Common Risk Factors in the Returns of Shipping Stocks

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Outline

Risk Factors: Shipping Stocks as an Asset Class?

- An asset class is characterized by its unique risk and return profile.
- The risk is driven by the sensitivities to and its co-movements with underlying economic risk factors.
- Industries with sufficiently different risk profiles should be viewed as an asset class.
- The knowledge of the factors is important for investors to make their investment decisions as well as for the company to determine the cost of capital.
- We identify these factors and compare them to other asset classes such as stocks and bonds.
- We estimate two models: one to estimate which risk factors are the drivers and one in which we estimate the risk premium and the sensitivities simultaneously.
- As risk factors we use a set common in asset pricing literature.

Why is it important to know risk factors?

- Fundamental Analyses
  - Factor sensitivities and the factor pricing model provide economic determinants of return volatility.
- Diversification
  - With the knowledge of the exposures of an asset class, an investor is able to control which risks he takes in his portfolio.
- Pricing potential
  - Cross-sectional differences can explain differences in expected returns.
  - The differences can be attributed to the set of risk factors.
- Hedging
  - Factor exposures are the basis for minimum variance hedging.

Prior Research on shipping stocks (1)

- Gramnous and Marcoulis (1996): stock beta and firm specific factors
  - Beta is below unity.
- Kavussanos and Marcoulis (1997a): whole ship market risk, comparison to US stock market
  - No difference between the average beta and US stock market.
- Kavussanos and Marcoulis (1997b): investigation of the return structure of different transportation sectors
  - Beta is below unity, some explanation power of accounting data.
- Kavussanos and Marcoulis (1998): systematic risk of the shipping sector
  - Low systematic risk in terms of the explanatory power of market model regressions.
- Kavussanos and Marcoulis (2000a, 2000b): explanatory power of firm level and macro data

Prior Research on shipping stocks (2)

- Kavussanos et al. (2003): comparison of the return structure of shipping subsectors
  - No evidence of differences between the subsectors, mispricing in terms of alpha, beta smaller than unity in most sectors.
- Gong et al. (2006): stability of betas in the shipping industry
  - Betas estimated out of daily data vary according to the estimation technique.
- Kavussanos and Marcoulis (2005): literature overview.

The Returns on shipping stocks seem to be related to firm-specific and common macroeconomic factors. Our goal is a deeper understanding of the macroeconomic risk drivers.

Methodology

- CAPM: The expected return can be explained by a linear function of a single risk factor -> the market portfolio.
- Extensions:
  - Different portfolio returns as further risk factors (e.g. Fama and French (1993)).
  - Macroeconomic risk factors (e.g. Ferson and Harvey (1994)) as proxies for the future economic environment. They proxy for shocks to the expected streams of earnings.
- Our Analysis:
  - Unconditional beta pricing model, useful from the perspective of a long term investor.
  - Consistent with Arbitrage Pricing Theory (e.g. Ross (1976), Huberman (1982))
  - But: strong assumptions necessary to use such a model in an international context (e.g. perfectly integrated national equity markets, no taxes, no transaction costs)
  - Bekaert and Harvey (1995) and DeSantis and Gérard (1997) find evidence of growing market integration.

The SUR-model

- We follow the path of Ferson and Harvey (1994)
- The starting point is the estimation of a SUR (seemingly unrelated regressions)-model

$$r_{it} = \alpha_i + \sum_{j=1}^{K} \beta_{ij} F_{jt} + u_{it}$$

with *r* as the vector of excess returns, *F* as the matrix of observations of the risk factors and *u* as the error term. *Alpha* and *Beta* are known from simple market models.

- We allow for contemporaneous shocks in all equations. In doing this, we estimate a seemingly unrelated regression system (Zellner (1962)) instead of a normal system of equations, where the shocks exhibit no common structure. One can think of shocks to the global economy as a whole that have influence on all markets to justify this structure.
- With this model we investigate a single factor model and a multi factor model. In this framework we decide which risk factors we use in the asset pricing model.

The risk factor model

- In the next step we estimate the risk sensitivities and premia simultaneously.
- We use the following pricing equation:

$$r_{it} = \sum_{j=1}^{K} \beta_{ij}(f_{jt} + \lambda_j) + u_{it}, \qquad i = 1, \ldots, N$$

with *f* as the matrix of observations of the risk factors (demeaned) and *r* as the vector of returns. We estimate simultaneously the betas coefficients (the sensitivities to the risk factors) and the lambdas (the risk premia of the risk factors) - see Hansen (1982) for the GMM estimation technique.

