THE POTENTIAL IMPACT OF A LEVY ON BUNKER FUELS ON DRY BULK SPOT FREIGHT RATES

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ABSTRACT

The objective of this paper is to assess the effect of bunker fuel prices on spot dry bulk freight rates, including coal. The study will also examine how the effects of a carbon tax on bunker fuels will affect spot freight rates for these dry bulk markets. The paper analyses and models the elasticities of spot freight rates with respect to bunker fuel prices from a top down approach, and probes some of the assumptions regarding market structure and competition on routes. The study analyses time series data drawn from Clarkson's Shipping Information Network database and reports the characteristics of relevant shipping cycles for the various series. Inter alia, work package 4 is analysing the economics of shipping markets, and the characteristics of boom-bust cycles and their impact on future requirements and market structure. Previous studies have shunned coal markets which provide an interesting case study of dry bulk shipping, the second most polluting type of ships. Results will feed into and assist validation of the holistic model, which will in turn test various fiscal and regulatory policies to reduce shipping CO_2 emissions.

Keywords: Impact, bunker fuels, dry bulk, spot rates

1. INTRODUCTION

In 2006, approximately 2.7 billion tonnes of dry bulk cargo was transported by sea, comprising more than one-third of all international seaborne trade. Coal is the second largest dry bulk trade after iron ore with imports of 941 million tonnes in 2009 mainly into Japan and Western Europe. Between 1965 and 2005 coal trade grew at 6.3 percent per annum, the fastest among the major dry bulk trades. Sea borne coal trade is influenced by steel production and power generation. There are two types of coal trade, namely coking coal, used in steel industries, and steam coal, a major energy source for power generation. In 2006 coal fired generation accounted for 41 percent of world electricity supply. Thermal coal trade grew at 9 percent per annum between 1980 and 2005 while the coking coal trade grew at only 2 percent per annum. At present most of the trade is in steam coal which represents 72 percent of world coal trade. The share of coking coal imports by Asian countries is expected to increase to 67 percent in 2030 (IEO, 2009).

A number of developing countries have decided to capitalise on the recent dramatic increase in oil and gas prices to build new power plants that utilise coal. This has resulted in significant growth in the steam coal trade. The most dramatic growth has occurred in China and Indonesia, both of which have increased their export capacity in the intra-Asian market. Furthermore, in the global market for steam coal, China is a major importer and Australia is the largest exporter.

With the increase in oil prices during the 1970s thermal coal became more competitive as a source of energy and from 1979 onwards there was a rapid increase in thermal coal imports. In 2009 Japan, China, South Korea, India, Germany and the UK were the top coal importers. Europe, Japan and South Korea use large quantities of coking coal but power generation is also a huge market. As transport costs account for a large share of the total delivered price of coal, international trade in steam coal is divided into 2 regional markets, the Atlantic and the Pacific. The Atlantic market consists of the UK, Germany and Spain. The Pacific market consists of developing and OECD Asian importers, mainly Japan, Korea and China. Australia is the world's largest coal exporter providing more than one-third of the total volume followed by Indonesia, Russia, Colombia, South Africa, USA and Canada. Australia is also the largest supplier of coking coal. Australia, South America, southern Africa and Eurasia are expected to expand their international coal trade by 2030.

Coal will continue to play a key role in the world's energy mix, with demand in certain regions set to grow rapidly. Growth in both the steam and coking coal markets will be strongest in developing Asian countries, where the demand for electricity and the need for steel in construction, car production, and demand for household appliances will increase as income rises. The largest increase in coal consumption through 2030 is projected for non-OECD Asia mainly China. China accounts for 47 percent of global coal consumption which is likely to reach 53 percent by 2030. Japan is expected to remain the world's largest coal importer in most years of projection. India, South Korea and Taiwan are also expected to import most of the coal they consume.

