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Global risk factors of NYSE- and NASDAQ-listed shipping companies' stock returns

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Abstract

Purpose – This paper aims to investigate the impact of global macro and other risk factors of the New York Stock Exchange (NYSE)- and National Association of Securities Dealers Automated Quotation (NASDAQ)-listed shipping companies' stock returns from January 2001 to December 2019.

Design/methodology/approach – The methodological design includes multi-factor regressions for individual companies, augmented versions of these regressions to examine the likely impact of additional factors and finally panel regressions to assess the impact risk factors on all companies simultaneously. Estimations are done via ordinary least squares and the generalized method of moments.

Findings – Multi-factor model results showed that some of the US-specific and global macro risk factors surfaced as statistically significant for most of the companies and appeared to exhibit a consistent pattern in the way they affected shipping stocks. Thus, these companies' exposures emanate mostly from the general US market's movements and to a lesser extent from other firm-specific factors. Second, from the results of panel specifications, this study observes that domestic risk factors such as unemployment, inflation rates and industrial production growth emerged as significant for the NYSE-listed companies. As regard, the NASDAQ-listed ones, it was found that Libor and the G20 inflation rate were also affecting their stock returns.

Research limitations/implications – Companies examined are listed only in the US's NYSE and NASDAQ. Hence, companies listed elsewhere were excluded. It may be concluded that these US exchange-listed companies abide mostly by domestic fundamentals and to some extent to selected global factors.

Practical implications – The significance of the findings in this study pertains to global investors and shipping companies' managers alike. Specifically, given the differential sensitivities of the shipping companies to various risk factors (and the global business cycle, in general), it is possible to view the shipping companies' stocks as a separate, alternate asset class in a global, well-diversified portfolio. Thus, such a broader portfolio would permit investors to earn positive returns and reduce overall risk. Managers of shipping companies would also benefit from the findings in this study in the sense that they should better understand the varying exposures of their companies to changing global and domestic macro conditions and successfully navigate their companies through business cycles.

Originality/value – Research on the global shipping industry has lagged behind and was mainly concentrated on the investigation of the sources of shipping finance and capital structure of shipping companies, investment and valuation, corporate governance and risk measurement and management. Empirical research on the potential micro and macro determinants of the stock returns of shipping companies, however, is scant. This paper fills the gap in the literature of identifying and evaluating the various macroeconomic, US and international risk, factors that affect shipping companies' stock returns in a highly financially integrated world.

Keywords Panel analysis, Shipping companies, Multi-factor models, Macro risk factors, Panel

Paper type Research paper

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1. Introduction

This paper investigates the impact of national and global macroeconomic risk factors such as inflation, stock markets, major economies' industrial productions, oil shocks, exchange rates and interest rate spreads, on the stock returns of all the shipping companies listed on the New York Stock Exchange (NYSE) and National Association of Securities Dealers Automated Quotation (NASDAQ). Early work on the potential determinants of stock returns was mostly done using the CAPM specification but later it was augmented with local macro and micro factors (Chen *et al.*, 1986; Chen and Jordan, 1993 and Fama and French, 2015). Over time, interest grew in examining the influences of stock returns at the global level, in view of the increasing pace of global market integration. However, research on the global shipping industry has lagged behind and was mainly concentrated on the investigation of the sources of shipping finance and capital structure of shipping companies, investment and valuation, corporate governance and risk measurement and management (Alexandridis *et al.*, 2018).

Grammenos and Marcoulis (1996), Poulakidas and Joutz (2009), Grammenos and Arkoulis (2002), Drobetz *et al.* (2010, 2016), El-Mashry *et al.* (2010) and Westgaard *et al.* (2017) found that factors such as inflation, industrial production, exchange rates, interest rates and oil prices were important for stock returns of global shipping companies. Kavussanos *et al.* (2002a, 2002b) investigated 38 international industries and found that various macroeconomic, global risk factors have had different impacts on industries as determined by their unique characteristics.

This paper fills the gap in the shipping industry literature of identifying and evaluating the various US and international macroeconomic risk factors that can potentially affect US shipping companies' stock returns. This paper is the first to examine all NYSE- and NASDAQ-listed shipping companies. Thus, one may derive insights particular to these companies and then compare/contrast them with global companies' sensitivities to global macro risks. Second, given that little work has been done on the impact of global inflation terms and credit spreads on shipping companies' stock returns, this paper empirically investigates their impact. The global nature of shipping companies necessitates the exploration of the influences of world inflation and global financing costs on their stock returns. Finally, this paper adds to the already scant literature on the subject by using multi-factor models and panel analyzes which could provide unique insights to all interested market agents in understanding the market and setting prudent policy policies.

The sample contains 60 shipping companies for the 2001–2019 period. Briefly, the findings show that some of the US and global macro risk factors have surfaced as significant for most of the companies and appeared to exhibit a consistent pattern in the way they affected shipping stocks. Thus, it may be inferred that these companies' exposures emanate mostly from the general US market's movements and to a lesser extent from other factors (such as own financial factors). The examination of the various risk factors of the global shipping industry yields important insights for shipping owners, managers, existing and prospective investors and policymakers. For example, prospective investors in the shipping industry should understand how shipping companies could alter their portfolio's risk-return profile when the shipping industry is viewed as a separate asset class in a well-diversified, global portfolio.

The paper is organized as follows. Section 2 contains the methodological designs of the study and the data sources. Section 3 contains some preliminary results, factor construction and model estimations and some robustness tests. Finally, Section 4 summarizes the findings of the study.

2. Methodology and data

2.1 Sample characteristics and data

Monthly data on 60 (41 NYSE- and 19 NASDAQ-listed) shipping companies' stock prices were collected, from January 2001 to December 2019, from *Bloomberg*. The raw variables are as follows: the stock prices for each of the companies, the US NYSE and NASDAQ stock market indices, the global benchmark stock market index Morgan Stanley Capital International (MSCI), the US consumer and commodity price indices, two major US dollar exchange rates, several industrial production indices, several US and global short- and long-term interest rates and the Clarksea index. These companies deal in various sectors such as tanker, energy, dry bulk, container, diversified and cruise. Table 1 displays these companies, their data periods, sector(s) and country of their headquarters.

Stock prices and all three market indices were converted into continuously compounded returns and then as excess returns, after subtracting the 3-month US Treasury bill. Variables such as a global commodity price index, the Brent and West Texas Intermediate (WTI) crude oil price indices, the trade-weighted US dollar indices for major currencies and goods and the industrial production indices for the US, G7, Europe and EMU were converted into log returns. Log returns of the consumer prices are inflation rates and rates of return of industrial production indices are industrial production growth rates. Some of these variables are then constructed into factors in Subsection 3.2.

