A Structural Model for Forecasting the Shipping Market

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ECONOMIC ANALYSIS & INVESTMENT STRATEGY

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Bloomberg:

Piraeus Bank Shipping Index: {PBGGSHPP Index<GO>}

Piraeus Bank Dry Bulk Index: {PBGGSHDB Index<GO>}

Piraeus Bank Container Index: {PBGGSHCN Index<GO>}

Piraeus Bank Oil Tanker Index: {PBGGSHOT Index<GO>}

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Aim of the Study

The aim of this study is to develop an econometric model **describing the evolution of new-build and second-hand ship prices**. While this model was developed originally to address internal needs within the Piraeus Bank Group, we believe that both our modelling methodology and the broader "philosophy" of our approach could be of wider interest.

The ability to identify the factors that affect the shipping market can be used in a number of ways, such as:

- **Estimate the "fair" value** in the new-build and second-hand market and assess current market pricing vs fair-valuation levels.
- Allow **banks to assess the future evolution** of the value of shipping loan collaterals (i.e. the value of the ship underlying the loan).
- To be used for **risk management purposes** by assessing the sensitivity of the collaterals under a series of explanatory factors.
- Create **long-term forecasts** under alternative macroeconomic scenarios.

Characteristics of the Shipping Industry

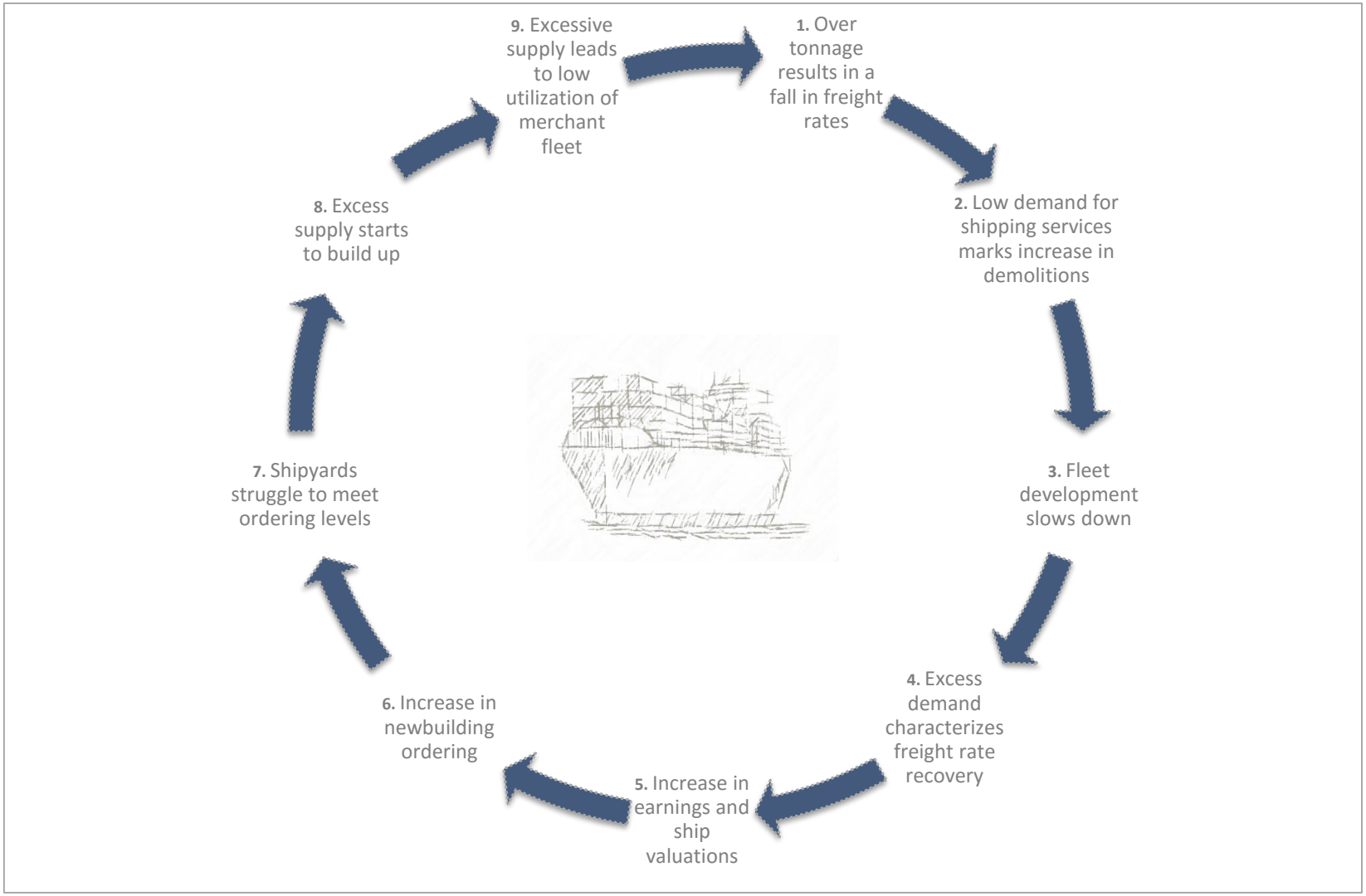
Modelling ship prices is extremely difficult since loosely speaking the price of a vessel can be thought of as a "derivative" contract upon another "derivative" contract.

This means that the price of a vessel depends on expectations about the future evolution of freight rates which in turn are determined by the interplay between global demand for shipping services (as a result of global growth and commodity prices) and supply of shipping services (determined by the current transportation capacity of world fleet and demolition volumes).