The estimates of UK coal production for the period 2005-2030 show that production will fall from about 22 million tonnes in 2005 to over 2 million tonnes in 2030. Therefore coal fired power stations will have to depend on imported coal. MDS Transmodal (2007) has assumed that from 2020 to 2030 the amount of coal required for electricity generation will remain constant at 27.4 million tonnes

Table 1: **Steam Coal Requirement in the UK up to 2030 (Source: Adapted from MDS Transmodal 2007)**

	2010	2015	2020	2025	2030
Steam Coal required (tonnes)	45.8	29.8	27.4	27.4	27.4
UK coal production	21.2	14.3	6.9	2.2	2.2
Import requirement for power generation	24.7	15.5	20.5	25.2	25.2

2. THE EFFECT OF BUNKER PRICE INCREASES ON COAL FREIGHT RATES

Coal is a low value commodity and transport costs constitute a large proportion of the delivered price (Notteboom and Vernimmen, 2009). If inflated bunker prices significantly impacts the spot freight rate for coal it will also affect the delivered market price of coal. Usually, the higher the value of the product the less impact the increased transport cost will have on final price. The major coal producing areas such as Australia, Colombia, South Africa and the United States are relatively distant from some of the major consuming areas such as Europe and Japan. The biggest market for coal is Asia, which currently accounts for 54% of global coal consumption. China consumes a significant proportion of this. Japan, Chinese Taipei and Korea import significant quantities of steam coal for electricity generation and coking coal for steel production. Capesize (the largest bulk carrier usually >100,000 deadweight tonnes (dwt)) and Panamax (the largest bulk carrier that can transit through the Panama Canal, 60,000 to 100,000 tonnes) vessels are used for international coal shipping. Asian coal is primarily traded in Capesize and Panamax tonnage. European countries tend to import steam coal from exporters in the Atlantic region using Panamax vessels due to origin-port draught restrictions.

3. DETERMINANTS OF FREIGHT RATE

Factors including commodity demand, global levels of industrial production, imports of coal by power stations and performance of the steel industry have a positive impact on freight rates. Factors including fleet supply and the availability of different types of ships tend to depress freight rates. Bunker fuel is a considerable expense and accounts for between a quarter and a third of vessel operating costs (Notteboom and Vernimmen, 2009). Thus higher oil prices will probably be reflected in higher freight rates. Where the market allows, ship owners will typically seek to compensate any increase in bunker costs with a higher freight rate by passing it on to the shippers. Therefore, the higher the bunker price the higher the freight rates. To the extent that the percentage change in freight rate is less than the change in bunker price, some portion of the cost will be borne by the ship owners. Weather has a major impact on both demand and logistics. Weather can lengthen loading, unloading and voyage time and severely impact port efficiency. Regarding demand, cold weather may increase the demand for coal and other energy creating raw materials. Regarding logistics, cold weather may cause ice to block ports and low rivers to prevent vessel movement. Both of these impacts cause increases in the freight rate. Conversely, a mild winter or early ice breakup in cold water ports will reduce the freight rate. Steam coal is linked to the energy markets and in general encounters upswings towards the end of the year in the northern hemisphere in anticipation of the forthcoming winter period as power supply companies try to increase their stocks, or during hot summer periods when increased electricity demand is required for air conditioning and refrigeration purposes.

The objective of this study is to determine the elasticity of spot freight rate with respect to spot bunker price, i.e., the percentage change in freight rate in response to a 1 percent change in bunker price. Vivid Economics (2010) has studied iron ore, grain, crude oil and container shipping. They found the average elasticity of the freight rate with respect to bunker prices to be 0.37 for VLCCs across a variety of routes, 0.25 for Panamax grain vessels, 0.96 for Capesize ore vessels and 0.11 for container ships. The United Nations Conference on Trade and Development (UNCTAD) has looked at the effect of oil prices on container freight rates along the three main East–West container routes - the transpacific, the transatlantic and Asia–Europe. The study finds that oil prices affect bunker fuel costs and maritime freight rates. However the effect of oil prices on freight rates is slightly higher during periods of rising and volatile oil prices than periods of low and stable oil prices

