Emission Reduction in International shipping—The hidden side effects

Meifeng Luo, Ph.D.

Associate Professor, Dept. of Logistics & Maritime Studies,
Director, IMC-Frank Tsao Maritime Library and R&D Center
The Hong Kong Polytechnic University

THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

IDEAS
Innovation-driven Education and Scholarship

Faculty of Business
工商管理學院

Department of
LOGISTICS
& MARITIME
STUDIES
物流及航運學系

Outline

1 Background

2 Possible impact on world trade pattern

3 Impacts on different shipping sectors

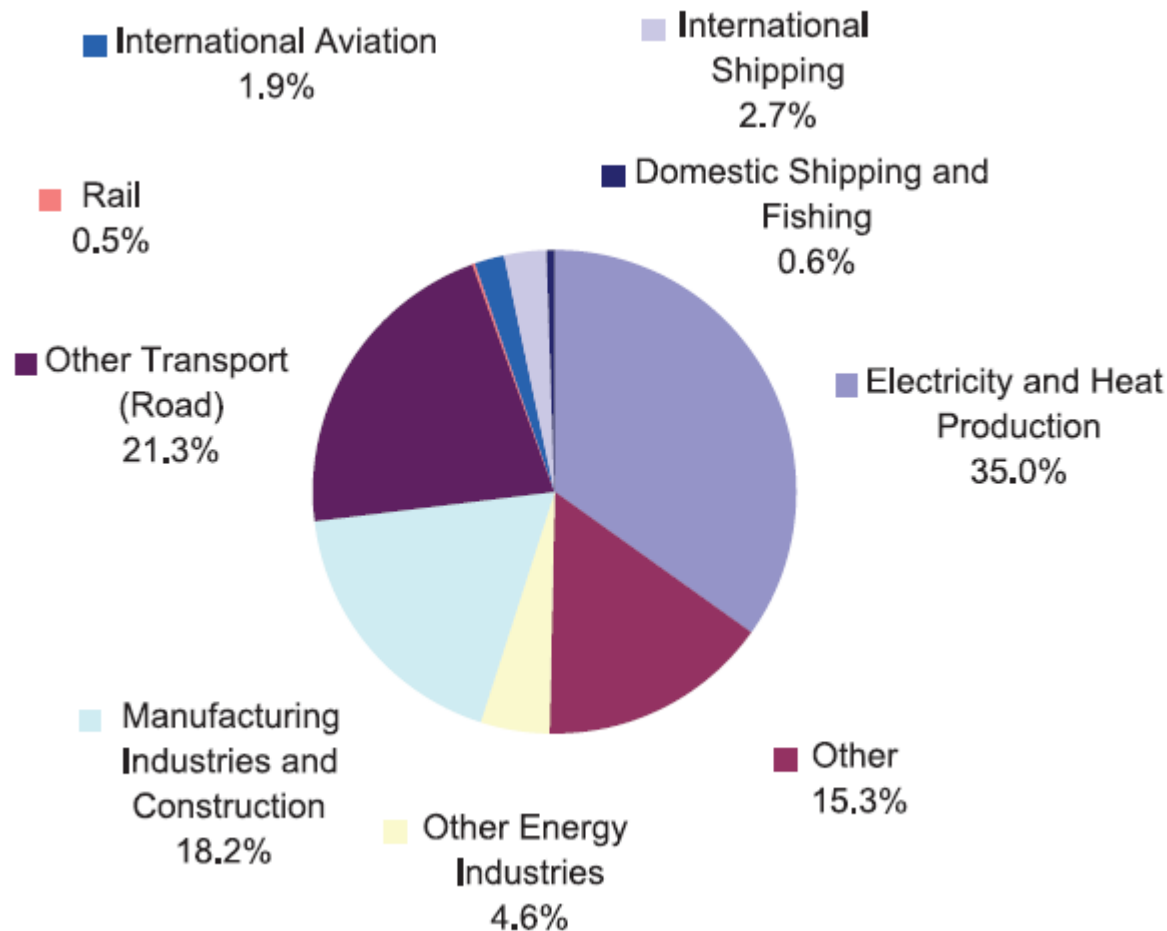4 Impacts on net exporting countries

5 Concentration in shipping industry

6 Environmental issues in service providers of shipping

Two published papers

- Luo, Meifeng. "Emission reduction in international shipping—the hidden side effects." *Maritime Policy & Management* 40.7 (2013): 694-708.

- Wang, Kun, Xiaowen Fu, and Meifeng Luo. "Modeling the impacts of alternative emission trading schemes on international shipping." *Transportation Research Part A: Policy and Practice* 77 (2015): 35-49.

The share of international shipping in global CO_2 emission

International Aviation 1.9%

International Shipping 2.7%

Rail 0.5%

Domestic Shipping and Fishing 0.6%

Other Transport (Road) 21.3%

Electricity and Heat Production 35.0%

Manufacturing Industries and Construction 18.2%

Other Energy Industries 4.6%

Other 15.3%

Marginal Abatement Cost

- Marginal abatement cost of CO_2 emission (MACC) is the cost of reducing one unit of emission at different emission reduction levels.

- The cost to reduce one ton CO_2 emission increases with the level of total emission reduction.

  - For example, shipping emitted 1046 million tons CO_2 in 2007. If the objective is to reduce one ton CO_2 emission, we can use the most cost-effective method, so cost is low. If the objective is to reduce 500 tons of CO_2 emission, it is necessary to use many costly approach. Therefore, the unit cost will be high.