By nature, demand as a function of economic growth and commodity prices is extremely volatile and fast changing. On the contrary, supply can adjust only at a very gradual pace due to the natural time-lag between new orders for ships and actual delivery by shipyards.

The interplay between a fast moving demand and a slow adjusting supply gives rise to the main characteristic of the shipping industry, which is none other than its extreme cyclicality.

Shipping Cycle: The Result of a Demand-Supply Mismatch



Our Approach

Our approach towards modelling new-build and second-hand prices is to bypass the freight market and focus on the underlying forces of demand and supply. In particular, we devise proxies for the theoretical concepts of “demand” and “supply” of shipping services and express ship prices as a function of the imbalance between the two.

Furthermore, to improve the statistical behaviour of the model we also include a few exogenous variables such as oil prices and the USD exchange rate.

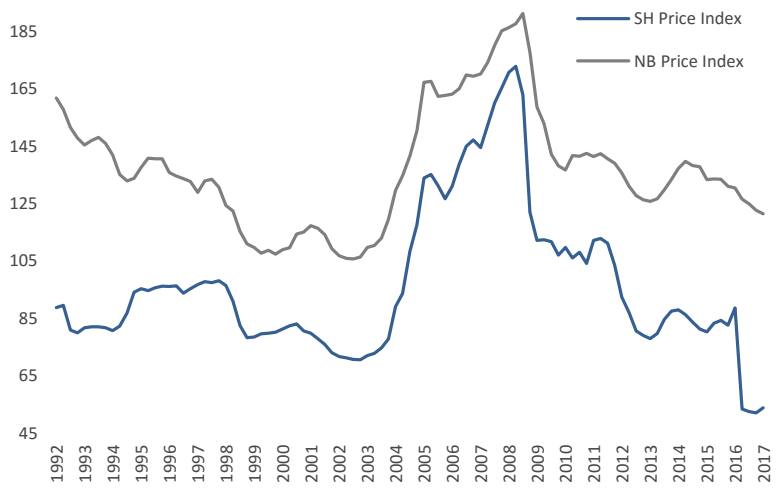
In turn, when it comes to modelling the price of new-build ships we find that developments in the second-hand markets also contain information we can exploit.

The fact that vessel prices in our model are allowed to be driven by supply and demand factors makes our model one of the “structural” models of the global shipping industry.

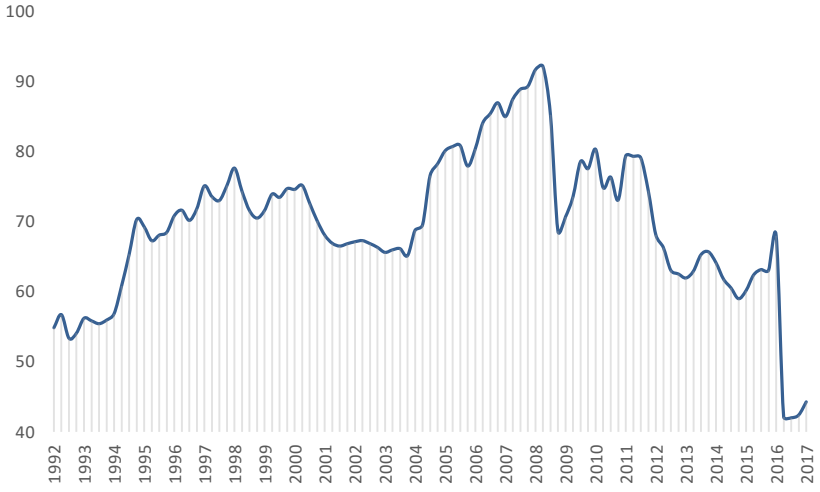
New-build & Second-hand Ship Prices

- The new-build market relates to ships that do not currently exist, but need to be ordered, built by the shipyards and then delivered with a two to three years lag. On the contrary, the second-hand market is a spot market conducted by dedicated brokers. Given the great variety of types (and age of second-hand ships) the price indices we use as dependent variables are an amalgamation of various prices and quotes.
- Limited new-build demand and weak market sentiment have led to a sharp drop in new-build ship prices along with a steady pressure on the second-hand market. Underutilization of shipyards and unfavorable market conditions led to a significant decrease in shipyard negotiating position and therefore to low new-build prices. On top of that, recent dollar depreciation intensified the pressure on shipyard for lower pricing. The competition in the second-hand market has increased considerably over the past 7 years as the gap between new-build and second-hand prices keeps widening. In effect, second-hand prices declined faster in 2016 than new-build and reached levels close to 45% of the respective new-build average price. Cheaper second-hand prices are adding an extra pressure on shipyards to adjust their pricing policy in order to maintain their already weakened orderbook levels.

