

Competition for Shipyard Capacity: Substitution Effects Between Dry Bulk and Tanker Newbuildings

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Abstract

This study investigates how shipbuilders allocate limited production capacity between dry bulk and tanker vessels, providing the first direct empirical evidence of cross-segment substitution in global newbuilding activity. Using monthly data from 1999 to 2025 and an ARDL modelling framework, the analysis examines how freight market conditions, newbuilding and second-hand vessel prices, and major economic shocks influence the relative shares of dry bulk and tanker orders. The results reveal strong intertemporal substitution effects: increases in orders in one segment systematically crowd out orders in the other with a significant lag, reflecting competition for shipyard capacity and gradual adjustment of production decisions. At the same time, contemporaneous positive relationships indicate that overall shipbuilding activity expands during favorable market conditions. Second-hand vessel prices act as delayed market signals that stimulate newbuilding demand, while relative newbuilding prices primarily shape dry bulk ordering behavior. Freight market conditions, especially the Baltic Dry Index, exert a meaningful influence on tanker orders, whereas tanker freight indices play a limited role in explaining dry bulk orders. Stability and diagnostic tests confirm the robustness of the estimated models. Overall, the findings highlight the dynamic and capacity-constrained nature of shipbuilding and contribute new empirical insights into how shipyards balance competing demand across major vessel segments.

Keywords: *Shipbuilding capacity, Substitution effects, Dry bulkers, Tankers*

JEL classification: *L92, L11, L23, C32*

1. Introduction

The global shipbuilding industry plays a central role in shaping shipping market dynamics by determining the future supply of maritime transport capacity. While a substantial body of literature examines shipowners' investment behavior and freight market cycles, considerably less attention has been paid to the production-side decisions of shipbuilders, particularly regarding how limited shipyard capacity is allocated across competing vessel segments. Understanding these allocation choices is crucial, as shipbuilders operate under capacity constraints and must continuously adjust their order books in response to changing market conditions.

Dry bulk and tanker vessels represent two of the most important segments in the global shipping market, both characterized by pronounced cyclical behavior and strong sensitivity to freight rates and vessel prices. They are closely linked, as many shipping companies and investors operate across multiple segments to manage risk and exploit market opportunities. Despite this interconnection, empirical research has primarily focused on spillover effects in freight rates, with limited attention paid to how such interactions might influence shipbuilding activity across segments. For example, Tsouknidis (2016) documents volatility spillovers between the dry and wet bulk freight markets, underscoring the relevance of cross-market dynamics, yet comparable evidence for newbuilding orders remains scarce. Given that dry bulk and tanker vessels compete directly for shipyard resources, an increase in newbuilding activity in one segment may occur at the expense of the other, potentially giving rise to substitution effects in shipbuilding production. Whether such substitution exists, and how it evolves over time, remains an open empirical question.

Vergottis (1978) emphasizes the interdependence of shipping market segments and highlights the role of newbuilding activity in shaping the long-run dynamics of the global shipping market. In particular, Vergottis' model acknowledges the interaction between tanker and dry bulk sectors through shared shipbuilding capacity and investment decisions. shipbuilding is a capacity-constrained, capital-intensive industry. Moreover, shipowners' investment is highly cyclical and segment-specific. Stopford's (2002) work on shipping cycles shows that freight booms in one segment trigger surges in orders for that segment, often at the expense of others, because capital and yard slots are limited. UNCTAD (2024) notes that shipbuilding capacity and ship recycling activity are key determinants of supply, alongside expectations and freight rates.

Building on these theoretical insights, the present study extends the existing literature by providing direct empirical evidence on the dynamic substitution mechanisms between dry bulk and tanker newbuilding orders. Using high-frequency monthly data and an ARDL modeling framework, this paper explicitly examines whether increases in orders in one

segment occur at the expense of the other, thereby shedding new light on the allocation of shipyard capacity from the perspective of shipbuilders. In doing so, the analysis moves beyond aggregate shipping market models and offers novel empirical findings on cross-segment interactions in shipbuilding activity.

Our results reveal strong intertemporal substitution effects between dry bulk and tanker orders, with statistically significant negative third-lag coefficients in both equations indicating that increases in one segment's orders crowd out the other with a delay due to shipyard capacity constraints. At the same time, contemporaneous positive effects suggest that overall shipbuilding activity expands during favorable market conditions. Second-hand vessel prices also influence newbuilding activity with delayed positive effects, supporting their role as lagged market signals. Differences across equations show that relative newbuilding prices significantly shape dry bulk orders, while freight market conditions play a meaningful role in tanker ordering decisions. In contrast, tanker freight indices are largely insignificant.