Several interest rates, some short-term and some long-term were also collected. The short-term interest rates are the US 3-month Treasury bill (3 m T-bill) and the London interbank offered rate (Libor) both of which are used as proxies for the risk-free rate. The long-term interest rates are the 2-year US Treasury Note (T-note), the 10-year US Treasury Note (10 yr T-note), the AAA-rated and BAA-rated US corporate bond yields. With these rates, several spreads were constructed: two US term spreads (10-year T-note *minus* T-bill and 10-year T-note *minus* 2-year T-note) and two US credit spreads (BAA *minus* 10-year T-note and BAA *minus* AAA corporate bond yields). Finally, a measure of the shipping companies' freight rates is the Clarksea index. Variations in freight rates impact a firm's earnings, and thus stock prices (returns).

2.2 Econometric specifications

Typically, one begins with the simple CAPM (Sharpe, 1964 and Lintner, 1965) specified as follows:

$$\left(R_{it}-R_f\right) = \alpha_{it} + \beta_{it}\left(R_{mt}-R_f\right) + \varepsilon_{it} \qquad i = 1, \ldots, n \text{ and } t = 1, \ldots, T \tag{1}$$

where R_{it} is the actual return on the stock price of the company i in period t, R_f is the risk-free rate, R_{mt} is the actual return on the equity market portfolio in period t and ε_{it} is the error term (or the residual). Parameter α_{it} is the alpha of stock and implies that if the stock's price is fair its value would be zero, if it is undervalued its value would be positive and if overvalued it would be negative and parameter β_{it} is the beta of the stock and measures the sensitivity of the stock's returns to market movements (or the stock's systematic risk).

However, a more robust specification would be to augment it with additional factors, macro and financial, in assessing the various sensitivities of a shipping company's stock returns to such factors. Following Chen *et al.* (1986), a general model can be expressed as:

$$er_{it} = \alpha_{it} + \beta_{1t}emr_t + \beta_{2t}uip_t + \beta_{3t}cs_t + \beta_{4t}ucp_t + \beta_{5t}\Delta sf_t + \varepsilon_{it} \tag{2}$$

where er_{it} is a company's excess stock returns, emr_t is a market excess return ($R_m - R_f$), uip_t is the unexpected change in global industrial production, cs_t is a credit spread, ucp_t is the

NYSE-listed	Sample begins from	Sector	Country headquarters
Ardmore Shipping Corporation (ASC)	9/2013		Bermuda
Buckeye Partners Ltd (BPL)	1/2008	Diversified	USA
Brookfield Infrastructure Partners (BIP)	1/2001	Infrastructure network	USA
Carnival Corporation (CCL)	1/2001	Cruise	USA
SEACOR Holdings, Inc. (CKH)	1/2001	Marine services	USA
Costamare Inc. (CMRE)	11/2012	Containers	Greece
Danaos Corporation (DAC)	9/2006	Containers	Greece
DHT Holdings, Inc. (DHT)	11/2005	Tankers	Bermuda
Diana Shipping Inc. (DSX)	11/2005	Transport services	Greece
Dynagas LNG Partners (DLNG)	9/2013	Carriers	Monaco
Euronav NV (EURN)	1/2015	Transport services	Belgium
Frontline Ltd. (FRO)	1/2001	Tankers	Bermuda
GasLog LP. (GLOP)	5/2014	Carriers (LNG)	Monaco
Global Ship Lease, Inc. (GSL)	9/2008	Containers lessor	Marshall Islands
Huntington Ingalls Ind., Inc. (HII)	12/2010	Transport services	USA
Hoegh LNG Partners (HMLP)	5/2014	Carriers (LNG)	Monaco
Hornbeck Offshore Services (HOS)	2/2004	Transport services	USA
International Seaways, Inc. (INSW)	10/2016	General shipping	USA
Kenon Holdings Ltd. (KEN)	1/2015	Shipping services	Singapore
Kirby Corp. (KEX)	1/2001	Tankers and barges	USA
KNOT Offshore Partners (KNOP)	2/2013	Tankers	UK
Dorian LPG Ltd. (LPG)	4/2014	Carriers (LPG)	USA
Matson, Inc. (MATX)	1/2001	Shipping services	Hawaii
Marine Products Corp. (MPX)	1/2001	Boats	USA
Nordic American Tankers Ltd (NAT)	1/2001	Tankers	Bermuda
Navios Maritime Holdings Inc. (NM)	1/2005	Shipping and logistics	Greece
Navios Maritime Partners (NMM)	6/2007	Shipping and logistics	Greece
Navios Maritime Acquisitions Corp. (NNA)	6/2007	Transportation and bulk	Greece
Navigator Holdings Ltd. (NVGS)	1/2007	Transport gas	UK
Overseas Shipholding Group, Inc. (OSG)	1/2015	Energy transport services	USA
Royal Caribbean Cruises Ltd. (RCL)	1/2001	Cruise	USA
Scorpio Bulkers Inc. (SALT)	11/2013	Dry bulk	Monaco
Safe Bulkers, Inc. (SB)	3/2008	Dry bulk	Monaco
Ship Finance Int'l Ltd (SFL)	5/2004	Tankers, bulk and containers	Norway
Seaspan Corp. (SSW)	7/2005	Containers	Hong Kong
Tidewater Inc. (TDW)	1/2001	Petroleum services	USA
Teekay LNG LP (TGP)	5/2005	LNG services	Canada
Teekay Corp. (TK)	1/2001	Crude and LNG tankers	Bermuda
Teekay Tankers Ltd. (TNK)	12/2007	Tankers	Bermuda
Teekay Offshore LP (TOP)	12/2006	Marine and oil transport	Norway
Tsakos Energy Navig. Ltd (TNP)	1/2002	Energy transport services	Greece
NASDAQ-listed			
Capital Product Partners LP (CPLP)	2/2007	Carriers	Greece

(*continued*)

Table 1. NYSE- and NASDAQ-listed shipping companies

NYSE-listed	Sample begins from	Sector	Country headquarters
Diana Containerships Inc. (DCIX)	1/2011	Containers	Greece
DryShips Inc. (DRYS)	1/2005	Cargo and dry bulk	Greece/Marshall Islands
Eagle Bulk Shipping Inc. (EGLE)	5/2005	Bulk	USA
Euroseas Ltd. (ESEA)	11/2005	Containers	Greece
Globus Maritime Ltd. (GLBS)	1/2008	Dry bulk	Greece
Golar LNG Ltd. (GLNG)	6/2003	LNG transport	Bermuda
Golden Ocean Group Ltd. (GOGL)	1/2001	Dry bulk	Bermuda
Malibu Boats, Inc. (MBUU)	1/2014	Boats and general	USA
Genco Shipping and Trading Ltd. (GNK)	9/2013	Dry bulk	USA
MasterCraft Boat Holdings, Inc. (MCFT)	1/2015	Boats and general	USA
Norwegian Cruise Line Hold Ltd. (NCLH)	1/2013	Cruise	Norway
Odyssey Marine Exploration, Inc. (OMEX)	1/2001	Ship salvage	USA
Pangaea Logistics Solutions Ltd. (PANL)	10/2013	Maritime logistics and transport	USA
Pyxis Tankers Inc. (PXS)	5/2015	Tankers	Greece
Star Bulk Carriers Corp. (SBLK)	9/2007	Bulk	Greece
Seanergy Maritime Holdings Corp. (SHIP)	11/2007	Dry bulk	Greece
StealthGas, Inc. (GASS)	10/2005	LNG, LPG transport	Greece
TOP Ships Inc. (TOPS)	4/2004	Oil and chemical transport	Greece
EuroDry Ltd. (EDRY)	2018		
Grindrod Shipping Holdings Ltd. (GRIN)	2018		
Navios Maritime Containers LP (NMCI)	2018		
TORM plc (TRMD)	2018		