Secondhand and Newbuild Ship Prices



Secondhand vs Newbuild Ratio

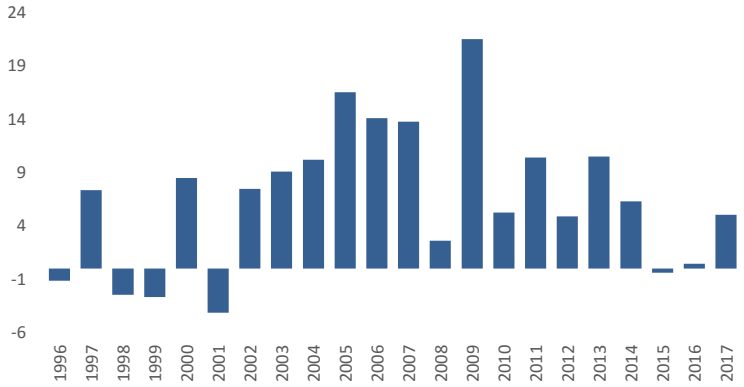


Source: Piraeus Bank Research, Clarksons Shipping Intelligence Network

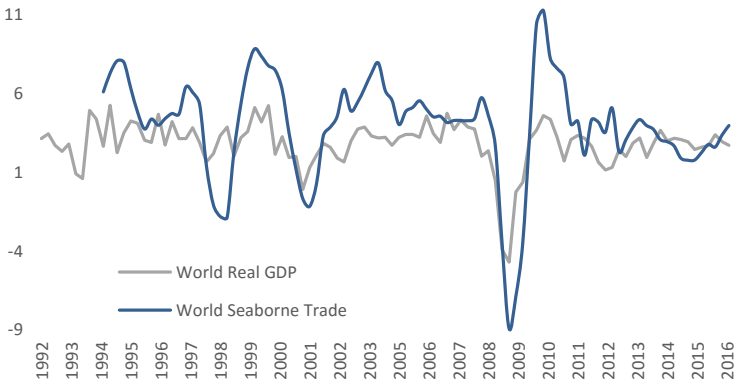
A NUMBER OF GLOBAL ACTIVITY INDICATORS...

... point towards a mild recovery of global economic growth and trade.

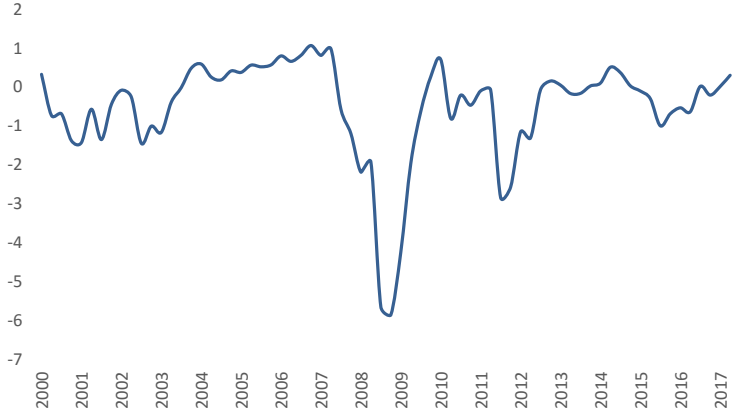
Trade Weighted Steel Production recovered following 2 years of depressed production growth…



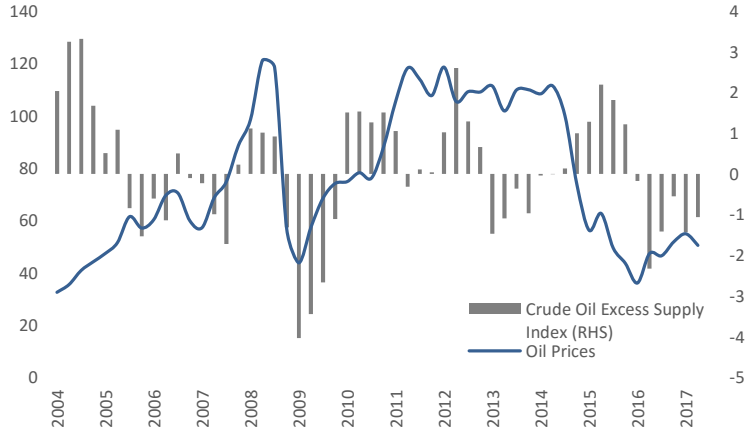
Seaborne Trade Growth surprised on the upside in Q1 2017 at 3.94% on a YoY basis…



Global Financial Conditions more accommodative as liquidity constraints are gradually lifted…



Crude Oil Prices stabilized at 50 $/bl in 2017 despite efforts to curb production…



Source: Piraeus Bank Research, Clarksons Shipping Intelligence Network

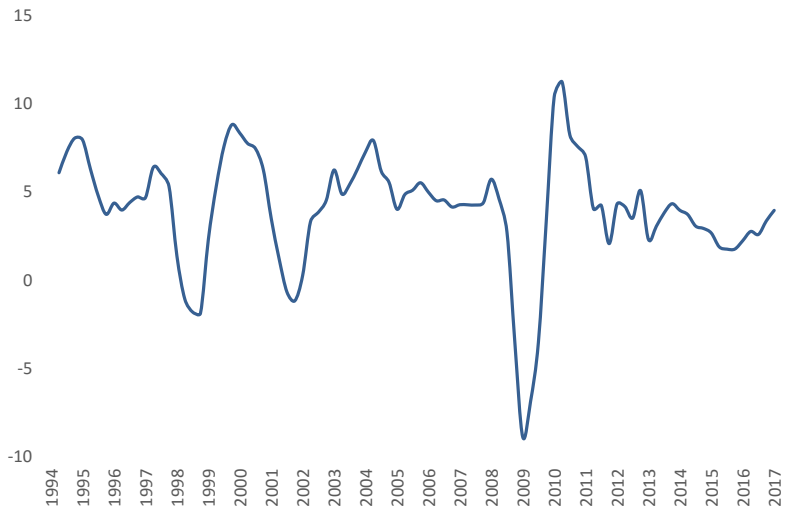
Our Preferred Proxy for Shipping Services Demand is …

… the **Global Seaborne Trade** growth, which reflects the dynamics on aggregate trade flows of major commodity shipments. As already mentioned, seaborne trade momentum exhibits substantial volatility around its long-term average with substantial declines in times of global economic slowdowns such as the Asian crisis of '97-'98, the Dotcom bubble, the Sept/11 terrorist attacks in 2001 and the Global Financial Crisis in 2008-2009.

