long (1 ½ years on average), but the regime appears less expensive with costs below 5% of real estate, the recovery rate of more than 80% is relatively high and it is one of the strongest regimes compared to other displayed shipbuilding economies. Japan's insolvency regime seems to be strong in all four categories: it costs only a low share of the real estate at stake (similar to Korea below 5%), it has the highest recovery rate of 90% across all analysed shipbuilding economies, it is the fastest one with only half a year of duration, and among the strongest ones. European Union countries show a diverse picture: in particular Italy is striking in the sense that its regime entails high costs similar to the Chinese one, the second lowest recovery rate with around 60%, more than 1 ½ years of duration, but with a relatively strong framework. In contrast, Germany's regime seems to be less costly with a higher recovery rate and faster proceedings among EU countries and is the strongest one across all analysed economies.

Weak bankruptcy laws can delay insolvency in general and may discourage firms to enter formal insolvency proceedings. Of particular concerns are formal proceedings that have been shown to offer very low creditors' protection (weak insolvency framework), to be very costly for creditors (high % of real estate costs involved), to have very low recovery rates, and to be extremely time-consuming. The World Bank therefore elaborated principles for an effective national insolvency and creditor rights systems (Box 6).

Box 6. World Bank Principles for Effective Insolvency and Creditor Rights Systems

In an effort to advice jurisdictions about well-designed bankruptcy laws the World Bank (2015[39]) has developed a catalogue of "Principles and Guidelines for Effective Insolvency and Creditor Rights Systems". This manuscript compiles 33 principles that countries should adopt to promote more efficient resolution of financial distress. These are separated into four categories: A. Legal Framework for Creditor Rights; B. Risk Management and Corporate Workout; C. Legal Framework for Insolvency; D. Implementation: Institutional and Regulatory Frameworks.

Figure 20. Insolvency proceedings (in-court), 2018



Note: In the context of the World Bank, the terminology used for insolvency proceedings equals the general term of bankruptcy proceedings. The World Bank Doing Business indicators are calculated as follows: Cost of the proceedings is recorded as a percentage of the value of the debtor's estate. The cost is calculated on the basis of questionnaire responses and includes court fees and government levies; fees of insolvency administrators, auctioneers, assessors and lawyers; and all other fees and costs. The recovery rate is recorded as cents on the dollar recovered by secured creditors through judicial reorganization, liquidation or debt enforcement (foreclosure or receivership) proceedings. The period of time is from the company's default until the payment of some or all of the money owed to the bank. The strength of insolvency framework index is based on four other indices: commencement of proceedings index, management of debtor's assets index, reorganization proceedings index and creditor participation index. The results for each country does not change over years since insolvency regimes are rather sticky and amendments are rare or only slowly implemented.
Source: World Bank (2018[38]).

While there is no direct government involvement in the formal and informal proceedings discussed above, there can be cases where the government may have a compelling interest in intervening in insolvency procedures. The national bankruptcy law may or may not allow governments to intervene in specific cases. There may also exist other legal frameworks under which public authorities could potentially discuss certain corporate bankruptcy proceedings.

Such government designed rescue systems ("bail-outs") are often justified by the government insofar as they could prevent a financial contagion to other parts of the economy ("too big to fail" argument) that results in large economic costs, or to solve the financial distress of systemically important firms. For instance, during the financial crisis of 2008 the US government arranged different solutions to ailing financial institutions with varying degrees of public support, such as public funds facilitating a merger, substantial direct loans or declining any support at all so that the firm ultimately filed for formal reorganization/restructuring (Chapter 11) (Ayotte and Skeel, 2010[40]). However, as shown in the following, public rescue support can lead to several unintended effects causing large economic costs.

Potential effects

Weak bankruptcy laws can delay insolvency and may discourage firms to enter formal insolvency proceedings. Non-enforcement of (even well-designed) bankruptcy laws through interference by governments can generally lead to principal incentive problems of stakeholders in the form of moral hazard (Box 7) that result in unexpected massive economic costs and will likely distort the market through various channels.

Box 7. Moral Hazard in the context of Government-aligned Rescue Efforts

The concept of moral hazard describes the concern that someone who is protected against any consequences of a risk has less incentives to take precautions against this risk. In the case of government aligned rescue efforts, if *creditors* anticipate that the firm they invested in will be rescued by the government if it runs into trouble, they may extend their funding volume beyond what they would have otherwise. This continued funding to companies on the edge of bankruptcy may also encourage *managers* to deliberately fail to take necessary steps to prepare for bankruptcy and continue with high risk projects. Besides, *potential acquirer* of the distressed firm may be inclined to wait until the target's condition is so desperate that it can argue for taxpayer assistance as a prerequisite for completing the deal. Hence, due to moral hazard the rescue funding may contribute ultimately to the instability the government backing was trying to prevent. In some instances, governments made attempts to control moral hazard by designing "hybrid" solutions that limit the systematic risks that come from one stakeholder group while at the same time solving some of the moral hazard concerns described above. Ayotte and Skeel (2010[40]) discuss some of these solutions in the context of the financial crisis and the intervention of the US government.

Source: Ayotte and Skeel (2010[40])

As summarized in Table 11, weak or non-enforcement of national bankruptcy laws will likely maintain unproductive capacity in the market and thereby aggravating the problem of industrial excess capacity. In particular, labour, land (yard area) as well as physical and financial capital are sunk in these insolvent firms rather than being allocated to and used for more efficient purposes. In addition, since mainly cost factors for the production of

ships are concerned it may likely be the case that weak or non-enforcement of national bankruptcy laws lead to a decline in ship prices of the company in question. If this company has enough market power it might pressure the market price of similar ships downwards.

Table 11. Potential effect of weak or non-enforcement of national bankruptcy law

Supply							
Direct	Indirect	Through cost factors					
A: Output	B: Company income	C: Cost of intermediate inputs	D: Labour	E: Land and natural resources	F: Capital		G: Knowledge
					physical	financial	
			x	x	x	x	

Source: based on OECD (2018[20]).