The remaining of the paper is structured as follows. Section 2 reviews recent prior literature. Section 3 gives a thorough description of the data used. The Autoregressive Distributed Lag (ARDL) methodology deployed for the analysis of the data is outlined in Section 4. In Section 5, we present our results and discuss the findings. Section 6 offers a summary of the study and concluding remarks.

2. Literature

The interdependence between the dry bulk and tanker segments has been widely examined in the maritime literature. Beenstock and Vergottis (1989a, 1989b) developed parallel models for dry bulk and tanker markets based on a common framework linking freight rate dynamics to newbuilding and second-hand ship prices. Their approach relies on two key assumptions: rational expectations, meaning market participants form expectations consistent with the model's predictions, and market efficiency, ensuring that prices adjust immediately to eliminate arbitrage opportunities.

In a later contribution, Beenstock and Vergottis (1993) connected the two sectors by highlighting the flexibility of combination carriers and the shared constraint of shipyard capacity, which can be allocated to either dry bulk or tanker construction. Following these seminal contributions, research on the dry bulk and tanker segments of the industry expanded to model prices, trading volume, and return volatility (Kavussanos, 1996, 1997; Syriopoulos and Roumpis, 2006), reporting practices (Oltedal and Engen, 2010), price behaviour and relative efficiency of maritime firms (Panayides and Lambertides (2011), volatility of freight rates (Drobetz et al., 2012), as well as temporal links with pertinent freights (Kou et al., 2010).

Competition for shipyard capacity between different vessel types has also been long observed and debated in maritime research. In the first place, it is stressed in studies that assert the existence of crowding out between military and commercial shipbuilding. Eloranta et al. (2017) point out that economic costs associated with displacement of production of ships for commercial purposes may well outweigh any positive effects stemming from enhanced security associated with military ships. More recently, several researchers and commentators point to country industrial structure characteristics being critical in determining the existence and extent of crowding out commercial newbuilding due to building warships (see, for example, Tulyakova et al., 2019; CRS, 2023; Hong et al., 2024; McKinsey, 2024; Dur, 2025).

In particular, the US has a shipbuilding industry that is relatively small, highly specialized, and dominated by US Navy contracts. Military shipbuilding occupies most shipyard capacity, leaving little room for commercial production (Birkler et al., 2005). US shipyards prioritize Navy contracts because they are more profitable and predictable. This specialization, in turn, reduces capacity and incentives for commercial shipbuilding, resulting in crowding out of commercial shipbuilding. As a result, US commercial shipbuilding is “globally uncompetitive” and US naval shipbuilding has become a “key vulnerability” of the US shipbuilding industry, because it lacks a strong commercial base (CRS, 2023).

Davies et al. (2012) identify similar challenges from the dominance of naval shipbuilding in the case of Australia, while Tulyakova et al. (2019) confirm crowding out for the Russian civil shipbuilding due to the disproportional structure of the Russian shipbuilding industry, which is heavily leaning to the more developed naval shipbuilding. In the case of these countries, therefore, the commercial shipbuilding sector is crowded out by military ships production, with military and commercial ship production being substitutes.

In contrast, in China military ship production tends to grow hand-in-hand with commercial vessels production. Chinese commercial shipbuilding activity is heavily subsidized by the state (Barwick et al., 2024) and it is the largest globally (CRS, 2023). China’s supportive policy appears to benefit its military production as well (Barwick et al., 2024). As put in the CRS (2023) report, China’s naval buildup “has been able to piggyback on its rapidly expanding commercial shipbuilding industry”. Hong et al. (2024) corroborate this point, showing that China’s industrial policy created a massive, vertically integrated commercial shipbuilding sector that also supports military production. China’s commercial shipbuilding scale and state support create spillovers that benefit naval shipbuilding and, instead of crowding out, the two sectors reinforce each other. More importantly, use of shipbuilding infrastructure is simultaneous and industrial policy is common for both military and commercial shipbuilding (Funairole et al., 2025), making concurrent development of both military and commercial shipbuilding possible. Thus, military and commercial ship production in China appear to complement each other.