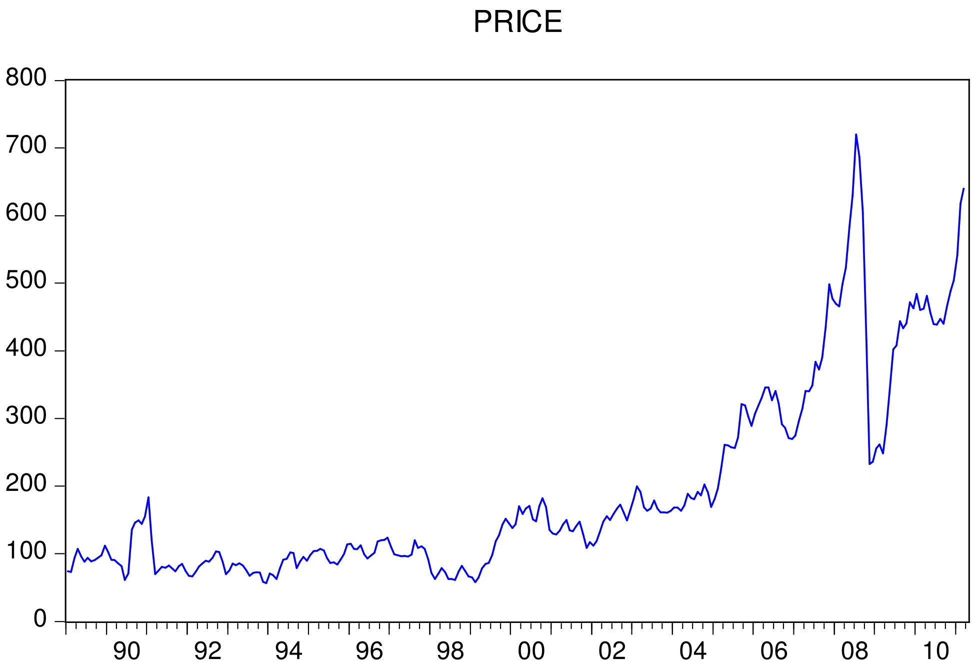

Figure 1: 380 CST Singapore Bunker Price

Figure 1 shows the 380 Cst Singapore bunker fuel price in USD per tonne over the period 1990 to 2010. There has been an upward trend in bunker price notably since 2007. Bunker prices constantly fluctuate due to market forces and the cost of crude oil. The bunker market is extremely price sensitive with ships often basing decisions on where to bunker on the relative price of fuel available in respective ports. Bunkering decisions are impacted by relative price premiums arising as a result of different fiscal policies across countries and regions, especially in terms of fuel taxes. As mentioned before a bunker price increase raises the cost of shipping.

In this study two econometric models are used to estimate freight rate elasticities. The OLS model uses 380 Cst Singapore bunker price, trade volume and fleet size as explanatory variables to explain changes in the absolute level of the freight rate. The Error Correction Model (ECM) is estimated to take into account the dynamics of a long run relationship between the variables. Data are taken from Clarkson's database. Table 2 presents OLS estimates for the elasticity of monthly spot freight rates with respect to 380 Cst Singapore spot bunker price for 5 Capesize and 6 Panamax routes.

Table 2: Spot freight rate elasticity of coal with respect to bunker price

Origin	**Destination**	**Cargo and ship type**	**Data availability**	**Elasticity (OLS estimate)**
Queensland	Japan	Coking coal, Capesize	1989-Feb 2011	1 (0.07)
H.Rds, R.Bay	Japan	Steam coal, Capesize	1987-2005	0.6 (0.09)
Queensland	Rotterdam	Coking coal, Capesize	1999-Jan 2011	1.36 (0.12)
Richard's Bay	Rotterdam	Steam coal, Capesize	1989-April 2011	1.24 (0.1)
Richard's Bay	Rotterdam	Steam coal, Capesize	1989-April 2011	1.15 (0.1)
H. Rds.	ARA	Coking coal, Panamax	1999-Jan 2011	1.07 (0.13)
Richard's	Sp. Med.	Coking coal,	2000- 2010	1.13 (0.16)

Bay		Panamax		
USA	ARA	Steam coal, Panamax	1998-2010	0.93 (0.12)
NSW	Cont.	Steam coal, Panamax	1999-Jan 2011	0.99 (0.14)
Newcast.	Japan	Coking coal, Panamax	May 1991-Feb 2011	1.04 (0.08)
Roberts Bank	Japan	Steam coal, Panamax	1987-Feb 2011	0.87 (0.07)