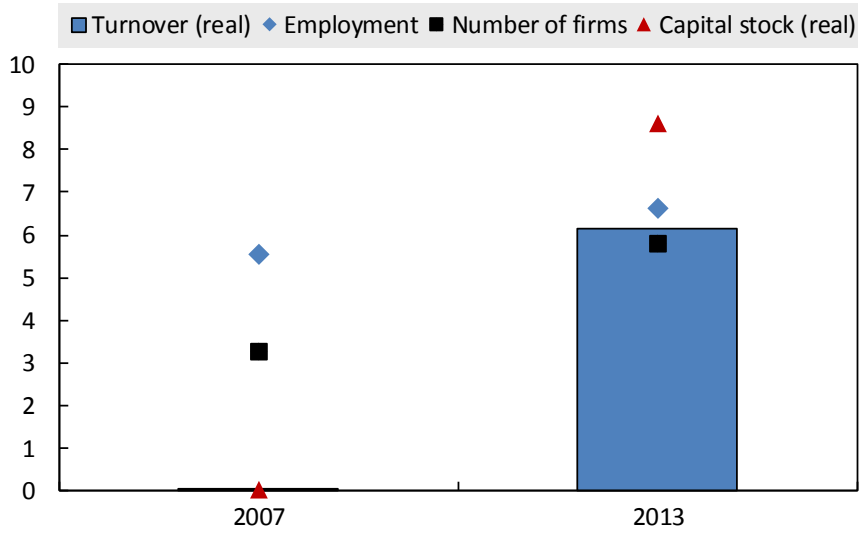
Measuring the extent of insolvent firms present in the shipbuilding industry is a challenging task. In the seminal work of Caballero, Hoshi and Kashyap (2008[41]), the authors show that firms in Japan, which are kept artificially alive through, for instance subsidized bank credit (firms they call "zombies"), reduce the profits of healthy firms, exhibit more depressed job creation and destruction, and lower productivity levels. McGowan, Andrews and Millot (2017[42]) draw on the topic of zombie firms and reshape the methodology and approach to be applied to the data available for OECD countries (i.e. ORBIS database). By further adapting this work to the shipbuilding industry, we follow their classification of (theoretically) insolvent firms that have an interest coverage (i.e. operating profit over interest paid) below 1 in three consecutive years and of age equal or above 10 years.[33] This financial indicator shows to what extent earnings can decline without the firm becoming unable to meet its annual interest costs. The higher the ratio the better the firm is able to cover its interest expenses through its operations.

Figure 21 shows the share of (theoretically) insolvent shipbuilding firms of our sample in 2007 and 2013. The share of firms that cannot cover their interest expenses by using operational income increased between the years 2007 and 2013. While in 2007, around 3% of all firms in the sample were below the threshold, this share increased to 6% in 2013. Most strikingly, 9% of shipbuilding capital stock in 2013 is sunk in these firms, which is an increase from close to 0% in 2007, indicating that mostly firms large in capital stock were not able anymore to cover their interest payments in 2013. In addition, in 2013 those firms cover around 6% of total shipbuilding turnover indicating their large size (and/or market power). Although the results are not based on recent data they provide implications about the situation in the shipbuilding industry following the economic crisis. Possible reasons for an increase in the share of insolvent firms staying in the market are manifold, such as weak or non-enforcement of bankruptcy laws, as well as subsidized bank lending to otherwise insolvent firms, or government guarantees to raise additional financing.

Misdirected bank lending may have distorting effects on foreign and domestic healthy firms that were competing with these unprofitable borrowers. In the absence of cheap bank financing these firms may not be able to survive in the long-term.[34] Since they continue operating they congest the market and prevent more profitable firms to enter and force more productive firms to exit. Statistical results show that these theoretically insolvent firms have significantly lower productivity levels (total factor productivity) of around 18% when controlling for country, time and firm-specific effects (i.e. age, size) (Annex I).

Figure 21. Share of insolvent firms by turnover, capital stock and employment

In %



Note: In line with other OECD work we define insolvent firms as those with an interest coverage below 1 in three consecutive years and of age equal or above ten years McGowan, Andrews and Millot (2017[42]).
The analysis is based on countries highlighted in green in Table A E.1. Due to a limited sample period for China the analysis covers only the years up to 2013.
Source: based on ORBIS; Kalouptsidi and Barwick (Fall 2017[12])

4. Conclusion and further remarks

This paper argues that government interventions in the shipbuilding industry make it not only difficult to restore a level-playing field, but will do more harm than good by exacerbating economic downturns in this cyclical industry through two channels. First, it may lead to a larger extent of over-ordering of vessels through lower time to delivery altering the investment behaviour of ship buyers – leading to a more pronounced cyclical downturn. Second, during bust times excess capacity may lead to government support to failing ship yards with the goal to minimize social costs. Government support to these practically insolvent firms (so-called "zombie firms"), for instance through the non-enforcement of national bankruptcy laws, will however prolong these economic bust periods and unproductive capacity will re-enter the new cycle, restarting the vicious circle. Not to forget that maintaining these zombie-firms in the market can largely reduce overall industrial productivity and, hence, profitability in the long-term. These government actions are rather illusive insofar as the social costs incurring in the long-term will likely outweigh any short-term benefits.

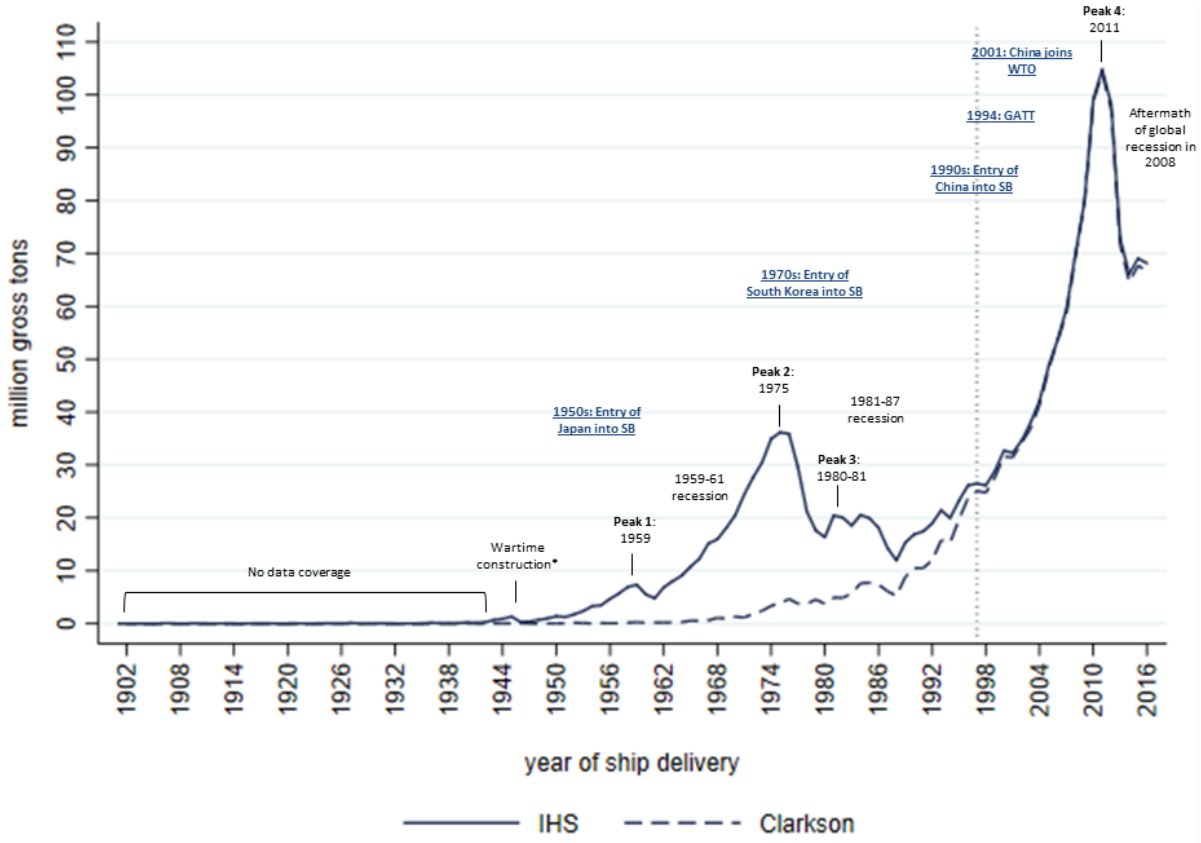
In any case independent of the cyclical stage, market-based investment decisions of yards into capital stock, for instance, and shipping firms into new vessels are based on expectations about future business. Government interventions will bias these forward looking assessments as they distort investment behaviour and harm investment efficiency. In other words, government intervention in shipbuilding can be seen as another form of a market friction distorting firms' optimal assessment of investment opportunities.