Indicative MACC emission for 2020
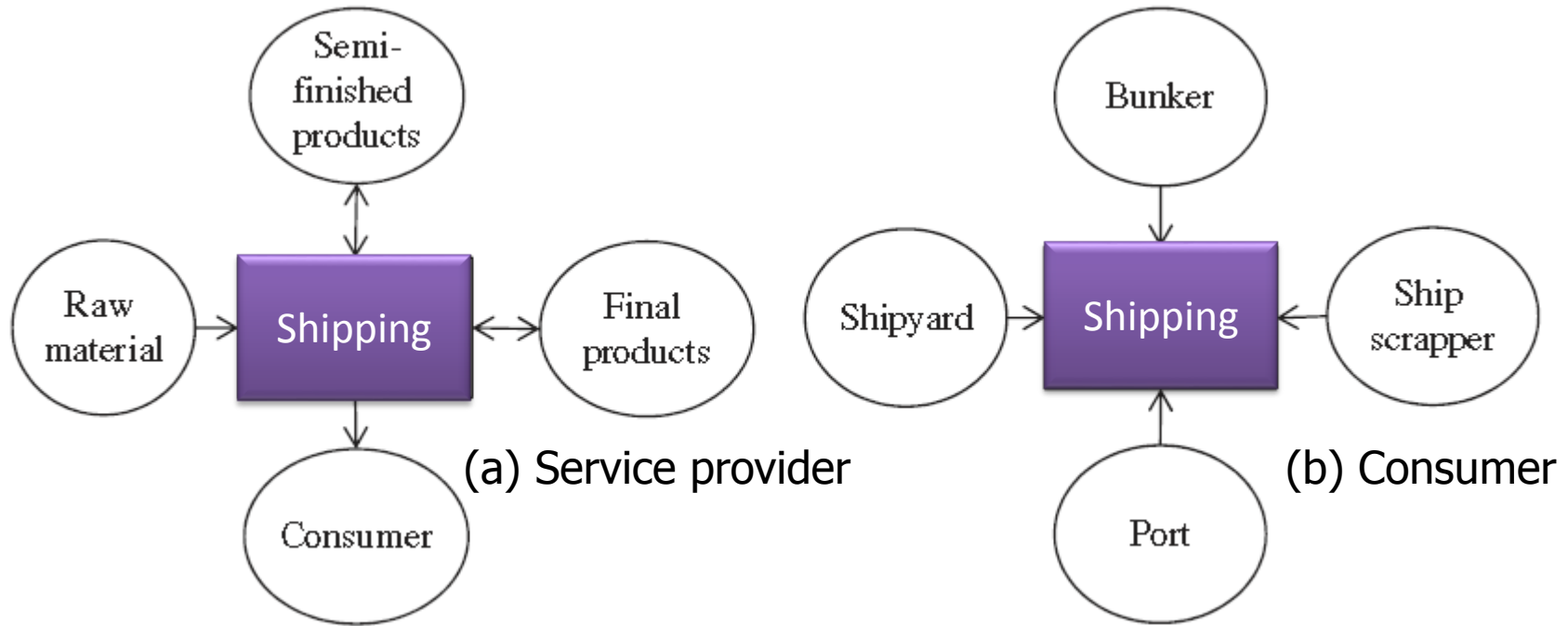
MACC: Marginal Abatement Cost of CO_2 emission
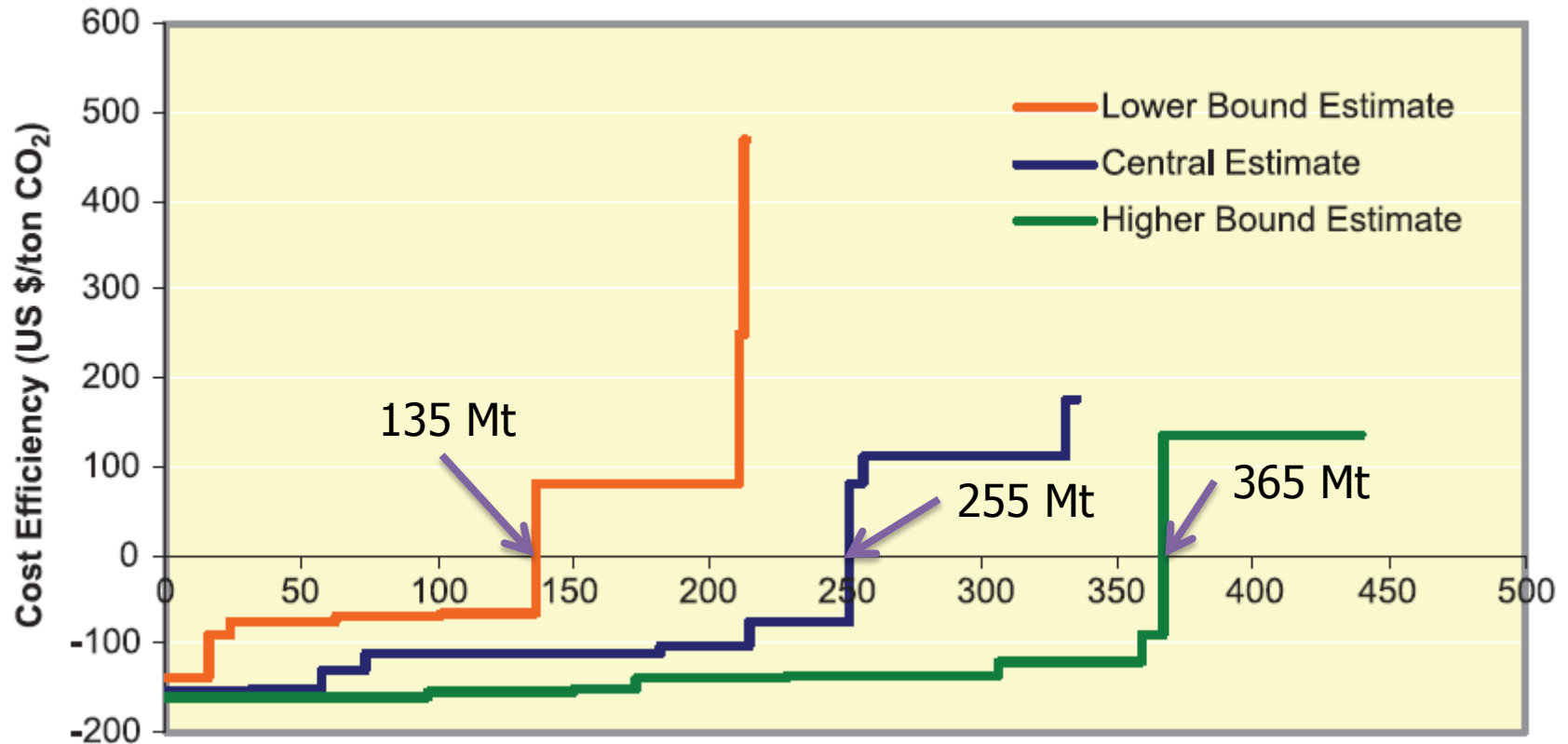
Estimated maximum abatement potential (million tons) based on 25 operational and technical measures where data could be obtained (bunker fuel price US$500/ton)