Elasticity of freight rate for coking coal with respect to bunker price ranges from 1 to 1.36 that is 1 percent increase in spot bunker price would increase spot freight rate by 1 to 1.36 percent. There is a considerable variation in the elasticities between routes and between coking coal and steam coal. Elasticity of freight rate for steam coal varies from 0.6 to 1.24. Freight rate elasticity is higher for coking coal than steam coal and coking coal is also more expensive than steam coal. The estimate of the elasticity on H. Rds, Richard's Bay to Japan route is lowest for steam coal. The elasticity on Queensland-Rotterdam route for coking coal is found to be highest. These results have important implications given that the trend of demand has shifted from the Atlantic market to the Pacific due to growth in demand from China and India coupled with supply growth from Australia and Indonesia. The shift towards the Pacific market will pose logistical issues for both Australia and Indonesia and also from Russia and the US.

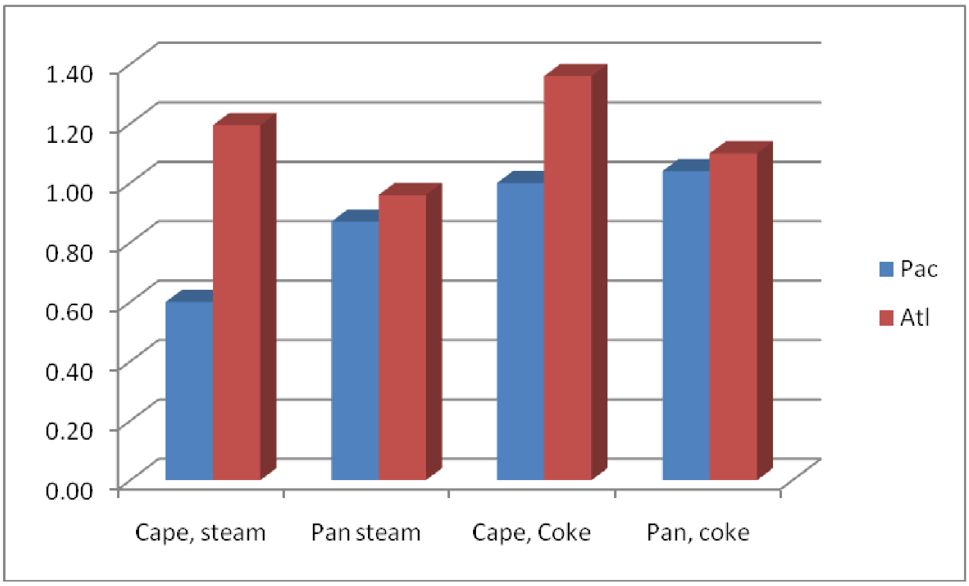

Figure 2: Average Elasticity for Atlantic/Pacific, Steam/Coking coal and Capesize/Panamax

Average elasticities are higher for coking coal, Panamax vessels and Atlantic market than the steam coal, Capesize vessels and Pacific market. In view of non-stationarity of several series we find the ECM estimates for some routes. Estimating a model with time series variables requires that either all time series variables in the model are stationary or they are cointegrated. It means that the variables are integrated of the same order, errors are stationary and the model defines a long run equilibrium relationship among the cointegrated variables. Therefore the first step is to conduct a unit root test on each variable to find if there is stationarity in the series. If there is non-stationarity then the next step is to examine if there is a cointegration between the variables. If the variables are found to be cointegrated then one can estimate a vector error correction model which shows the short run adjustments to the long run equilibrium.

Therefore first we conduct the augmented Dickey-Fuller test on each of the series: 380 Cst bunker price, freight rate for each route, trade volume and fleet size for Capesize and Panamax vessels. For instance we test the hypothesis whether the bunker price has a unit root with constant, we find that bunker price has a unit root. Then we test the hypothesis with a linear trend, we find that the bunker price has a unit root at the 1 percent level of significance but not at the 5 or 10 percent level of significance. Next we test the hypothesis with bunker price in first difference and find that it is integrated after first difference. In case of spot freight rate on most routes the series has unit root only at the 1 percent level of significance. Many trade volumes are found to be stationary. Fleet sizes have unit roots.

