Testing Speculative Bubble in Dry Bulk Freight rates: a multi-factor approach

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Abstract.

Dry bulk industry witnessed a boom and bust phase between 2005 and 2010. Aim of this work is to assess whether this pattern was driven by speculation or was a supply and demand outcome. In order to evaluate the presence of speculation, a global multi-factor risk model is implemented to estimate the long term (cointegration) relationship between freight rates and cargo prices. The empirical results obtained suggest that a speculative period took place in dry bulk industry between 2005 and 2011.

Keywords: *Dry Bulk Cargo, Freight Rates, Speculation*

Introduction

Dry bulk industry plays a pivotal role in international trade and is a remarkable example of earning driven market which attracts a well-diversified class of investors in particular due to the generous profits that are generated (Stopford, 2007). It has been claimed that dry bulk freight rates is the new commoditised asset class for global speculative investors and has experienced increasing level of attention from risk seekers to further diversify their portfolios (Geman, 2005). However, the boom and bust phase experienced by dry bulk freight rates between 2005 and 2010 has created a large debate regarding the presence of speculative behaviours in shipping markets.

As a matter of fact, shipping market is a particular type of commodity characterised by non-storability, seasonality and strong correlation to the performance of economic business cycle thus to the level of international merchandise trade. (Geman & William, 2012) This makes freight rates very dynamic, volatile and prone to boom and bust phases that sometimes assume the pattern of speculative bubbles (Binkley & Harrer, 1981).

As freight rates are the main source of earnings for maritime companies they play a pivotal role in signalling period of investments in shipping industry; in boom period, earnings are growing steadily and share prices of dry bulk listed company are at their maximum. The combination of these factors leads to the perfect economic environment for dry bulk company to gain access to credit and thus increasing their corporate leverage. When the freight market reaches its top and collapses, many maritime firms are not able to fulfil their credit obligation and file bankruptcy.

A fundamental concern is whether shipping market should be subject or not to speculation because of its pivotal role in the movement of international goods and being the life blood of international trade. In response to this situation, governments and policy makers have sought to identify causes, consequences and innovative ways to curtail speculation and its appalling consequences over the global economy. Therefore, there is the need to create a rational background and a methodology to evaluate whether speculative activities take place in dry bulk industry. Given this background, this work aims to investigate whether a speculative effect was present in the dry bulk shipping market between 2005 and 2009, creates a methodology to assess the presence of speculative activity in dry bulk freight rates and evaluate the extent to which these boom and bust periods influence the market dynamics. According to these objectives, the work is organised as follow: Section 2 introduces speculative bubble in the context of dry bulk freight rates and provide some preliminary analysis; Section 3 develops a global multi factor model to test speculation in dry bulk freight rates; Section 4 summarises the research results, draws conclusions and provide policy recommendations.

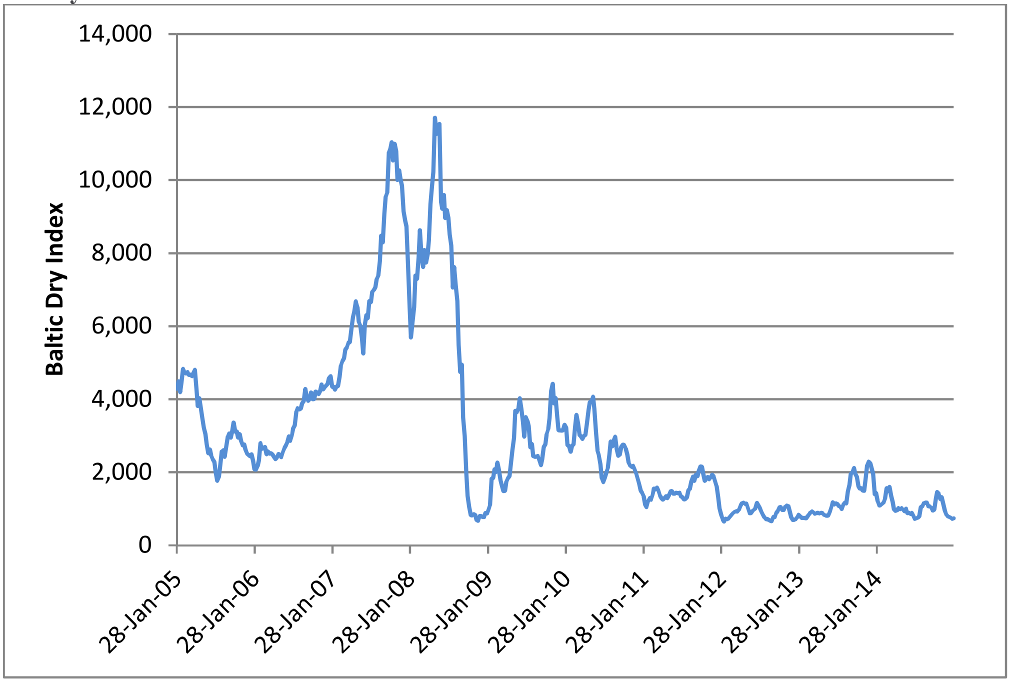
Identifying Dry Bulk Speculative Bubbles