Table 1.

unanticipated change in global commodity prices, Δsf_t is a change in a shipping industry-specific factor and ε_{it} is the error term. We consider this as the benchmark multi-factor model.

A variation of a basic multi-factor model would be one, which would include specific factors such as the Fama and French (1993) three-factor model. The three factors were the excess market return, as described above, the High *minus* Low (HML) value premium on the book-to-market factor and the Small *minus* Big (SMB) premium on the size factor. The model is expressed below:

$$\left(R_i - R_f\right)_{i,t} = \alpha + \beta_{m,i}\left(R_m - R_f\right)_t + \beta_{HML,i} HML_t + \beta_{SMB,i} SMB_t + \varepsilon_{i,t} \quad (3)$$

where factors are as explained above for stock i at time t and $\varepsilon_{i,t}$ is the error term. Thus, the two extra factors are included in our multi-factor model estimation [1].

Fama and French (2015) extended their model above to include two more factors, profitability and investment, claiming that the five-factor model is superior to their original three-factor model. The measure of operating profitability, Robust *minus* Weak (RMW), is annual revenues minus the cost of goods sold, interest and other expenses during the previous fiscal year divided by the end book value of equity. The investment factor, Conservative *minus*

Aggressive (CMA), is calculated as the change in the book value of total assets from the beginning to the end of the previous period divided by the previous end book value of total assets. Finally, there is another factor, momentum (MOM), suggested by Carhart (1997) and refers to the cumulative return for the preceding 2–12 months. Naturally, many more factors such as other interest rate term spreads can be added to the above specifications. The idea is that common, global sources of risk may require a risk premium relative to internationally diversified risks. Ferson and Harvey (1994) found evidence that a number of common world-wide sources of risk in US and European stocks account for their variations.

Autocorrelation and/or heteroskedasticity are very likely to be present in time-series multi-factor models because of the nature of the stock returns. If that is the case, then ordinary least squares (OLS) would provide biased estimates. A solution to avoid violations of the *iid* error term is to apply generalized methods of moments (GMM) proposed by Hansen (1982). GMM uses the orthogonality conditions to allow for efficient estimation in the presence of an unknown form of heteroskedasticity.

Finally, we use an unbalanced panel specification to determine if all factors' explanatory power changed over time. The basic framework for this discussion is a regression model of the form:

$$y_{it} = \alpha + \beta\, x_{it} + \varepsilon_{it} \tag{4}$$

where y_{it} is the dependent variable, is the intercept term, β is a $k \times 1$ vector of parameters to be estimated on the explanatory variables and x_{it} is a $1 \times k$ vector of observations on the explanatory variables, $t = 1, \ldots, T$ and $i = 1, \ldots, K$. The simplest type of fixed effects models is to allow for an intercept in the regression model to differ cross-sectionally but not overtime, while all slope estimates are fixed both cross-sectionally and over time.

3. Empirical results

3.1 Preliminary statistics

Table 2 displays some descriptive statistics for each company's stock returns, from February 2001 to December 2019. First, more than half of the companies' stock returns were negative while the rest experienced positive average returns. This result was expected considering that the sample period includes the financial crisis subperiod and also because the shipping industry underwent serious financial problems due to lower freight rates, excess capacity, lower oil prices, etc. Second, the risk of these stocks varied considerably when one looks at their standard deviations. Third, almost all skewness values are negative implying a higher probability of extreme negative returns and all kurtosis values are all higher than 3 (the value for the normal distribution) suggesting that the likelihood of extreme values would be on either side of the mean at the expense of a smaller likelihood of moderate deviations. Finally, the Jarque–Bera (J-B) statistic for measuring the (non)normality of returns corroborates the above conclusions that all stock returns distributions deviate from normality.

Table 3 in three panels displays the listed companies' stock return correlations (in Panels A and B) and the other macro variables' correlations (Panel C). For the sake of space preservation, we only report the highest and lowest (positive and negative) correlations instead of the whole matrix. From the values, it appears that stock returns correlations have a great range of values, very low positive, high positive (reaching almost 70% between TGP and TOP, in the NYSE-listed group and 77% between GLBS and SBLK, in the NASDAQ-listed group) and many negative ones. This implies that not all companies have the same sensitivity to business cycles and do not move in tandem, even though they belong to the same (or similar) line of business. This is also verified by the mixed positive and