Maritime Emission Trading Scheme (ETS)

- Involves all ships in the world above certain size.

- A cap on global maritime emissions would be set based on historical emissions and a target for their reduction.

- Emission permits are open for trade

- There are several options to allocate initial allowances: selling or auction, free allocation based on the past activities or based on a benchmark, or a combination of these approaches.

- The maritime sector may be able to trade with other sectors.

The position of shipping industry

(a) Service provider

Semi-finished products — Shipping — Final products; Raw material → Shipping; Shipping → Consumer

(b) Consumer

Bunker → Shipping; Shipyard → Shipping ← Ship scrapper; Port → Shipping

- Increase in shipping costs will result in a decrease in shipping supply, reduce the goods shipped, or substitute with goods that require less shipping.
- It may also affect the countries that have imbalanced trade, leading to the change in international trade pattern.
- Carriers may prefer ships with higher energy efficiency, increase new orders and shorten ship life. This also can result in market concentration.
- Inconsistency in world production and shipping.

Consider two main sectors in the world trade: Production and Shipping. They may have different Emission Reduction (ER) requirement and marginal abatement cost (MAC).
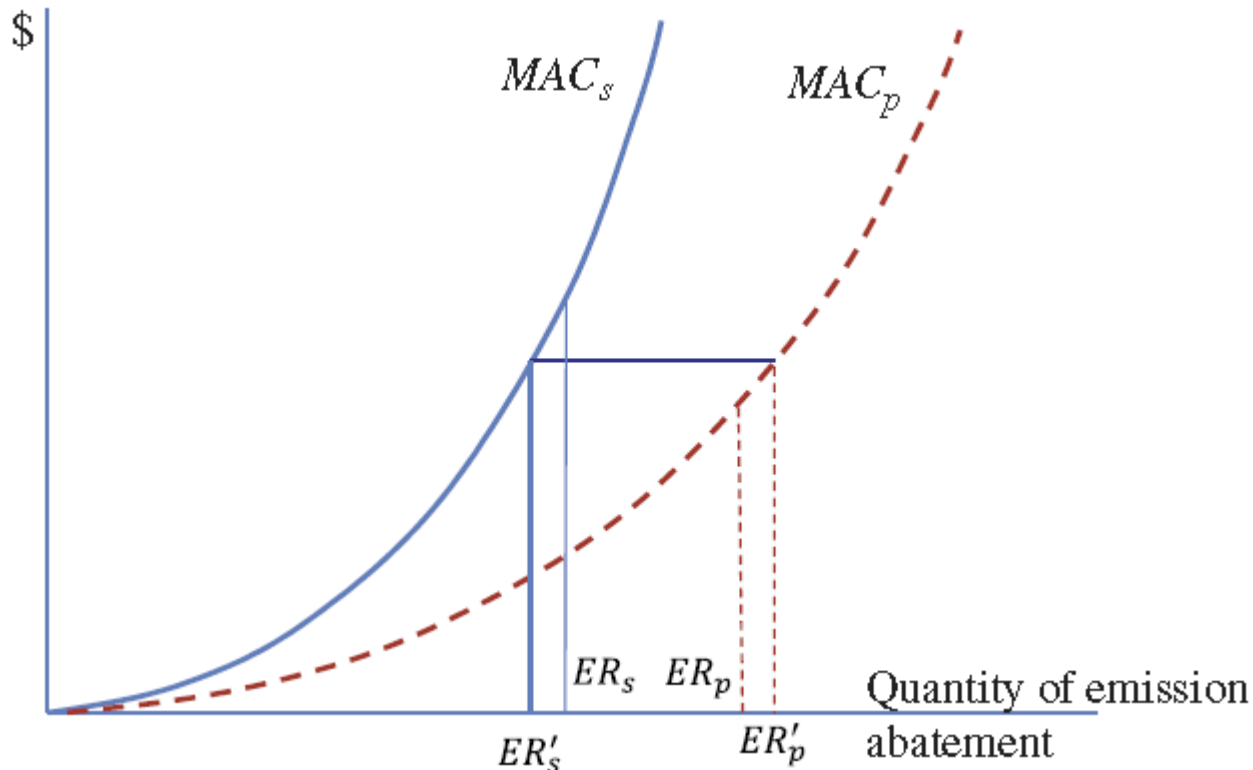
However, emission should also be considered a necessary input to the production and shipping activity. Reducing emission may result in reducing production and shipping.
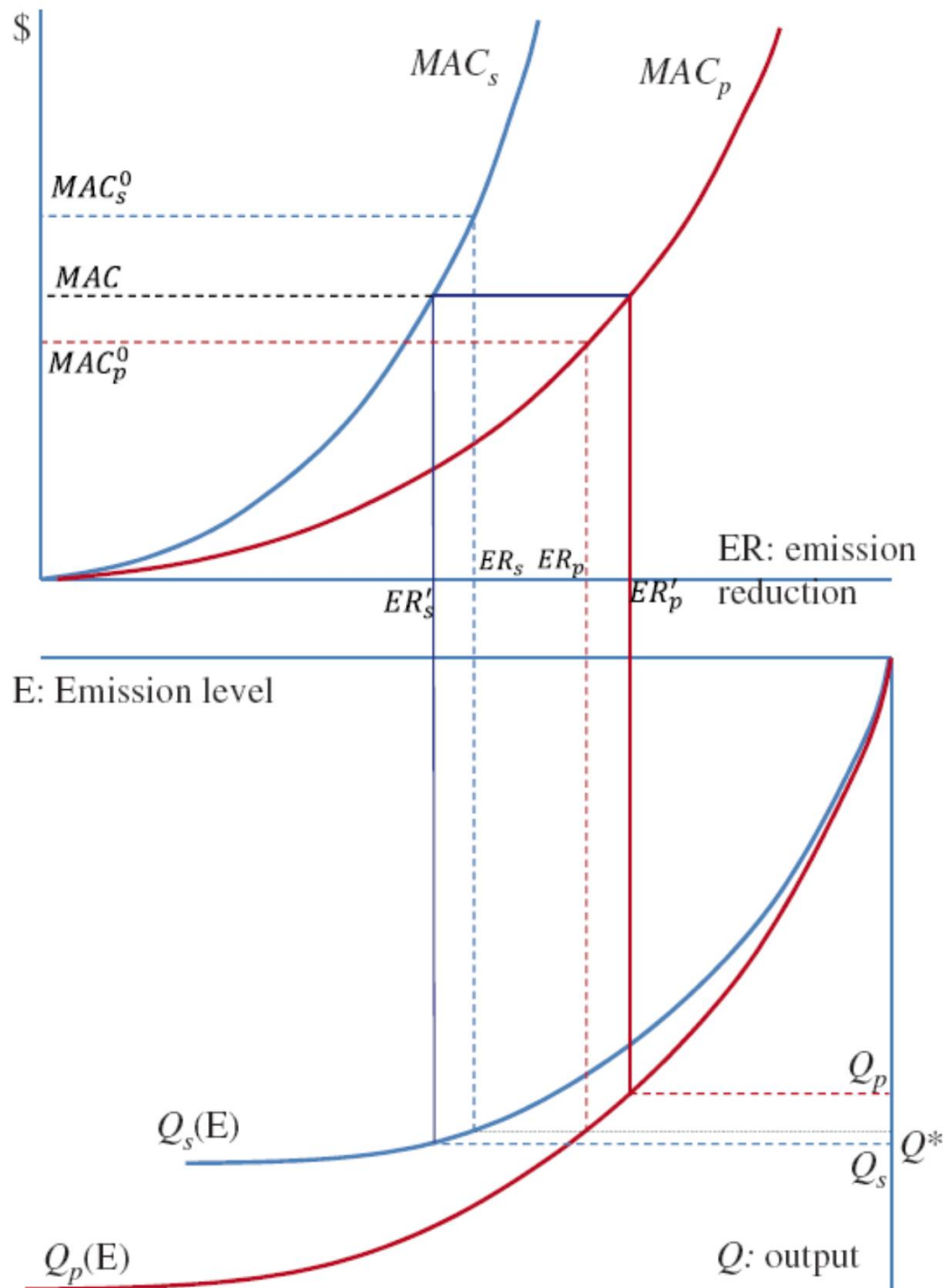
Emission-output relationship