A speculative bubble is a situation where asset prices are highly inflated and the value of assets is not correlated with the performance of their own fundamentals (Stiglitz, 1990) and is typically characterised by sharp increase in asset prices, credit expansions and irrational exuberance of investors (Akerlof & Shiller, 2009). The constant asset price increase instigates higher returns over the short-run, which in turn attracts a large number of investors. The growing number of investors put a pressure on prices which causes a strong increase in the general level of asset prices. In most cases, the bubble burst when becomes more difficult for borrower to refinance their short-term debt positions, creates number of defaults and generates a spectacular crash in the price of the securities (Minsky, 1986).

In most cases, an asset price bubble is followed by a spectacular crash in the price of the securities in question. The damage caused by the bursting of a bubble depends on the economic sectors involved, and also whether the extent of participation is widespread or localized. The bubble in its developing phase distorts the asset prices, creates inflation and influences the debt structure of market participants. In its bursting phase, the bubble generates several bankruptcies and defaults, generates financial instability and thus propagates into a major contraction of the business cycles. Given this background, studying formation and patterns of speculative bubble plays a remarkable role to achieve long term sustainable development.

This is particular true in the case of the shipping industry, the life blood of international trade is a very dynamic and volatile environment where freight rates can experience period of high inflation and unpredictable collapse. As Figure 1 shows, dry bulk freight rates are prone to periods of spikes, acceleration in the growth level of freight rates and contractions. For Geman (2009), this peculiar element is linked to the non-storability of the asset under investigation which tends to exacerbate fluctuations, peaks to through phases and volatility.

Figure 1. Baltic Dry Index

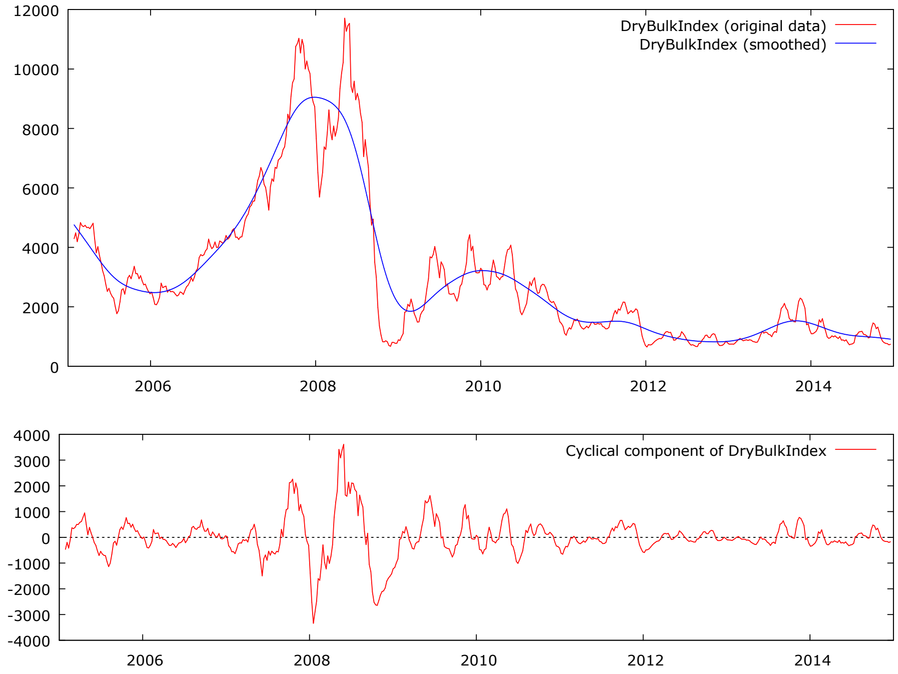


Nevertheless, it is between 2006 and 2009 that dry bulk index has experienced the largest fluctuations of the last two decades. In August 2005 the Baltic dry index traced its minimum low at 1,769 point and started a dramatic climb to the top reached 11,534 in June 2008. Over the span of these 3 years, the volatility of dry bulk index was very low: the average level was 0.36 ranging from a maximum of 0.54 to a minimum point of 0.29. As volatility can be considered an adamant index that reflects risk for investors, we observe that low volatility increased the appealing of freight rates as safe investment associated with high returns and low risk. This characteristic boosted the consumptions of freight rates and therefore has plumbed further the freight rates increase towards its maximum of the last two decades.