Company	Mean	SD	Skewness	Kurtosis	J-B	Obs.
NYSE-listed						
ASC	−0.127	10.781	−0.108	0.118	20.121*	81
BIP	1.804	7.550	0.640	15.879	58.890*	140
BPL	−0.160	5.554	0.150	4.321	10.591**	227
CCL	0.691	8.413	−0.561	1.367	89.239*	226
CKH	0.159	8.567	−1.312	11.802	79.678*	226
CMRE	0.605	10.902	−0.778	1.879	78.217*	106
DAC	−0.589	16.123	0.350	1.977	98.321*	168
DHT	−0.862	11.345	2.889	2.221	56.212*	168
DSX	0.221	13.332	0.723	3.667	67.321*	168
DLNG	−2.200	11.656	−0.231	3.456	23.321*	71
EURN	0.760	8.890	−0.123	2.671	34.432*	60
FRO	0.021	18.452	0.534	5.109	96.221*	199
GLOP	1.138	11.334	0.860	2.110	88.211*	91
GSL	1.567	22.346	6.456	5.136	78.561*	140
HMLP	0.335	7.467	−0.435	1.543	55.321*	71
HOS	−0.077	17.781	−0.177	1.789	45.167*	168
HII	1.889	7.198	0.125	1.542	66.211*	106
INSW	0.463	5.324	0.332	2.223	33.432*	60
KEN	1.443	15.554	−0.945	8.568	83.678*	60
KEX	0.234	7.546	−0.321	2.967	44.213*	60
KNOP	0.541	7.986	−0.483	3.756	23.332*	60
LPG	−0.665	12.667	0.201	2.367	15.445	66
MATX	0.265	9.054	−0.273	2.602	21.332*	60
MPX	1.188	10.665	−0.235	2.897	31.332*	60
NAT	0.128	12.013	−0.024	4.987	57.654*	226
NNA	−2.467	31.789	−0.397	13.345	81.661*	60
NM	−3.456	28.223	−0.753	17.456	66.789*	60
NMM	−2.456	29.667	−0.937	19.314	78.890*	60
NVGS	−0.467	13.671	−0.879	5.136	21.321*	60
OSG	−3.632	29.546	1.013	18.561	66.415*	60
RCL	0.775	14.456	−1.134	11.332	62.189*	226
SALT	−4.112	33.435	−1.361	21.321	77.891*	73
SB	−1.395	20.154	−0.601	5.987	57.336*	140
SFL	0.902	10.045	−0.712	5.346	50.778*	185
SSW	0.209	11.067	−0.672	5.443	60.326*	172
TDW	−1.954	35.678	−1.342	25.556	89.667*	226
TGP	0.245	9.562	−1.345	10.114	45.445*	174
TK	−0.335	13.665	−2.102	16.113	56.3218	225
TOP	−1.254	13.867	−0.713	11.443	47.547*	155
TNK	−0.882	13.234	0.149	3.621	20.231*	145
TNP	0.044	11.812	−0.034	4.224	25.445*	213
NASDAQ-listed						
CPLP	−2.021	20.412	−1.043	22.324	33.324*	152
DCIX	5.425	32.234	1.123	24.435	41.234*	106
DRYS	−5.456	24.556	−0.345	6.789	35.321*	178
EGLE	−4.237	40.334	−0.772	25.324	33.332*	174
ESEA	−2.897	16.556	−0.534	5.089	44.556*	166
GASS	−0.710	12.456	−1.065	9.087	29.557*	169
GLBS	−3.548	32.335	−0.523	7.443	19.234*	142
GLNG	0.385	13.234	−0.885	3.456	5.567	197

(*continued*)

Table 2.
Summary statistics of stock returns

Company	Mean	SD	Skewness	Kurtosis	J-B	Obs.
GNK	−1.221	10.221	0.321	9.890	61.121*	227
GOGL	−0.467	13.556	−0.371	3.234	6.779	226
MBUU	1.088	12.645	−0.623	3.456	5.445	70
MCFT	0.678	12.134	−0.173	4.126	3.335	60
NCLH	0.856	8.798	−0.777	3.978	3.989	83
OMEX	0.113	20.123	0.546	5.872	88.345*	226
PANL	−1.534	13.445	−0.287	5.534	19.678	54
PXS	−1.045	28.345	0.625	19.445	45.556*	145
SHIP	−5.456	30.456	−1.078	25.678	55.678*	145
SBLK	−2.717	25.678	−0.886	19.678	35.556*	145
TOPS	−5.671	20.546	−0.367	6.678	77.989*	187

Notes: J-B is the Jarque-Bera statistic for detecting non-normality in the series; *, ** denote statistical significance at the 5 and 10% levels, respectively

Table 2.

negative average returns found in Panel A of the table. The above results suggest that there is an attractive risk/return tradeoff in the global shipping sector. The finding that some companies are negatively affected and others positively affected by the general, global economic conditions implies non-synchronicity with the global business cycle and, in turn, great diversification potential. Thus, it may be worthwhile to view shipping stocks as an alternate, separate asset class for inclusion in a well-diversified, global portfolio.

Finally, Panel C contains the correlations among the macro variables. We observe several negative and positive correlations among them. For example, the highest correlations were between crude oil (CRUDE) and commodity inflation (COMINF), 0.934, EMU inflation (EMUINF) and Europe inflation (EURINF), 0.985 and the two exchange rates (EXRT or USD vs major currencies and TEXR or the trade-weighted), 0.922, as expected in all cases. The lowest correlations were observed between crude oil and the trade-weighted exchange rate (−0.441) and commodity inflation and trade-weighted exchange rate (−0.530). Note that these are the correlations among the raw variables, not the factors, which will be constructed for the subsequent empirical investigation.

3.2 Factor construction

At this point, it is instructive to briefly mention the results from the CAPM regressions [2]. We have found both positive (some were higher/lower than unity) and negative betas. Negative betas are useful because in case of economic slowdown people could buy them as an investment to gain significant diversification opportunities.

Before embarking on the estimation of the multi-factor models, it is important to construct the factors from the macroeconomic variables. The idea is to remove any spurious relationships among the variables and ensure that we do not have multicollinearity in the model to be estimated. There are various ways one can do that but, in this paper, we will specify various univariate AR(p) models. Then, we will take the variables' residuals (that is, the unexpected component of each series) to use as explanatory variables in the model specified earlier in equation (2). The approach of estimating AR(p) models for each macro variable was applied by Poon and Taylor (1991), Grammenos and Arkoulis (2002) and Kavussanos *et al.* (2002a, 2002b). In our case, the derivation of the factors yielded an AR(1) as the optimal specification.

Table 3.
Stock return and macro variable correlations

Lowest positive		Lowest negative		Highest positive	
Panel A: NYSE-listed stocks					
ASC & BPL	0.003	& TDW	−0.271	& DHT	0.430
BIP & BPL	0.001	& DHT	−0.224	& TDW	0.476
BPL & DAC	0.001	& DHT	−0.256	& NM	0.423
CCL & SALT	0.030	& NMM	−0.267	& NTP	0.275
CKH & KNOP	0.004	& SSW	−0.176	& SFL	0.374
CL & HOS	0.003	& DLNG	−0.254	& DSX	0.289
CMRE & KNOP	0.007	& HII	−0.248	& MPX	0.296
DAC & SSW	0.004	& NVGS	−0.176	& NAT	0.312
DHT & SALT	0.030	& DLNG	−0.283	& TOP	0.122
DLNG & OSG	0.006	& NAT	−0.196	& SB	0.332
DHX & NAT	0.019	& NM	−0.299	& NNA	0.281
FRO & MATX	0.008	& MPX	−0.152	& KNOP	0.376
GLBS & GSL	0.001	& OSG	−0.365	& NMM	0.423
GLOG & KEN	0.058	& GSL	−0.256	& KNOP	0.453
GNK & NVGS	0.006	& OSG	−0.212	& KEX	0.339
GSL & TNP	0.001	& SALT	−0.400	& MPX	0.356
HII & MATX	0.001	& TDW	−0.186	& KNOP	0.292
HMLP & SSW	0.047	& SALT	−0.373	& NMM	0.261
HOS & TDW	0.014	& NNA	−0.245	& SFL	0.512
KEN & TNK	0.036	& KNOP	−0.307	& TOP	0.286
KEX & MATX	0.071	& RCL	−0.131	& TGP	0.454
LGP & MPX	0.001	& NNA	−0.332	& NVGS	0.486
KNOP & TK	0.012	& MATX	−0.256	& OSG	0.475
MATX & TNP	0.006	& NAT	−0.134	& SSW	0.414
MPX & TNP	0.005	& TNK	−0.332	& SB	0.209
NAT & TGP	0.005	& SFL	−0.200	& TNP	0.411
NM & OSG	0.033	& NNA	−0.243	& SSW	0.287
NMM & NNA	0.003	& OSG	−0.471	& SALT	0.423
NNA & TDW	0.011	& TOP	−0.316	& TNP	0.171
NVGS & OSG	0.101	& TNP	−0.213	& SSW	0.396
OSG		& SALT	−0.515		
RCL & TOP	0.073	& SSW	−0.046	& TNP	0.401
SALT & SB	0.042	& SALT	−0.060	& TK	0.332