- We estimate the equation using a 2-step GMM approach with moment conditions $E(u_{it}) = 0$ and $E(u_{it}F_{jt}) = 0$
  - with $u_t = r_t - (f + \lambda \otimes \iota)\beta$

  and *F* as the matrix of observations (not demeaned) of the risk factors.

Data: Asset Returns

Market	Description
Containerequal	Equal weighted return index of 24 listed container firms Clarkson Liner share price index
Tankerequal	Equal weighted return index of 21 listed tanker firms Clarkson tanker share price index
Bulkerequal	Equal weighted return index of 21 listed bulker firms Dry Bulk Insight
Stocksgermany	MSCI Stock Market return index Germany
Stocksjapan	MSCI Stock Market return index Japan
Stocksuk	MSCI Stock Market return index UK
Stocksus	MSCI Stock Market return index US
Sectors	MSCI sector indices: energy, materials, industrials, consumer discretionary, consumer staples, health care, financials, information technology, telcomunication services, and utilities

- We subtract a short term risk free interest rate (US-Libor) from the returns series to generate excess returns.
- Our sample contains the period from 02/1999 to 12/2007.
- Source: Datastream

Data: summary statistics

Table 1: Summary statistics - dependent variables, monthly data

Variable	Observations	Mean	Std. Dev.	Min	Max
Container	107	0.0216	0.0714	-0.1621	0.2120
Tanker	107	0.0289	0.0684	-0.1122	0.2169
Bulker	107	0.0430	0.0947	-0.2035	0.3563
United States	107	-0.0003	0.0397	-0.0972	0.1040
United Kingdom	107	0.0024	0.0392	-0.1238	0.0828
Japan	107	0.0011	0.0525	-0.1201	0.1349
Germany	107	0.0037	0.0652	-0.2048	0.2368
Energy	107	0.0116	0.0532	-0.1616	0.1535
Materials	107	0.0123	0.0538	-0.1356	0.1830
Industrials	107	0.0057	0.0412	-0.1259	0.1163
Consumer Discretionary	107	0.0019	0.0475	-0.1480	0.1307
Consumer Staples	107	0.0031	0.0303	-0.0841	0.0608
Health Care	107	0.0008	0.0334	-0.0865	0.0830
Financials	107	0.0045	0.0424	-0.1118	0.1181
Information Technology	107	0.0016	0.0871	-0.2538	0.2321
Telecommunication Services	107	0.0007	0.0593	-0.1794	0.2076
Utilities	107	0.0061	0.0356	-0.1150	0.0848

- High mean returns and high volatilty in all three shipping subsectors.
- Negative excess return in our sample.

Data: Global risk factors

Factor	Describtion
Dmsci	MSCI World Index returns (excess retruns)
Dexchangerate	Log changes of a trade weighted currency basket against the dollar
Doil	Log changes of the Oil price
Dipg7	Log changes of the G7 industrial production
Dipchina	Log changes of the chinese industrial production
Inflationppi	Log changes of a US producer price index
Dted	Log changes in the TED-Spread (3-month Treasury yield minus 3-month interbankrate)
dterm	Log change in the term-spread (10-year interest rate minus 3-month interest rate)
d10yir	Log change in the 10 year yield (weighted G7)
d3mir	Log change in the 3 month yield (weighted G7)

- Ferson and Harvey (1994) and Drobetz et al. (2002) use a comparable set.

Data: summary statistics risk factors

Table 2: Summary statistics of independent variables

Variable	Obs	Mean	Std. dev.	Min	Max
dWrldE	107	0.0020	0.0386	-0.1015	0.0965
dCurB	107	-0.0024	0.0188	-0.0500	0.0451
dOil	107	0.0199	0.1112	-0.3274	0.3320
dIPG7	107	0.0013	0.0045	-0.0130	0.0108
dIPChina	107	0.0005	0.0391	-0.1439	0.1512
InflG7	107	0.0019	0.0046	-0.0133	0.0130
dTED	107	0.0131	0.4066	-0.8650	1.1939
d3MIG7	107	-0.0007	0.0449	-0.2360	0.0853
d10YIG7	107	-0.0007	0.0449	-0.1005	0.1637

- High mean return and volatility of the change in the oil price in the sample period.