An additional factor explaining why crowding out in shipbuilding occurs in some countries but not in others has to do with structural differences of the local shipbuilding industry. Birkler et al. (2005) show that industrial structure determines whether military and commercial shipbuilding compete or complement each other. Along the same lines, the McKinsey (2024) report discusses how global shipbuilders adapt to defense demand and how industrial capacity varies across countries. Hong et al. (2024) offer a comparative analysis of Japan, Korea, and China, showing that industrial scale and policy shape outcomes. Overall, countries with small, defense dominated shipbuilding sectors (e.g., US, UK) tend to experience crowding out, while countries with large, integrated, state supported commercial sectors (e.g., China, South Korea) experience complementarity.

Crowding out may also be present in the shipbuilding of different types of commercial ships. Evidence presented in the 2024 UNCTAD Review of Maritime Transport (UNCTAD, 2024) supports the idea that investment in one segment can suppress investment in others, noting structural overcapacity in some shipbuilding segments. Specifically, overcapacity in one segment can distort investment in others, while fleet age and decarbonization pressures force prioritization of certain ship types. The extent of crowding out depends on shipyard specialization, orderbook cycles, and capacity constraints. When shipyards face full orderbooks or limited capacity, orders for one vessel type can delay or displace orders for others (e.g., tankers or bulkers). As noted by Climate Analytics (2023), the LNG shipbuilding industry is adding capacity aggressively, even as demand may fall, creating oversupply and tying up shipyard slots. LNG carrier orders occupy scarce high-specification shipyard capacity, resulting in other ship types (tankers, bulkers) being delayed or priced out. Shipyards may also prioritize LNG vessels' production because they are high-margin and technologically advanced.

Additionally, crowding out may be attributable to cyclical factors, as Fan et al. (2022) argue for investment decisions between different vessels within the dry bulk segment. Dry bulk and tanker shipbuilding cycles fluctuate sharply. When one sector surges, it absorbs slots that could have gone to others; when demand collapses, yards pivot back. Further, shipyard capacity is tightened by the recent high deliveries in bulkers and tankers. High orderbooks in these segments reduce available slots for containerships or LNG carriers forcing shipyards to choose which orders to accept. In addition, prices rise when capacity is tight, discouraging production of other ship types.

Overall, different aspects of the interrelationship between the tanker and the dry bulk segments of the shipping industry are well documented in prior research. This provides the basis and allows room for an examination of potential substitution in the building of tankers and dry bulk ships. Although several explanations for the occurrence of crowding out have been put forward, there has been no explicit empirical treatment of cross-segment crowding out, delineating how and by how much variables such as freight market conditions, newbuilding prices, and second-hand vessel prices explain the variation in dry bulk and

tanker newbuilding orders, once common influences such as the great recession and structural breaks are taken into account. This study sets out to contribute to the literature by filling this gap.

3. Data

The empirical analysis employs monthly data covering the period from November 1999 to November 2025, corresponding to when the Baltic Freight Index (BFI) was rebranded as the Baltic Dry Index (BDI). All series are transformed into natural logarithms and subsequently differenced, yielding first logarithmic differences that approximate monthly growth rates and stabilize variance.

Newbuilding activity is measured using orders of dry bulk vessels (BORD) and tanker vessels (TORD), each expressed as a percentage of total vessel orders. This transformation captures shipbuilders' relative allocation of production capacity, allowing the analysis to examine potential substitution effects between the two segments. In particular, the framework investigates whether increases in dry bulk orders occur at the expense of tanker orders, conditional on market signals.

Freight market conditions are captured using widely recognized sector-specific indices. The BDI represents conditions in the dry bulk freight market, while the Baltic Clean Tanker Index (BCTI) and the Baltic Dirty Tanker Index (BDTI) proxy earnings conditions in the tanker market. These indices are commonly employed in the maritime economics literature as benchmarks for freight rate developments and as indicators of expectations regarding future market conditions, which influence shipbuilders' and ship owners' decisions.

Shipbuilders' income from newbuilding activity is proxied using newbuilding prices in each segment, reflecting the revenue earned from delivering vessels. The newbuilding prices are denoted PNB for dry bulk vessels and PNT for tankers. In addition, second-hand vessel prices are included as signals affecting demand in the newbuilding market. Specifically, higher second-hand vessel prices create an incentive for shipowners to place newbuilding orders instead of purchasing second-hand vessels, thereby increasing the expected income for shipbuilders. The second-hand prices are denoted PSB for dry bulk vessels and PST for tankers. To capture cross-segment effects, the analysis also considers ratios of second-hand vessel prices (e.g., PSB/PST), which serve as indicators of relative substitution incentives across segments.

