BUNKER LEVY SCHEMES AND THEIR IMPACT ON THE COMPETITIVENESS OF SHORT SEA SHIPPING

VASILEIOS KOSMAS
(BSc Economics, MSc Marine Transport with Management, Ph.D. Candidate)

Prof.Dr. MICHELE ACCIARO

KÜHNE LOGISTICS UNIVERSITY
HAMBURG, GERMANY

VASILEIOS.KOSMAS@THE-KLU.ORG

RESEARCH BASED ON…

2 papers:

1) Presented at SCC2015 entitled "Bunker levy schemes for GHG emission reduction in international shipping"

2) New work

NECESSITY FOR FURTHER EMISSION MITIGATION ACTIONS

- Inadequacy of existing measures
  - Emission Control Areas (ECAs)
  - Energy Environmental Design Index (EEDI)
  - Ship Energy Efficiency Management Plan (SEEMP)

- Market Based Measures: the new solution?
  - (Maritime) Emission Trading Scheme
  - Bunker Levy Scheme

SSS: high competitive environment

ECAs= operational cost increase

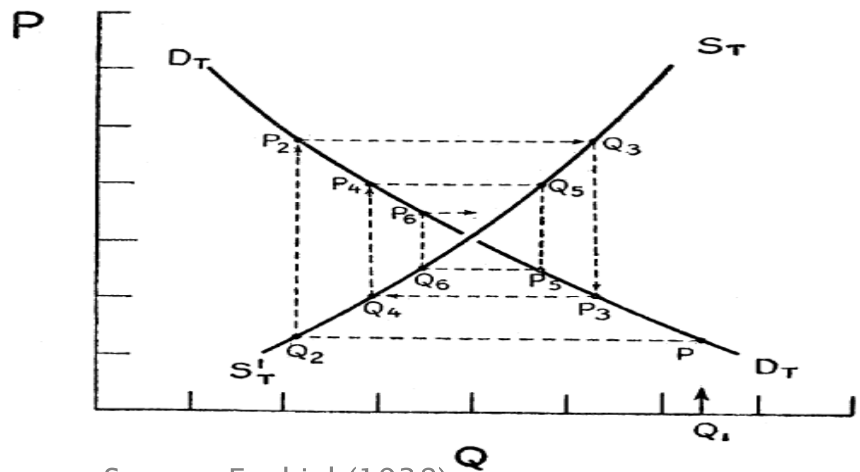
Bunker levy schemes = modal shift ?

AIM OF THE RESEARCH PAPER

- Effect of this regulatory regime on the competitiveness of SSS against road transportation (modal shift).
  - a unit tax per ton of fuel
  - an ad valorem tax; as percentage of fuel prices

METHODOLOGY

- Equilibrium in shipping; interaction among the four markets
- Application of the cobweb theorem to the shipping industry
- Binary Choice Model



Source: Ezekiel (1938)

ASSUMPTIONS

New order for ships at period t according to Luo et al.(2009)

$$N_{t=}\ n \times \Pi_t$$

n= average proportion of profit accounting for new vessel purchase

Π= Profit ,

$$\Pi_t = P_t W_t - F_t \Psi_t$$

P=freight rates ($/TEU), W= TEUs carried, F=fuel costs

$$F_t = \rho_t f_t \lambda_t S_t^3$$

$$\Psi_t = \frac{W_t * d_t}{H_t * S_t * \rho_t}$$

ρ=operating time at sea (hours), f=fuel price ($/ton), λ=coefficient of ship´s energy efficiency, S= (knots) is average speed. Ψ= no of ships required, d= route distance (nautical miles) and H is ship's average capacity (TEU)

Based on the cobweb theorem

For the unit tax scheme

$$\Delta Z_t = n(P_{t-\theta}W_{t-\theta} - (OC_{t-\theta} + \rho_{t-\theta}(f_{t-\theta}+TP)\lambda S_{t-\theta}^3)\Psi_{t-\theta})$$

$$\Delta P_t = \delta(\Delta W_t - \varphi\Delta Z_t) = \delta\Delta W_t - \delta\varphi n(P_{t-\theta}W_{t-\theta} - (OC_{t-\theta} + \rho_{t-\theta}(f_{t-\theta}+TP)\lambda S_{t-\theta}^3)\Psi_{t-\theta})$$

For the *ad valorem* scheme

$$\Delta Z_t = n(P_{t-\theta}W_{t-\theta} - (OC_{t-\theta} + \rho_{t-\theta}f_{t-\theta}(1+VP)\lambda S_{t-\theta}^3)\Psi_{t-\theta})$$

$$\Delta P_t = \delta(\Delta W_t - \varphi\Delta Z_t) = \delta\Delta W_t - \delta\varphi n(P_{t-\theta}W_{t-\theta} - (OC_{t-\theta} + \rho_{t-\theta}f_{t-\theta}(1+VP)\lambda S_{t-\theta}^3)\Psi_{t-\theta})$$

ΔW=change in cargo transported, ΔZ=change in fleet capacity, $\delta>0$=freight adjustment factor on the basis of demand and supply alterations, $\phi>0$ (constant)=average fleet capacity utilization rate.

