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Effect of fuel price on sailing speeds in short-sea shipping

Introduction

Speed reduction is proposed to be a cost-efficient way to reduce emissions due to a non-linear relationship between fuel consumption and speed (approximated by a third power).

1) Estimate a change in speed with respect to a change in fuel prices for the years 2007-2018
2) Address identification issues arising from correlation between fuel prices and freight rates (Figure 1)

Methods

Fixed effects model (a_i route fixed effects)

$$ln\ speed_{it} = \beta_0 + \beta_1 \ln(fuelprice_t) + \beta_2 ln(freightrate_t) + \beta_3 ln(capacityutilization_{it}) + \beta_4 ln(fleetcapacity_{it}) + \beta_5\ fleetcharacteristics_{it} + \beta_6\ month_t + a_i + \varepsilon_{it}.$$

Correlation between fuel prices and freight rates can lead to biased estimates. To disentangle the effects of fuel prices and freight rates on speed, we instrument fuel price on unanticipated oil supply shocks derived from oil supply outages and on historical decomposition of oil supply shocks estimated by a structural vector autoregressive (SVAR) model proposed by Kilian (2009). Changes in global demand do not impact the oil supply shocks. Additionally, if the oil supply shocks do not impact freight rates during the same month, the elasticities are robust against the correlation between fuel prices and freight rates → **unbiased estimates.**

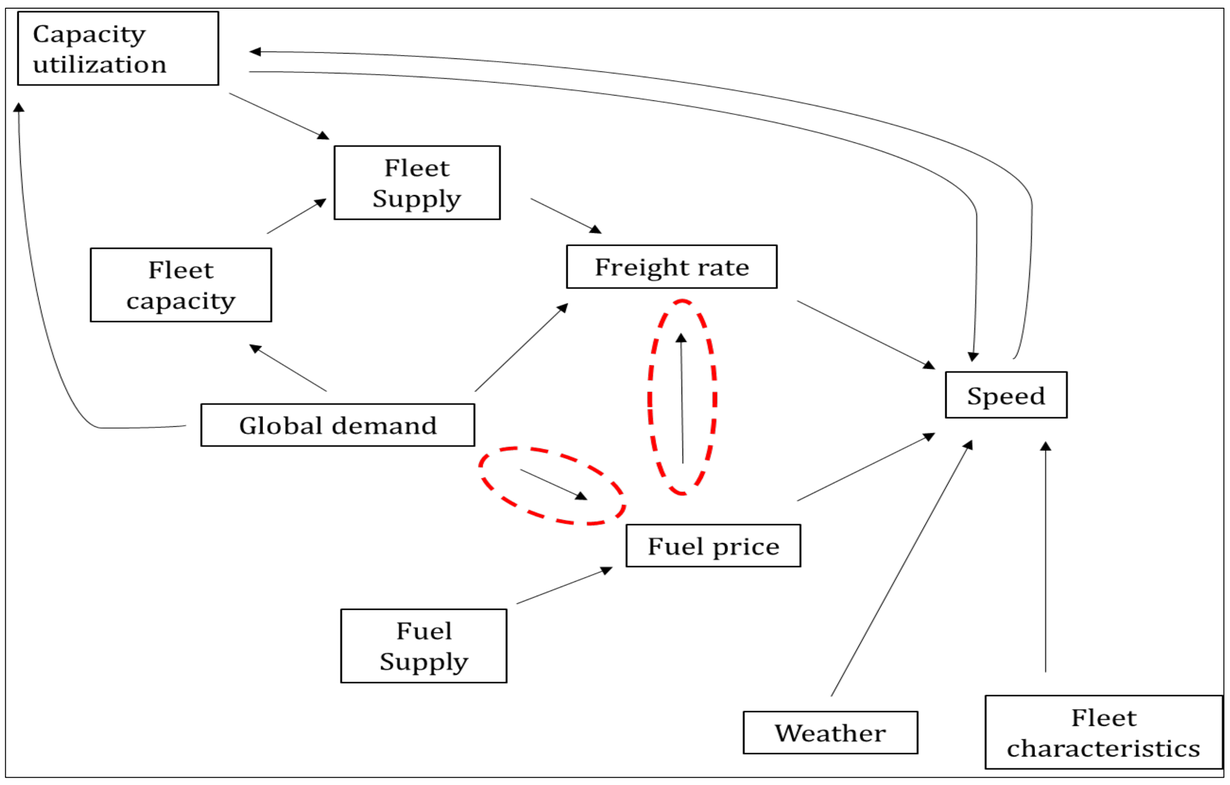

Figure 1 Ceteris paribus, sailing speed decreases with fuel price and increases with freight rate. The two red circles denote sources of correlation between fuel prices and freight rates; 1) a positive shock to global demand increases fuel prices and freight rates and 2) ship owners can pass increased fuel costs on transport buyers. Speed: AIS data on Baltic Sea and Norwegian coastal area; Fuel price: Brent crude oil (FRED); Freight rate: Baltic Dry Index (Refinitiv Eikon); Oil supply outage (EIA); Oil production (EIA); Fleet characteristics (IHS); Capacity utilization (AIS and IHS); Fleet capacity (AIS and IHS)

Results and conclusions

10% increase in fuel price leads to on average a 0.7% decrease in sailing speeds

Disregarding correlation between fuel prices and freight rates yields underestimated elasticities

Policies increasing fuel price can lead to small emission reductions also in short-run since vessels respond to increasing fuel price by decreasing speed.

	FE	IV
Fuel price	-0.0155***	-0.0688***
	(0.00345)	(0.0152)
Freight rate	0.00943***	0.0216***
	(0.00156)	(0.00373)

Table 1 Results for the years 2007-2018. The first column shows results from a fixed effects model. In the second column, fuel price is instrumented on historical decomposition of oil supply shocks. When fuel price is instrumented on oil supply outages the parameter estimate is -0.11 (2009-2018) but the results are exposed for a weak instrument problem. Robust standard errors in the parenthesis.

Kilian, L., 2009. Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market. Am. Econ. Rev. 99, 1053–1069. https://doi.org/10.1257/aer.99.3.1053

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