(*continued*)

Table 3.

	Lowest positive		Lowest negative		Highest positive
SB & SSW	0.064	& TNK	−0.176	& TGP	0.408
SFL & TDW	0.140	& TNP	−0.248	& TNK	0.624
SSW & TGP	0.030	& TNP	−0.170	& TNK	0.234
TDW & TGP	0.025			& TNK	0.324
TGP & TNK	0.143			& TOP	0.699
TK & TNK	0.278			& TOP	0.596
TNK		& TNP	−0.047	& TOP	0.158
TOP & TNP	0.154				
Panel B: NASDAQ-listed stocks					
CPLP & PANL	0.037	& EGLE	−0.598	& TOPS	0.519
DCIX & GASS	0.021	& SBLK	−0.234	& PXS	0.286
DRYS & GASS	0.032	& SBLK	−0.229	& OMEX	0.292
EGLE & SHIP	0.026	& GLBS	−0.709	& ESEA	0.187
ESEA & PANL	0.000	& MCFT	−0.319	& TOPS	0.401
GASS & DCIX	0.020	& GLBS	−0.256	& GOGL	0.396
GLBS & GLBG	0.017	& GASS	−0.251	& SBLK	0.771
GLNG & MCFT	0.005	& DRYS	−0.223	& TOPS	0.395
GOGL & GLNG	0.042	& DCIX	−0.123	& GASS	0.397
MBUU & DCIX	0.009	& MCFT	−0.273	& NCLH	0.552
MCFT & GLNG	0.005	& NCLH	−0.401	& OMEX	0.064
NCLH & PXS	0.027	& MCFT	−0.405	& MBUU	0.552
OMEX & SHIP	0.021	& GLBS	−0.081	& DRYS	0.296
PANL & MBUU	0.030	& PXS	−0.186	& GLNG	0.332
PXS & DRYS	0.071	& SBLK	−0.289	& TOPS	0.180
SBLK		& SHIP	−0.174	& TOPS	0.026
SHIP				& PANL	0.474
TOPS		& EGLE	−0.321		

(*continued*)

Table 3.

Panel C: Macro variable correlations

	CRUDE	COMINF	SPREAD	UN	EMUINF	EURINF	G20INF	IPGEU	IPGG7	LCSPR	CEXR
COMINF	0.934										
SPREAD	−0.152	−0.212									
UN	−0.144	−0.204	0.375								
EMUINF	0.281	0.258	−0.076	0.022							
EURINF	0.308	0.293	−0.067	0.040	0.985						
G20INF	0.472	0.524	−0.165	−0.039	0.488	0.527					
IPGEU	0.164	0.232	−0.350	−0.270	0.008	0.026	0.167				
IPGG7	0.147	0.232	−0.444	−0.362	0.003	0.005	0.098	0.680			
LCSPR	−0.007	−0.005	0.494	0.000	−0.014	−0.005	−0.009	−0.021	0.041		
CEXR	−0.388	−0.467	0.054	0.098	−0.081	−0.092	−0.191	−0.090	−0.090	−0.032	
TEXR	−0.441	−0.530	0.111	0.138	−0.103	−0.115	−0.204	−0.114	−0.130	−0.017	0.922

Notes: COMINF is commodity price inflation; SPREAD is the 10yr US T-note minus 3-m Treasury bill; UN the unemployment rate; EMUINF is EMU inflation rate; EURNF is Europe's inflation rate; G20INF is the G20 countries inflation rate; IPGEU is Europe's industrial production; LCSPR is the long credit spread (BAA minus 10-year T-note); CEXR is the USD exchange rate vs. other currencies; TEXR is the US trade-weighted exchange rate. Sample spans from 1/2001 to 12/2019

Before estimating equation (2), it is useful to discuss the importance and expected signs of the risk factors [3]. The impact of exchange rates on the shipping companies' stock returns is mixed. Leggate (1999) reported that exposure to exchange rate risk can have a positive or a negative effect on US-dollar denominated expenditures of shipping companies, depending on the direction of movement in the exchange rate. Grammenos and Arkoulis (2002) found a negative relationship between stock returns of shipping firms and the dollar exchange rate of the domestic currency, while El-Mashry *et al.* (2010) reported negative, positive or no relationships.

The evidence is also varied on the influence of interest rates and credit spreads on the shipping companies' stock returns. The slope of the term structure of interest rates reflects market expectations about the future path of the macroeconomy and, by extension, companies' stock returns. The slope of the credit term structure negatively predicts future stock returns (Han *et al.*, 2017). El-Mashry *et al.* (2010) concluded that stock returns of shipping firms were, generally, negatively impacted by changes in interest rates, which affected their debt-servicing capacity. Similar arguments can be made for changes in credit spreads. For example, Grammenos and Arkoulis (2003) implied that credit spreads negatively influence laid-up tonnage, and thus, indirectly, stock returns. Kavussanos and Tsouknidis (2014) also argued that credit spreads are important determinants for global financing risk(s) given that global shipping is a highly asset-intensive business.

Evidence on the influence of news in crude oil prices on shipping companies' stock returns is again mixed. On one hand, Grammenos and Arkoulis (2002) reported that companies' stock returns were negatively affected by oil price changes, Kavussanos and Marcoulis (2000), Drobetz *et al.* (2010) and El-Mashry *et al.* (2010) on the other, argued that oil prices may be a contributor to stock returns given that oil is the major input for generating cargo service.

Unanticipated US and global inflation rates are also expected to exert a negative impact on international trade and investment. Global inflation (proxied by the global commodity price index, G20 or Europe's inflation rates) is viewed as a proxy for worldwide investor uncertainty regarding expectations on global economic activity, which would adversely impact global shipping companies' profits. Kavussanos *et al.* (2002a, 2002b) stated that the negative consequences of unexpected inflation can be mitigated by hedging (in stock prices). Grammenos and Arkoulis (2002), however, failed to establish a significant empirical relationship.

