

Pricing the negative externalities of freight transportation: A literature review

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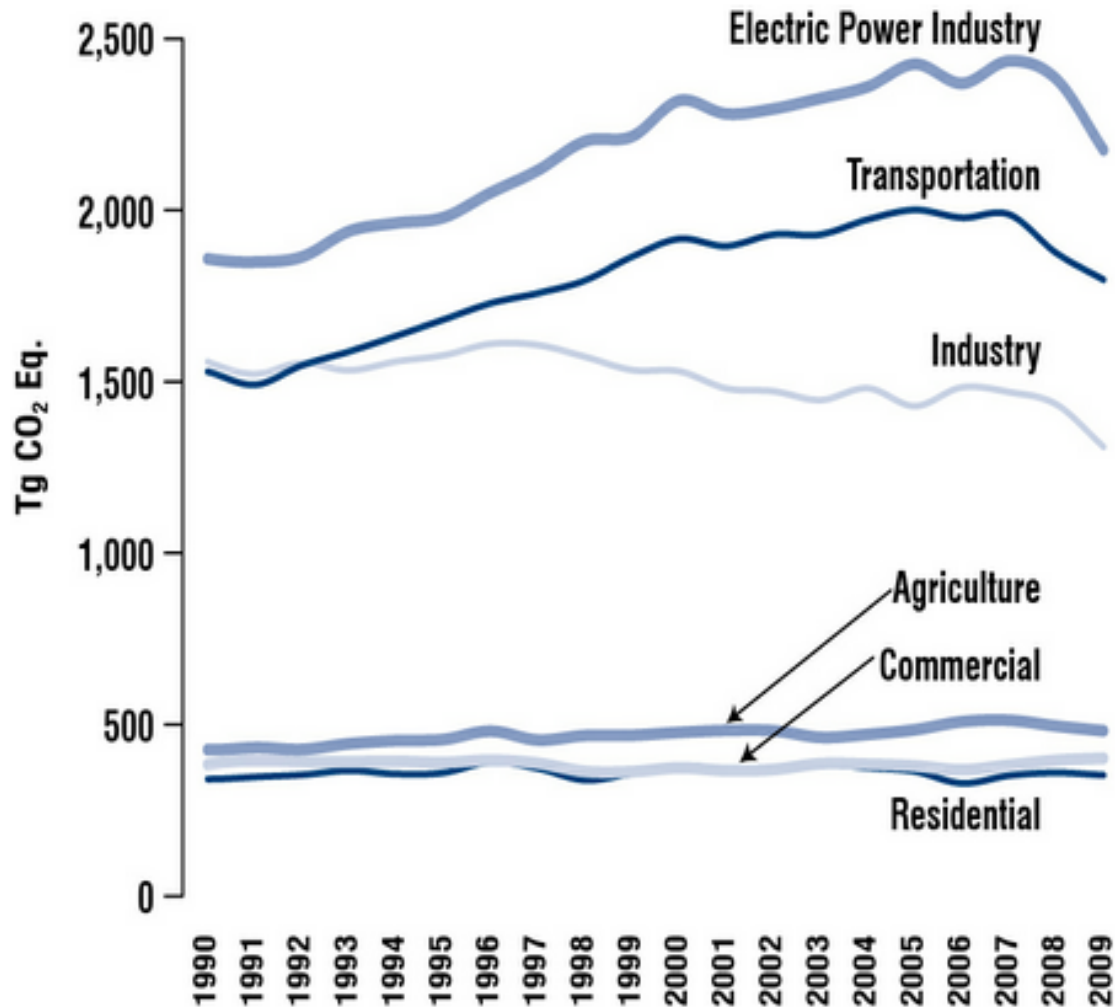
CEE298 - Project II