Against the background of the global nature of the shipbuilding and shipping industries any market-distorting government intervention in one country will ultimately affect industry developments in third countries. These channels furthermore reinforce the case for effective international disciplines on government interventions in the shipbuilding industry. In any case, the mature nature of shipbuilding undermines the case for an active industrial policy, beyond facilitating structural adjustment. More than that, as a mature industry the sector requires a horizontal policy approach, particularly one focused on: (i) allowing free market entry and more importantly exit of yards, (ii) upgrading the general level of labour skills and other capabilities through strong training policies and education programs; (iii) ensuring efficient capital markets rather than targeted financial interventions inconsistent with market conditions; and (iv) enabling resources (i.e. capital stock and labour) to move easily between sectors. With respect to the latter issue, policies supporting yards to re-orientate to other business would also be conducive to address the problem of natural excess capacity associated with cyclical downturns affecting the shipbuilding industry.

A consequent continuation of this work would be reflected in an analysis of how governments can minimize the social costs associated with industrial excess capacity as a result of cyclical downturns in general. Moreover, a better understanding of anti-competitive firm behaviour decoupled from government interventions (i.e. in the area of competition law) would provide a clearer picture of market-distortions in general.

Annex A. Cyclicality of ship production

Figure A A.1. Shipbuilding output across time

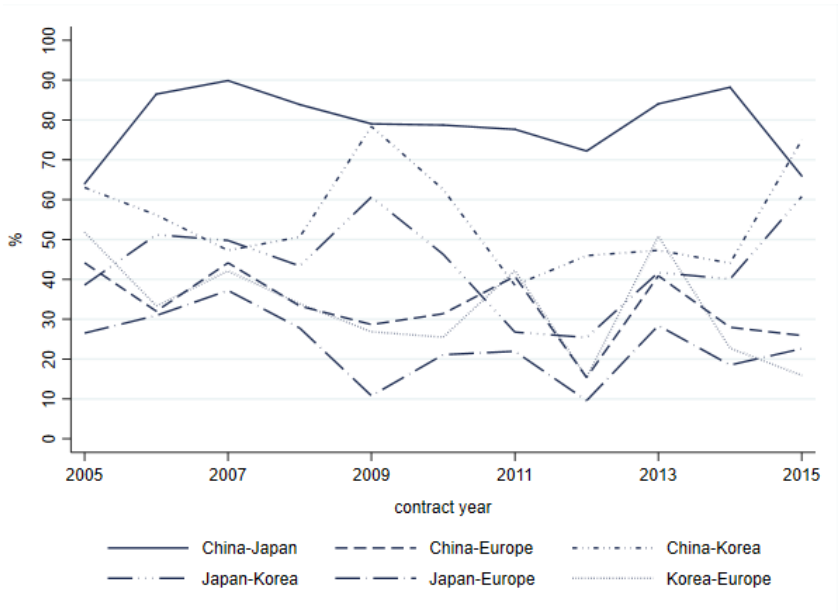


Note: *Data during wartime construction is not covered by IHS.
Source: based on IHS Seaweb and Clarkson World Fleet Register.

Annex B. Product Mix Similarity Index

In the early 2000s China slowly entered the production of tankers and bulkers, and since 2006/2007 the country's product mix consists mostly of bulkers. Between 2006 and 2016 China's ship production consisted of on average ~60% of bulkers similar to Japan with an average share of ~62% during the same period.

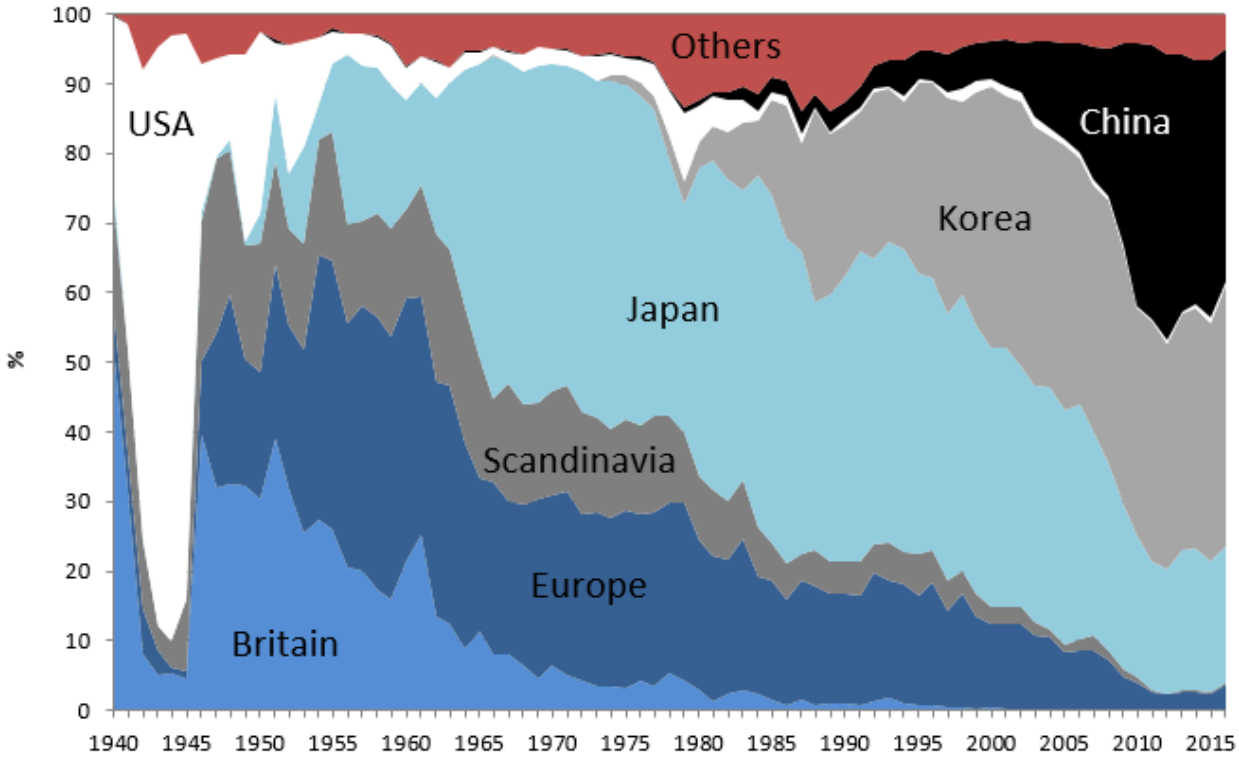
Figure A B.1. Finger-Kreinin index (in %) for product mix analysis



Note: There may exist differences at lower levels of product aggregation. The calculation is based on the following 13 product categories: bulker, cruise ships, containerships, gas carrier, offshore services, pure car carriers, passenger, reefer, ro-ro, tankers, other dry cargo, other non-cargo, miscellaneous.
Source: based on Clarkson World Fleet Register, 2018.