The month of June 2008 had been the main turning point for dry bulk industry and the impact of global crisis on international trade created the perfect storm to finally burst the bubble. In a matter of few months, dry bulk index plunged from 11,534 point to 772 point in January 2009. The drop in freight rates created a generalised panic in the shipping industry and this effect is well stated in volatility index for dry bulk freight rates; during this period of time, volatility peaked to its historical maximum over the last ten years with an average of 1.02 and a maximum of 1.3.

In order to provide a more sophisticated picture of the freight rate boom and bust cycle, we separate long term and the cyclical components in freight rate time series by using the methodology suggested in Hodrick and Prescott (1997). The Hodrick Prescott methodology is in the form of double-side moving average filter which is able to detect the long period trend and separate any transitional component in the form of cyclical, speculative and transitional effects. As Figure 2 shows, the Hodrick Prescott filter analysis depicts how the boom and bust between 2005 and 2009 was and exceptional period out of any other fluctuations of the last years.

Figure 2. Hodrick-Prescott filter application to Dry Bulk Index



According to the cyclical component plot shown in the second graph of Figure 2, it is possible to spot the exceptional peak to through phase between 2006 and 2008; furthermore, the graph emphasises the large fluctuations that has been generated after the boom period where a period of high volatility characterised freight markets between 2009 and mid-2010. The large fluctuations depicted in this figure are the noise and the large level of risk that was perceived by dry bulk market makers after the collapse of prices in June 2008.

Given this time line of the events, we separate the dry bulk boom and bust phase in two components: the "*boom*", ranging from August 2005 to June 2008 and the "*bust*" phase from June 2008 to February 2009. We collect weekly data of the Dry Bulk Index (Baltic Dry Index) from Thomson Reuter's database and we provide descriptive statistics of the two periods in Table 1.

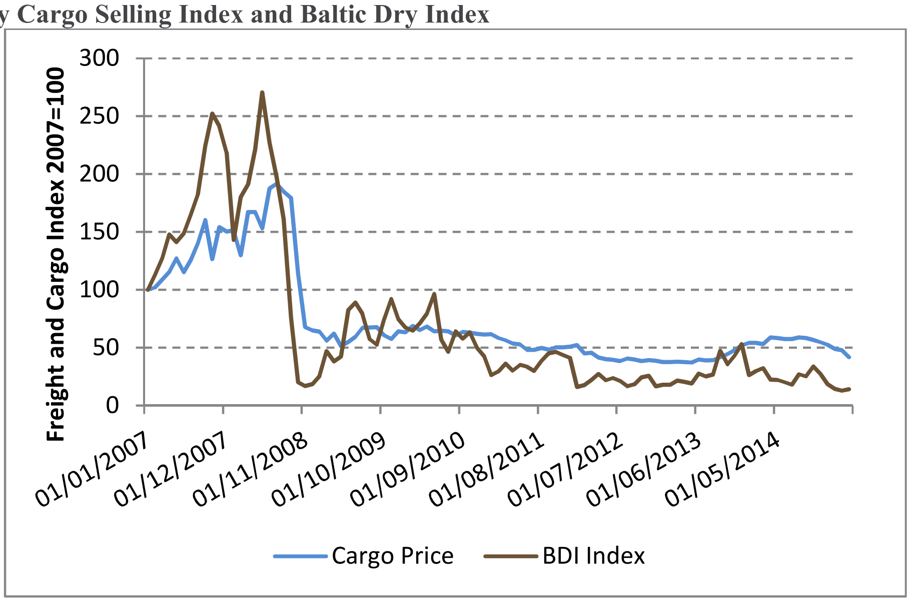
Table 1. The Boom and the Bust phase: descriptive statistics

	The Boom…	…and the Bust
Number of weeks	128	40
Mean	0.010387	-0.04656
Median	0.013332	-0.03558
Minimum	-0.20257	-0.41487
Maximum	0.183895	0.50169
Std. Dev.	0.061242	0.16997
C.V.	5.89626	3.65047

The first thing to notice is that the boom period is much more long lived than the bust: the dry bulk expansion lasted 128 weeks whereas the contraction phase only 40. In total, the boom period accounted for the 76% of the speculative cycle whereas the bust only for the 24%. This is common to many other speculative pattern where a prolonged period of positive returns is followed by a sudden steep decrease very short lived. The average return spanning over the boom phase was on average 10% on a weekly base with a standard deviation of 0.061. On the other hand, the return in the bust phase was on average -4% with volatility conspicuously higher around 0.17. The presence of a period of high returns and low risk followed by a period of negative return and high risk has been reported to be a first symptom of speculative cycles and in particular when extreme values takes place. This is a typical pattern in speculative periods: returns and asset prices change their normal development path toward an explosive dynamic growth which creates a wide spread investment exuberance which fulfils itself by attracting more investors thus further inflating asset prices.