Correlation structure of independent variables

	dWrldE	dCurrB	dOil	dIPG7	dIPChina	InflG7	dTed	d3MIG7	d10YIG7
dCurrB	-0.3438	1.0000							
dOil	0.1259	-0.1139	1.0000						
dIPG7	0.0644	-0.0067	0.1041	1.0000					
dIPChina	-0.1002	0.0358	0.0697	-0.0608	1.0000				
InflG7	0.0370	-0.0666	0.4868	0.1588	0.0232	1.0000			
dTed	-0.0836	0.0539	-0.0921	0.0612	0.1356	0.0563	1.0000		
d3MIG7	0.1655	-0.0260	0.1310	0.3491	-0.0134	0.2352	-0.2577	1.0000	
d10YIG7	0.2187	0.2829	0.0075	0.0761	-0.1579	0.0358	-0.0477	0.2418	1.0000

- High correlation between change in oil price and change in PPI-Index.

Results: one-factor regressions

Table 3: Results of one factor regressions

	dWrldE	Constant	R^2
Container	1.004***	0.022***	0.30
	(0.150)	(0.006)	
Tanker	0.966***	0.029***	0.32
	(0.140)	(0.005)	
Bulker	0.923***	0.045***	0.16
	(0.220)	(0.008)	
United States	0.982***	-0.002*	0.91
	(0.030)	(0.001)	
United Kingdom	0.881***	0.001	0.75
	(0.049)	(0.002)	
Japan	0.827***	0.000	0.37
	(0.100)	(0.004)	
Germany	1.441***	0.002	0.73
	(0.085)	(0.003)	
Standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			
test on equality of betas.		188.83	
		0.000	
test on equality of shipping betas		0.22	
		0.895	

	dWrldE	Constant	R^2
Energy	0.832***	0.010**	0.36
	(0.110)	(0.004)	
Materials	1.068***	0.010***	0.59
	(0.086)	(0.003)	
Industrials	0.969***	0.003*	0.82
	(0.043)	(0.002)	
Consumer Discretionary	1.147***	-0.001	0.87
	(0.043)	(0.002)	
Consumer Staples	0.353***	0.002	0.20
	(0.068)	(0.002)	
Health Care	0.334***	-0.000	0.15
	(0.077)	(0.003)	
Financials	0.941***	0.002	0.74
	(0.054)	(0.002)	
Information Technology	1.909***	-0.004	0.72
	(0.120)	(0.005)	
Telecommunication Services	1.171***	-0.003	0.58
	(0.096)	(0.003)	
Utilities	0.498***	0.005	0.29
	(0.075)	(0.003)	

- Beta below unity in the shipping sectors.
- Not much difference between the subsectors.
- Beta in the range of the country betas, but lower explanatory power.
- Significant alphas: indicating mispricing.
- Low betas compared to other industry markets
- Low explanatory power. of beta compared to other industry markets.
- The null of equality of all shipping betas can not be rejected.

Results: multifactor model

Table 4: Multifactor model

	dWrldE	dCurB	dIPG7	dipchina	d3MIG7	d10YIG7	dTED	InflG7	doil	Constant	R^2
Container	0.851***	-0.720**	2.238*	0.054	-0.123	0.050	-0.021	-0.801	0.095*	0.017***	0.38
	(0.160)	(0.340)	(1.320)	(0.140)	(0.140)	(0.140)	(0.014)	(1.410)	(0.057)	(0.0061)	
Tanker	0.872***	-0.597*	-0.505	0.093	0.101	0.028	0.004	0.697	0.070	0.026***	0.38
	(0.150)	(0.320)	(1.270)	(0.140)	(0.140)	(0.130)	(0.014)	(1.360)	(0.055)	(0.0059)	
Bulker	0.796***	-1.223**	1.340	0.070	-0.014	-0.142	0.012	0.393	0.078	0.039***	0.25
	(0.240)	(0.490)	(1.930)	(0.210)	(0.210)	(0.200)	(0.021)	(2.060)	(0.084)	(0.0089)	
United States	1.060***	0.368***	0.065	-0.004	-0.025	-0.041*	0.000	-0.671***	-0.000	-0.000	0.94
	(0.027)	(0.056)	(0.220)	(0.024)	(0.024)	(0.023)	(0.002)	(0.240)	(0.010)	(0.0010)	
United Kingdom	0.827***	-0.329***	-1.460***	-0.003	0.102**	-0.026	-0.005	0.634	-0.030*	0.002	0.82
	(0.048)	(0.100)	(0.390)	(0.043)	(0.043)	(0.042)	(0.004)	(0.420)	(0.017)	(0.0018)	
Japan	0.735***	-0.375*	2.563***	-0.076	-0.111	0.015	0.004	1.360	0.056	-0.008*	0.48
	(0.110)	(0.230)	(0.890)	(0.097)	(0.096)	(0.094)	(0.010)	(0.950)	(0.038)	(0.0041)	
Germany	1.351***	-0.415**	-0.017	0.120	0.008	0.207***	-0.002	0.304	-0.066**	0.002	0.76
	(0.091)	(0.190)	(0.750)	(0.082)	(0.081)	(0.079)	(0.008)	(0.800)	(0.032)	(0.0035)	
test on equality of betas	37.19	46.67	24.42	2.84	9.11	10.44	6.35	9.47	7.99		
	0.000	0.000	0.000	0.829	0.168	0.108	0.385	0.149	0.239		
test on zero betas	13720.97	54.83	25.92	3.21	10.4	10.62	6.88	10.28	13.9		
	0.000	0.000	0.001	0.865	0.167	0.156	0.442	0.173	0.053		