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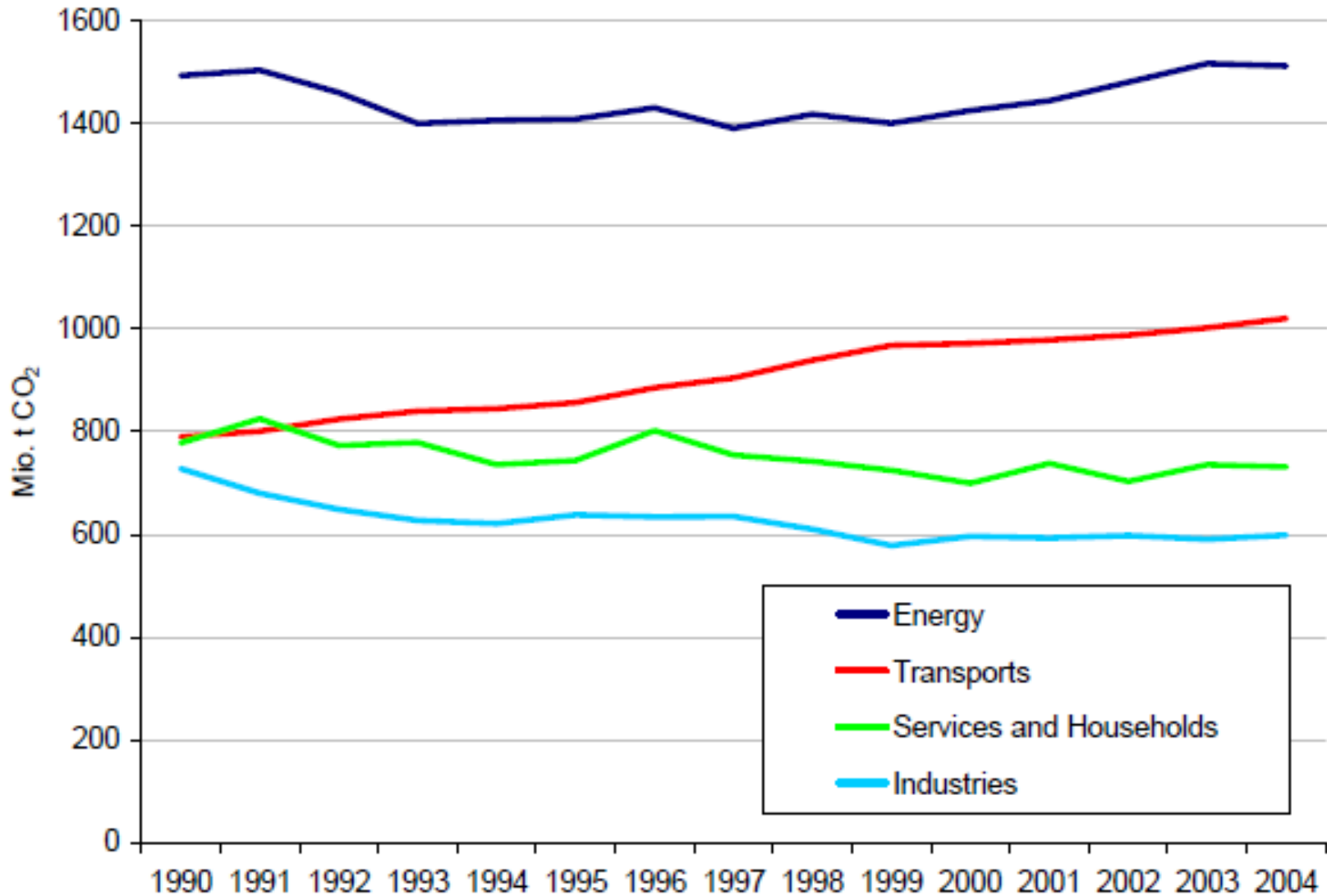
Questions

- Why consider pricing strategies?
- Can pricing affect freight mode choice?
- Can freight deliveries in urban areas be shifted to off-peak hours using pricing programs?
- What other policy alternatives exist besides pricing?