Given to this preliminary background information, we specify a model which comprehensively evaluates the presence of speculative bubbles in dry bulk industry. We employ an extensive dataset which accounts for two key variables in the industry, namely the freight rates (Baltic Dry Index, "*BDI*") and the cost of purchasing a new cargo (Bulk Dry Cargo Selling Price Index).

Figur 3. Bulk Dry Cargo Selling Index and Baltic Dry Index



As shown in Figure 3, Dry Cargo Price Index and Baltic Dry Index have experienced large movements after 2007 however we emphasise a behavioural switch: between 2007 and 2008, BDI has grown at a faster rate in respect to Dry Cargo Prices whereas after 2010 BDI has witnessed a period where it couldn't trace back the pace of the Cargo Index.

In order to fully describe the relationships between the two indexes and verify if speculation occurred, we use an analytical model which is able to identify and separate the bubble component from the fundamental value of the asset. For this purposes, the econometric time series analysis provides some preliminary test to verify the presence of speculative pattern in asset pricing. According to Watson (1982), a speculative bubble is when the security price diverges from its own fundamental values. Examples come from stock prices and dividends (Flood & Hodrick, 1990), real estate prices and rent values (Cocconcelli & Medda, 2013), commodity prices and macro fundamentals (Du, et al., 2011). The common idea to all these studies is summarised into the view that the fundamental price of an asset (i.e. the cargo price) is given by the present value of the benefits stemming from the possession of the asset (i.e. the freight rate); in this instance, the model is specified in the following mathematical terms:

$$P_t = \frac{P_{t+n} + \sum_{i=1}^{n} f_i}{(1+r)^n} \tag{1}$$

Where:

P_t is the price for a new dry bulk cargo at time t;

P_{t+n} is future selling price after n-periods;

f_i is the freight rate or the premium accrued to the owner of the cargo;

r is the discount factor.

If we assume that the price of a dry bulk vessel is given by all the future expected revenues generated by the vessel itself (namely, the freight rates), under the assumption of risk neutrality and no arbitrage, we can rewrite the equation with the conditional expectation operator which provides the fundamental asset price of a dry bulk vessel as:

$$P_t = \frac{\mathbb{E}[P_{t+n} + \sum_{i=1}^{n} f_i]}{(1+r)^n} \tag{2}$$

The term $\{P_t - \mathbb{E}[P_{t+n}]\}/\,(1+r)^n$ converges to the fundamental price P^* and the relevant part of the equation becomes the discounted cash flow generated by the vessel:

$$P_t^* = \frac{\sum_{i=1}^{n} f_i}{(1+r)^n} \tag{3}$$

According to this specification, a speculative price is the situation in which the fundamental cargo price diverges from the underlying freight rate and thus is inflated by a bubble component such as:

$$P_t = P_t^* + B_{t+n} \tag{4}$$

Given this specification, the term B_{t+n} represents the speculative bubble component, or the speculative gain which the cargo owner expects to receive by reselling the asset at time-$t + n$. If freight rates experience speculative periods, Equation (4) requires that the rational ship-owner, willing to invest in a brand new cargo, expects the speculative price to grow at a rate that equals the interest rate r. If this is the case and if B_t is strictly positive, speculative investors find the possibility to invest and capitalise future profits: the rational ship-owner invests in an "overpriced" cargo since believes that the future price increases will sufficiently compensate for the today's extra payment B_t. If the bubble component constitutes a large part of the price, then the expectation that it will increase at rate r means that investors expect price increases that are unrelated to changes in fundamentals. If enough investors have this expectation and buy shares, the stock price will indeed go up and complete a loop of a self-fulfilling prophecy. Since the fundamental value is not observed, assumptions have to be imposed to characterize the time series properties of the fundamental price P_t^*.

A convenient – and nevertheless empirically plausible – assumption is that freight rates follow a random walk with drift. Diba and Grossman (1988) argue as follows: in the absence of bubbles observed prices are equal to fundamental prices and are hence integrated of the same order as dividend. As suggested in Bhargava (1986), it is possible to verify the switch from stationary to explosive path by testing the parameter associated to the first lag of an AR(1) model (Bhargava, 1986)

Therefore, to preliminary test speculative behaviours, we specify the autoregressive model "AR(1)" as following:

$$Fr_t = \rho Fr_{t-1} + \varepsilon_t \tag{5}$$

Where Fr_t represents the level of Freight rates at time-t, Fr_{t-1} is the first lag and ε_t is the white noise component of the model with $\mathbb{E}[\mathcal{E}] = 0$ and variance $\mathbb{E}[\mathcal{E}^2] = \sigma^2$. Following Bhargava, we test whether ρ assumes values larger than 1 The model is specified without the constant because the parameter did not result significant to preliminary tests and this result is in line with other studies applied on high frequency data (for a review see: (Homm & Breitung, 2010)).