A DYNAMIC ECONOMIC DISCRETE CHOICE MODEL

$$P_j = \exp(V_j) \Big/ \sum_{j=r,s} \exp(V_j) = 1/(1 + \exp(V_r - V_s))$$

$$U_r = V_r = \theta_{r1}x_{r1} + \theta_{r2}x_{r2} + \theta_{r3}x_{r3}$$

$$U_s = V_s = \theta_{s1}x_{s1} + \theta_{s2}x_{s2} + \theta_{s3}x_{s3}$$

x_{j1}	**demand**
x_{j2}	speed
xj_3	freight rates

For the unit tax scenario

$$Us=\theta_{s1}x_{s1}+\theta_{s2}x_{r2}+\theta_{s3}\ (\delta(\Delta X_t - \varphi\Delta Z_t)= \theta_{s1}X_t+\theta_{s2}S_t+ \theta_{s3} * (\delta\Delta Xt - \delta\varphi n(P_{t-\theta}X_{t-\theta} - \rho_{t-\theta}(f_{t-\theta}+T)\lambda S_{t-\theta}^{3}\Psi_{t-\theta})+P_{t-1}))$$

For the ad valorem scenario

$$Us=\theta_{s1}x_{s1}+\theta_{s2}x_{r2}+\theta_{s3}(\delta(\Delta X_t - \varphi\Delta Z_t) = \theta_{s1}X_t+\theta_{s2}S_t+ \theta_{s3} * (\delta\Delta X_t - \delta\varphi n(P_{t-\theta}X_{t-\theta} - \rho_{t-\theta}(f_{t-\theta}+(1+T)\lambda S_{t-\theta}^{3}\Psi_{t-\theta})+P_{t-1}))$$

