Risk Management in Vessel Finance Using the Decoupled NPV Approach

Masterarbeit

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vorgelegt von

Name: Schrader Vorname: Philipp
[redacted] [redacted] [redacted] [redacted]

Prüfer: Prof. Dr. Michael H. Breitner

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1 Introduction

Shipping has always been a risky business to be involved in. In the early beginnings of shipping as an important business in the 16th century, the return of ships from voyages often lasting several months could decide over the financial prosperity or ruin of the trader awaiting the goods. With the rise of international trade, fortunes were made and destroyed daily in the upcoming maritime clusters across Europe[1]. The growing interconnectedness spurred the growth of cargo ships, which were able to haul cargo more efficiently on prolonged journeys. These larger ships, however, were equally more difficult to finance with the long-established partnership model, in which two or three merchants would come together and purchase a ship[2]. In order to attract capital and spread risk at the same time, shares in the ship were sold to family members and friends - a prototype of modern ship investment funds. As investors poured into shipping, they made use of the emerging bond market to finance their much more risky, but also more lucrative shipping investments. As can be seen from this short historic review, the evolution of shipping should not be regarded as separate from that of shipping finance.

About half a millennium later, few things have materially changed in the shipping industry - it is still enormously risky and capital intensive. Over the past 50 years in particular, earnings in the shipping industry have seen several boom and bust cycles spawned by economic and/ or geopolitical crises. They have been mirrored by an equally changing mix of financing sources. Stopford (2002) identifies five phases of ship finance in the years from the midst of the 20th century, the first of which was characterized by an avoidance of debt and a focus on retained earnings to finance operations. In the golden age of shipping from the mid-50's to the early 70's, operators could finance newbuildings and second-hand vessels because they were provided with long-term charter contracts by large corporations in desperate need to ship their cargo. The 70's then quickly saw the break with charter-backed finance, as margins on long-term charter contracts eroded and more shipowners took to finding their luck on the spot market. Earnings exploded in the following, prompting owners to order additional ships, which bankers were eager to finance. As supply and demand went further astray, the dual shock of the oil crises in '73 and '79 popped the bubble and called in a 10-year period of distress, during which $ 10bn of shipping loans had to be written off. Starting in the early '90s, the introduction of the KG system as a means of financing sparked shipping's slow recovery[3].

[1] Magirou (2009)
[2] Gelderblom and Jonker (2004), p. 648
[3] Johns and Sturm (2015), p. 73

Extending the overview given by Stopford (2002), a final sixth phase can be identified. The years leading up to the financial crisis of 2007/ 08 were marked by a favourable interest environment, stable or rising earnings and optimism in the industry. Consequently, what befell the financial markets in general also caused havoc in the shipping industry: overoptimism paired with loose lending policies spurred fleet growth to unsustainable levels. The expectation of further rising values led bankers to pay little attention to Loan-to-Value (LTV) ratios and in some cases to offer 100 % financing[4]. Very similar to the residential mortgage market, loans backed ships assets were also bundled together and sold as mortgage-backed securities to investors hungry for yield. Today, ten years after the crisis the shipping industry has yet to recover from the fallout and has entered into a phase which many hope is a phase of consolidation[5]. Two recent events are symptomatic for this "new normal" in the shipping industry: Charter rates far below the required level to cover operating expenditures force shipowners to lay up vessels or declare bankruptcy like Hanjin Shipping, South Korea's largest container operator, in August 2016. On the other side, banks are cutting back their exposure to shipping loans by restricting origination and selling their portfolios to more risk-averse investors, as the transaction between Germany's second largest shipping bank NordLB and the hedge fund KKR symbolized[6].

The financial crisis also induced a change in the way of thinking about ship value. Throughout the history of shipping, putting a fair value on a vessel has been of utmost importance for anyone involved in the business. Whether a company contemplates a purchase or sale on the second-hand market or needs an assessment of its balance sheet positions, ship values are of great concern. Most importantly, because vessels serve as the main collateral for banks, ship values also determine the amount of debt capital a company can attract. As part of the minimum value clause in many loan agreements, they also decide if the bank can repossess the asset in times of a market decline. As can be expected in light of the importance of asset values, the correct method to arrive at a fair value has often been the matter of disagreement. Prior to the financial crisis, ship values were appraised predominantly based on recent comparable market transactions, adjusted for age, cargo and overall vessel specifications. While this approach is accepted to produce the fair value in undisturbed markets, many shipbrokers and banks quickly came to the realisation that this might not be the case in the illiquid markets of 2008/ 09[7]. What Duru (2013) coins the "ship mortgage crisis" then unfolded with consequences that are still being felt today. Ship values began to fall drastically as shipowners scrambled to pick up any cash left in the market and sold their