If two time series variables are non-stationary but cointegrated, at any point in time the two variables may drift apart but there will always be a tendency for them to have a proximity to each other. We test for cointegration using the Johansen cointegration test. Except for two routes we find that the four variables are cointegated. When variables are cointegrated there must be an error correction model that describes the short run dynamics or adjustments of the cointegated variables towards their equilibrium values. ECM consists of one-period lagged cointegrating equation and the lagged first differences of the endogenous variables. Since our model involves 4 nonstationary variables the ECM is a simultaneous equation system of 4 equations, one for each variable describing the short run adjustment of that variable towards the long run equilibrium. In many cases we did not find a stable relationship in the long run. Therefore we come up with the following stable long run elasticity estimates.

Table 3: ECM estimates for freight rate elasticity of coal with respect to bunker price

Origin	Destination	Cargo and ship type	Data availability	Elasticity
Queensland	Japan	Coking coal, Capesize	1989-Feb 2011	2.31 (0.57)
H.Rds, R.Bay	Japan	Steam coal, Capesize	1987-2005	1.81 (0.62)
Queensland	Rotterdam	Coking coal, Capesize	1999-Jan 2011	2.69 (0.54)
Newcast.	Japan	Coking coal, Panamax	May 1991-Feb 2011	1.91 (0.33)
Roberts Bank	Japan	Steam coal, Panamax	1987-Feb 2011	1.12 (0.22)

The Pattern of ECM elasticities looks similar, but consistently higher than OLS estimates.

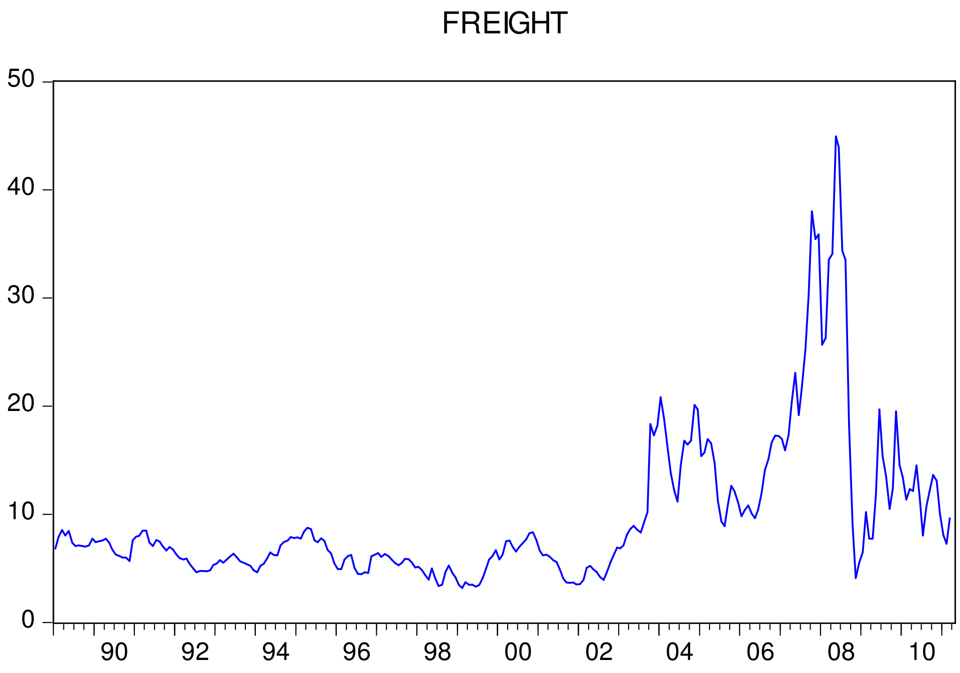

Figure 3: Spot coal freight rate from Queensland to Japan

There has been considerable volatility in spot coal freight rate for Queensland to Japan in USD per tonne between 2002 and 2008.

REFERENCES

International Energy Outlook (2009). 'US Energy Information Administration'

MDS Transmodal (2007)

Notteboom, T. & Vernimmen, B. (2009). 'The effect of high fuel costs on liner service configuration in container shipping', Journal of Transport Geography, Vol. 17, No. 5, pp. 325–337

UNCTAD (2010). 'Oil Prices and Maritime Freight Rates: An Empirical Investigation'

Vivid Economics (2010). 'Assessment of the economic impact of market-based measures', World Coal Association