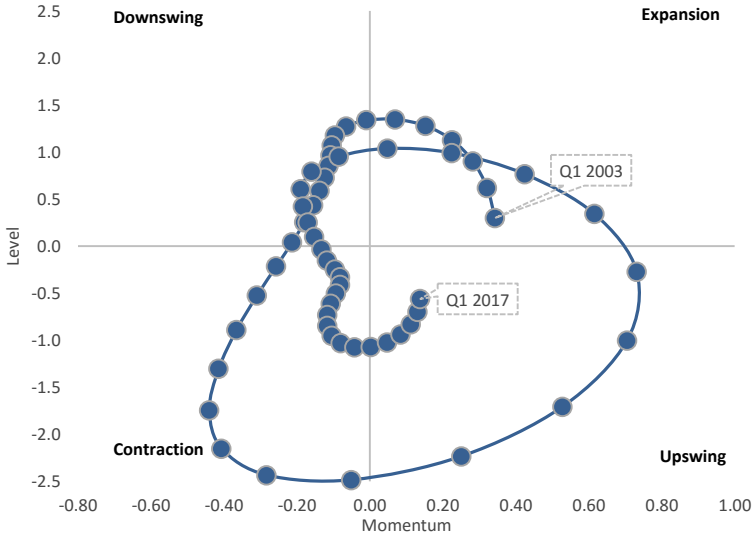
More information can be extracted by decomposing the index in four phases, namely an **expansion phase** with above average levels and positive momentum; a **downswing phase** with above average levels but negative momentum; a **contraction phase** with below average levels and negative momentum; and an **upswing phase** with below average levels but positive momentum.

Currently, in full accordance with the rest of our indicators, our demand proxy lies in the "upswing" phase.

Shipping Demand Index



Demand Tracer

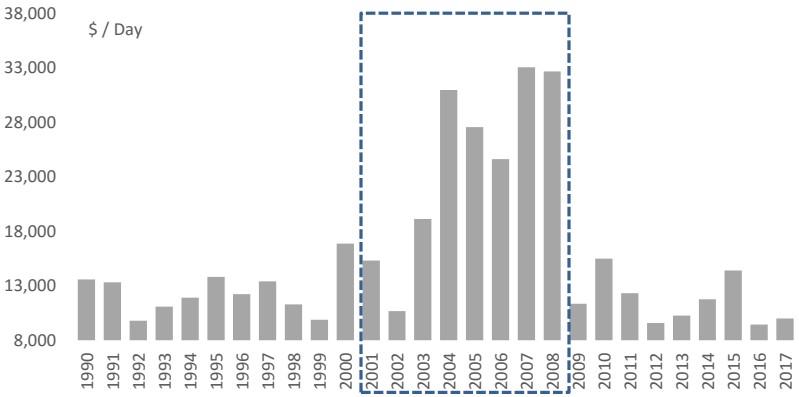


Source: Piraeus Bank Research, Clarksons Shipping Intelligence Network

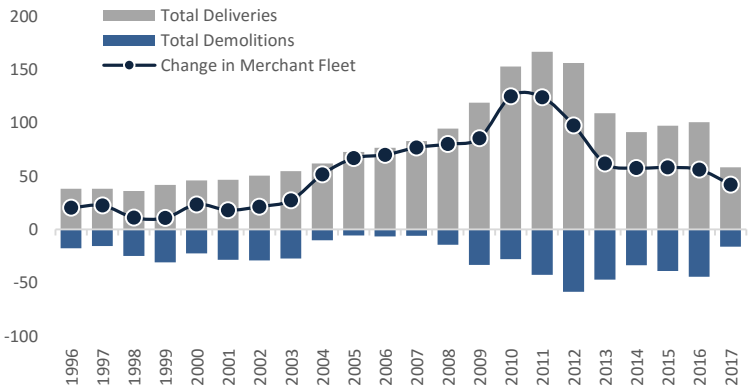
AT THE SAME TIME …

… a number of factors that could signal a pickup in the availability of shipping tonnage remain muted.

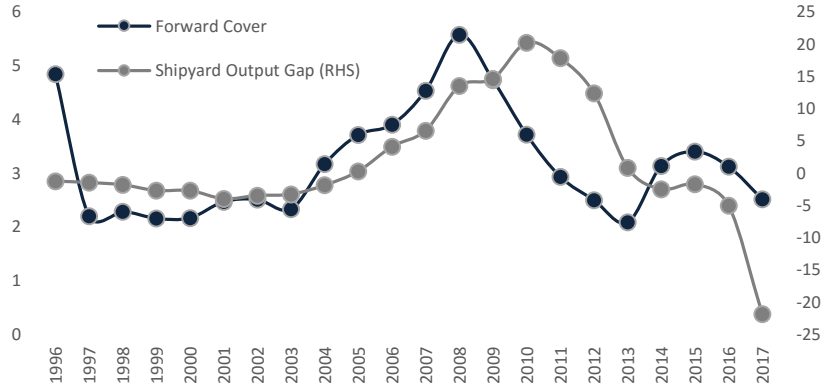
Post-crisis **Aggregate Earnings** ranged between 9,400-15,500 $/day …