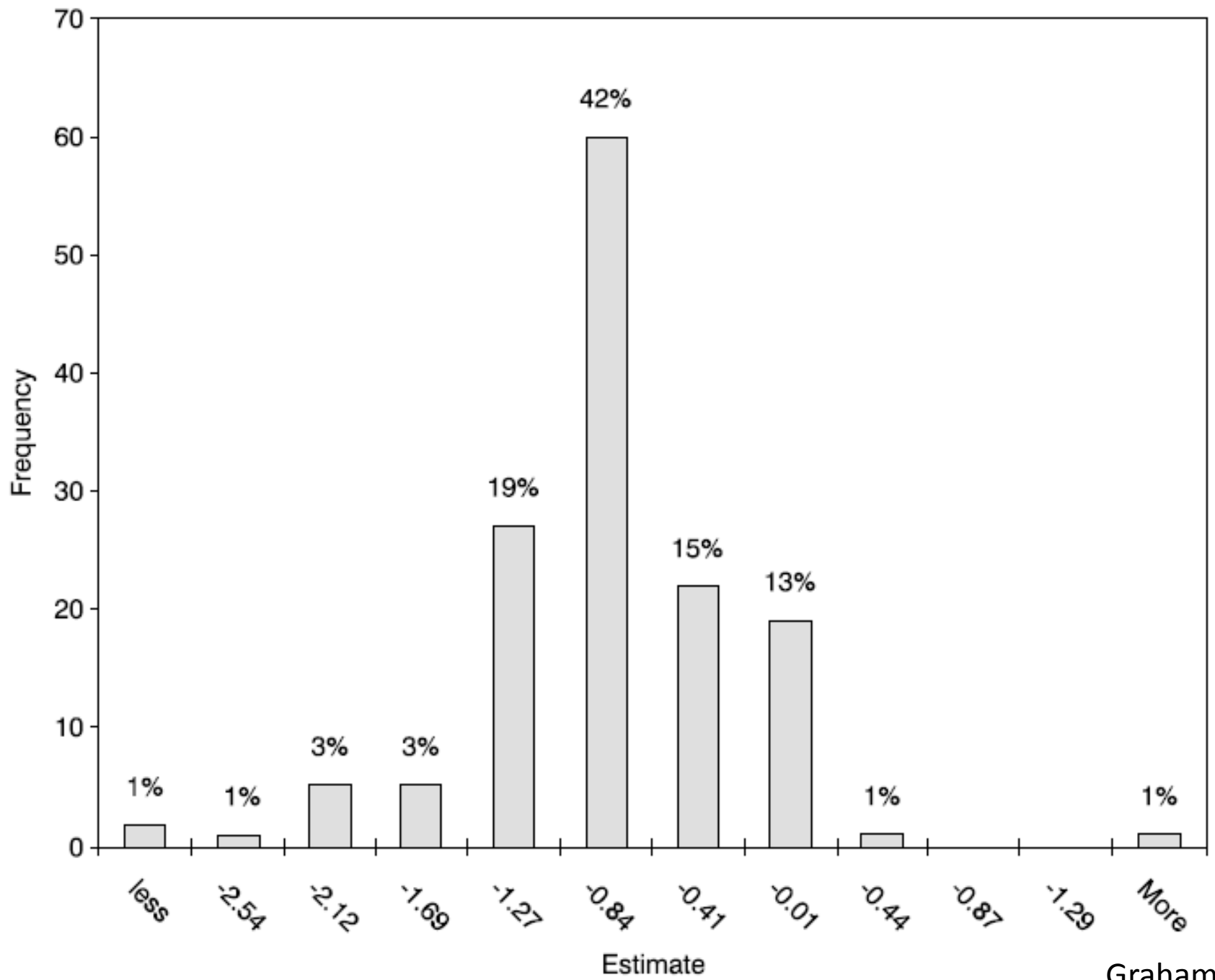
CO₂ emissions in the US



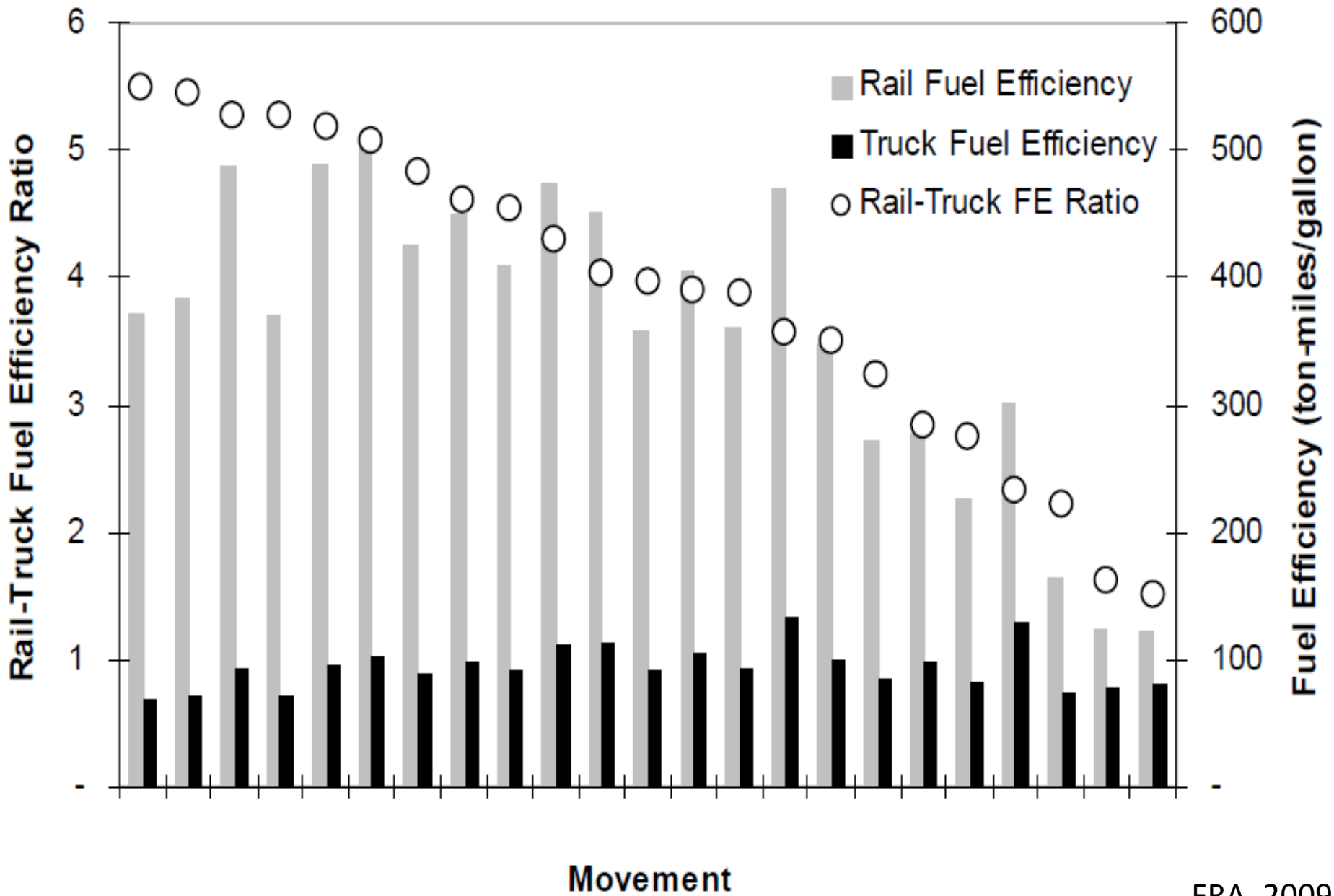
CO₂ emissions in the EU



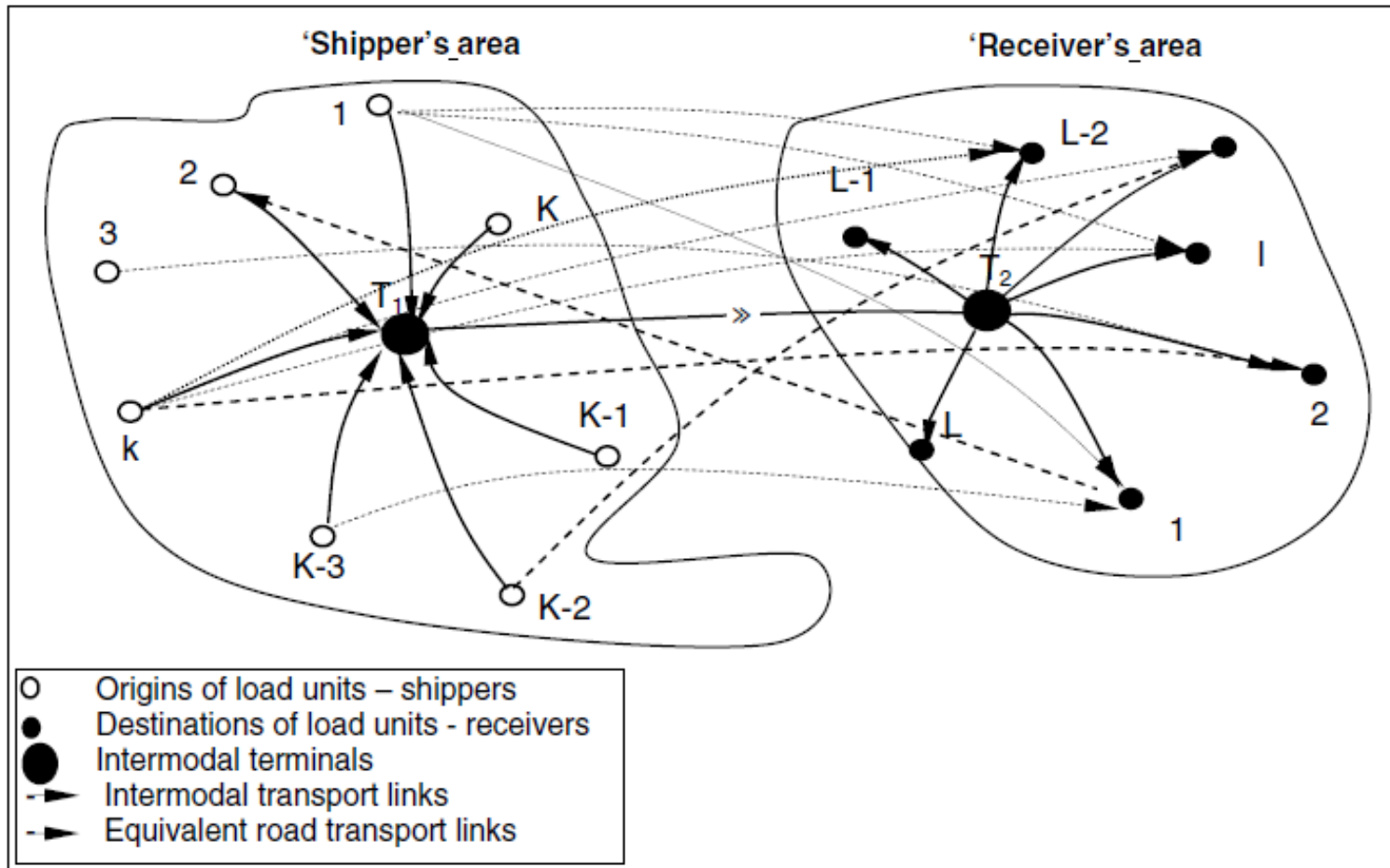
Freight transportation elasticities

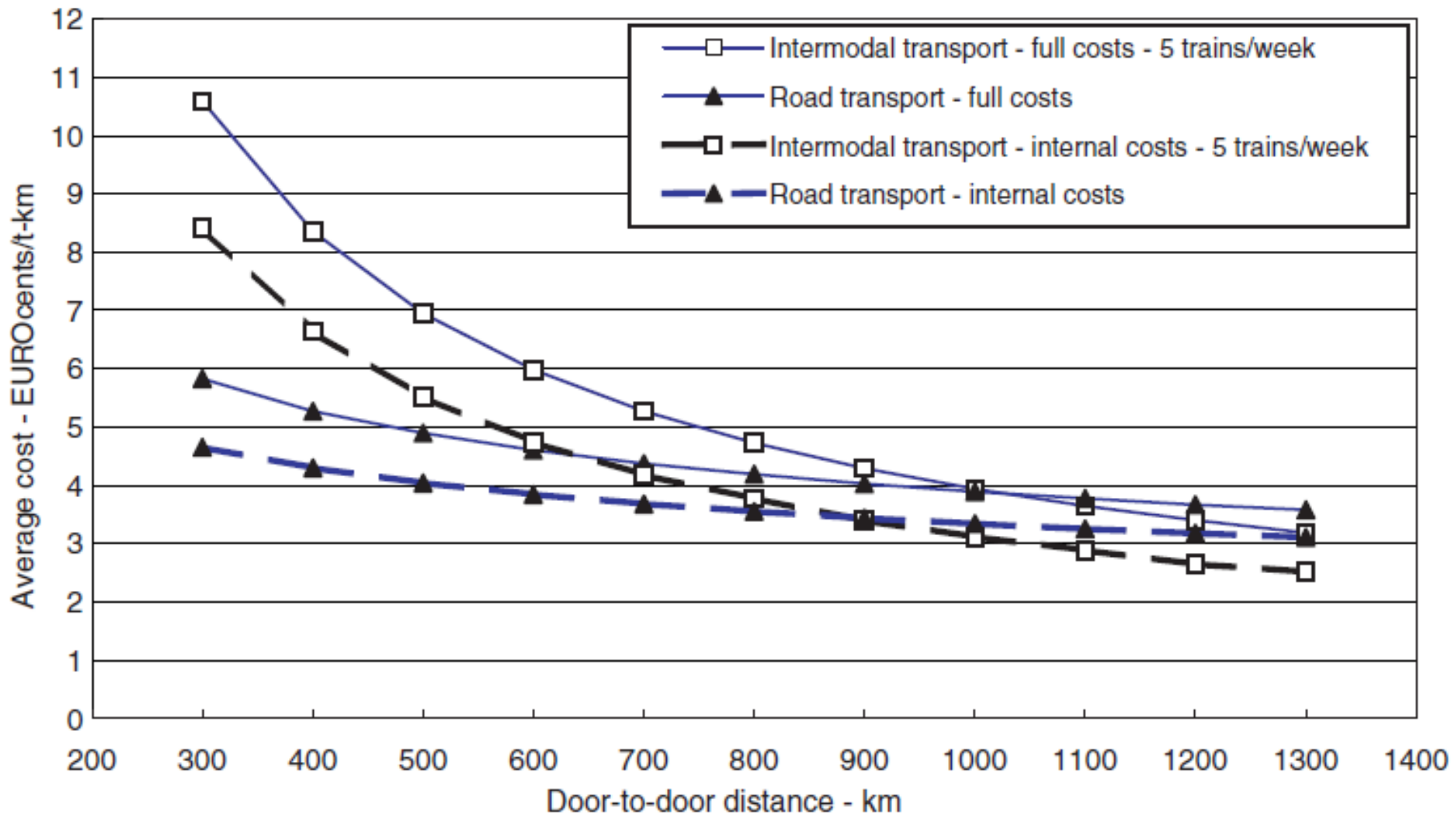


Rail vs. Truck



The full cost of road and intermodal freight transportation (Janic, 2007)





How to Stimulate Environmental Friendly Behaviour?

(Buhler and Joachim, 2008)

- Discrete binary logit model estimated using data from 500 German forwarders.
- Two scenarios considered:
 - Increase in road user charges
 - Service improvements in intermodal facilities

Elasticities of choice probability

| Attributes | Total | Large companies | Small companies |