Additionally, in order to further evaluate the presence of significant differences between the dry bulk speculative periods, we divide our dataset in three sub-sample: during, after speculative bubble effect and full sample (according to the aforementioned event timeline). Then, we perform a stationarity test (augmented Dickey–Fuller test, ADF) over the three periods under scrutiny. The basic idea of the test is to assess whether or not the three samples experience different degrees of persistency, autocorrelation and changes in memory of the time series.

Table 2. ADF test of bubble, post bubble and full sample datasets

ADF Test	During	After	Full Sample
Tau	-4.82307	-1.69839	-2.22371
Asymptotic P-Value	1.73E-06	0.08506	0.02523

The ADF tests confirms that there has been a substantial change in the test and in particular the results of Table 2 show that during the peak to trough phase the hypothesis of stationarity is not confirmed. The coefficient tau has an associated asymptotic p-value that rejects the hypothesis of stationarity whereas in the "*full sample*" and "*after*" sample we cannot draw the same conclusions from the statistic. Finally, we emphasise that the "*during*" sample has registered the highest level of non-stationarity in the time series: following the literature mainstream, a first evidence of speculative cycle is present in dry bulk freight rates.

Freight rates speculative bubble testing: an extension based on global factor risk modelling

We corroborate our finding of the existence of a speculative bubble obtained by the ADF test by applying the cointegration test. In this case we examine whether there is a long-term relationship between cargo price and freight rates in order to verify the existence of the speculation in the dry bulk industry. Following the relationship stated in Equation (4), if the test outcome confirms no cointegration between freight rates and cargo prices it mean that the bubble component is priced in the asset price of a new built vessel. In fact, the cointegration analysis tests for long-term relationship among the variables and shows whether two variables share a common stochastic trend: in econometric terms, we expect that if the speculative bubble affects prices it disrupts the long-term relationship between fundamental and underlying prices (Engle & Granger, 1987).

However, a shift in the level of the Data Generating Process (DGP) must be taken into account when testing for a unit root because this effect might create biased estimations of the parameter of interest. In fact, it has been argued that if a speculative bubble exists, the variance of prices is greater than the variance of fundamental prices (LeRoy 1989; Shiller 1992). Originally conceived as a test on rational market hypothesis, these speculative tests aim to verify whether the observable asset price is the expectation of the unobservable fundamental price conditional on the available information and thus it constitutes an optimal forecast for f_t. It follows that under the null hypothesis of no bubbles the variance of the fundamental price sets an upper bound to the variability of the actual asset price thus variance bounds tests interpret an excess volatility as an indication for price bubbles. However, West (1988) points out that excess volatility may also be caused by variations in expected returns therefore the volatility tests suffer from a small sample bias.

In order to overcome this caveat, we implement a methodology which enables a direct control on variance and covariance changes on the variables under scrutiny and provides the unique opportunity to slice and dice the main risk components that contribute to the fluctuations of freight rates. Thanks to this flexible approach, we then use these estimations to derivate the variance/covariance matrix of the two variables under scrutiny and finally we use these estimations to test Freight Rates and Cargo prices cointegration (Johansen, 1991).

For this purposes, we collect an extensive dataset of four major global indexes: Global Equity prices (MSCI World), Global Bond Prices (JP Morgan Global Bond Index), Global Commodity Prices Index (S&P - SPGSCI), Trade Weighted U.S. Dollar Index (USDTW). The time series spans from Jan-1990 to Jul-2015. This comprehensive modelling takes steps from the global risk modelling developed by MSCI Barra (MSCI Barra, 2007)(MSCI Barra, 2007) and assumes that these four key drivers of global economic activity can comprehensively describe the functioning of Dry Cargo Prices and Baltic Dry Freight Index (Stopford, 2007).

According to this specification, we first derive from a global multi-factor model the main trends between global factors and freight rates, coefficient estimations and residuals (Ng, et al., 1992). We then use this information to estimate variance, covariance and standard errors for the speculative testing between Baltic Dry Index (*BDI*) and Cargo Prices. The global multi-factor regression model can be analytically derived as follow:

$$Cargo\ Price_t = \alpha_t + \beta_1 JPMGBI_t + \beta_2 SPGSCI_t + \beta_3 MSCI_t + \beta_4 USDTW_t + \varepsilon_t \quad (6)$$

$$BDI_t = \alpha_t + \beta_1 JPMGBI_t + \beta_2 SPGSCI_t + \beta_3 MSCI_t + \beta_4 USDTW_t + \varepsilon_t \quad (7)$$

The results of multi-factor regressions are listed in Table 4.