Annex C. History of shipbuilding

Figure A C.1. Market shares (% of deliveries in gross tons) by region



Note: Britain includes United Kingdom, British Guiana, British Honduras, British India; Europe includes Albania, Andorra, Armenia, Austria, Austria-Hungary, Azerbaijan, Belarus, Belgium, Bulgaria, Croatia, Cyprus[1], Czech Republic, Estonia, France, Georgia, Germany, Greece, Hungary, Ireland, Italy, Kazakhstan, Kosovo, Latvia, Lithuania, Liechtenstein, Luxembourg, Macedonia, Malta, Moldova, Monaco, Montenegro, Netherlands, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Switzerland, Ukraine, Scandinavia includes Sweden, Denmark, Norway, Finland, Iceland; China includes China P.R., Kuomintang Mainland, Hong Kong.
Source: based on IHS Seaweb (2017), and following (Stopford, 2003[8]).

Annex D. Constructing real capital stock at the firm-level

Real capital stock K for firm *i* in time *t* is derived via:

$$K_{it} = K_{i,t-1}(1 - \delta_{it}) + I_{it}$$

where real investment I is the difference between the book value of fixed tangible assets in the current period t and the previous period t-1, plus depreciation and deflated by country and industry-specific investment deflators:

$$I_{it} = (K_{it}^{bv} - K_{i,t-1}^{bv} + D_{it})/\boldsymbol{\rho}_t$$

With K_{it}^{bv} as the book value of fixed tangible assets of firm i in time t, D depreciation from ORBIS and $\boldsymbol{\rho}$ as investment price deflator at the 2 digit level.

The depreciation rate is derived via:

$$\delta_{it} = D_{it}/K_{i,t-1}^{bv}$$

For the first observation of each firm in the dataset (i.e. t=0) it is not possible to derive the real capital stock via our formulations above. Therefore, the real capital stock for t=0 is approximated by the observed net capital stock in the data deflated by the investment price index:

$$K_{i0} = K_{i0}^{bv}/\boldsymbol{\rho}_t$$

Source: Gal (2013[43]).

Annex E. Data coverage

Table A E.1. Number of companies per year and country

co	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CN*	99	102	113	122	158	172	192	227	284	241		268	266	218		
DE	2	3	5	8	12	21	33	30	47	51	51	50	50	38	3	
FI	42	38	48	56	59	58	60	59	46	53	53	56	60	53	53	30
FR	43	48	54	57	55	54	40	41	37	34	35	33	24	26	26	3
IT	98	107	154	115	61	73	140	177	230	200	166	361	365	346	312	60
JP	36	41	99	116	122	120	131	131	143	148	166	169	169	166	129	
KR	5	5	11	12	12	13	14	15	15	15	14	15	15	14	13	15
NO	133	156	155	119	183	4	1	3	6	14	12	6	14	197	186	
PL	20	27	25	26	25	24	41	56	56	85	36	24	16	9	3	1
PT	4	3	3	2	1		58	49	50	50	44	44	46	44	43	
RO	67	75	92	118	169	198	213	242	236	185	178	189	195	219	248	
RU	2	15	17	127	142	120	145	127	146	150	132	129	265	368	348	19
total sample of # of firms of included countries	452	518	663	756	841	685	876	930	1012	985	887	1076	1219	1480	1364	128
*China from Kalouptsidi and Barwick (Fall 2017[12]).	99	102	113	122	158	172	192	227	284	241		268	266	218		
Total sample	**551**	**620**	**776**	**878**	**999**	**857**	**1068**	**1157**	**1296**	**1226**	**887**	**1344**	**1485**	**1698**	**1364**	**128**

Note: Bold highlighted countries are major shipbuilding economies. The results do not change if we restrict the sample only to those firms or analyse the shipbuilding market by including all available firms as in the table above. This sample has no missing data on interest coverage, employment and capital stock. I used the ORBIS version with the highest number of firms for each country, and only with firms in the shipbuilding sector as primary industry.
Source: based on ORBIS version 2016-1 and 2016-2; *China is based on Kalouptsidi and Barwick (Fall 2017[12]).

Annex F. Cost factors

Estimation is based on:

$$\ln(C_{it}) = \alpha + \beta_1 * \ln(Q_{it}) + \beta_2 * \ln(Q_{it}^2) + \beta_3 * \ln(K_{it}) + \beta_4 * \ln(K)_{it}\ln(Q)_{it} + \beta_5 * \ln(omega_{it}) + \beta_6 \ln(SteelJP_t) + \delta_c + \delta_t + \varepsilon_{it}$$

with δ_c, δ_t and ε_{it} as country-, time-fixed effects and robust standard errors respectively. Please note, the firm-fixed effects model does not include a country-fixed effect.

Table A F.1. Cost curve estimates

		(1)	(2)
		Country-fixed effects	Firm-fixed effects
	VARIABLES	ln_cost	ln_cost
Quantity	**ln_Q**	**0.647*** **	**0.564*** **
		[0.0618]	**[0.0311]**
Quantity^2: shape of curve	**c.ln_Q#c.ln_Q**	**0.0167*** **	**0.0186*** **
		[0.00209]	**[0.000951]**
Quantity*Capital stock	**c.ln_Q#c.ln_K**	**-0.0129*** **	**-0.0143*** **
		[0.00197]	**[0.00129]**
Capital stock	**ln_K**	**0.168*** **	**0.197*** **
		[0.0402]	**[0.0271]**
Total Factor Productivity	**ln_omega**	**-0.702*** **	**-0.723*** **
		[0.0162]	**[0.0100]**
Japanese steel prices	**ln_JPsteelplatericeUSDton**	**0.530*** **	**0.568*** **
		[0.0398]	[0.0411]
	2001.year	-0.0149	-0.00628
		[0.0235]	[0.0248]
	2002.year	0.0268	0.0398
		[0.0230]	[0.0253]
	2003.year	-0.0318	-0.0398*
		[0.0236]	[0.0237]
	2004.year	-0.282***	-0.309***
		[0.0255]	[0.0234]
	2005.year	-0.299***	-0.344***
		[0.0312]	[0.0285]
	2006.year	-0.194***	-0.232***
		[0.0274]	[0.0242]
	2007.year	-0.209***	-0.204***
		[0.0283]	[0.0240]
	2008.year	-0.447***	-0.480***
		[0.0453]	[0.0410]
	2009.year	-0.118***	-0.135***
		[0.0319]	[0.0264]
	2010.year	-0.127***	-0.139***
		[0.0351]	[0.0277]
	2011.year	-0.121***	-0.165***
		[0.0353]	[0.0290]