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

- Beta below unity
- Currency as risk driver (negative sign)
- Industrial production as risk driver
- Oil as risk driver
- Still low explanatory power of R^2
- Significant alpha indicates misspricing
- R^2 higher than in the single beta case

Results: Global economic risk factors

Table 5: Long-run risk with country indices

	One-factor model			Four-factor model				
	dWrlmE beta	Average return %per month	Average pricing error %	dWrlmE beta	dCurrBe beta	dIPG7 beta	doil beta	Average pricing error %
Container	0.9659	0.0217	0.0234	0.8135	-0.7627	1.5723	0.0752	0.0010
	(0.129)		(0.008)	(0.104)	(0.229)	(0.648)	(0.023)	(0.008)
Tanker	0.8641	0.0289	0.0303	0.8534	-0.5363	0.3734	0.0624	-0.0005
	(0.119)		(0.008)	(0.054)	(0.163)	(0.715)	(0.023)	(0.007)
Bulker	0.6794	0.0430	0.0483	0.6159	-1.3627	0.5460	0.0898	-0.0015
	(0.195)		(0.012)	(0.134)	(0.291)	(0.943)	(0.029)	(0.010)
United States	0.8749	-0.0003	-0.0009	1.0357	0.3186	-0.1865	-0.0125	-0.0001
	(0.032)		(0.001)	(0.016)	(0.034)	(0.158)	(0.006)	(0.001)
United Kingdom	0.8456	0.0024	0.0023	0.8556	-0.2733	-0.5796	-0.0331	-0.0002
	(0.038)		(0.002)	(0.021)	(0.072)	(0.211)	(0.012)	(0.002)
Japan	0.8909	0.0011	0.0014	0.7313	-0.3852	2.2525	0.0552	0.0015
	(0.081)		(0.005)	(0.062)	(0.165)	(0.587)	(0.023)	(0.004)
Germany	1.3778	0.0037	0.0042	1.4092	-0.2470	-0.1373	-0.0233	0.0004
	(0.080)		(0.003)	(0.071)	(0.098)	(0.340)	(0.015)	(0.003)
Mean pricing error			0.0156					0.0001
	dWrlmE		test on over identification	dWrlmE	dCurrB	dIPG7	dOil	test on over identification
Risk premium	0.0001		37.39	0.00521	-0.01156	-0.01306	0.37587	12.85
	(0.0004)		0.0004	(0.002)	(0.010)	(0.010)	(0.219)	0.9983

- Beta below unity
- High pricing error in the one factor model
- Test on over-identification must be rejected (rare event)
- Lower pricing error in multifactor model
- High risk premium on oil
- High factor loading of container sector to industrial production
- Test on overidentification passes in the multi-factor model

Conlusion

- The shipping sector exhibits low risk in terms of beta.
- We find a high portion of unsystematic risk in the shipping industry.
- The market risk alone is not sufficient to price shipping stocks in an asset pricing test.
  - Risk in the shipping industry is multidimensional .
  - Investors should not „only look on the beta“ when making decisions on ship investments.
- We find that the equity market risks, the currency risk, industrial production, and the change in the oil price drive shipping returns.
- We conclude that the shipping industry exhibits a specific risk return profile and should therefore be regarded as a specific asset class.
- The exposures in combination with the factor risk premia allow – in general – to calculate the cost of capital.