Table 3. Global Multi-Factor Regression: Cargo Price and Freight Rates

PRICE	Coeff.	Std. Error	Pr(>|t|)		FREIGHT	Coeff.	Std. Error	Pr(>|t|)
JPMGBI	-3.353	0.625	0.000		JPMGBI	-1.469	1.933	0.249
SPGSCI	0.007	0.185	0.969		SPGSCI	1.010	0.571	0.080
MSCI	0.438	0.250	0.063		MSCI	0.026	0.775	0.674
USDTW	-1.590	0.964	0.083		USDTW	-3.930	2.982	0.091
R.S.Error	0.091	R2	0.55		R.S. Error	0.181	R2	0.40

Before entering in the core aspect of this analysis, we emphasise some important outcome of the global multi-factor modelling; first, interesting to notice, both cargo prices and freight rates are negatively affected by the performance of global bonds. This result is in line with our expectations: an increase in borrowing costs leads to a better performance for the index itself while restrict the access to credit and therefore reduces the cost of cargoes, generally, long term investment financed by debt.

Furthermore, interesting to notice the commodity behaviour has no significant impact on the cargo price performance whereas it has a large and significant impact on the level of freight rates.

The vector containing beta coefficients (β) derived in the previous estimations is now used to derive the estimated variance-covariance matrix for the Dry Bulk Freight Index (Zivot, 2015):

$$\boldsymbol{\hat{\sigma}} = \boldsymbol{\beta}\,\boldsymbol{\Omega}\,\boldsymbol{\beta}' + \boldsymbol{D}$$

Where:

$\boldsymbol{\hat{\sigma}}$ is the variance matrix estimated for cargo prices / freight rates;

$\boldsymbol{\beta}$ is the vector containing the multi-factor regression coefficient for cargo prices / freight rates;

$\boldsymbol{\Omega}$ is the factors covariance matrix;

$\boldsymbol{D}$ is a diagonal matrix of the residual variance from the regression.

Applying this methodology to derive the variance and covariance for the dry bulk and the cargo prices allows us to: first, understand main sources of systematic risk generated from shifts in underlying global factors; second, equalise specific marginal risk contribution arising in the two instances under examinations; third, mitigate for unexpected short-term changes in the underlying markets (cargoes and freight) thus reducing structural variations in the level of volatility.

As suggested in Maillard et al. (2009), we can derive and equalise the marginal risk contributions for each factor included in our analysis as following (Maillard, et al., 2009):

$$\sigma_{Index} = \frac{\partial \sigma_{factor}}{\partial w} \tag{8}$$

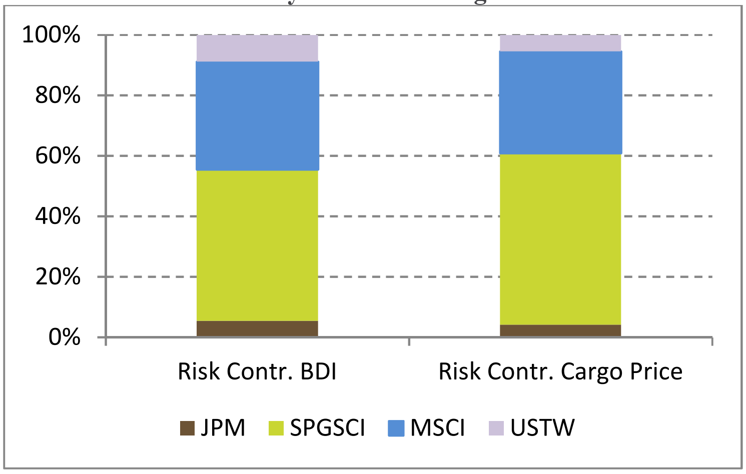
Where:

σ is the standard deviation;

w is the weight derived by the estimations of beta from the multi-factor regression.

The marginal risk contributions for BDI freight index and Dry Cargo Price index is the first derivative of its variability in respect to its weight. A summary visualisation of marginal risk contribution for BDI and cargo Price is provided in Figure 4.

Figure 4: Marginal Risk Contributions: Baltic Dry Index and Cargo Price Index



As Figure 4 shows, by approaching these types of estimations we can attribute to each factor similar variability contributions: although there are some small differences, the factors contribute with the same proportion to the final total variations in both BDI and Cargo Prices. We notice that under this framework, the main risk contributions are provided by Commodity Prices and Equity Market exposures: this is probably the result of a larger variability is stock prices and a commodity prices dynamic which has been on a roller coaster in the past 10 years.