The models include dummy variables to account for extraordinary economic events, such as the Great Recession (DD), and other identified structural breaks (STB). These exogenous variables control for abrupt changes in market conditions that may temporarily influence shipbuilders' allocation decisions.

All time series data were obtained from the Clarksons' database, except for the dummy variables, which were downloaded from the Federal Reserve of St. Louis Database. By combining information on order shares, freight-market-based earnings, and relative second-hand vessel prices, the dataset allows for a detailed examination of how shipbuilders allocate newbuilding activity across dry bulk and tanker segments in response to market signals.

4. Methodology

The present analysis employs two complementary unit root tests to examine whether the variables under consideration are stationary in their levels. Specifically, the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests are applied to determine the order of integration of each series and, consequently, the appropriate specification used in the empirical analysis (Dickey & Fuller, 1979; Phillips & Perron, 1988).

To investigate the dynamic relationship between orders of dry bulk and tanker vessels, two Autoregressive Distributed Lag (ARDL) models, as proposed by Pesaran and Shin (1999), are employed, one for each of the two variables. The ARDL framework is particularly suitable as it allows for flexible lag structures and can be applied when the variables are integrated of order zero or one.

The general form of the ARDL model is expressed as:

$$Y_t = a_0 + \sum_{i=1}^n a_i Y_{t-i} + \sum_{j=1}^k \sum_{i=1}^q \beta_{j,i} X_{j,t-i} + \theta_t$$

where Y_t is the dependent variable, $X_{j,t-i}$ are the explanatory variables, a_0 is the intercept, a_i and $\beta_{j,i}$ are parameters to be estimated, n and q denote lag orders, and θ_t is a disturbance term.

Each ARDL model is specified separately and incorporates a distinct set of explanatory variables selected according to the economic characteristics of the respective shipping segment under examination. This modeling strategy also allows for the examination of potential substitution effects between market segments, as shipowners allocate capital across alternative vessel types. In this context, the analysis explicitly investigates whether increased ordering activity in the dry bulk sector occurs at the expense of tanker vessel orders, after controlling for freight market conditions, relative vessel prices, and macroeconomic shocks. Lag lengths for each ARDL model are determined independently using the Akaike Information Criterion (AIC).

To account for potential structural breaks that may affect model stability, dummy variables corresponding to identified break periods are incorporated into the ARDL specification. Therefore, ARDL with exogenous variables (ARDL-X) were applied.

The stability of the estimated ARDL model is subsequently evaluated using the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests developed by Brown et al. (1975). Following the recommendations of Pesaran and Shin (1999) and Pesaran et al. (2001), these diagnostic tests are applied to assess parameter stability and overall model adequacy. Model stability is confirmed when the CUSUM and CUSUMSQ statistics remain within the 5% critical bounds.

Finally, standard diagnostic tests are conducted to examine the statistical properties of the residuals. Specifically, the presence of autocorrelation and heteroskedasticity is tested using the Breusch–Godfrey LM test and the Harvey test, respectively.

5. Empirical results

5.1 Stationarity Tests

The results of the ADF and PP unit root tests indicate that all variables become stationary after first differencing. In particular, the null hypothesis of a unit root is rejected for the first logarithmic differences of all series. Detailed results are presented in **Tables 1** and **2**.

Table 1: Stationarity Tests for Freight Indices & Orderbook

	BDI	BDTI	BCTI	BORD	TORD
ADF	-14.82***	-13.81***	-14.92***	-3.62***	-4.12***
P-P	-15.16***	-15.74***	-15.72***	-12.20***	-14.39***
Notes: ADF and P-P stands for the Augmented Dickey–Fuller and Phillips–Perron tests. *, **, *** indicate the rejection of null hypothesis for 10%, 5%, and 1% significance level respectively.					

Table 2: Stationarity Tests for Vessel Prices

	BNP	TNP	BSP	TSP
ADF	-5.69***	-6.77***	-10.21***	-12.10***
P-P	-10.66***	-10.49***	-10.14***	-13.00***
Notes: ADF and P-P stands for the Augmented Dickey–Fuller and Phillips–Perron tests. *, **, *** indicate the rejection of null hypothesis for 10%, 5%, and 1% significance level respectively.				