Finally, other macro risk factors are the unexpected changes in global industrial production, as measured by the G7 and Europe's industrial production indices all of which reflect the global economic/business cycle. Isserlis (1998) and Drobetz *et al.* (2012) reported that movements in world economic cycles and freight rates followed similar patterns. Stopford (2009) found that business cycles in advanced economies reflected cycles in sea trade and, consequently, the relationship between global industrial production and international shipping stock returns is expected to be positive. Grammenos and Arkoulis (2002), however, found a negative relationship between these magnitudes.

3.3 Empirical results from multi-factor models

Table 4 contains the results for the benchmark multi-factor model, with the US factors mentioned above and the extended model with the global factors, which surfaced as mostly statistically significant in preliminary runs of a model, which contained all variables [4]. The GMM approach to estimate the benchmark model uses the Newey-West heteroscedasticity-consistent correction and the estimated J-statistics, which are the most common diagnostics to evaluate the suitability of the model, which were above zero and their probabilities near zero. In addition, in each regression, related variables were used, for example, for the crude oil the Brent and WTI we used, in turn, but the final model specification was the one reported in the table (the NYSE-listed companies in Panel A and the NASDAQ-listed companies in Panel B).

		Macro risk factors								
Firm	*constant*	*COMINF*	*LCSPR*	*EMR*	*TEXR*	*USINF*	*USIPG*	*LIBOR*	*EUIPG*	*J-stat*
Panel A: NYSE-listed stocks										
ASC	0.345	0.424**	4.357	−0.618	−0.037	1.534**	1.123	−0.345	−1.589	0.445
BIP	0.656	0.032	7.244	0.489*	−0.289	−0.671	1.456	−0.807	0.823	0.945
BPL	2.165*	−0.083	−5.231	−0.467	3.078	2.443*	0.735	−1.034**	0.078	0.523
CCL	1.734*	0.334	6.007	0.131	0.347	2.197	1.365	−0.323**	0.002	0.332
CKH	−0.567	−0.176	−5.457	0.907*	0.182	0.878	−0.225	0.245	−0.954	0.291
CMRE	0.478	0.104	−6.113	−0.360	−0.167	4.445*	2.356	−0.334	2.271	0.226
DAC	−2.061**	0.334	4.223	0.865*	0.035	−5.667	1.078	−0.234	3.500**	0.033
DHT	−2.567	−0.445	−6.491	−0.245	−0.222	4.567*	−4.042	0.243	1.256	0.789
DLNG	3.987	0.867	7.497	−0.238	1.313	5.667	3.298	−4.189**	−3.211	0.607
DSX	−1.587	−0.534	−6.156	−0.123	−0.601	6.334**	−1.287	0.787	−0.876	0.656
EURN	−1.467	−0.012	−7.808**	1.156*	−0.686	5.456	−2.572	0.445	0.078	0.045
FRO	−1.767	0.434	6.156	0.234	−0.567	−6.497*	−0.468	0.787	1.856	0.032
GLOP	1.089	−0.123	6.198	0.267	0.589	1.445	7.412**	−0.561	1.066	0.244
GSL	2.389	2.312	3.078	−0.956	2.223	6.516	2.798	−2.432	2.776	0.023
HII	1.113**	0.078	3.323**	0.239	1.245	−0.332	2.173	−0.332	1.967	0.022
HMLP	0.734	0.630**	−0.423	−0.712	2.321	3.245**	0.512	0.443	0.332	0.565
HOS	−2.451**	0.571	3.897	2.034*	0.817*	3.223	0.254	0.332	0.056	0.352
INSW	−3.867	−1.234	−1.108	1.876**	1.445	−5.112	−2.287	4.556	1.232	0.598
KEN	−1.234	0.223	1.387	2.208*	1.443	1.332**	3.087*	1.445	−0.679	0.923
KEX	0.345	0.322	2.091	0.934*	0.140	1.276	1.065	0.134	1.171	0.667
KNOP	1.334	0.173	3.134	−0.366	−0.744	3.591	1.045	0.254	0.767	0.951
LPG	−2.187	−0.143	−3.176	1.234*	−0.265	4.334	−3.387	1.223	−0.335	0.932
MATX	0.834	−0.023	−1.275	1.248*	0.034	1.089	−0.398	−0.887*	0.378	0.019
MPX	2.332*	0.623	2.122	0.254	−0.478	3.334	2.512	−0.093**	0.774	0.018
NAT	0.029	0.191	3.078	−0.119	−0.397	−3.578	0.712	0.006	0.721	0.012
NM	−2.334	2.223	2.787**	2.898*	3.334	3.678	2.154	−0.445	2.556	0.034
NMM	0.422	−0.323	−3.226	0.402**	−1.734	−0.123	−3.423	−1.443	1.074	0.834
NNA	−1.598	−0.234	−1.123	−0.975**	−0.345	−4.321	−4.778	0.889	−0.849	0.045
NVGS	−0.645	−1.834	−3.200	0.332	−1.223	3.234	−4.034	1.388	0.445	0.067
OSG	−0.213	1.334**	−2.508	0.389	−4.334	−4.456	4.775	1.556	2.434	0.299
RCL	2.778*	0.145	−3.187**	0.323	−0.287	−2.665	1.112	−1.443*	−1.334	0.934
SALT	−3.332	−2.189	1.775	2.812*	0.334	4.332	−3.176	0.309	−1.331**	0.841
SB	−0.945	1.332*	3.667	0.898**	2.445	−4.132	4.486	−0.221	2.657	0.531
SFL	0.132	−0.012	−1.308*	1.346*	−0.445	2.109	0.267	0.398	0.014	1.078
SSW	−0.123	−0.456	0.065	1.187*	0.066	3.223	1.108	0.007	2.387	1.012
TDW	−2.878*	0.487	3.697*	1.727*	−0.162	3.445	2.467	0.712	−0.334	1.055
TGP	−0.376	−0.801	4.176	0.712*	0.497	4.554*	2.837	0.123*	−0.567	1.092
TK	−0.276	−0.023	4.067	1.234*	−0.223	2.332*	1.710	−0.189	0.221	0.348
TNK	−2.345	−0.701	−5.445**	1.423*	−0.034	4.534	−3.403	1.423*	−2.765	1.008
TNP	−1.023	−0.402	−3.056	0.145	0.245	1.342	−1.167	0.434	−0.112	1.006
TOP	−1.023	0.311	4.002	0.839*	1.287**	5.445**	2.187	−0.589	0.321	1.100
Panel B: NADAQ-listed stocks										
CPLP	−4.223	0.365**	2.571	1.467*	1.342**	3.534	4.280*	0.845	−1.121	0.989
DCIX	7.089	−1.889	5.331	2.089*	−4.234	3.221	−4.335	−1.089	−2.077	0.011
DRYS	−5.778*	−0.124	−4.334*	0.687*	−2.334**	2.145	−2.211	2.089	1.956	0.011
EGLE	−6.887*	0.278	−5.008	0.334	1.897	3.089**	−5.011	1.664*	1.523	0.070
ESEA	−4.689*	−0.089	−1.587	0.404**	0.423	−4.789*	−2.445**	0.978	−0.771	0.012
GASS	−1.675	0.297**	5.332**	1.213*	−0.323	5.008*	−0.245	0.042	−0.267	0.013
GLBS	−5.234	−0.523	5.998	1.297**	−0.912	−3.335	5.656	1.109	1.978	0.012