Q: output

$Q_p(E)$

Q^* Q_s

$Q_s(E)$

Q_p
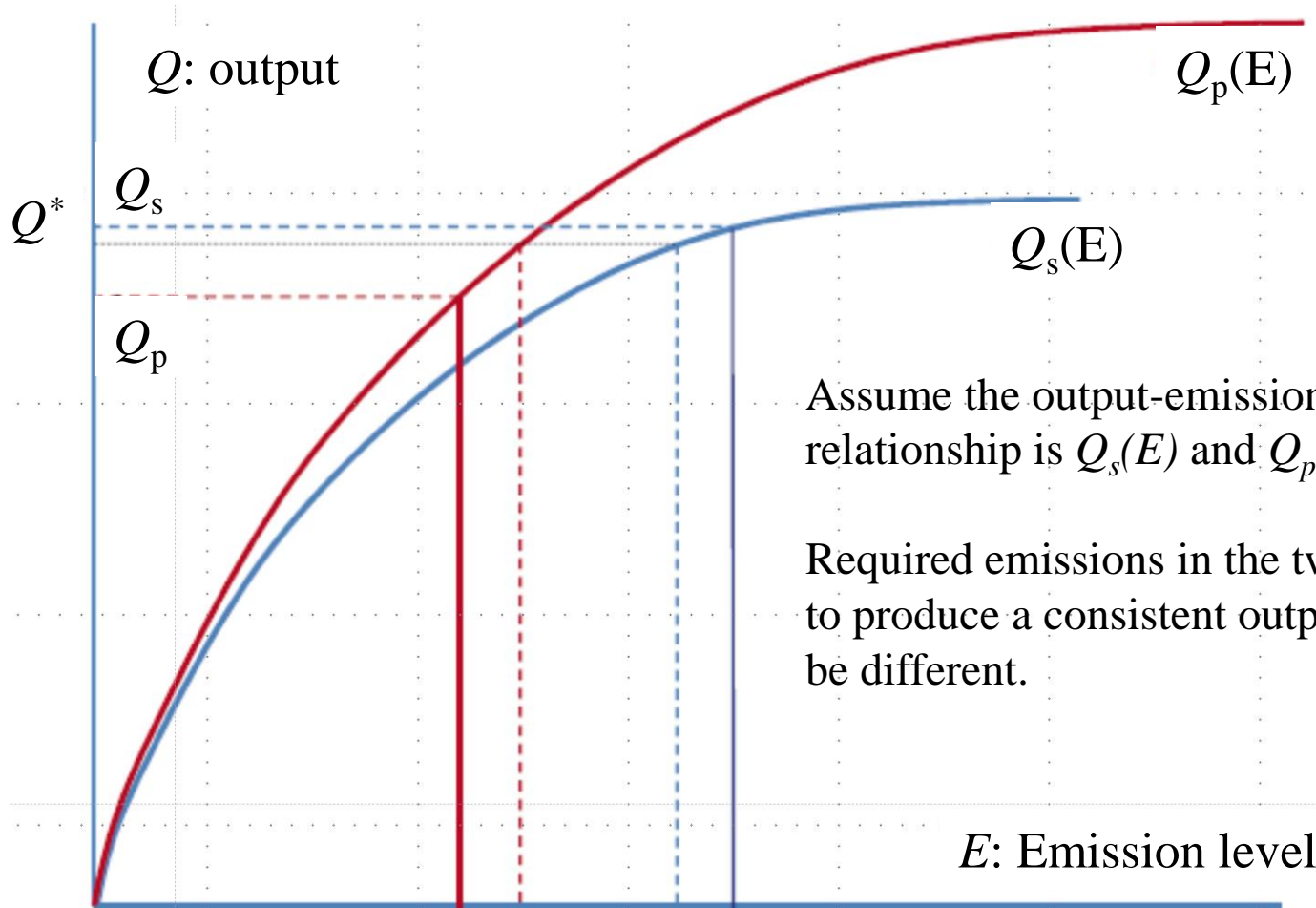
Assume the output-emission relationship is $Q_s(E)$ and $Q_p(E)$.

Required emissions in the two sectors to produce a consistent output Q^* can be different.