|-------------------------------------------------------|-------|-----------------|-----------------|
| Share of commercial employees | – | -0.12 | 0.14 |
| Trip distance | 0.84 | 1.06 | 1.23 |
| Used loading unit is a trailer | -0.38 | -0.29 | -0.51 |
| Transport volume | 0.33 | – | 0.44 |
| Product characteristics: Perishable | – | -0.05 | – |
| Service arrangements: Tracking & tracing | -0.24 | -0.35 | -0.30 |
| Number of assignments on the corridor | – | 0.03 | – |
| Pairing of the trips on the corridor | – | -0.26 | – |
| Period for the organisation of the trip | 0.09 | – | 0.10 |
| Frequency of service provision in combined transport | 0,23 | 0.25 | 0.28 |
| Direct connection of the combined service | 0.09 | – | 0.11 |
| Duration of the combined transport service | -0.46 | -1.06 | -0.48 |
| Costs per kilometre of the combined transport service | -1.20 | -0.89 | -1.49 |
| Costs per kilometre of the road transport service | 0.74 | 0.78 | 0.80 |

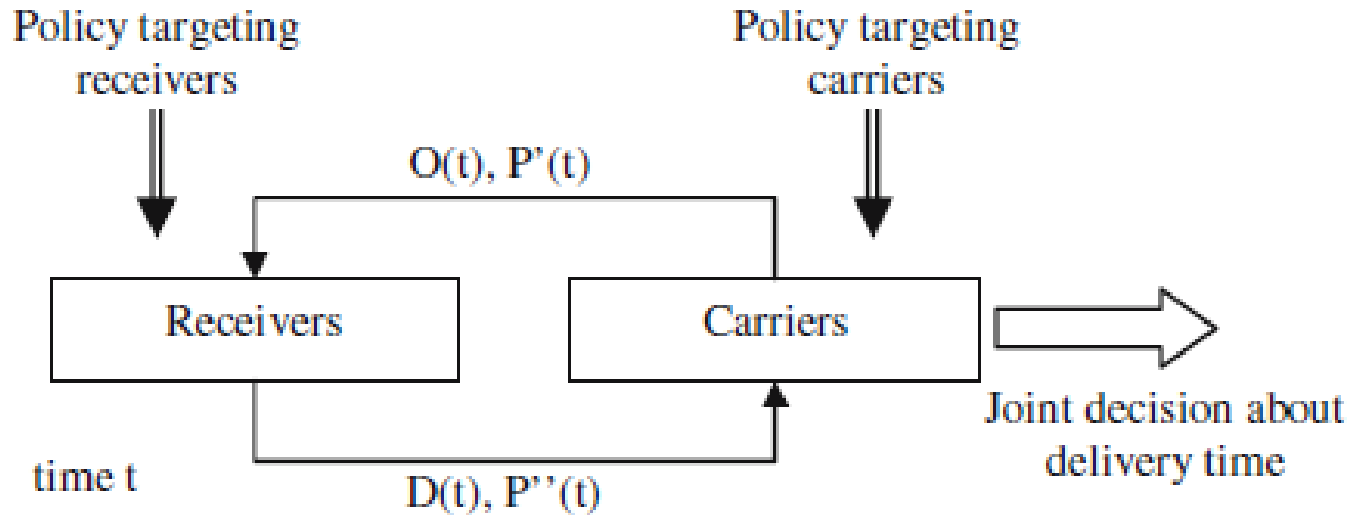
Choice simulations

- Sample enumeration was used to simulate the mode choice response to road user charges.

| Increasing costs due to road user charges on German motorways | Unimodal | Combined transport | |
|------------------------------------------------------------------|-----------------|-----------------------|-------|
| | truck transport | Pre- and post haulage | total |
| N=498 | 7.34% | 2.40% | 0.75% |