5.2 ARDL Model

In this section the results of ARDL models are presented. For the ARDL model that contains TORD as a dependent variable, we included as independent variables the BORD,

BDI, the dummy variables for the Great Recession and structural breaks, and the two fractions TNP/BNP, TSP/BSP. For the ARDL that includes BORD as a dependent variable, we used as independent variables the TORD, BDTI, BCTI, the dummy for the Great Recession and the reverse fractions BNP/TNP, BSP/TSP. The results are presented in **Table 3**.

Both equations validated the initial hypothesis regarding the substitution effect between the dry bulk and tanker vessel orders. Specifically, the lagged coefficients of dry bulk orders are predominantly negative, with the third lag being statistically significant. This pattern provides evidence of intertemporal substitution effects, whereby increases in dry bulk orders tend to crowd out tanker orders with a delay, reflecting competition for shipyard capacity. The same results are valid in the tanker order equation, where the coefficient of third lag coefficient being negative.

Our empirical findings provide novel evidence that extends the theoretical framework of Vergottis (1978), demonstrating that substitution effects between dry bulk and tanker vessel orders are not contemporaneous but materialize with economically meaningful time lags. This dynamic pattern suggests that shipbuilders' allocation decisions adjust gradually in response to changing market conditions, reflecting production constraints, order-book commitments, and delayed responses to relative profitability signals across segments.

The negative effect the orders of vessels two segments is observable only in lag variables, while there is also a contemporaneous positive and statistically significant effect between them suggesting that overall shipbuilding activity expands during favorable market conditions.

Relative price signals from the second-hand market are also relevant in both equations. While most lags of the second-hand price are positive and some of them statistically significant, indicating that tanker second-hand prices in both markets eventually stimulate newbuilding orders. This supports the notion that second-hand market valuations act as delayed signals for newbuilding demand.

Table 3: ARDL Models

ARDL MODEL FOR TORD			ARDL MODEL FOR BORD		
VARIABLES	COEFICIENTS	P-VALUE	VARIABLES	COEFICIENTS	P-VALUE
TORD(-1)	0.11	0.06*	BORD(-1)	0.13	0.03**
TORD(-2)	0.27	0.01***	BORD(-2)	0.29	0.01***
TORD(-3)	0.11	0.06*	BORD(-3)	0.20	0.01***
TORD(-4)	0.18	0.01***	BORD(-4)	0.12	0.04**
BORD	0.30	0.01***	BORD(-5)	0.04	0.47
BORD(-1)	-0.01	0.89	BORD(-6)	0.2	0.01***
BORD(-2)	-0.09	0.16	BORD(-7)	-0.15	0.01***
BORD(-3)	-0.13	0.04**	BORD(-8)	-0.13	0.02**
TNP/BNP	0.12	0.40	TORD	0.30	0.01***
TSP/BSP	0.04	0.32	TORD(-1)	0.01	0.87
TSP/BSP(-1)	0.04	0.37	TORD(-2)	-0.05	0.30
TSP/BSP(-2)	0.04	0.35	TORD(-3)	-0.11	0.03**
TSP/BSP(-3)	0.01	0.79	BNP/TNP	0.02	0.83
TSP/BSP(-4)	-0.01	0.98	BNP/TNP(-1)	-0.03	0.82
TSP/BSP(-5)	0.04	0.36	BNP/TNP(-2)	0.03	0.78
TSP/BSP(-6)	0.12	0.01***	BNP/TNP(-3)	0.05	0.64
TSP/BSP(-7)	0.05	0.21	BNP/TNP(-4)	0.28	0.01***
TSP/BSP(-8)	0.02	0.61	BNP/TNP(-5)	0.09	0.41
TSP/BSP(-9)	0.09	0.03**	BNP/TNP(-6)	0.27	0.02**
BDI	0.02	0.07*	BNP/TNP(-7)	0.01	0.91
BDI(-1)	0.02	0.03**	BNP/TNP(-8)	0.01	0.97
BDI(-2)	0.01	0.33	BNP/TNP(-9)	-0.30	0.01***
BDI(-3)	0.02	0.01***	BNP/TNP(-10)	0.24	0.03**
BDI(-4)	0.02	0.10	BSP/TSP	-0.03	0.37
BDI(-5)	0.02	0.08*	BSP/TSP(-1)	0.07	0.05*
BDI(-6)	0.04	0.01***	BDTI	-0.01	0.99
BDI(-7)	0.02	0.08*	BCTI	0.01	0.25
BDI(-8)	0.02	0.03**	C	-0.01	0.70
BDI(-9)	-0.01	0.94	DD	0.01	0.26
BDI(-10)	0.03	0.01***			
C	0.01	0.97			
DD	0.01	0.58			
STB	-0.01	0.73			
R-SQUARED	0.49		R-SQUARED	0.59	
ADJUSTED -SQUARE	0.43		ADJUSTED -SQUARE	0.54	
LM	0.57		LM	0.56	
HARVEY	0.55		HARVEY	0.08*	
Notes:					
LM and HARVEY refer to the p-values of the Breusch–Godfrey LM test and the Harvey test, respectively.					
*, **, and *** indicate rejection of the null hypothesis at the 10%, 5%, and 1% significance levels, respectively. The number in parentheses next to a variable indicates the lag of that variable included in the model.					