	2012.year	-0.0577*	-0.0917***
		[0.0322]	[0.0242]
	2013.year	0.0623**	0.0192
		[0.0279]	[0.0202]
	2014o.year	0	0
		[0]	[0]
	DE	0.512***	
		[0.0278]	
	FI	0.833***	
		[0.0239]	
	FR	0.680***	
		[0.0250]	
	IT	0.563***	
		[0.0181]	
	KR	2.235***	
		[0.0958]	
	NO	1.560***	
		[0.0211]	
	PL	0.0106	
		[0.0410]	
	RO	-0.321***	
		[0.0216]	
	RU	-0.248***	
		[0.0440]	
	Constant	0.264	1.579***
		[0.528]	[0.408]
	Observations	9,654	9,654
	R-squared	0.978	0.823
	Number of id		2,115
	Robust standard errors in brackets		
	*** p<0.01, ** p<0.05, * p<0.10		

Note: Reference year is 2000, reference country is China. I exclude Japan from the estimates due to the low number of material costs reported (in any case the results do not change significantly by excluding this country).
Source: based on ORBIS version 2016-1 and 2016-2; *China is based on Kalouptsidi and Barwick (Fall 2017[12]).

Annex G. Estimation results for Total Factor Productivity

Estimates (1) are based on a Cobb Douglas production function by drawing on the control function approach by (Levinsohn and Petrin, 2003[44])[2]and by implementing it via the Wooldridge methodology (Wooldridge, 2009[45]) for sake of simplicity and practicability (i.e. one step estimation rather than a two-step approach as in (Levinsohn and Petrin, 2003[44]). Estimates (2) are based on a simple OLS regression where TFP (ω) is the residual of a Cobb-Douglas production function (i.e. $\ln(\omega) = \ln(Q) - \ln(L) - \ln(M) - \ln(K)$. For both methods, L indicates the number of employees, M material costs, K real capital stock and Q output. The results of both methods are very similar and significant.

Table A G.1. Total Factor Productivity Estimation

	(1)	(2)
	Wooldridge GMM (based on Levinsohn and Petrin, 2003)	OLS
VARIABLES	ln_Q	ln_Q
ln_L	**0.480*** **	**0.495*** **
	[0.0162]	**[0.0111]**
ln_M	**0.342*** **	**0.400*** **
	[0.102]	**[0.00877]**
ln_K	**0.157*** **	**0.0985*** **
	[0.0337]	**[0.00766]**
ln_K_l1	-0.0361	
	[0.105]	
ln_M_l1	-0.906***	
	[0.0783]	
km_l1	0.103***	
	[0.0190]	
k2_l1	-0.0527***	
	[0.00918]	
m2_l1	-0.000228	
	[0.0142]	
k2m_l1	0.00426***	
	[0.00146]	
km2_l1	-0.00881***	
	[0.00159]	
k3_l1	7.29e-05	
	[0.000534]	
m3_l1	0.00371***	
	[0.000735]	
DE	0.163	-0.00639
	[0.0999]	[0.0625]
FI	**-0.429*** **	**-0.379*** **
	[0.103]	[0.0456]
FR	0.108	-0.149***
	[0.0799]	[0.0488]
IT	0.00127	-0.238***
	[0.0550]	[0.0325]
JP	Excluded: not enough observations on material costs	
KR	**2.939*** **	**3.992*** **
	[0.196]	**[0.0856]**

NO	**0.876*** **	**0.585*** **
	[0.0813]	**[0.0403]**
PL	**1.304*** **	**1.179*** **
	[0.0755]	**[0.0667]**
RO	**0.589*** **	**0.348*** **
	[0.0659]	**[0.0355]**
RU	**0.970*** **	**0.670*** **
	[0.0793]	**[0.0711]**
2001.year		0.0899*
		[0.0477]
2002.year		0.125***
		[0.0470]
2003.year	0.0870	0.142***
	[0.0621]	[0.0496]
2004.year	0.152**	0.141***
	[0.0701]	[0.0489]
2005.year	0.212***	0.0604
	[0.0785]	[0.0513]
2006.year	0.0630	0.132***
	[0.0670]	[0.0489]
2007.year	0.163**	0.265***
	[0.0649]	[0.0490]
2008.year	0.142**	0.264***
	[0.0619]	[0.0503]
2009.year	0.0564	0.146***
	[0.0628]	[0.0528]
2010.year	-0.136*	-0.0616
	[0.0742]	[0.0652]
2011.year	-0.154**	0.0307
	[0.0737]	[0.0504]
2012.year	-0.333***	-0.0464
	[0.0737]	[0.0554]
2013.year	-0.458***	-0.352***
	[0.0615]	[0.0487]
2014.year	-0.122*	-0.00610
	[0.0677]	[0.0500]
Constant	17.63***	12.40***
	[0.558]	[0.0985]
Observations	4,444	9,709
R-squared	0.948	0.928
Standard errors in brackets		
*** p<0.01, ** p<0.05, * p<0.10		

Note: Reference year in Wooldridge approach is 2001-2002 (due to two times lags for material) and in OLS regression 2000. China is the reference category in both approaches.
Source: based on ORBIS version 2016-1 and 2016-2; Results on China are based on Kalouptsidi and Barwick (Fall 2017[12]).

Annex H. OECD Taxonomy on Government Procurement

This annex provides an overview of the remaining GP groups part of the OECD taxonomy.

Collateral Restrictions/Restrictive effects

Table A H.1. Collateral Restrictions/Restrictive effects

Subgroup	Sub-category
M4: Collateral restrictions / Restrictive effects	**M41**: Tax on procurement for foreign entities
	M42: Barriers to FDI
	M43: Restricted eligibility to subsidies and tax preferences
	M44: Transparency measures in investment and trade

Source: Gourdon, Bastien and Folliot-Lalliot (2017[34]).

Conduct of procurement

Table A H.2. Conduct of procurement

Subgroup	Sub-category
M5: Conduct of procurement	**M51**: Design of methods of procurement
	M52: Registration mechanisms
	M53: Shortlist / pre-selected list of bidders
	M54: Direct/Limited tendering
	M55: Selective tendering
	M56: Securities
	M57: Time period

Source: Gourdon, Bastien and Folliot-Lalliot (2017[34]).

Qualification criteria

Table A H.3. Qualification criteria

Subgroup	Sub-category
M6: Qualification criteria	**M61**: Certification or license criteria
	M62: Set asides for specific groups
	M63: Past performance requirement
	M64: Prior experience requirement

Source: Gourdon, Bastien and Folliot-Lalliot (2017[34]).

Evaluation criteria

Table A H.4. Evaluation criteria

Subgroup	Sub-category
M7: Evaluation criteria	**M71**: Technical contractual conditions favour domestic firms
	M72: Financial requirements
	M73: Preference for specific groups

Source: Gourdon, Bastien and Folliot-Lalliot (2017[34]).

Review/complaint system

Table A H.5. Review/complaint system

Subgroup	Sub-category
M8: Review/ complaint system	**M81**: Challenge of bidding process or award
	M82: Choice of complaint forum
	M83: Time period
	M84: Cost
	M85 Suspension of bidding process
	M86 Sanction and remedies

Source: Gourdon, Bastien and Folliot-Lalliot (2017[34]).