Off-peak hour deliveries

Interactions between carriers and receivers



Case Study:
PANYNJ Time-of-Day Pricing Scheme
(Holguin-Veras et al., 2006)

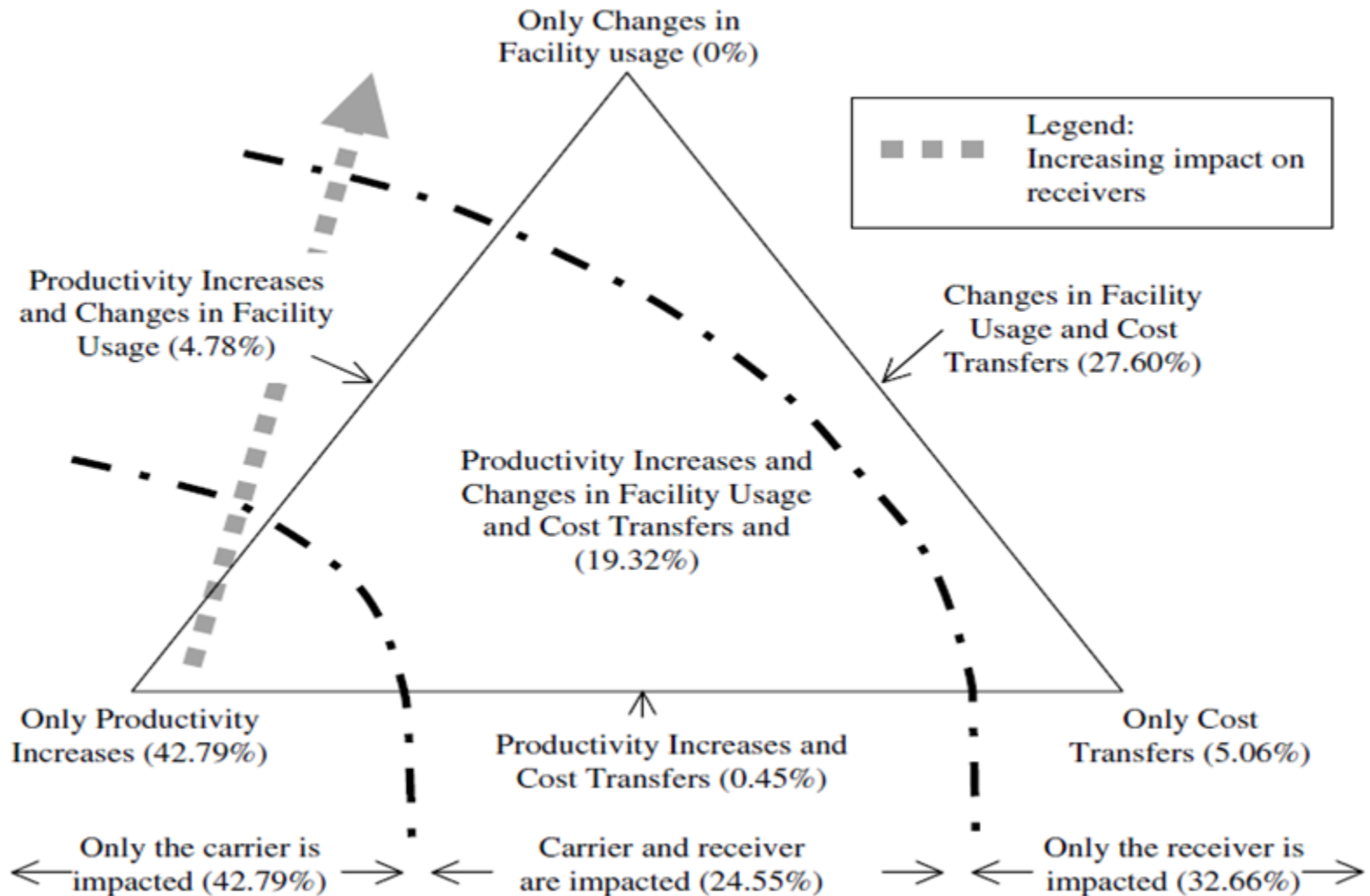


Toll schedule

Toll rates before and after the time of day pricing initiative

| Type of vehicle | Passenger cars | | Trucks | | |
|-------------------|----------------|------------|-------------|-------------|--|
| | Before | After | Before | After | |
| Cash peak | \$4.00/car | \$6.00/car | \$4.00/axle | \$6.00/axle | |
| Cash off-peak | \$4.00/car | \$6.00/car | \$4.00/axle | \$6.00/axle | |
| E-ZPass peak | \$3.60/car | \$5.00/car | \$3.60/axle | \$6.00/axle | |
| E-ZPass off-peak | \$3.60/car | \$4.00/car | \$3.60/axle | \$5.00/axle | |
| E-ZPass overnight | | | \$3.60/axle | \$3.50/axle | |

Behavioral responses to the time-of-day pricing initiative



Why carriers did not respond to the time-of-day tolls

Reasons for not changing travel behavior

| Reasons | For-hire carriers (%) | Private carriers (%) | Carriers that did not change (%) |
|-----------------------------------------------------|-----------------------|----------------------|----------------------------------|
| No flexibility | | | |
| Cannot change schedule due to customer requirements | 72.3 | 61.0 | 68.9 |
| Must use quickest route | 3.3 | 13.6 | 6.4 |
| Cost paid by others | | | |
| Customers absorb costs | 19.1 | 15.9 | 18.2 |
| Cost paid by shippers | 0.0 | 0.4 | 0.1 |
| Cost paid by receivers | 2.1 | 0.0 | 1.5 |
| Small price difference/can afford it | 0.2 | 6.1 | 2.0 |
| No change in off-peak travel cost | 0.3 | 0.4 | 0.4 |
| Do not know/refused | 2.6 | 2.5 | 2.6 |
| <i>Total</i> | 100.0 | 100.0 | 100.0 |
| <i>Total truck trips</i> | 573 | 245 | 817 |