There are also differences between the two equations. Hence, relative newbuilding prices play a significant role only in shaping dry bulk orders, with several lagged coefficients being economically large and statistically meaningful. This finding suggests that shipbuilders respond to relative revenue opportunities across segments, reallocating newbuilding activity toward the segment offering higher expected returns.

In addition, freight market conditions, proxied only by the BDI, have a consistently positive and largely significant impact across several lags, highlighting the role of dry bulk freight market strength in shaping tanker ordering decisions through broader expectations about shipping market profitability, whereas The inclusion of tanker freight rate indicators (BDTI and BCTI) yields small and statistically insignificant coefficients, implying that tanker freight market conditions do not directly influence dry bulk ordering decisions once relative prices and order dynamics are accounted for. Therefore, the study highlights the importance of BDI as a benchmark for the expected economic conditions

5.3 Stability Tests

The results of the CUSUM and CUSUMSQ tests are presented on **Figures 1 to 4** and confirm the stability of both ARDL models, as the corresponding statistics do not cross the 5% significance boundaries. This provides evidence of stable coefficients and supports the reliability of the estimated relationships over the sample period.

Figure 1. Plot of CUSUM for Coefficients Stability for dry bulkers ARDL Model

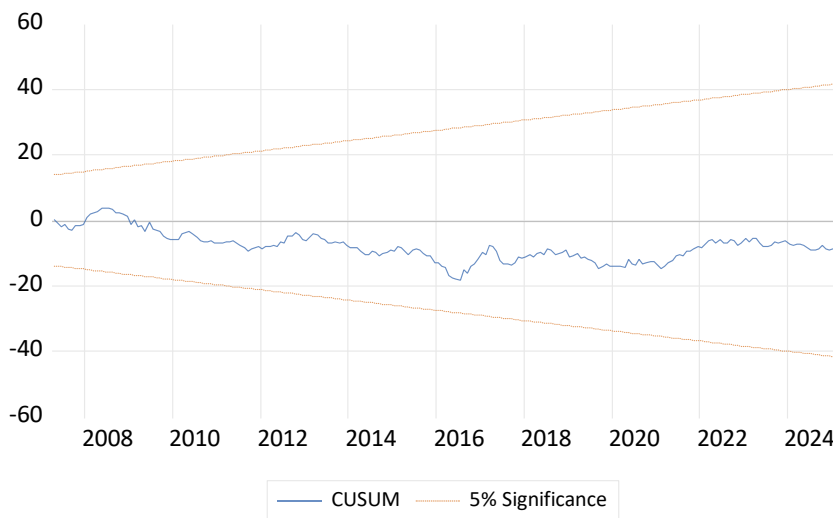


Figure 2. Plot of CUSUMQ for Coefficients Stability for dry bulkers ARDL Model

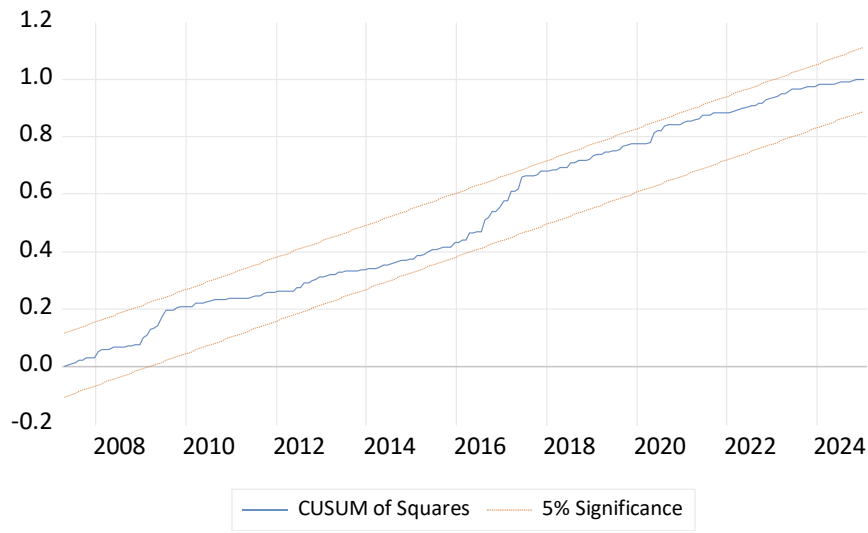


Figure 3. Plot of CUSUM for Coefficients Stability for Tankers ARDL Model

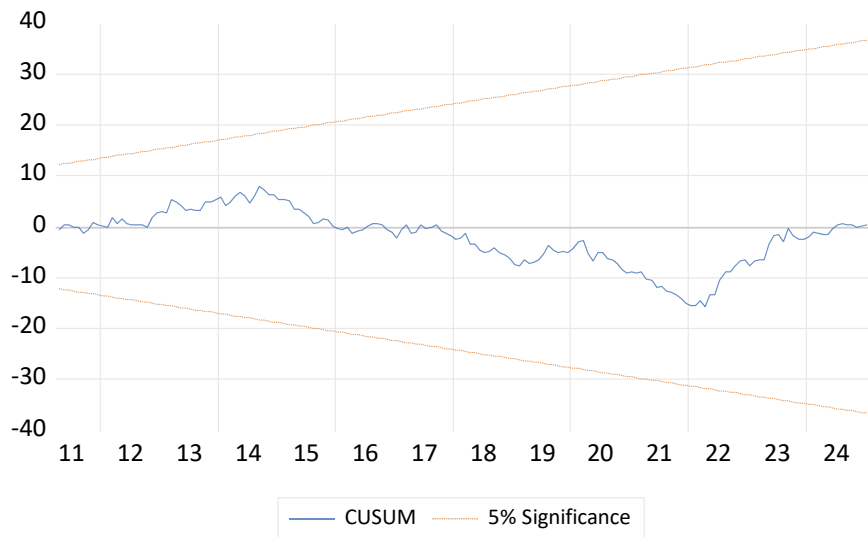
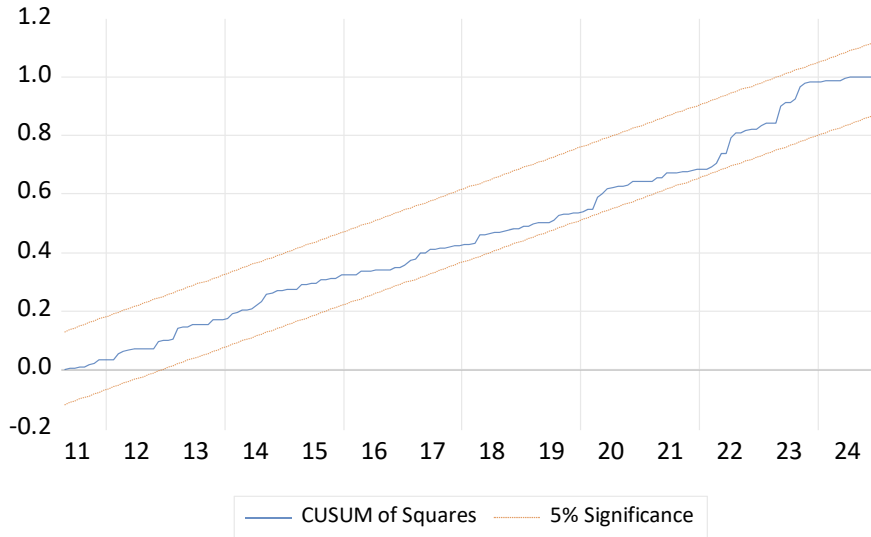


Figure 4. Plot of CUSUMQ for Coefficients Stability for Tankers ARDL Model



5.4 Model Diagnostics

The LM test results indicate that the null hypothesis of no serial correlation cannot be rejected for either model, suggesting that the residuals are free from autocorrelation and that the dynamic specification adequately captures the underlying data-generating process.