E: Emission level

Emission reduction and emission have opposite directions: *reduce more, emit less*
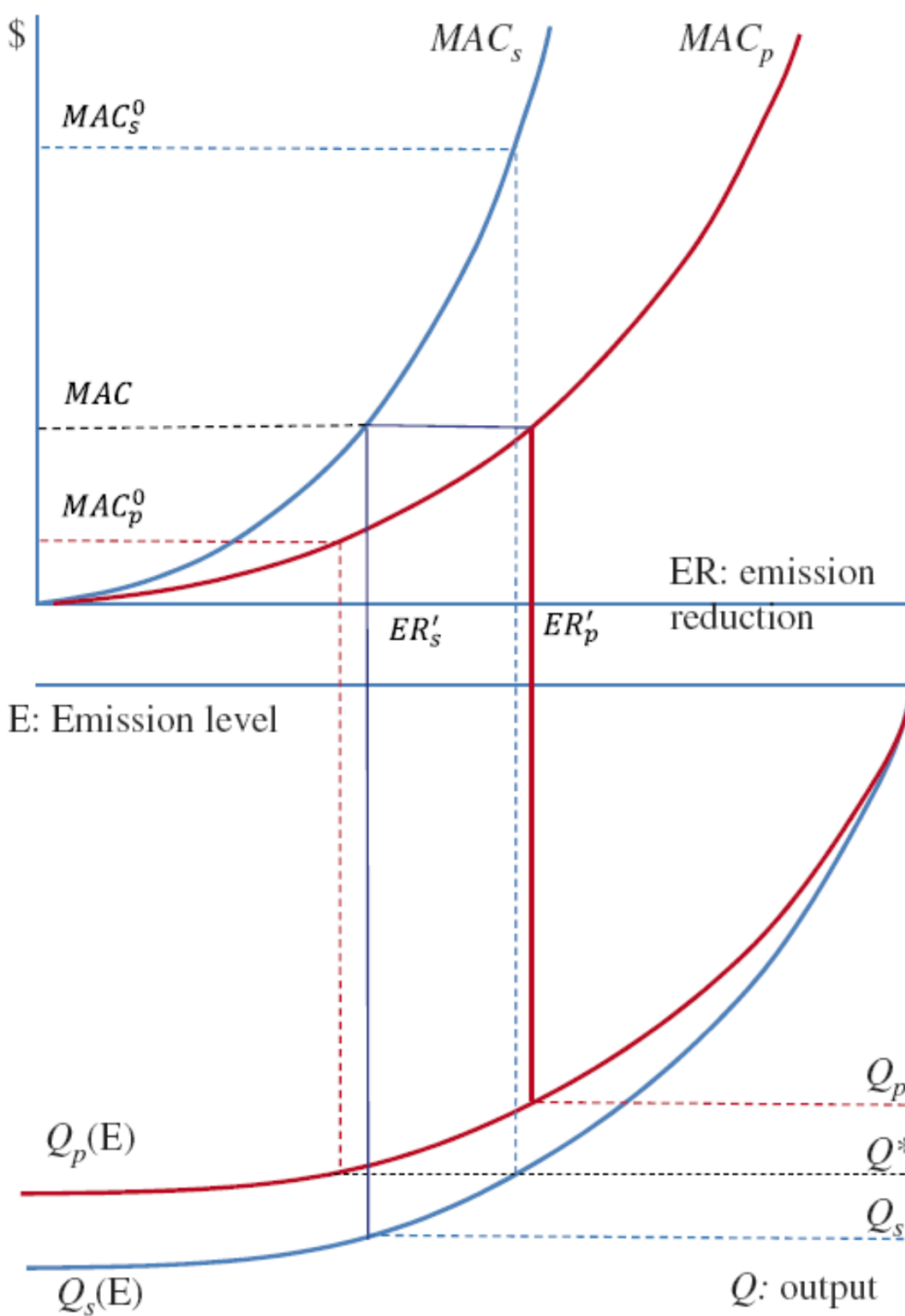
1: If $MAC_s > MAC_p$, and $Q_p(E) > Q_s(E)$