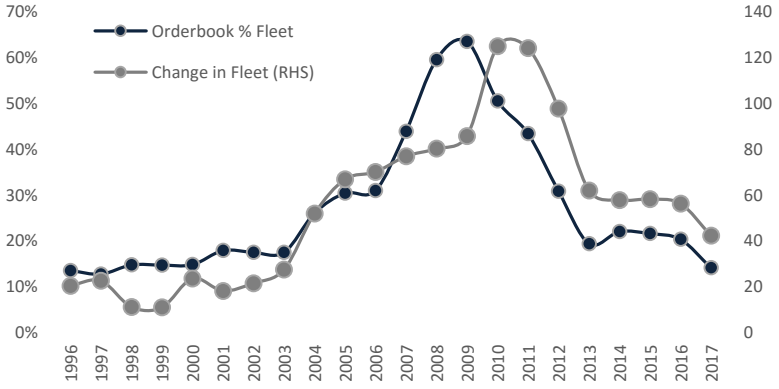
In Q1 2017, **Total Ship Deliveries** were 2.54 million dwt lower compared to the same quarter of the previous year …



Shipyard Capacity remains low increasing ship owners' negotiating power…



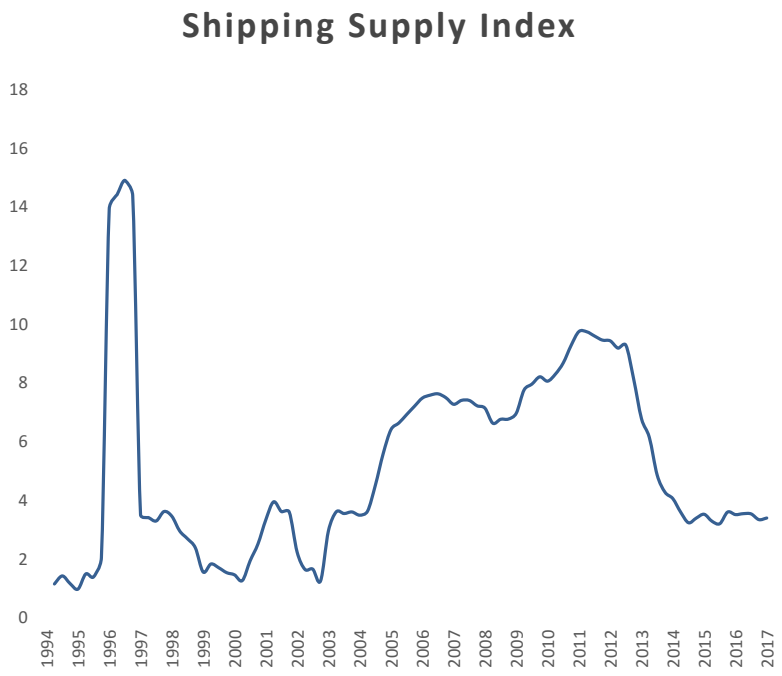
Ordering in 2017 is significantly lower and is anticipated to decline further in the following years…

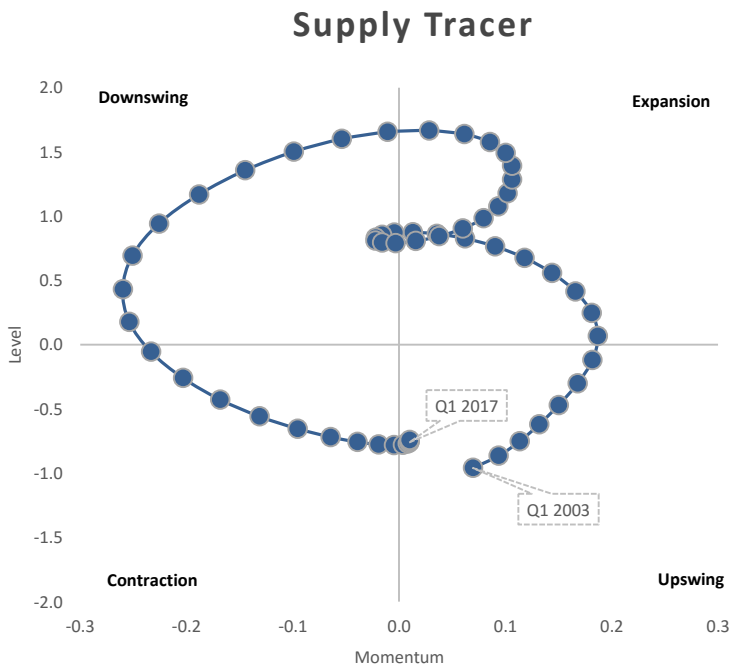


Source: Piraeus Bank Research, Clarksons Shipping Intelligence Network

Our Preferred Proxy for Supply of Shipping Tonnage is …

… the **Merchant Fleet growth**, which is driven by new vessel deliveries minus demolitions and losses. Given the natural constraints that this variable is subject to, i.e. shipyard capacity for new deliveries, its volatility is much more constrained with a notable exception in the mid-90s. Decomposing our tonnage supply proxy into its 4 phases, signals that in Q1-2017 the proxy was still in the contraction phase of the cycle due to the significant decline in new-build ship deliveries.