(*continued*)

Table 4.
Multi-factor model estimates of US and global risk factors

		Macro risk factors								
Firm	*constant*	*COMINF*	*LCSPR*	*EMR*	*TEXR*	*USINF*	*USIPG*	*LIBOR*	*EUIPG*	*J-stat*
GLNG	0.208	0.156	−6.121*	0.407**	0.354	−1.967	3.645**	−0.132	−0.324	0.067
GNK	−4.334	0.278	−1.408	0.235	0.824	6.556**	1.345	2.334	−4.231	0.745
GOGL	−1.334	0.435**	5.234	0.822*	0.254	5.667*	0.345	0.185	0.412	0.055
MBUU	−1.443	0.068	−2.078	1.601*	−0.056	−5.776*	−3.223**	0.476	−2.007**	0.077
MCFT	4.987*	−0.443**	−5.434*	−0.612*	−2.334	2.245	1.254	−2.445*	0.987	0.100
NCLH	−0.324	−0.387**	5.445	1.323*	0.012	0.886	0.132	−0.452	−0.756	0.002
OMEX	−3.077**	−0.411	−2.656	0.987*	−0.497	−1.732	−0.987	1.332**	0.143	0.002
PANL	−3.908	0.756	−3.443	0.507**	−0.987	0.453	5.871**	1.967**	2.554**	0.045
PXS	−3.501	−1.234	−4.332	0.513**	−0.276	3.334	−5.461	1.387	−3.223	0.001
SBLK	−3.667	0.036	4.776	0.235**	0.065	2.341	5.889	0.607	−0.287	0.001
SHIP	−5.779*	0.807	5.008**	0.513**	1.412	2.276	6.008**	1.297	1.387	0.069
TOPS	−6.007*	0.047	6.008*	0.712*	−1.167	−3.997	2.109	0.087	−3.228**	0.088

Notes: Global commodity inflation (COMINF); US long credit spread (LCSPR); NYSE excess market returns (EMR); Trade-weighted US dollar exchange rate (TEXR); US inflation (USINF); US industrial production growth (USIPG); the London Interbank Offered Rate (LIBOR); European industrial production growth (EUIPG); J-stat is the GMM J-statistic; *, ** refer to 5% and 10% levels of significance, respectively

Table 4.

The following observations can be made on the NYSE-listed companies' results. First, there were no consistent signs of a particular factor across all companies. Second, all factors appear to have been useful in some companies but not in others and their signs agree with our expectations. Third, the least significant factor seems to have been the USIPG and the most significant factors, in terms of appearing most often, were the stocks' betas, US inflation and the long credit spread. The latter factor's coefficients are almost always negative and mostly statistically insignificant, which indicates that increases in credit spreads depress stock returns. Fourth, the fact that the companies' betas are mostly statistically insignificant suggests that other risk factors may be more important at play. Further, the finding that the (unexpected) exchange rate's coefficients are mostly statistically insignificant hint that companies did in fact engage in foreign exchange hedging.

Fifth, the global commodity inflation factor's (*COMINF*) coefficients surface as both positive and negative and occasionally as statistically significant. This finding connotes that these companies might have used inflation as hedges for their stock returns but the empirical literature is not conclusive on the sigh of unanticipated inflation against stock returns (see, for example, Chen *et al.*, 1986). Sixth, LIBOR did not always emerge as statistically significant which means that these shipping companies may not have used it frequently as a means of financing for their activities. At the peak of the shipping frenzy, during the global financial crisis, margins were unreasonably low and most global loans were extended at LIBOR plus 80 basis points. Afterward, shipping loans were commanding much higher margins. It appears that the global shipping industry has been able to cope with these much higher margins, and thus it is expected to cope with some small interest rate increases in the years to come.

Finally, Europe's industrial production factor's coefficients were not found significant for these shipping companies, which is surprising given that they reflect the global business cycle. This finding agrees with the inconclusive results in the literature. For example, Poon and Taylor (1991) found a negative relationship between stock returns and industrial production in the UK and Chen and Jordan (1993) reported no association between the two magnitudes.

As regard the results for the NASDAQ-listed companies, shown in Panel B, we observe that almost always the stocks' betas are statistically significant while the remaining risk

factors appeared to be occasionally significant. Thus, it may be inferred that these companies' exposures emanate mostly from the general US market's movements and to a lesser extent from other factors (and, perhaps, from their own financial factors). This can be partly rationalized by the fact that these companies had their initial public offerings in the US market and have greater exposure to the US market. Overall, it can be deduced that some of these US and global macro risk factors surfaced as statistically significant for most of the companies investigated and appear to exhibit a consistent pattern in the way in which they affected shipping stocks. These findings are also in line with the hypothesized signs of each of the variables (factors) discussed above.

What about using the Fama-French factors in exploring the companies' stock returns? Regarding the NYSE-listed stocks, the excess market returns (EMR) surfaced as significant and with the correct sign, more often than the other factors. Also, SMB and HML were typically insignificant but the RMW factor appeared more often significant. A similar picture is evident also for the NASDAQ-listed companies. Thus, it may be inferred that these factors are not important for these shipping companies, besides the market [5].

Finally, given that the sample period contains a serious financial crisis, which became global in nature, a dummy variable was created to capture the effect of the crisis years (2007–2009). In all regressions, the dummy variable did not surface as statistically significant but was mostly negative and, at times, large in size, suggesting that it did have an adverse economic impact on the shipping companies' stock returns (but not in a statistical sense) [6].

3.4 Empirical results from panel models

We have estimated several variants of (unbalanced) panel models but report only the most statistically significant ones (fixed effects) in Table 5. Looking at the results for the NYSE-listed companies in Panel A, we observe that regardless of the approach used, OLS or GMM, the relevant market, the US unemployment rate, the US inflation rate and the US industrial production growth factors emerged as statistically significant, while the world commodity inflation, the credit spread, Europe's industrial production growth and the trade-weighted exchange rate did not. In addition, the G20 countries' inflation rate appears to be significant in the GMM approach and with the appropriate sign. At the bottom of the panel, some diagnostic statistics are reported, namely, the adjusted R-squared, J-statistic and a test for the redundancy of the fixed effects. In all cases, their values did not point to issues or worries about the appropriateness of the models.