[4]Duru (2014)
[5]Jung-a (2017)
[6]Drost (2016)
[7]Karatzas (2009)

ship at fire sale prices, initiating a vicious cycle of lower valuations and hence even lower transaction prices. For lending banks, this posed a major threat in the form of defaults on loans whose minimum value covenants were breached. Some say that, in order to artificially inflate asset prices and bring covenants back in line, banks willingly opted for the Long-Term Asset Value (LTAV) approach to value their collateral[8]. The LTAV was devised by the Vereinigung Hamburger Schiffsagenten und Schiffsmakler (VHSS) in 2008 as an addition to the market comparable method and to be used in distressed markets. As a Discounted Cash Flow (DCF) valuation model, its use allowed banks to smooth values and determine the long-term earnings potential of the ship, thereby postponing necessary impairments indicated by mark-to-market valuations.

With the formal seal of approval from auditing firm PriceWaterhouseCoopers, the LTAV quickly gained in acceptance as a valuation tool besides the market approach[9]. However, criticism still abounds, citing unrealistic assumptions and an inherent optimism leading to inflated asset prices[10]. While the market approach tends to follow market sentiment closely by construction and tends to exacerbate market swings, the LTAV is often characterized as too optimistic. Thus, a valuation vacuum seems to exist between an overestimation of risk under the market approach and an underestimation of it in the LTAV valuation. What are the features a valuation model filling this gap should exhibit? In general, it should be able to combine the advantages of DCF valuation with those of mark-to-market valuation. That being said, an alternative model should be able to provide a sensible value estimate in distorted markets while also accounting for risk more explicitly. The importance of such a model becomes clear if we look at how simply risk is embodied in the LTAV: as other DCF models, it assumes a constant annual free cash flow (FCF) and adjusts for project risk by increasing the discount rate. Hence, the complexities of risk in the shipping industry are condensed into a single constant number that dramatically affects the value of the ship. Since this practice most likely oversimplifies the problem, there is room for a valuation method with a greater focus on risk.

Reconciling a complex risk structure and straightforward valuation methods is of exceptional relevance for market participants. Most importantly, a better understanding of the risks involved in a loan would enable banks to monitor and manage their exposure more efficiently. Benefits include more competitive pricing, a better assessment of collateral value and ultimately a revival of interest in shipping loans as an asset class. In particular in light

[8]Fernando (2009)
[9]Bockmann (2011)
[10]Dobert (2009)

of upcoming new regulations, communication of risks to the business becomes even more important and could be supported by a new valuation model. For shipowners, decisions could be put on a more risk-oriented basis, thereby allowing an improved assessment of investment and divestment decisions under capital constraints. This is all the more critical considering the long investment horizons and capital needs in shipping. From a macroeconomic perspective, an improvement of investment decisions benefits a more efficient allocation of capital. In the end, the acceptance of a new valuation method that highlights risks and makes them more transparent could even contribute to jump starting momentum in the shipping industry by creating an awareness for risk and reducing overoptimism.

In search of a suitable valuation model that fulfils the aforementioned requirements, the Decoupled Net Present Value (DNPV) is identified as a promising choice. Based on the available research, this relatively new approach appears to be a natural fit for the shipping industry, as it was devised for an industry similarly characterized by long investment horizons, high capital needs and a multitude of technical and financial risks. It accounts for risk in the project by means of a concept called Synthetic Insurance Premium (SIP) which separates risk from the discount rate. Thereby it incorporates probabilistic information to estimate risk, which is much more intuitive than simply adjusting the discount rate. Testing the hypotheses that the DNPV can be applied to and actually improve the evaluation of shipping investments is the primary goal of thesis. To this end, the thesis follows the Design Science Research (DSR) paradigm by Hevner (2007) to develop a Financial Decision Support System (FDSS). The FDSS is developed in Python and is able to evaluate investments from both the standard LTAV as well as from the DNPV perspective. Combining both approaches in an Information System (IS) artefact facilitates the comparison between the two and ultimately the transition from the LTAV to the DNPV. Developing a comprehensive, GUI (graphical user interface)-based artefact that also calculates well-known key financial figures such as the Internal Rate of Return (IRR) lowers the hurdle for an application in practice. For the demonstration, evaluation and communication of the DNPV approach, valuations of actual vessels are presented as instantiations of the artefact.