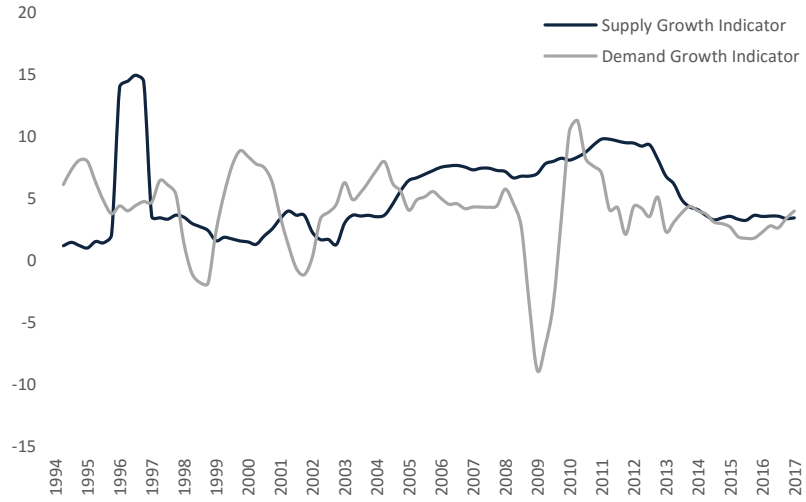


Source: Piraeus Bank Research, Clarksons Shipping Intelligence Network

Putting Everything Together: The Shipping Imbalance Index

- Shipping cycles are defined by five interrelated markets: the commodity market, the secondhand market, the shipbuilding market, the demolition market and the funding market. Interaction among those five markets contributes to the evolution of aggregate demand and supply in the shipping sector. Constructing a model that takes into account all the interactions and features of each market is a non-trivial task. Instead, we model shipping market cycles by focusing only in two aggregate indicators of supply and demand proxied by merchant fleet and seaborne trade growth rates respectively.
- Having already identified a demand and supply proxy it is natural to proceed to the approximation of the shipping sector business cycle as the gap between these new variables depicted by our Shipping Imbalance Index. Given that the demand and supply proxies are expressed in % rates of change, the Shipping Imbalance Index does not detect imbalances between the current stock of available shipping tonnage and the level of seaborne trade, but rather approximates more closely the trending behaviour of those quantities. In that way it provides a forward-looking measure of the anticipated imbalances in the shipping sector.
- After 6 years of excess supply in the shipping market, stronger seaborne trade growth in Q1 2017 signals a momentum reversal in the balance in the maritime sector. More specifically, supply momentum stabilized at 3.4% per annum while seaborne trade growth picked up in 2016 and reached 3.9% in Q1 2017 on a YoY basis.

Shipping Supply & Demand Indicators



Shipping Imbalance Index

Source: Piraeus Bank Research, Clarksons Shipping Intelligence Network

Shipping Sector Structural Model: Estimation & Forecasting

In order to forecast the new-build and second-hand ship prices we developed a simple structural model for the aggregate shipping market. The forecasting process can be split into the following 4 stages:

1. First, we create a separate model for both Demand and Supply proxies. We express demand as a function of global GDP growth and oil prices as well as an ARMA(2,1) specification. In parallel, we express supply as a function of orderbook size (with a 2-year lag) and an ARIMA (4,1,2) term.

2. We express the price of second-hand ships as a function of the Shipping Imbalance Index, assuming that the second-hand market is the first to adjust to departures from an equilibrium level.

3. We proceed to modeling the price of new-build ships as a function of the imbalance index in conjunction with the prices of second-hand ships, the USD exchange rate and an AR(1) term.

4. We use the equations in steps 1 & 2 to generate 3-year forecasts for the explanatory variables which in turn are used as inputs in our second-hand and new-build price models to generate forecasts over a 3-year horizon.

Aggregate Shipping Model Outline

Demand
$D_t = f(GDP_{t-1}, Oil_t, D_{t-l})$

Supply
$S_t = f(Obk_{t-8}, S_{t-l})$

Shipping Imbalance Index
$Imb_t = S_t - D_t$

Secondhand Market
$SH_t = f(Imb_t, SH_{t-l})$

Newbuilding Market
$NB_t = f(Imb_t, Dollar_t, SH_t, NB_{t-l})$

Where:

D_t: World Trade Growth
S_t: Fleet Development
Obk_t: Orderbook
Imb_t: Shipping Imbalance Index
GDP_t: World Real Output Growth
Oil_t: Oil Price Growth
$Dollar_t$: Trade Weighted Dollar Rate
SH_t: Secondhand Prices Growth
NB_t: Newbuilding Prices Growth
l: Number of Lags for Dynamic Model

Aggregate Shipping Model Findings

Demand Growth Model

$$D_t = \beta_{D,0} + \beta_{D,1} * GDP_{t-1} + \beta_{D,2} * Oil_t + \text{ARMA terms} + \varepsilon_{D,t}$$

Supply Growth Model

$$S_t = \beta_{S,0} + \beta_{S,1} * Obk_{t-8} + \text{ARMA terms} + \varepsilon_{S,t}$$

Secondhand Market Model

$$SH_t = \beta_{SH,0} + \beta_{SH,1} * Imb_t + \text{ARMA terms} + \varepsilon_{SH,t}$$

Newbuilding Market Model

$$NB_t = \beta_{NB,0} + \beta_{NB,1} * Dollar_t + \beta_{NB,2} * Imb_t + \beta_{NB,3} * SH_t + \beta_{NB,4} * NB_{t-1} + \varepsilon_{NB,t}$$