Panel B of the table contains the results for the NASDAQ-listed companies. Contrary to the other shipping companies' results, we see that the US industrial production growth and the trade-weighted exchange rate did not emerge as significant. Further, in this set of companies, Libor was statistically significant in both panel approaches. As with the NYSE-listed companies, the models' diagnostics corroborate their suitability. Thus, it may be concluded that these US exchange-listed companies abide mostly by domestic fundamentals and to some extent to global factors such as Libor and G20 inflation rate. This conclusion agrees with the multi-factor models' results. This is a surprising result given the global nature of these companies' business. Further, it is possible that these companies' stock returns are affected by their financials such as operating and financial leverage, dividend payout ratio and the like but these are not examined in this paper (for those, see Grammenos and Marcoulis, 1996). The above findings, in general, are in line with those of the extant literature (Drobetz *et al.*, 2010; Grammenos and Arkoulis, 2002; Westgaard *et al.*, 2007).

3.5 Robustness tests

Some robustness tests are performed to ensure that the above results remain valid to alternate specifications and factors. First, the benchmark multi-factor model was run with both the US

Factor	*OLS coefficient (stand. error)*	*GMM coefficient (stand. error)*
Panel A: NYSE-listed companies		
constant	−0.323* (0.120)	−0.333* (0.120)
cominf	0.018 (0.012)	0.054 (0.035)
nyse	0.530* (0.029)	0.540* (0.029)
lcspr	0.484 (0.345)	0.230 (0.135)
usun	2.545* (0.802)	2.416* (0.794)
usinf	2.244* (0.487)	2.118* (0.490)
usipg	0.473* (0.203)	0.522* (0.203)
euipg	0.188 (0.115)	–
texr	0.068 (0.088)	0.070 (0.068)
G20inf	–	−2.212* (0.822)
Fixed effects	Yes	Yes
Adj-R^2	0.061	0.062
J-statistic		1.078
F-stat (prob)	8.416 (0.000)	
Redundant fixed		
Effects F-test (prob)	1.319 (0.024)	
Panel B: NASDAQ-listed companies		
constant	−2.763* (0.480)	−2.443* (0.420)
cominf	0.075 (0.062)	0.088 (0.075)
nasdaq	0.350* (0.065)	0.371* (0.067)
usinf	2.264* (0.987)	2.070* (1.011)
usipg	0.413 (0.332)	0.372 (0.283)
libor	0.548* (0.215)	0.549* (0.213)
texr	−0.068 (0.088)	−0.071 (0.067)
G20inf	–	−1.612 (0.982)
Fixed effects	Yes	Yes
Adj-R^2	0.040	0.039
DW	2.094	–
J-statistic		0.378
F-stat (prob)	4.781 (0.000)	–
Redundant fixed		
Effects F-test (prob)	2.431 (0.004)	–

Notes: * denotes statistical significance at the 5% level; G20inf is the inflation rate of the G20 countries; see Table 4 for additional variable definitions

Table 5. Panel estimation results

standard equity market index, S&P500 and the world equity index, MSCI, in place of the NYSE and NASDAQ. The estimated betas of the NYSE-listed companies with the S&P500 index were almost always lower than those using the relevant index, while the NASDAQ-listed companies' betas were mostly above the ones with the relevant market. Thus, in the first case, the standard market proxy underestimated betas while in the second case it overestimated them. Finally, when using the MSCI index and contrary to the results with the NYSE and NASDAQ indices, we see much lower beta values for all companies, as well as negative betas for some companies at both stock exchanges[7]. These results, in general, imply that these companies are not influenced much by a world benchmark index even though their operations are global. Thus, using the US equity indices proved to be a correct choice for the market proxy.

Second, the Clarksea index's coefficients were always statistically insignificant in both sets of companies, and thus not reported. This is consistent with previous work by Drobetz *et al.* (2016). Regarding other variables as substitutes for the original ones, we alternated a number of them such as spreads (short and medium-term ones), industrial production

growth rates (EMU's and Europe's) and crude oil variables (Brent and WTI) in all models but did not emerge as significant.

Finally, we estimated a random-effects panel specification and performed a Hausman (1978) specification test to ensure that our choice of a fixed-effects model was the correct one versus the random-effects one. The results pointed to the rejection of the null hypothesis of "random effects are preferred" in all cases, as the probability values were less than 0.05.

4. Conclusions

This study examined the impact of the US and global macroeconomic risk factors on all NYSE- and NASDAQ-listed shipping companies' stock returns from January 2001 to December 2019. The main results are summarized as follows. First, the multi-factor models showed that some of the US and global macro risk factors surfaced as significant for most of the companies and appeared to exhibit a consistent pattern in the way they affected their stocks. Second, from the results of panel analyzes we observed that domestic magnitudes such as the relevant market were significant for the NYSE-listed companies and for the NASDAQ-listed ones, LIBOR and the G20 inflation rate was also significant. Thus, it may be concluded that these US exchange-listed companies abided mostly by domestic fundamentals and to some extent to selected global factors, which is a surprising result given the global nature of these companies' business.

The significance of the findings pertains to global investors and shipping companies' managers alike. Given the differential sensitivities of the shipping companies to various risk factors (and the global business cycle, in general), it is possible to include them as a separate asset class in a global portfolio. Managers of shipping companies would also benefit from these findings so they could better understand the exposures of their companies to changing global and domestic macro conditions and successfully navigate their companies through business cycles. Finally and practically-speaking, the findings emphasize the potential diversification benefits from the shipping industry as investors and portfolio managers could hedge their exposures and optimize their portfolio allocations.

A suggestion for future research would be the assessment of the effects of the COVID-19 pandemic on these companies' stock returns to see the extent of the, presumably negative, impact and infer if global non-economic events are capable of affecting globally-operating firms.

Notes

1. Data for these factors are obtained from the Kenneth French's online data library.
2. The full results are available upon request from the author.
3. Although not reported (but are available upon request), the correlations among the factors, US and global alike, were very low (the highest correlation of 0.245 was observed between the European inflation and crude oil changes).
4. We performed a stepwise regression with all variables to determine the ones that always emerged as statistically significant.
5. In all cases, the momentum factor did not appear to be significant.
6. The results are not reported but are available upon request. At the suggestion of a referee, we also tested the dotcom bubble and September 11, 2001 attacks using dummy variables but did not find any noteworthy statistical significance.
7. NYSE-listed: *CMRE, FRO, INSW, KNOP, NAT* and NASDAQ-listed: *CPLP, DCIX, ESEA, PXS, SHIP* and *TOPS*.

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