The remainder of this thesis is organized as follows. First, a comprehensive review of research on the valuation of ships is given to set the stage for the ensuing analysis. Adhering to the DSR paradigm throughout the thesis helps to ensure a meticulous research approach. Chapter 3 then introduces the shipping markets and the basic concepts required to put the importance of ship valuation and finance into perspective. Further, it gives an overview of the market for ship finance and the types of financing available. Before discussing the risks and risk management tools in the shipping industry, a breakdown of the most important valuation method used in practice establishes the reference point for the newly proposed

model in the following chapter. Chapter 4 starts off by providing a critique of traditional valuation methods before presenting the fundamentals of the DNPV. In the following applicability study, the case is first described and a risk register is set up. After a short outline of the developed FDSS, the underlying cash flow model, key financial figures and the calculation of the SIPs are presented. The chapter closes with a comment on the results of the applicability study. Some extensions of the model are discussed, implemented and evaluated by comparing two mutually exclusive investments. Finally, the newly obtained results are discussed, limitations of the conducted research and the FDSS are highlighted and areas of future research identified. The thesis is summarized and round up in the conclusion.

2 Research Background

2.1 Extant Literature

The introduction provided an insight into the current environment in the discipline of ship valuation. Foremost unchallenged methods had their merits tested by the financial crisis hitting the industry. It also prompted the initiation of new techniques that quickly gained acceptance. The literature review will serve the purpose of identifying important approaches to ship valuation, both old and new, and to formulate the research question. The review follows the procedure suggested by Webster and Watson (2002), i.e. i) identify meaningful keywords, ii) search for relevant contributions in scholarly databases and iii) conduct further searches based on the article's references (backward) and citations of them in other papers (forward). In the pursuit of building a relatively complete census of relevant research the keywords *Ship/ Vessel Valuation, Shipping Market, Risk Management and Decoupled Net Present Value* have been chosen and searched for to cover all aspects of the thesis topic. However, the contributions below are chosen because they relate most strongly to ship valuation and ship prices, the area for which the DNPV approach is proposed as an alternative to traditional methods.

The research on ship valuation and ship prices selected for this review can be dichotomized in approaches from an empirical perspective and those from a more practice-oriented perspective. In the past, empirical research has - often implicitly - focused on testing the Efficient Market Hypothesis (EMH) in the shipping industry. From the results, they inferred consequences for the time series and formation of second-hand prices. Most of these studies acknowledge some form of present value formula for the fundamental value of the ship, thereby assuming that market participants discount future cash flow accurately.
As one of the first researchers to focus on ship prices, Beenstock (1985) first rejects the

6 Conclusion

Players in the shipping industry still suffer tremendously from the aftermath of the financial crisis. This includes not only shipowners and yards affected by less demand for shipping goods, but also banks, other parties providing capital and nonetheless whole countries heavily reliant on shipping services. Yet there is no silver lining on the horizon, quite in contrast, the prospect of a receding globalization and therefore of less international trade overshadows expectations of future earnings. The spillover effects from the current crisis feed into the collateral of shipping loans, many of which are already in technical default, and threaten the stability of the banking sector. The trend towards securitisation of portfolios and less exposure to loans is a clear symptom of a diminishing profitability and the risks associated with ship investments. Of utmost importance in this challenging market environment is the valuation of the asset itself, as it establishes the basis for collateral values and investment/ divestment decisions.

The foremost ubiquitous market approach faced criticism of worsening the downturn during the crisis, when fire-sale prices distorted the fair valuation of ships. A new valuation technique, the LTAV which was introduced in 2009, filled the apparent gap and made it possible to determine a long-term value based on well-established DCF analysis. Shortly after its introduction, it was accused of artificially inflating asset prices and providing banks with a tool to avert necessary impairments. This suggests that the LTAV tends to underestimate risk. While the academic and professional communities largely agree that DCF analysis is a sound valuation method, it still exhibits certain drawbacks, in particular in its notion of how to account for risks. The DNPV, on the other hand, offers a new approach to think about risk in project valuations and resolves some of the issues of the LTAV, but has not been applied in a shipping context. In order to evaluate the benefits and shortcomings of this new approach, if applied to shipping, this thesis considered the question if and how the DNPV can improve the risk management in vessel financing.