Model Estimates

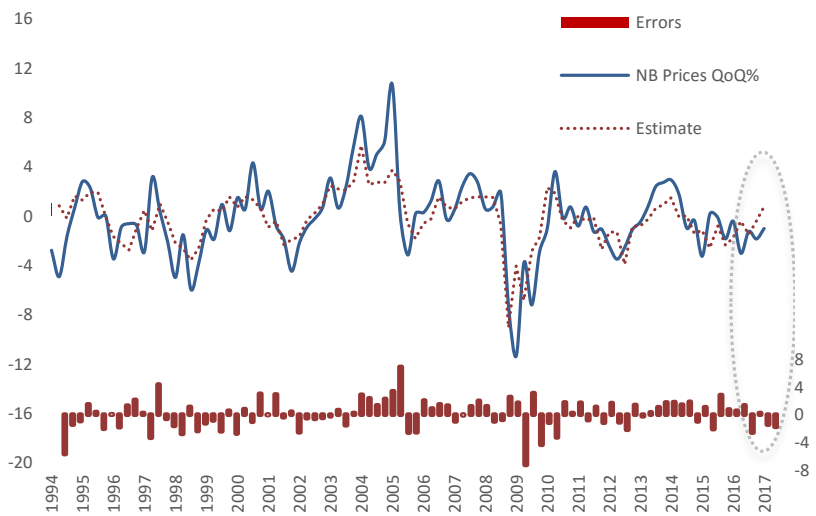
	Dependent Variables			
Explanatory Variables	D_t	S_t	SH_t	NB_t
GDP_{t-1}	0.26			
	(2.36)			
Oil_t	0.05			
	(5.00)			
Obk_{t-8}		5.37		
		(1.61)		
Imb_t			-1.73	-0.17
			(3.39)	*(2.43)*
$Dollar_t$				-0.10
				(2.50)
SH_t				0.13
				(4.33)
NB_{t-1}				0.30
				(2.50)
$adj.R^2$	56%	42%	89%	54%

- The MA and AR order in each ARMA model is chosen through the use of the AIC, BIC and Root Mean Squared Error (RMSE) criteria.
- In the supply model the order of integration is chosen after we check for unit roots using the Augmented Dickey Fuller and Phillips-Perron tests.
- t-statistics robust to autocorrelation and heteroscedasticity are reported in parenthesis under each coefficient and are computed using the HAC estimator.

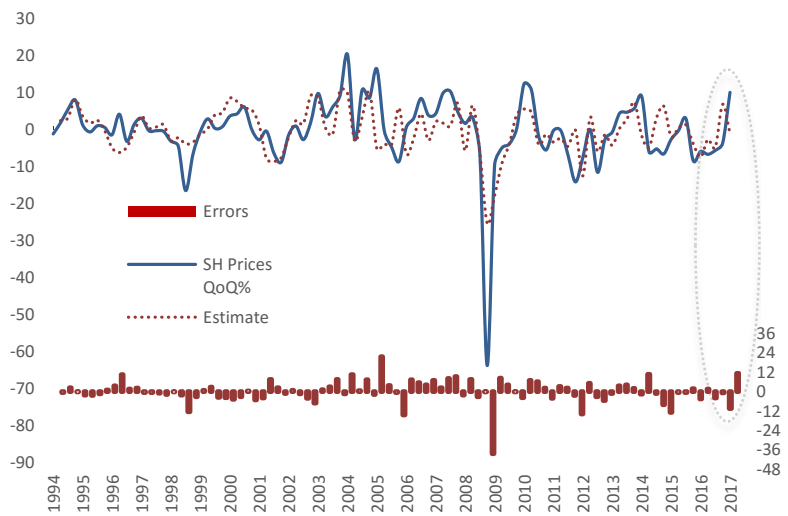
Model Fit for Newbuild and Secondhand Prices

- The model seems to fit the actual ship price evolution reasonably well with adjusted R squared coefficients above 50% of total variation in new-build and second-hand prices respectively. Moreover, the coefficient estimates in each series have the anticipated sign. In particular, both shipping price indices are negatively correlated with the imbalance index, with second-hand prices being relatively more sensitive to market disequilibrium. In addition, the dollar's value is negatively related to new-build prices as a dollar appreciation gives flexibility to shipyards to adjust their pricing policy on new-build contracts.
- According to the model, current conditions in the shipping sector render actual new-build price growth undervalued relative to its "fair" estimate. On the contrary, the abrupt increase in actual second-hand prices in the first quarter of 2017 is higher compared to the growth rate that would be proper according to the model.

Newbuild Prices Model Fit



Secondhand Prices Model Fit

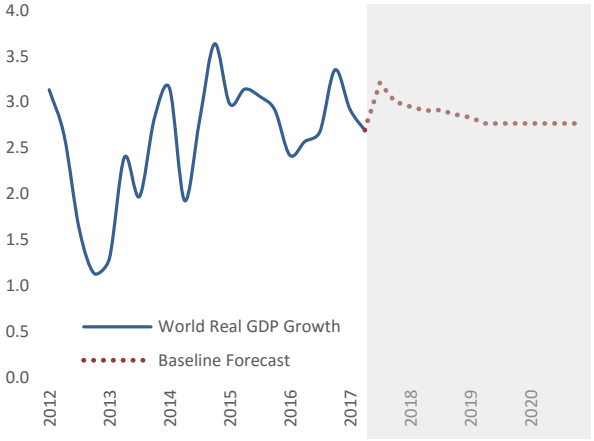


Source: Piraeus Bank Research, Clarksons Shipping Intelligence Network

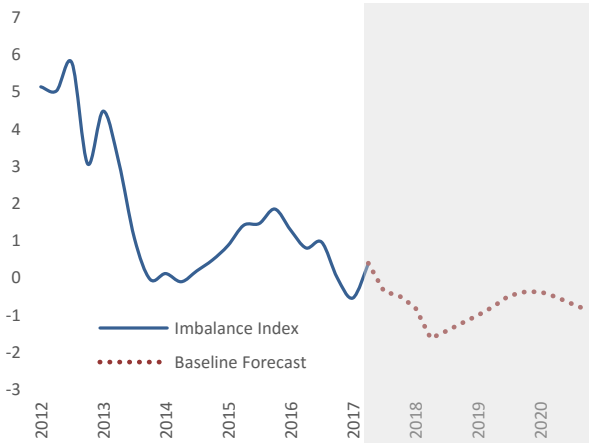
Baseline Scenario for 3-Year Forecasts

The baseline scenario is constructed upon the assumptions that:

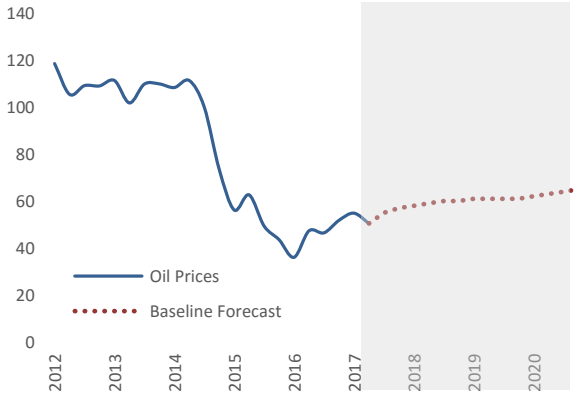
World real GDP growth accelerates in 2017 and stabilizes after 2018…



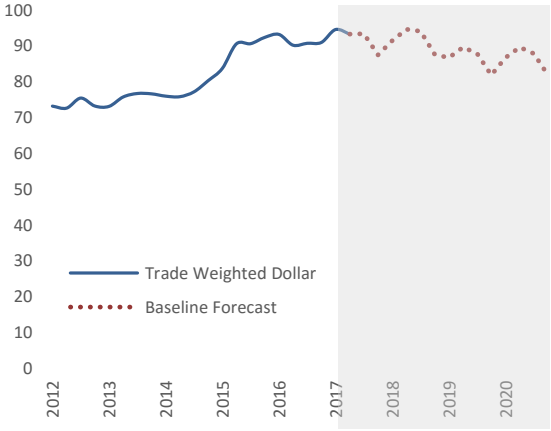
Excess demand increases over the next three years reaching a peak during 2018…



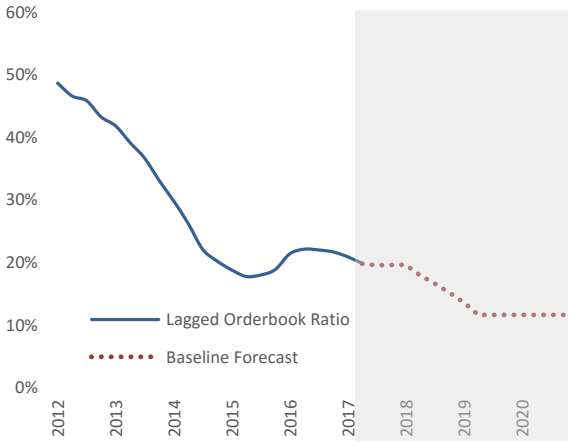
Oil prices follow a slow 3-Year path towards 65 $/bl…



Dollar depreciates by 13% over the next 3 years…



Orderbook will remain depressed at 12% of merchant fleet…



Source: Piraeus Bank Research, Clarksons Shipping Intelligence Network

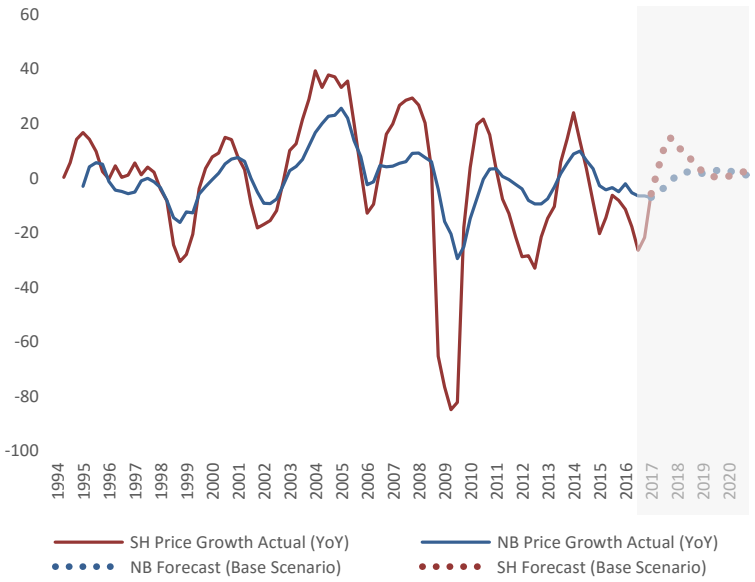
3 YEAR FORECAST – GRADUAL INCREASE OF PRICES

- The baseline scenario refers to a recovery in global output growth and therefore seaborne trade is expected to reverse the downward path of ship prices. Second-hand prices are expected to rise first in response to anticipated fleet shortages sector since the orderbook adjustment over the past years contributed to low capacity utilization of shipyards. New-build prices will gradually increase over the next three years, with their growth rate expected to reach a peak in 2019.
- Despite the fact that economic activity in the US, Europe and emerging markets started to gain momentum, this development is still associated with substantial downside risks around the global macroeconomic environment.

3-Year Projections under the Baseline Scenario

	2016	2017e	2018f	2019f	2020f
Newbuilding Prices (%)	-6.38	-1.42	1.62	3.16	0.88
Secondhand Prices (%)	-19.66	15.73	4.35	0.22	2.64
Trade Growth (%)	3.35	4.11	4.54	3.52	4.01
Fleet Growth (%)	3.34	3.61	3.32	3.13	3.15
Imbalance Index	-0.01	-0.50	-1.22	-0.39	-0.86

Shipping Prices Base Scenario Forecast



Source: Piraeus Bank Research, Clarksons Shipping Intelligence Network

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