Transparency and information

Table A H.6. Transparency and information

Subgroup	Subcategory
M9: Transparency & information	**M91**: Publication in Official gazette or accessible publication
	M92: Accessible e-procurement
	M93: Notification delay
	M94: Complexity of procurement rules

Source: Gourdon, Bastien and Folliot-Lalliot (2017[34]).

Annex I. Estimates of insolvent firm productivity

Table A I.1. Estimates of insolvent firms' total factor productivity

	(1)
	OLS
VARIABLES	Total factor productivity
Insolvent_firm_dummy [1=insolvent; 0 otherwise]	-0.210***
	[0.0590]
Constant	12.76***
	[0.0571]
Observations	8,863
R-squared	0.420
Robust standard errors in brackets	
*** p<0.01, ** p<0.05, * p<0.10	

Note: Since the dependent variable is in log the coefficient on zombie changes to -18% [exp(-.210)-1)*100]. In other words, zombie firms have on average a 18% lower total factor productivity. Control variables on country, time-fixed effects, firm size and firm age are suppressed for saving place.
Source: based on ORBIS version 2016-1 and 2016-2; *China is based on Kalouptsidi and Barwick (Fall 2017[12]).

References

Adalet McGowan, M., D. Andrews and V. Millot (2017), "The Walking Dead?: Zombie Firms and Productivity Performance in OECD Countries", *OECD Economics Department Working Papers*, No. 1372, OECD Publishing, Paris, https://dx.doi.org/10.1787/180d80ad-en. [42]

Adland, R. and H. Jia (2015), "Shipping market integration: The case of sticky newbuilding prices", *Maritime Economics & Logistics*, Vol. 17, pp. 389–398, http://dx.doi.org/doi:10.1057/mel.2014.35. [11]

Ayotte, K. and D. Skeel (2010), "Bankruptcy or Bailouts?", *Journal of Corporation Law*, Vol. 35/3, pp. 469-498, https://scholarship.law.berkeley.edu/cgi/viewcontent.cgi?article=3460&context=facpubs. [40]

Bloom, N. (2014), "Fluctuations in Uncertainty", *Journal of Economic Perspectives*, Vol. 28/2, pp. 153-176, http://dx.doi.org/doi=10.1257/jep.28.2.153. [53]

Brandt, L., J. Van Biesebroeck and Y. Zhang (2012), "Creative accounting or creative destruction? Firm-level productivity growth in Chinese manufacturing", *Journal of Development Economics*, Vol. 97/2, pp. 339-351, https://doi.org/10.1016/j.jdeveco.2011.02.002. [19]

Caballero, R., T. Hoshi and A. Kashyap (2008), "Zombie Lending and Depressed Restructuring in Japan", *American Economic Review*, Vol. 98/5, pp. 1943-77, http://dx.doi.org/10.1257/aer.98.5.1943. [41]

Deloitte (2018), *Finance Leasing*, https://www2.deloitte.com/cy/en/pages/financial-services/articles/finance-leasing.html (accessed on 20 November 2018). [22]

Dixit, A. and R. Pindyck (1994), *Investment under Uncertainty*, Princeton University Press. [55]

Fusillo, M. (2003), "Excess Capacity and Entry Deterrence: The Case of Ocean Liner Shipping Markets", *Maritime Economics & Logistics*, Vol. 5/2, pp. 100-115. [54]

Gal, P. (2013), *Measuring Total Factor Productivity at the Firm Level Using OECD ORBIS*. [43]

Gourdon, J., V. Bastien and L. Folliot-Lalliot (2017), "OECD taxonomy of measures affecting trade in government procurement processes", *OECD Trade Policy Papers*, No. 198, OECD Publishing, Paris, https://dx.doi.org/10.1787/5bfb44c3-en. [34]

Gourdon, K. (2019), "Ship recycling - An overview", *OECD Science, Technology and Industry Policy Papers, No. 68*, OECD Publishing, Paris, https://doi.org/10.1787/397de00c-en. [10]

Gourdon, K. and J. Guilhoto (2019), "Local content requirements and their economic effect on shipbuilding - A quantitative assessment", *OECD Science, Technology and Industry Policy Papers, No. 69*, OECD Publishing, Paris, https://doi.org/10.1787/90316781-en. [33]

Greenwood, R. and S. Hanson (2015), "Waves in ship prices and investment", *Quaterly Journal of Economics*, pp. 55-109, http://dx.doi.org/10.1093/qje/qju035. [9]

IMF (2003), *External Debt Statistics: Guide for Compilers and Users – Appendix III, Glossary*, https://www.imf.org/external/pubs/ft/eds/Eng/Guide/index.htm. [26]

Japan Metal Daily (2017), *Japan Metal Daily*, http://www.japanmetaldaily.co.jp/. [17]

Kahnemann, D. (2011), *Thinking Fast and Slow*, New York: Farrar, Straus and Giroux. [52]

Kalouptsidi, M. (2017), "Detection and Impact of Industrial Subsidies: The Case of Chinese Shipbuilding", *The Review of Economic Studies*, Vol. 85/2, pp. 1111-1158, https://doi.org/10.1093/restud/rdx050. [50]

Kalouptsidi, M. (2014), "Time To Build and Fluctuations in Bulk Shipping", *American Economic Review*, Vol. 104/2, pp. 564-608, http://dx.doi.org/10.1257/aer.104.2.564. [1]

Kalouptsidi, M. and P. Barwick (Fall 2017), *Research stay of Karin Gourdon*. [12]

Karakitsos, E. and L. Varnavides (2014), *Maritime Economics - A Macroeconomic Approach*, Palgrave Macmillan. [3]

Keating, E. et al. (2008), *Using the Steel-Vessel Material-Cost Index to Mitigate Shipbuilder Risk*, https://www.rand.org/content/dam/rand/pubs/technical_reports/2008/RAND_TR520.pdf (accessed on 20 July 2018). [51]

Lam, R. et al. (2017), *Resolving China's Zombies: Tackling Debt and Raising Productivity*. [49]

Levinsohn, J. and A. Petrin (2003), "Estimating production functions using inputs to control for unobservables", *The Review of Economic Studies*, Vol. 70/2, pp. 317-341, https://doi.org/10.1111/1467-937X.00246. [44]

Lintner, J. (1965), "The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets", *Review of Economics and Statistics*, Vol. 47/1, pp. 13–37. [28]

Livesey, F. (2012), "Rationales for industrial policy based on industry maturity", *Journal of Industry Competition and Trade*, Vol. 12/3, pp. 349-363, https://doi.org/10.1007/s10842-011-0103-8. [13]

Lucas, D. (2018), *Assessing financial subsidies: A market-based framework & applications*. [23]

Lucas, D. (2014), "Evaluating the Cost of Government Credit Support: The OECD Context", *Economic Policy*, Vol. 29/79, pp. 553-597, http://dx.doi.org/doi.org/10.1111/1468-0327.12034. [24]

Mossin, J. (1966), "Equilibrium in a Capital Asset Market", *Econometrica*, Vol. 34/4, pp. 768–783. [29]