To this end, we first look at the shipping market and its peculiar supply and demand mechanism to build a knowledge base for the ensuing analysis. It is established that earnings for the shipowner exhibit significant swings because the supply of tonnage is fixed in the short to medium run. Furthermore, the industry is affected by pig cycles, as market participants order new ships at the peak of the cycle which enter the market only years later, creating an oversupply of tonnage.

Then we turn to the process of financing marine vessels. Shipping as a capital intensive industry heavily relies on debt capital to fund acquisitions and newbuildings, highlighted by the overarching role of banks in the market. Although other forms of finance have recently gained in importance as banks reduce their exposure, the procedure of setting up a SPV that borrows against the value of the asset as the most common way to financing however will not be challenged any time soon.

A review of valuation techniques currently in use establishes the importance of this task as a risk management tool for each stakeholder. The two most prevalent models are examined and contrasted against each other with a focus on the LTAV. While the market approach is able to determine the fair value of a ship in functioning markets, the LTAV can be employed even if this is not the case, making it a worthwhile addition. The discussion of the LTAV also hints at its shortcomings in a business so fraught with risk. Like many other "simple" DCF models, it assumes that risk can be accounted for by a single number and bundles it with the time value of money in the discount rate. That this does not represent an appropriate approach becomes clear after a discussion of the manifold risks in shipping, which can be broadly categorized in cash flow and asset value risks, and the tools available for owners to mitigate and transfer them.

In the main part of the thesis, the DNPV is proposed as an alternative to the LTAV. The DNPV sets out to provide a valuation method that is better suited to account for risk in large-scale projects. By decoupling risk from the time value of money, it is able to resolve some of the problems associated with risk-adjusted discount rates. These fundamental flaws in DCF analysis, e.g. the logical inconsistencies when discounting negative cash flows, have been raised numerous times in the academic community, yet have not impeded the expansion of these methods in practice. Hence a new approach that is able to reconcile theoretical robustness and applicability in practice fills a significant gap in both realms. The DNPV separates time value of money from risk by introducing synthetic insurance premiums, which account for the possible deviation of actual cash flows from expected cash flows as direct costs to the ship. Because SIPs render the projected cash flows risk free, they can be discounted with the risk free rate. Having laid out the fundamentals of this new approach, it is applied to the valuation of a second-hand vessel.

For the implementation of the DNPV to the hypothesized investment decision, a Python-based FDSS is developed that allows the calculation of multiple key financial figures and their visualization. The base case scenario assigns a significant premium to the vessel according to the DNPV, suggesting that the traditional approach overestimates risk, i.e. specifies a discount rate that is too high for the actual risk profile. Alternatively, the high valuation

points to a misspecification of our model. In order to address this possibility, the model is again applied on two mutually exclusive investment opportunities with differing parameters. In this additional exercise, the importance of bank loan financing in the industry is acknowledged by introducing the lending perspective and the debt performance ratio that integrates well in the DNPV performance matrix. It allows to evaluate if the debt financing is structured in a way to not overburden the borrower while also offering an attractive ROE for the bank. In the comparison of the two ships, neither can be preferred over the other outright because of their different risk profiles. It also shows how the use of a constant hurdle rate to value different investment opportunities can lead to sub-prime investment decisions: only relying on the LTAV as decision support favours the riskier investment in the case study. Plotting the SIPs over time and the contribution of each single SIP to the total present value quantifies the different risk structures of the investments. This offers the chance to illustrate how the maximum cost and effect of risk management measures can be precisely determined in the DNPV. With an investment that can reduce the uncertainty surrounding the charter rate estimate, the risk performance of one ship can be improved to the point where it clearly outperforms the other.

Overall, the case study confirms that the DNPV can be tailored to suit investments in the shipping industry. Though relying on the same simple mechanics as traditional NPV analysis, it facilitates a broader and more comprehensive evaluation of the asset at hand, in particular when severe risks affect the valuation. The individual modelling of risks provides managers with a greater transparency of the different aspects driving the value of the ship. On the other side, it increases the effort required for a valuation that can take in every one of these aspects adequately. The greatest challenge in this respect concerns the probabilistic information needed for the calculation of the SIPs. Without further research and guidance on how to describe the significant risks in the shipping industry, in particular less sophisticated players could be overwhelmed with a full implementation of the DNPV. Nevertheless, while its transition to practice will ultimately depend on further research to be conducted, this thesis confirms the general applicability of the DNPV to shipping and illustrates how it can benefit the investment decision as an addition to traditional methods.