- Before ETS, outputs in shipping and production are consistent (at Q^*)
- Allowing trade, the emission in production will reduce, and that in shipping increase. This could result in smaller production.
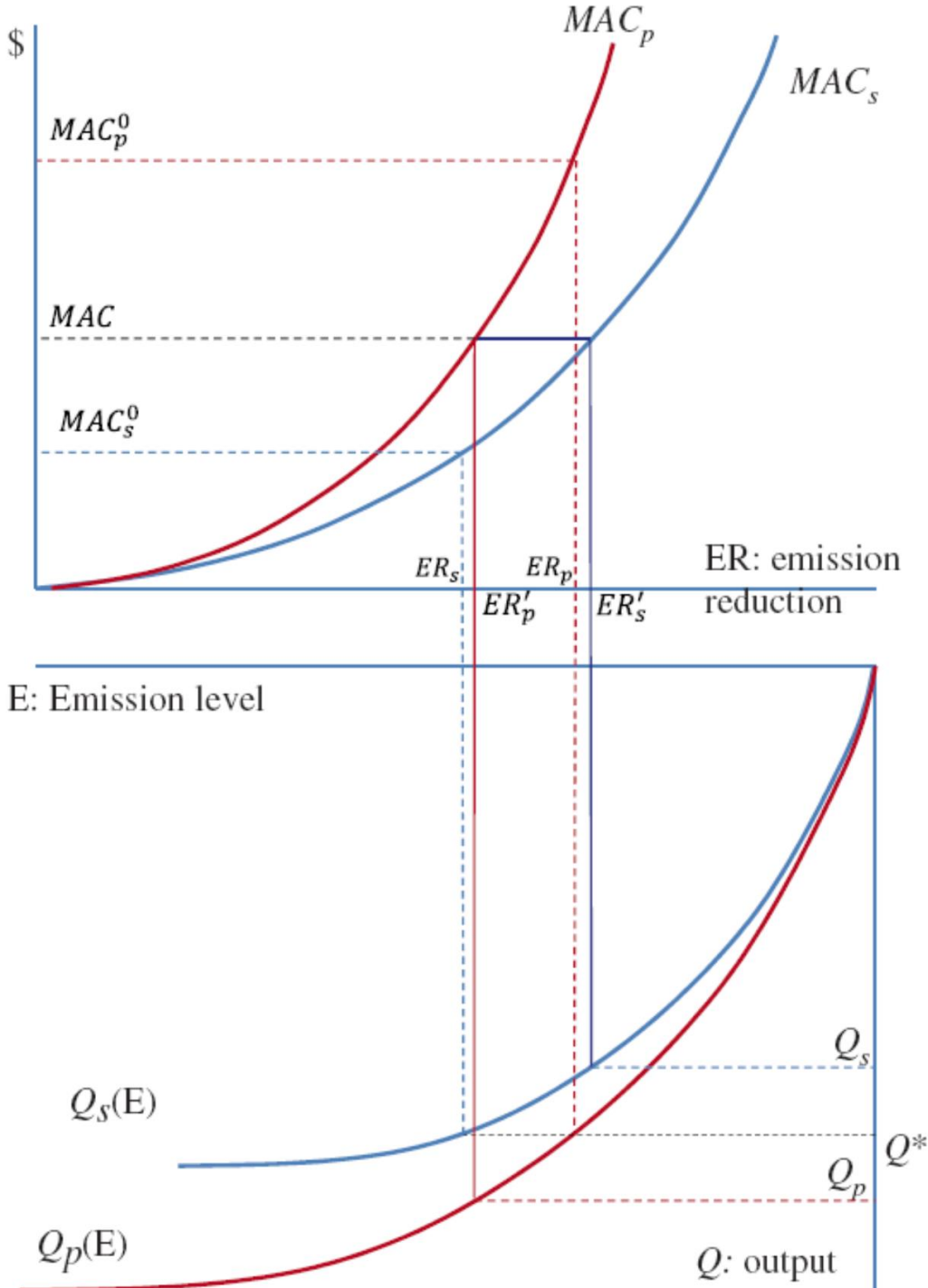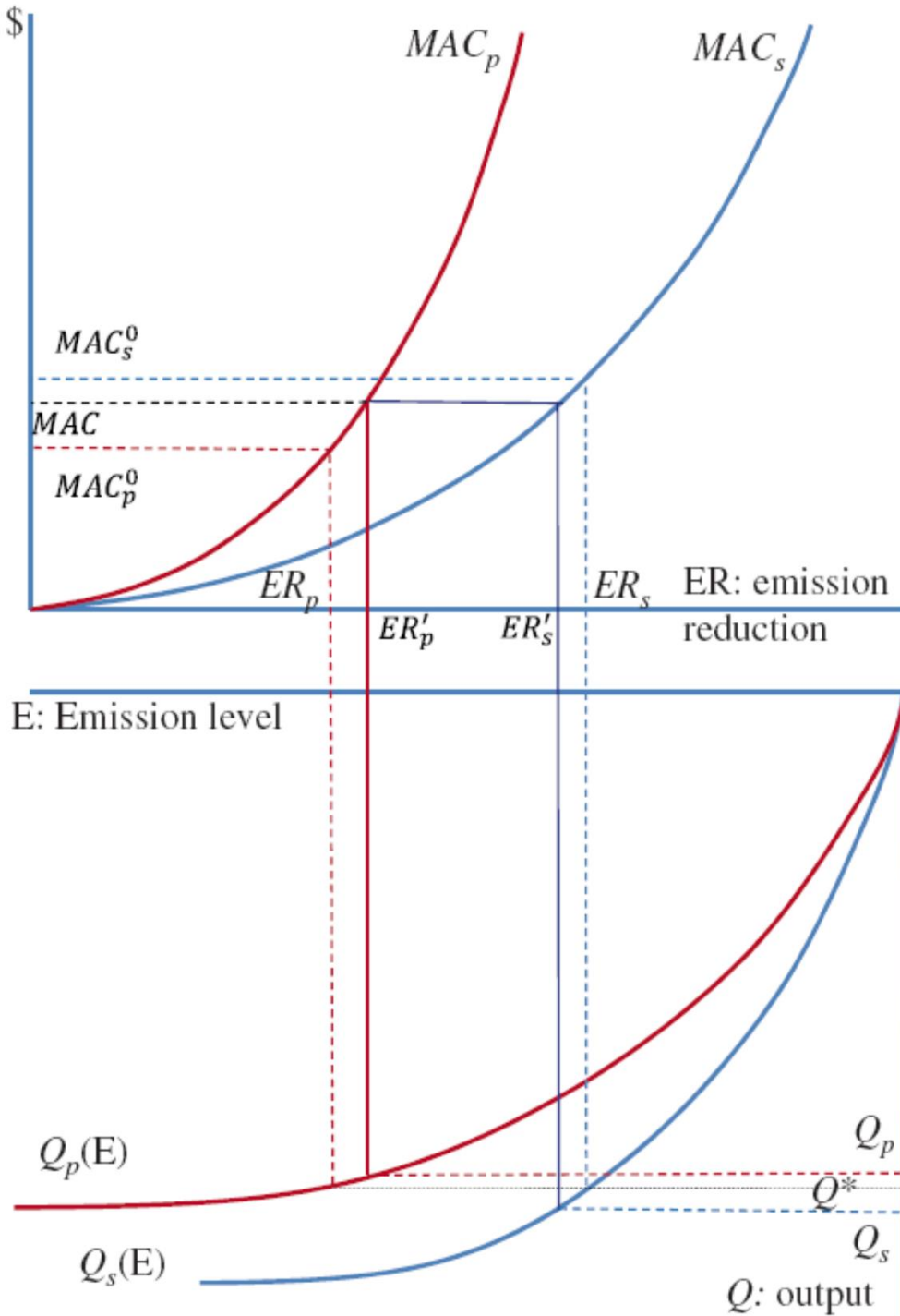
2: If $MAC_p > MAC_s$, and $Q_p(E) > Q_s(E)$

- Before trade, the production sector has high MAC and ER.

- Allowing trade, the ER' flipped the positions.

- Result in large shortage in shipping supply.

3: If $MAC_s > MAC_p$, and $Q_s(E) > Q_p(E)$

- Although MAC of shipping is above that of production, the ER in shipping is set too high.

- Allowing trade, the ER' flipped the positions.

- Result in excessive shipping supply.

4: If $MAC_p > MAC_s$, and $Q_s(E) > Q_p(E)$

- The MAC of production is above that of shipping, the ER in production is too low.

- Allowing trade, the ER' re-adjusted.

- Result in little over supply in shipping.

Further research required

- This 4 figures are only illustrative. The actual Q(E) and MAC are hard to estimate.