Having estimated the variance covariance matrix for both Freight Rates and Cargo Prices, we can now finally estimate the cointegration parameters by using the general estimation framework provided in Johansen (1995); doing so, combines in a flexible context the global multi-factor results with a testing of cointegration parameters for the two variables under scrutiny without losing any important information due to volatility spikes and regime switches in the variable under scrutiny.

Following Engle and Granger (1987), we test Dry Cargo Prices and freight rates for the cointegration at 5% level of significance. We obtain that we cannot reject the null hypothesis of cointegration between cargo prices and freight rates, thus confirming a difference between the asset price and the economic fundamentals (Table 3)

Table 4. Bivariate cointegration results: Cargo Price vs Freight Rate

Cointegrating Regression				
Cargo Price	Coef.	Std. Error	T-ratio	P-Val.
BDI	0.00069	0.0353	0.0195	0.98
Akaike Criterion	165.62	Durbin-Watson		1.72

These results have a remarkable role for the aim of this paper: as Diba and Grossman (1988) argue, if the price of the asset depends only on future revenues that self generates (i.e. dividends, rents, freight rates) and if there are no rational speculative bubbles then if the revenues are stationary the same should be for the price of the asset. According to this view, the cointegration test should return a significant cointegration test between freight rates and cargo price: in this light we can confirm that speculation affected the dry bulk market between 2005 and 2010.

Table 5. Cointegration results

Cointegration tests					
Rank	*Eigenvalue*	*Trace Test*	*P-Val*	*Lmax Test*	*P-Val*
0	0.18504	24.882	[0.0002]	17.597	[0.0027]
1	0.081222	7.2851	[0.0074]	7.2851	[0.0082]
Corrected for sample size			**Beta (cointegrating vectors)**		
Rank	*Trace Test*	*P-value*	*CARGO*	47.564	-25.512
0	24.882	[0.0002]	*BDI*	-33.269	-7.6562
1	7.2851	[0.0079]			

Table 5 provides the test results for both ranks of coefficient matrix: the Eigenvalue test and Rank Trace test. These results corroborate the findings of former section however it is further emphasised that the two Indexes are not cointegrated for the long run relationship test (see Trace Test, Table 5). Cargo Index and BDI time series show no evidence of cointegration thus we can confirm our initial hypothesis that freight rates and cargo prices do not share a common behaviour and therefore a bubble exist.

Back-testing

In order to back-test the coefficient estimations used to derive variances and covariance matrix, a rolling window analysis of 48 periods is applied to Equation (7). The estimations generated by this model provide three important pictures: first, the sensitivity of coefficients; second, time varying patterns; and third, a comparison between the full sample estimations and the rolling regression estimation distributions. According to these goals, the global multi-factor model is re-written as following:

$$BDI_{t:t-48} = \alpha_{t:t-48} + \beta_1 JPMGBI_{t:t-48} + \beta_2 SPGSCI_{t:t-48} + \beta_3 MSCI_{t:t-48} + \beta_4 USDTW_{t:t-48} + \varepsilon_{t:t-48} \quad (9)$$

Where the term (*t:t-48*) represents the rolling window applied in our testing. We assume that this model explains the general level of freight rates in dry bulk industry since these four variables represent accurately the global economic activity. Given this assumption, we run a multifactor regression on a first on rolling window of 48 months and second on a static full sample selection. This analysis identifies if any particular factor change has happened in the period spanning between 1993 and 2015 and it is particularly useful to evaluate any unusual pattern through the speculative period.

Figure 5. Static and Rolling Correlation: Dry Bulk Freight Index vs Global Factors