OECD (2018), *Export Credits*, http://www.oecd.org/trade/exportcredits.htm (accessed on 1 November 2018). [30]

OECD (2018), *OECD Companion to the Inventory of Support Measures for Fossil Fuels 2018*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264286061-en. [20]

OECD (2018), *Peer review of the Finnish shipbuilding industry*, https://www.oecd.org/finland/peer-review-finland-shipbuilding-industry.pdf (accessed on 4 July 2018). [6]

OECD (2017), *Arrangement of officially supported export credits*, http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=tad/pg(2017)1 (accessed on 15 October 2018). [31]

OECD (2017), *Peer review of the Norwegian shipbuilding industry*, https://www.oecd.org/industry/ind/PeerReviewNorway_FINAL.pdf (accessed on 4 July 2018). [5]

OECD (2016), *Imbalances in the Shipbuilding Industry*, OECD Publishing Paris, https://www.oecd.org/industry/ind/Imbalances_Shipbuilding_Industry.pdf. [15]

OECD (2016), *Imbalances in the shipbuilding industry and assessment of policy responses*, https://www.oecd.org/industry/ind/Imbalances_Shipbuilding_Industry.pdf (accessed on 11 July 2018). [4]

OECD (2015), *Peer Review of the German Shipbuilding Industry*, OECD Publishing, https://www.oecd.org/sti/ind/PeerReview_Shipbuilding_Germany_FINAL.pdf (accessed on 20 July 2018). [7]

OECD (2006), *OECD Glossary - Market Failure*, https://stats.oecd.org/glossary/detail.asp?ID=3254 (accessed on 12 July 2018). [25]

OECD Productivity Statistics (2018), , https://data.oecd.org/lprdty/multifactor-productivity.htm (accessed on 10 April 2018). [18]

Olley, S. and A. Pakes (1996), "The Dynamics of Productivity in the Telecommunications Equipment Industry", *Econometrica*, Vol. 64/6, pp. 1263-1297, http://dx.doi.org/10.2307/2171831. [47]

Pindyck, R. (1991), "Irreversibility, Uncertainty, and Investment", *National Bureau of Economic Research (NBER)*. [2]

Rodrik, D. (2004), *Industrial Policy for the twenty-first century*. [46]

S&P Platts (2017), *Steel prices*. [16]

Sharpe, W. (1964), "Capital asset prices: A theory of market equilibrium under conditions of risk", *Journal of Finance*, Vol. 19/3, pp. 425–442. [27]

Stone, S., J. Messent and D. Flaig (2015), "Emerging Policy Issues: Localisation Barriers to Trade", *OECD Trade Policy Papers*, No. 180, OECD Publishing, Paris, https://dx.doi.org/10.1787/5js1m6v5qd5j-en. [35]

Stopford, M. (2003), *Maritime Economics*. [8]

The Economist (2009), *Secret sauce - China's rapid growth is due not just to heavy investment, but also to the world's fastest productivity gains*, https://www.economist.com/node/14844987 (accessed on 10 April 2018). [48]

Thomson Reuters (2018), *Export Credit Agency (ECA) - Glossary*, https://uk.practicallaw.thomsonreuters.com/7-501-2283?transitionType=Default&contextData=(sc.Default)&firstPage=true&comp=pluk&bhcp=1 (accessed on 3 October 2018). [32]

Warwick, K. (2013), "Beyond Industrial Policy: Emerging Issues and New Trends", *OECD Science, Technology and Industry Policy Papers*, No. 2, OECD Publishing, Paris, https://dx.doi.org/10.1787/5k4869clw0xp-en. [14]

Wooldridge, J. (2009), "On estimating firm-level production functions using proxy variables to control for unobservables", *Economics Letters*, Vol. 104/3, pp. 112-114, https://doi.org/10.1016/j.econlet.2009.04.026. [45]

World Bank (2018), *Doing Business Indicators*, http://www.doingbusiness.org/data/exploretopics/resolving-insolvency (accessed on 10 April 2018). [38]

World Bank (2017), *Insolvency and Debt Resolution*, http://www.worldbank.org/en/topic/financialsector/brief/insolvency-and-debt-resolution (accessed on 1 November 2018). [37]

World Bank (2017), *Resolving Insolvency Methodology*, http://www.doingbusiness.org/en/methodology/resolving-insolvency (accessed on 20 November 2018). [36]

World Bank (2015), *Principles for Effective Insolvency and Creditor/Debtor Regimes*, http://www.worldbank.org/en/topic/financialsector/brief/the-world-bank-principles-for-effective-insolvency-and-creditor-rights (accessed on 20 November 2018). [39]

World Resources Institute (2012), *Glossary of financing instruments*, http://pdf.wri.org/glossary_of_financing_instruments.pdf. [21]

Endnotes

[1] Kalouptsidi (2014[1]) discusses this argument in the context of the shipping industry (i.e. the long delivery time for ordered ships). Moreover, following Fusillo (2003[54]), as long as the costs of supply shortage during good times is higher than the cost of carrying excess capacity during bad times the firm has stronger incentives to err on its decision to keep and/or expand capacity rather than on facing supply shortage during future periods of high demand.

[2] These numbers refer to the average of the minimum delivery time for a given ship type of yards observed in Clarkson's World Fleet Register. In addition, we received a production plan from yard contacts for three different ship types, which largely confirm the net production time stated.

[3] For an overview of concepts and conclusions on the topic of investments taken under uncertainty see Dixit and Pindyck (1994[55]). The literature on investment behaviour stresses in general that the demand uncertainty and adjustment costs (e.g. in the form of time to delivery) are closely linked and are both necessary to affect investment behaviour.

[4] Indeed, yards with large capacity could also decide to produce more vessels instead of reducing the delivery time. However, once time becomes an important constraint for ship buyers (i.e. during cyclical upturns) early delivery will command a premium insofar that ship buyers would accept to pay to a certain extent a price premium for faster delivery. Adland and Jia (2015[11]) state "There exists, in fact, a term structure of newbuilding prices, describing the combinations of cost and time to delivery between which ship owners would be indifferent. If the opportunity cost of time for the operation of modern vessels is positive, this term structure will be downward sloping such that early delivery slots (and resales) command a premium over deliveries further into the future."

[5] Market-distortions can be manifold. For the scope of this work market-distortive government interventions "[…] reinforce or counteract the allocative effects that the existing market would otherwise produce." This definition is based on Rodrik (2004[46]) of his description of industrial policy, which nicely applies to this analysis. Since a market is a medium where supply and demand meets to exchange goods at an agreed price, this paper uses a supply and demand framework to illustrate the channels through which public interventions distort market quantity and ship prices and in the short or long run industrial capacity.

[6] Shipbuilding is an entirely demand-driven industry; yards will start ship construction only after reception of a definite order. This differs from a wide range of other industries where producers are able to produce on inventory owing to the nature of the good (i.e. in particular homogenous goods such as intermediate inputs or raw materials that are not perishable), such as steel.

[7] An analysis of speculative orders are outside the scope of this paper.

[8] Kahnemann (2011[52]) argues that competition neglect can be particularly strong when firms receive delayed feedback about the consequences of their investment decisions (e.g. time to build).