Second, heteroskedasticity was assessed using the Harvey test. The results of the Harvey test fail to reject the null hypothesis of homoskedasticity, indicating that the variance of the residuals remains constant over time. This finding supports the efficiency and consistency of the estimated coefficients and confirms that heteroskedasticity does not pose a concern for inference.

6. Policy Implications

The findings of this study have clear implications for maritime industrial policy and shipbuilding strategy. The evidence of intertemporal substitution between dry bulk and tanker newbuilding orders indicates that shipyard capacity is a binding constraint. Policies that stimulate demand in one vessel segment may therefore crowd out investment in others unless they are accompanied by measures that expand or reallocate shipyard capacity.

This highlights the importance of flexible and scalable shipbuilding infrastructure. Countries with rigid or highly specialized shipyards are more likely to experience displacement effects across segments, increasing cyclicalities and reducing competitiveness. By contrast, policies that support adaptable production processes and workforce flexibility can mitigate these substitution dynamics.

The role of second-hand vessel prices as delayed signals for newbuilding activity suggests that market transparency matters beyond shipowners' investment decisions. Improving the availability and timeliness of second-hand price information can help shipbuilders and financiers anticipate demand shifts and adjust capacity planning more efficiently.

Finally, the results have implications for decarbonization and industrial transition policies. As environmental regulations and green incentives increasingly favor specific vessel types, capacity constraints may lead to unintended crowding out of other segments. Policymakers should therefore account for cross-segment substitution effects when designing climate-related shipping policies, to avoid amplifying volatility in shipbuilding cycles.

7. Conclusion

This study advances the maritime economics literature by demonstrating that shipbuilding decisions are shaped not only by market fundamentals within each segment but also by dynamic interactions across segments competing for limited production capacity. The empirical evidence of substitution effects between dry bulk and tanker newbuilding orders provided offers new insights into how shipbuilders allocate scarce production capacity across major vessel segments.

Using monthly data from 1999 to 2025 and an ARDL modelling framework, the analysis examines how freight market conditions, newbuilding and second-hand vessel prices, and major economic shocks shape the relative shares of dry bulk and tanker orders. Unit root tests confirm that all variables become stationary after first differencing, allowing for a robust dynamic specification. The empirical results reveal a clear pattern of intertemporal substitution between the two segments. In both ARDL equations, the third lag of the alternative segment's orders is negative and statistically significant, indicating that increases in dry bulk orders crowd out tanker orders with a delay, and vice versa. This dynamic substitution reflects the reality of shipbuilding as a capacity-constrained industry in which production decisions adjust gradually to evolving market conditions. At the same time, the presence of contemporaneous positive effects suggests that overall shipbuilding activity expands during favorable market conditions, even as segments compete for yard slots.

The analysis also highlights the importance of relative price signals. Second-hand vessel prices exert delayed positive effects on newbuilding activity, consistent with their role as forward-looking indicators of vessel profitability. Relative newbuilding prices significantly influence dry bulk orders, suggesting that shipbuilders respond to cross-segment revenue opportunities when allocating production capacity. Freight market conditions, particularly the Baltic Dry Index, play a meaningful role in shaping tanker

orders, whereas tanker freight indices do not significantly influence dry bulk ordering behavior once relative prices and order dynamics are accounted for. Stability tests confirm that the estimated relationships remain structurally stable over the sample period.

The findings carry several implications for policymakers, regulators, and shipbuilding/shipping stakeholders. Because countries with limited or highly specialized shipbuilding capacity may face stronger crowding-out effects across segments, there is a need for policies that support flexible, scalable shipyard infrastructure that can mitigate these constraints and enhance country competitiveness in global shipbuilding markets. Moreover, since second-hand prices and freight indices act as leading indicators for newbuilding demand, improving transparency in these markets can help shipbuilders and policymakers anticipate investment cycles and adjust capacity or regulatory frameworks accordingly. Further, cross-segment substitution dynamics can help improve investment timing, portfolio diversification, and credit risk assessment, particularly for institutions exposed to multiple vessel classes. Finally, as decarbonization pressures intensify, substitution effects may influence which vessel types receive priority in shipyard production.

Future research could expand the analysis to containerships, LNG/LPG carriers, and other shipbuilding segments, shedding light on substitution effects across the entire shipbuilding industry and identifying whether certain segments exert stronger displacement pressures than others. In addition, as decarbonization policies and fuel-specific regulations are transforming newbuilding demand, future research could examine how green-technology requirements and carbon-pricing mechanisms influence substitution patterns.

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