Bunker levy schemes= decrease of SSS´s utility

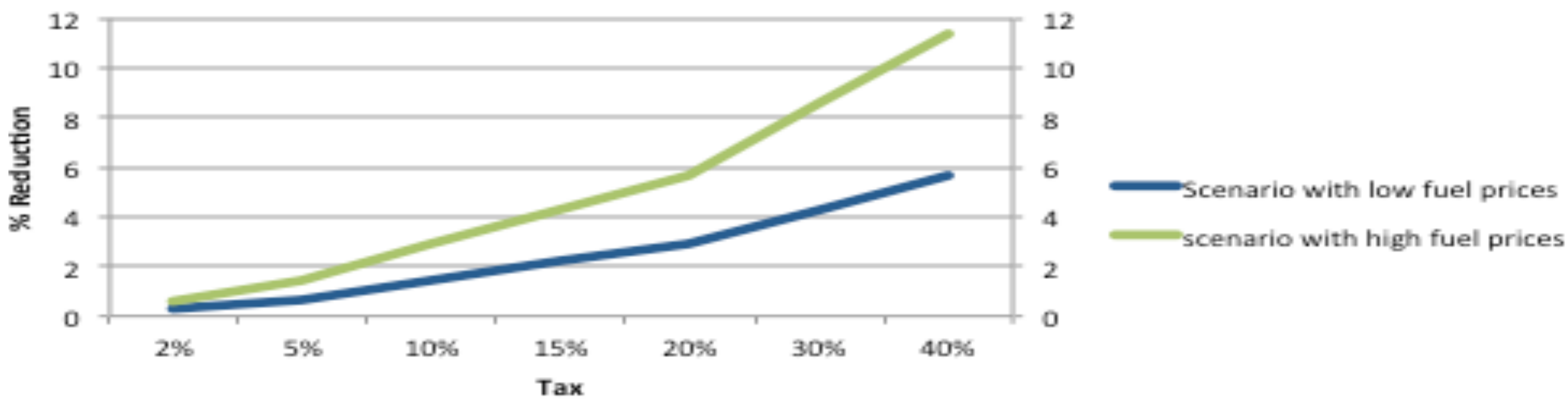
Scenario for analysis

Xs_{t-1}	**1950000 TEU**
d	750 nm
S	12 knots
H	2000 TEU
Fuel price ($/t)	300 or 600
θ_{s1}	0.000003
θ_{s2}	0.0055
P_{t-1}	800 $/TEU
λ	0.0012
θ_{s3}	-0.003
δ	0.00894
n	0.0000034
φ	42.27
θ_{r1}	0.000001
θ_{r2}	0.0045
θ_{r3}	-0.002
X_r	1500000 TEU
S_r	43 miles/hour
X_{r3}	1330 $
X_{st}	2200000 TEU
$P_{t-\theta}$	900 $/TEU
$X_{t-\theta}$	1850000 TEU

AD VALOREM SCHEME

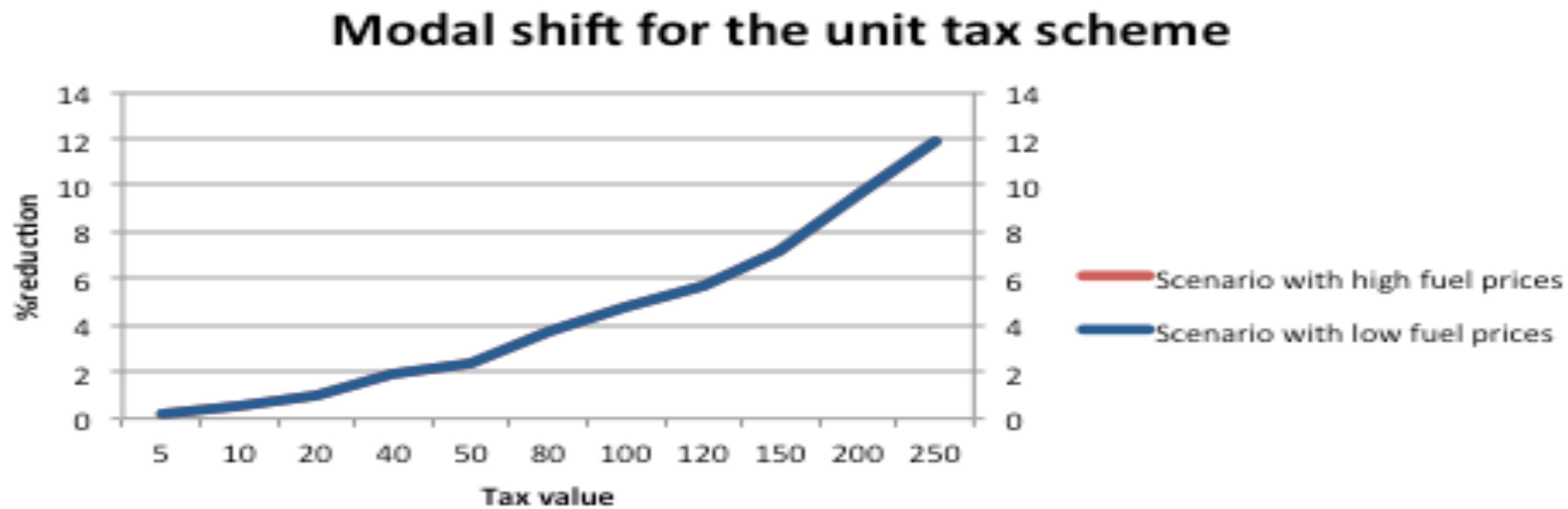
Tax percentage (%)	Modal shift percentage (%)	
	Low fuel prices (300$/t)	High fuel prices (600$/t)
2	0.3	0.6
5	0.7	1.4
10	1.4	2.9
15	2.2	4.3
20	2.9	5.7
30	4.3	8.6
40	5.7	11.4

Modal shift for the *ad valorem* scheme



UNIT TAX SCHEME

Tax amount ($/t)	Modal shift	
	Low fuel prices (300$/t)	High fuel prices (600$/t)
5	0.2	0.2
10	0.5	0.5
20	0.95	0.95
40	1.9	1.9
50	2.4	2.4
80	3.8	3.8
100	4.8	4.8
120	5.7	5.7
150	7.2	7.2
200	9.6	9.6
250	11.9	11.9



CONCLUSION

First attempt to model modal shift from SSS to road in case of bunker levy scheme enforcement

Ad valorem → SSS´s Utility decrease

Unit tax scheme → Modal shift

Policy implications: Unit tax prevents uncertainty

Future steps of this research: Sensitivity analysis of variables, Effect on Social Welfare after modal shift occurrence.

Thank you

Questions?