Necessary condition for off-peak hour deliveries (Holguin-Veras, 2008)

- To illustrate the analytical approach, consider the following necessary conditions for off-peak hour deliveries to be feasible in the case of independent carrier-receiver operations:

$$\begin{array}{l} \Delta G_i(\pi_R) \geq \Delta C_i(\pi_R) \quad \forall i \in \Omega_j^O \\ \Delta G_j(\pi_C) \geq \Delta C_j(\pi_C) \\ \tau_i^O \geq \tau_{\min}^O \quad \forall i \in \Omega_j^O \end{array} \quad \longrightarrow \quad \begin{array}{l} F_{ii} \geq \Delta C_i \quad \forall i \in \Omega_j^O \\ \sum_{i \in \Omega_j^O} F_{ij} \geq \Delta C_j \\ F = F_{ii} + F_{ij} \quad \forall i \in \Omega_j^O \end{array}$$

Time-Distance pricing

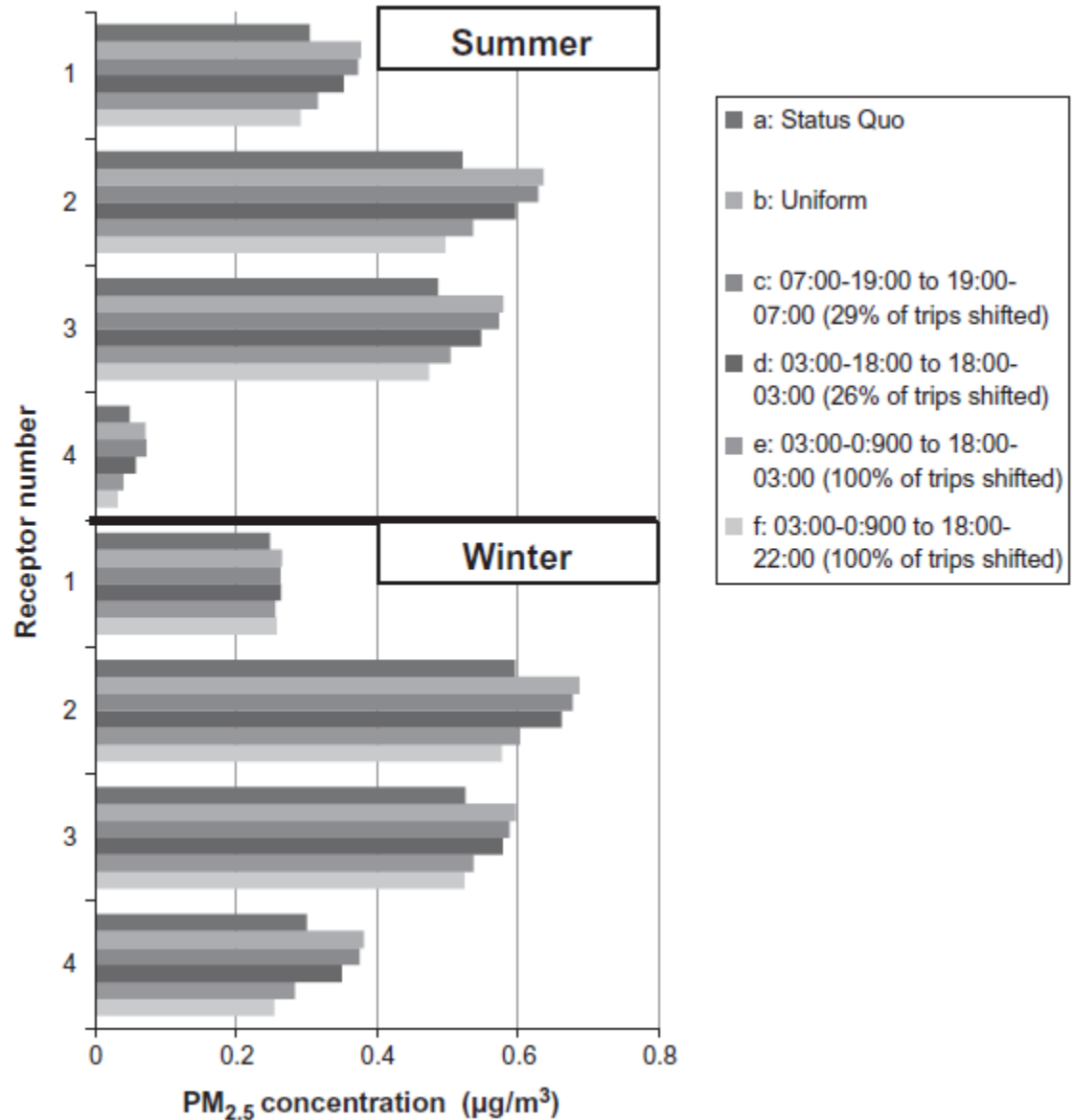
(Holguin-Veras, 2011)

“The paper established the presence of a market failure that prevents the urban delivery industry to reach the most efficient outcome, i.e., off-hour deliveries.”