Quellen (1)

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Results: Global economic risk factors (backup)

Table 6: Long run risk with sector indices

	One factor model			Four factor model				
	dWrldE beta	Average return % per month	Average pricing error %	dWrldE beta	dCurrB beta	dIPG7 beta	dOil beta	Average pricing error %
Container	0.9154	0.0216	0.0206	0.8856	-0.4990	1.0201	0.0738	-0.0022
	(0.121)		(0.008)	(0.252)	(0.430)	(1.567)	(0.056)	(0.002)
Tanker	0.9924	0.0289	0.0273	0.8180	-0.7033	0.2275	0.0903	0.0018
	(0.093)		(0.007)	(0.226)	(0.375)	(1.713)	(0.068)	(0.002)
Bulker	0.8904	0.0430	0.0429	0.6817	-1.3043	0.9821	0.0817	0.0003
	(0.160)		(0.011)	(0.323)	(0.578)	(1.984)	(0.072)	(0.001)
Energy	0.9820	0.0101	0.0096	0.7502	-0.2269	-1.5983	0.1526	-0.0007
	(0.076)		(0.004)	(0.144)	(0.177)	(1.049)	(0.066)	(0.001)
Materials	1.1190	0.0108	0.0096	0.9977	-0.3775	-1.0162	0.0299	0.0008
	(0.060)		(0.004)	(0.132)	(0.219)	(1.156)	(0.056)	(0.002)
Industrials	0.9374	0.0048	0.0035	0.9659	0.0327	0.4487	0.0052	0.0006
	(0.032)		(0.001)	(0.091)	(0.160)	(0.480)	(0.022)	(0.002)
Consumer Discretionary	1.1241	0.0008	-0.0011	1.1850	0.2280	0.3550	0.0017	0.0010
	(0.030)		(0.002)	(0.091)	(0.162)	(0.488)	(0.026)	(0.002)
Consumer Staples	0.4993	0.0026	0.0023	0.3285	-0.2922	-0.2909	-0.0463	-0.0011
	(0.058)		(0.003)	(0.121)	(0.130)	(0.847)	(0.037)	(0.002)
Health Care	0.4038	0.0002	-0.0002	0.3475	-0.0595	0.3251	-0.0718	0.0012
	(0.057)		(0.003)	(0.138)	(0.212)	(0.616)	(0.037)	(0.002)
Financials	0.9676	0.0036	0.0024	0.9425	-0.1304	0.1075	-0.0539	0.0007
	(0.042)		(0.002)	(0.100)	(0.112)	(0.536)	(0.035)	(0.001)
Information Technology	1.5212	-0.0022	-0.0056	1.9957	0.6236	-0.0068	0.0913	0.0000
	(0.109)		(0.005)	(0.231)	(0.263)	(1.180)	(0.069)	(0.002)
Telecommunication Services	1.0405	-0.0011	-0.0033	1.1983	0.0937	0.5024	-0.0545	-0.0016
	(0.063)		(0.004)	(0.171)	(0.238)	(1.041)	(0.072)	(0.003)
Utilities	0.7091	0.0054	0.0048	0.4516	-0.4185	-0.6528	-0.0357	-0.0011
	(0.076)		(0.003)	(0.160)	(0.172)	(0.867)	(0.049)	(0.001)
Mean pricing error			0.0087					-0.00002
	dWrldE		test on over identification	dWrldE	dCurrB	dIPG7	dOil	test on over identification
Risk premium	0.0014		60.69	0.0031	-0.0249	0.0040	0.0658	19.25
	(0.0003)		0.0001	(0.001)	(0.014)	(0.006)	(0.054)	0.9999

- Beta below unity
- The shipping sector is a mid beta sector when compared to the other indices' betas
- Also in this specification the test on over-identification passes only in the multi factor world
- The global risk factors of the shipping subsectors differ not much among themselves, but to the ones of the other industries.

Backup: Thin Trading

- Most of the shipping stocks in our sample are „small stocks“ when it comes to measures of size and liquidity.
- Dimson(1979) and Scholes and Williamson(1977) reported serious problems of thin trading for these class of stocks
  - Gong et al. (2006) does the investigation for the shipping industry.
- We avoid the reported problems in serveral ways:
  - In the study we use monthly data. Gong et al. (2006) reports the the bias is smaller when using monthly stock returns.
  - We use aggregated data in the shipping sector. Sercu et al. (2008) reports more reliable betas for portfolios than for single stocks.