[9] The authors study the bulk dry shipping industry, but they highlight in their paper that the rationale is applicable to other capital-intensive industries that face boom and bust cycles similar to those they documented in the bulk dry shipping industry.

[10] This result hold in particular following a positive demand shock for shipping services (e.g. reduction in trade barriers) where the shock fades away due to mean-reverting shipping earnings

(i.e. earnings will tend to move to average earnings over time) (Kalouptsidi, 2017[50]). In addition, as the model shows, freight rates are more volatile in the case of time to build. Volatility represents uncertainty that makes firms cautious about investments into new ships. Investments into new ships go along with adjustment costs which make it expensive to reverse any investment decision (i.e. the used-good discount on resale since a newbuilt ship will hardly be scrapped and reselling may involve value losses by the ship owner) (Bloom, 2014[53]). Hence, longer time to build (i.e. more volatility) may lead shipping companies to refrain from investing in new ships which in turn lead to less overinvestment.

[11] Strictly speaking, time to delivery is partly influenced in the short-run by hiring of short-term labour and/or outsourcing activity. For instance, while keeping capacity constant, an increase in the number of short-term workforce decreases time to delivery since a ship can be built faster and thereby a berth will be available quicker for the construction of a subsequent order. Since capacity expansions take time it will have a direct impact on time to delivery only in the long-term.

[12] Adland and Jia (2015[11]) state "There exists, in fact, a term structure of newbuilding prices, describing the combinations of cost and time to delivery between which shipowners would be indifferent. If the opportunity cost of time for the operation of modern vessels is positive, this term structure will be downward sloping such that early delivery slots (and resales) command a premium over deliveries further into the future."

[13] For more information on the history of shipbuilding see Annex C.

[14] Note by Turkey

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Note by all the European Union Member States of the OECD and the European Union

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[15] Livesey (2012[13]) presents this approach in a four-by-four grid showing the stage of maturity of the home industry along the horizontal access and the stage of maturity of the global industry along the vertical axis. Each box in the grid then represents the comparative maturity of the industry sector in the home country relative to the global norm.

[16] Some yards invest also in machinery for plate bending, automated welding, material transfer for panel fabrication, material control and distribution as well as IT systems for design development. In general these investment decisions are rather lumpy so that investments feature patterns of spikes.

[17] Real capital stock is constructed via the perpetual inventory method (PIM) based on individual firm's fixed assets following Gal (2013[43]), see Annex D.

[18] Kalouptsidi (2014[1]) discusses this argument in the context of the shipping industry (i.e. the long delivery time for ordered ships). Moreover, following Fusillo (2003[54]), as long as the costs of supply shortage during good times is higher than the cost of carrying excess capacity during bad times the firm has stronger incentives to err on its decision to keep and/or expand capacity rather than on facing supply shortage during future periods of high demand.

[19] Exceptions include specialized ship types, such as cruise ships, LNG/LPG vessels or offshore services, which require experience and a well-connected supplier base.

[20] These numbers refer to the average of the minimum delivery time for a given ship type of yards observed in Clarkson's World Fleet Register. In addition, we received from yard contacts a production plan for three different ship types, which largely confirm the net production time stated.

[21] The analysis is based on production costs equal to material, labour and capital (depreciation to reflect usage) costs. Additional yard specific direct costs in the ship production are capital, financing and insurance costs.

[22] There are basically several factors shaping the form of a firm's cost curve that are working against each other: learning by doing (reflected in productivity estimates) lead to concave cost functions, indicating that each additional output can be produced at lower marginal costs (i.e. decreasing marginal costs), while capacity constraints explain concave cost functions (i.e. increasing unit costs), indicating that each additional output is produced at a higher marginal cost.

[23] This study does not include an analysis of the use of financial instruments (e.g. future or forward contracts) to hedge risk against steel price fluctuations since this was not a usual practice according to our contacts to shipbuilders. The steel contracts are negotiated case by case with each new order. Back in 2003, when it was a very sudden and sharp increase in steel prices (from USD 270 per ton to almost USD 500 per ton), many shipyards were extremely affected for the shipbuilding contracts ongoing and some of them unsuccessfully attempted to include a "steel price indexation" clause in shipbuilding contracts. For an illustration of the mechanism of such material cost indexes the interested reader is referred to Keating et al. (2008[51]) for an example in the context of the US Navy.

[24] The Economist (2009[48]) called TFP China's secret sauce by citing a study by UBS showing that China has had the fastest annual rate of TFP growth with around 4% which is by far a rapid efficiency gain compared to other economies.

[25] Due to the lack of data availability similar results published on Chinese ship yards' TFP are rare, if not even non-existent.

[26] Note: land area is not part of physical capital as it is strictly speaking not a reproducible product of human activities, while for instance machinery, buildings, equipment indeed are.

[27] With quasi-direct equity financing we refer to hybrid solutions, such as products with a mix of debt and equity characteristics in terms of ownership and claim to assets in the case of default. Their risk-return profile typically falls between debt and equity in a firm's financial capital structure (World Resources Institute, 2012[21]).

[28] This means that the item in the discussion paper of May 15, 2018, on "Equity infusions and conversions (including debt-for-equity swaps) inconsistent with market-based conditions will be discussed as part of the report on state-ownership in the context of the PWB for 2019-2020

[29] Indeed, reduced ship prices benefit ship buyers and might increase consumer welfare (i.e. of end consumer purchasing goods transported by ships) due to lower transportation costs. However, in the long-term such market-distorting support might pressure the financial health of the shipbuilding industry and reduce producer welfare.

[30] ECAs can be government institutions or private companies operating on behalf of governments.

[31] There are also medium-and long-term export credits that may take the form of "supplier credits", which essentially extend the credit by the exporter to the overseas buyer (OECD, 2018[30]). The mechanism is different compared to "buyer credits" provided in the context of export credits. However, at the end both types enable the foreign buyer of exported good and/or services to defer payment over a period of time.

[32] For more information about the criteria and assumptions used to collect comparable cases, see World Bank (2017[36]).

[33] The Chinese State Council broadly defines nonviable "zombies" as firms that incur three years of losses, cannot meet environmental and technological standards, do not align with national industrial

policies, and rely heavily on government or bank support to survive. Other definitions in the literature include Fukuda and Nakamura (2011), which identifies zombies as firms that face persistent losses and receive subsidized credit (actual interest cost less than market prime interest rates). In practice, local governments use both financial and production benchmarks to identify zombies. For example, financial benchmarks include three years of losses, liability to asset ratios exceeding 85 percent, negative operating cash flow, and debt in arrears for more than one year. Production benchmarks include capacity utilization rates less than 50 percent, suspended production for six months, and unpaid taxes or electricity bills. In this paper, the State Council definition uses three years of cumulative losses as the criterion (Lam et al., 2017[49]).

[34] Please note that we do not have any information available about whether or not the firms follow insolvency proceedings. The statistics provided are descriptive only and do not judge whether a bankruptcy proceeding is necessary or not.

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[2] No use of the control function by Olley and Pakes (1996[47]) using investments to control for unobservable since investments in ship yards are lumpy rather than monotone.