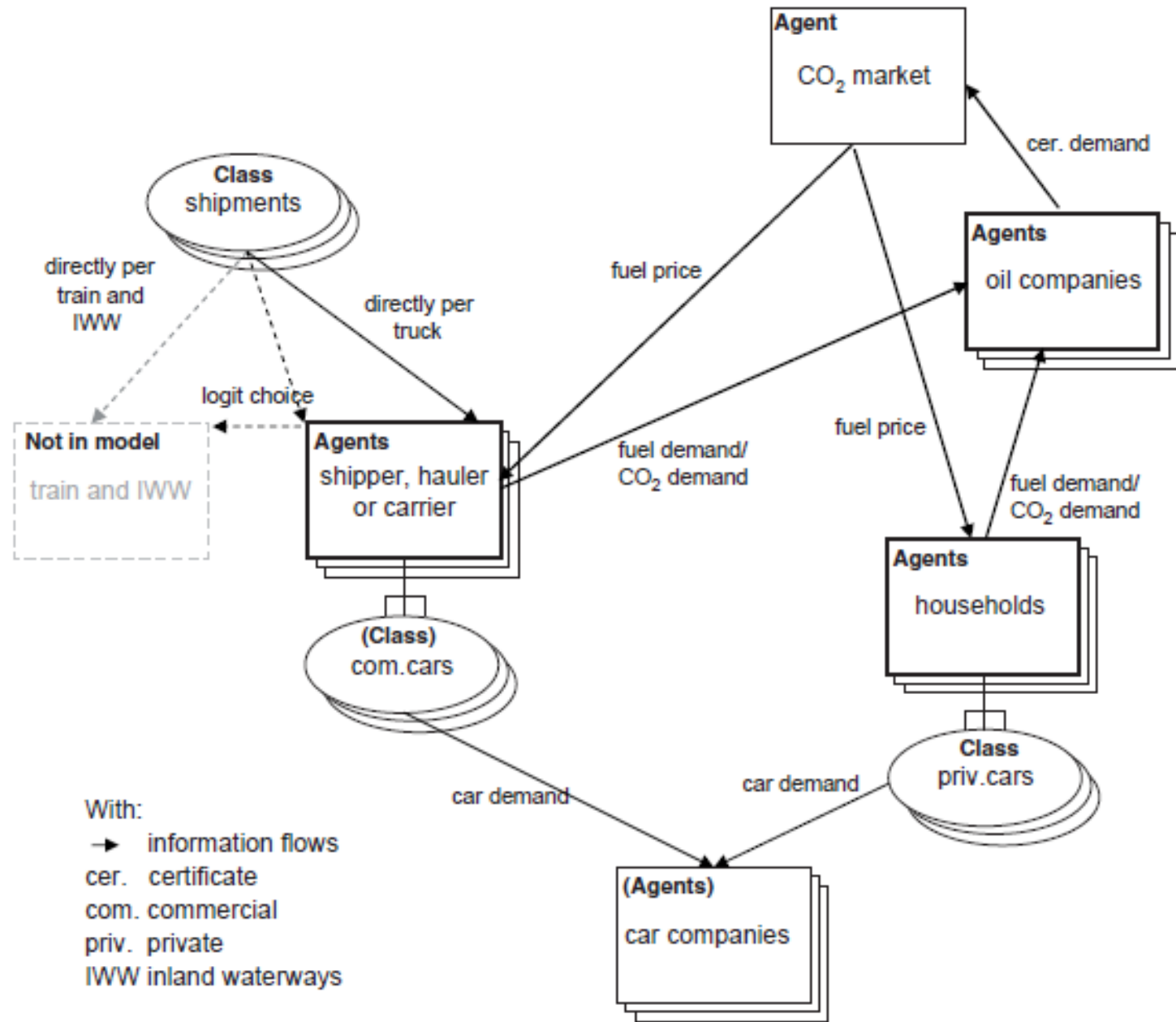
Cost-benefits of allowing night-time deliveries

| Group | Costs | Benefits |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Retailers receiving fewer restrictions | <ul style="list-style-type: none"> • Cost of noise abatement policies and measures | <ul style="list-style-type: none"> • Distribution costs • RDC costs • Journey reliability • Improved sales • Less produce waste |
| Shoppers | | <ul style="list-style-type: none"> • Fresher perishable products • Improved availability in morning |
| Residents | <ul style="list-style-type: none"> • More noise disturbance at night • Disturbance by lights at delivery point | <ul style="list-style-type: none"> • Fewer lorry trips in day-time • Less noise in day-time • Fewer vehicle trips in total • Less traffic pollution in total |
| Other road users | | <ul style="list-style-type: none"> • Fewer lorries on roads in day • Fewer vehicle trips in total • Less traffic pollution in total • Reduced risk of lorry related accidents • Reduction in congestion at the delivery point |
| Society/economy | <ul style="list-style-type: none"> • Reduced retail sales for other local retailers | <ul style="list-style-type: none"> • Reduction in total vehicle fuel consumption for delivery to stores • Fewer total vehicle kilometres • Economic growth in quiet distribution equipment sector |

Unintended consequences of night-time deliveries (Sathaye et al. 2010)



Permits



Conclusions

- Freight transportation decisions are the result of complex interactions between multiple agents
- On its own, pricing appears to have limited effect on the behavior of freight agents
- Additional research is required to ascertain the effectiveness of pricing strategies in conjunction with complementary policies

Thank you!
Questions?