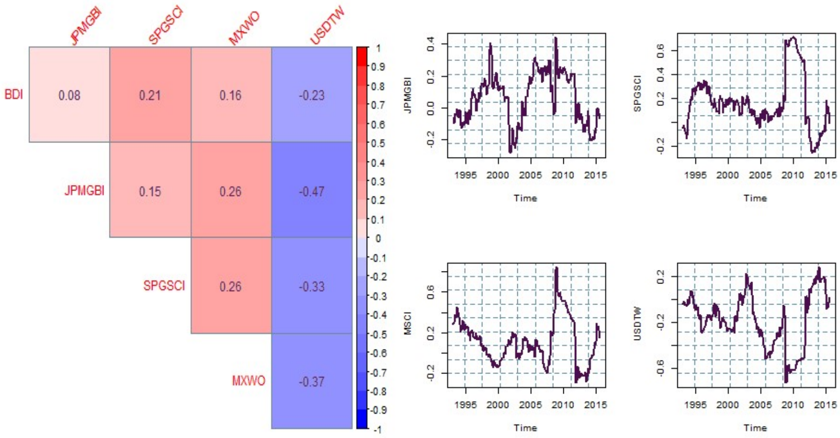
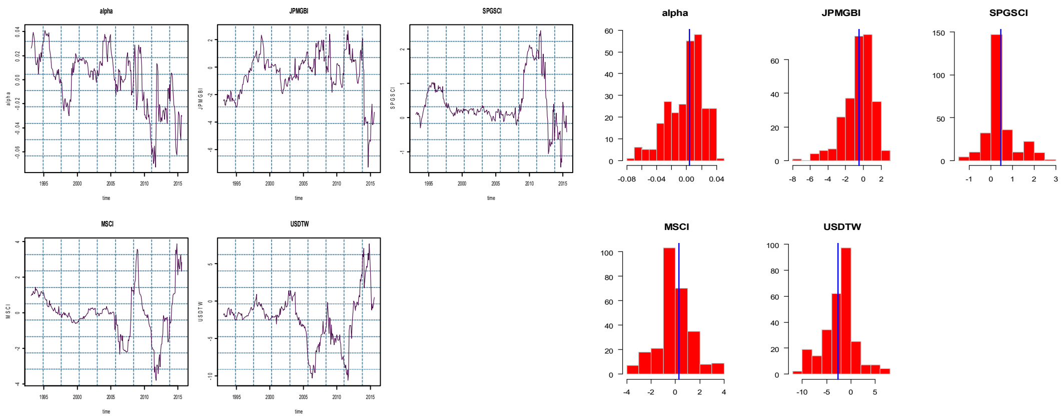


Figure 5 depicts a preliminary analysis of correlations between dry bulk freight index and global factors: what appears immediately interesting is the behaviour of correlation between 2005 and 2010. While some of these correlation coefficients suddenly drops (USDTW and JPMGBI) others spikes and what is in particular interesting is the Commodity Global Index (SPGSCI) which from a low correlation of 0.2 in 2006 leaped to a correlation of 0.8 in 2008.

This large change (0.6) and the steepening of the correlation coefficient is further enlightened in the multivariate modelling. Figure 6 shows the results of the rolling window multi-factor regression model against Baltic Dry Index. On the left hand side it shows the coefficient behaviours whereas on the right hand side it presents the graphical distribution for each coefficient and compares to the static regression coefficient (blue vertical line) used before to estimate the covariance matrix.

Figure 6. Multi-Variate Regression: Dry Bulk Freight index vs Global Factors



Based on these results, we can argue that freight rates dynamics were particularly under pressure between 2005 and 2010. In particular we verify that there is a consistent time-varying and regime switching across the global factors: to some degree, the model is well balanced before the boom and bust period and an important component is linked to the global performance of bonds (JPGBI). However, this relationship weakness between 2005 and early 2011 suggesting that major forces were driving the level of freight rates apart from the debt market trends. As Figure 4 shows, equities (MSCI) and commodities (SPGSCI) become the main factors driving freight rates patterns and this suggests compelling patterns in directionality for the dry bulk market: equity oriented risk factors explain a more aggressive and rather volatile market place where sudden spikes and momentum changes might turn the level of freight rates from booms to busts. Ultimately, the speculative period has created a more nervous market, vulnerable to reversals and stiffer shock absorption.

On the right hand side of Figure 6, we show the distribution of the parameters for the global multi-factor modelling; the blue vertical line indicates the parameter estimated by the full sample static model. Although dislocations in the coefficient estimations and a time varying effect are present, this figure shows that, the static full sample estimations provide a good broad picture of the underlying forces driving freight rates changes. Empirical evidence shows that most of the parameters estimated from the static model are on average cantered in the dynamic parameter estimations therefore we can use the static estimation to derive a variance and covariance matrix for the two main variables under investigation.

Conclusion

The boom and bust cycle experienced in dry bulk industry between 2005 and 2010 was the background of this work. Given this context, the main goal was to prove speculation in the dry bulk industry by testing the long term relationship between the asset price (i.e. Dry Bulk Cargo price) and its fundamental (i.e. the Baltic Dry Index). This objective was achieved by implementing a global multi-factor model which estimated the variance-covariance matrix to be tested for cointegration relationship. The global multi-factor model accounted for the main drivers of global economic growth: Equity, Bond, Commodity and Trade. The estimations were used to derive the variance covariance matrix and finalise a cointegration test following Johansen (1995).

The main results of this work are summarised as following: the Dry Bulk Cargo industry has experienced a large period of fluctuations; the cointegration test has shown that this boom and bust cycle in freight rates was driven by speculation; there has been a sudden shift in the main variables explaining the behaviour of dry bulk freight rates and among those the predominant is Commodity Prices.