- It only considers the immediate impacts of ETS on world trade. The long-run impact need further study.

- Shipping industry is not homogeneous
  - Compared with bulk sector, containerships are newer, more expansive, faster, more energy efficient; its market is more colluded; it carries more valuable cargo; and receives higher freight rates.
  - What is the impact of ETS to different sectors?

Kun Wang, Xiaowen Fu & Meifeng Luo, "Modeling the impacts of alternative emission trading schemes on international shipping". *Transportation Research Part A*, 77(2015):35-49

Result

- With ETS, both will reduce shipping output, but bulk sector reduces more than container sector.

- The container sectors uses more fuel (sell less permits), and

- The higher the price of emission permits, the greater the gap between the reduction in bulk sector and that in the container sector.

Will this also cause inconsistency in different production sectors?

Trade imbalances and low bargaining power made the net export countries, mostly the poor developing ones, to pay more to ship the cargo to the developed world, and subsides the cargoes on the return trip.
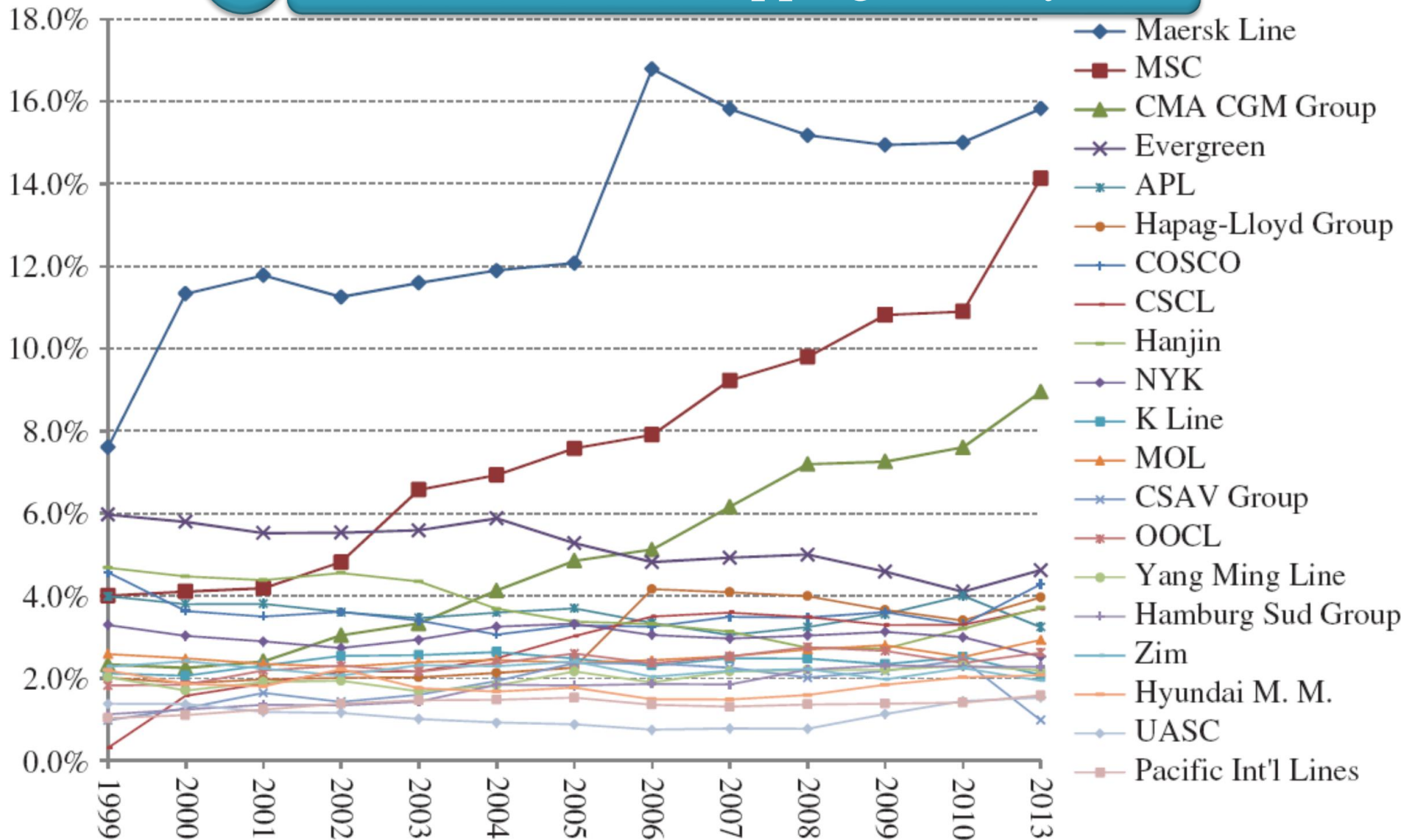
	Asia→ USA	USA → Asia
Container volume (million TEU)	15.4	4.9
Average freight rate ($/TEU)	1683	769
	China → USA	USA → China
Footwear, gaiters, and the like, parts thereof ($/unit)	0.4211	0.2126
Toys, games, sports requisites ($/unit)	0.3902	0.1231

Source: OECD Maritime transportation cost (2007)

From 2005 to 2012, the developing economies' share in the global export of goods and services increased from around 35% to 42%. However, the rate of increase of exports from developing economies decreased to only 4% in 2012 compared with an overall average of 19% in the same period. (UNCTAD, 2013)

THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

Faculty of Business
工商管理學院

LOGISTICS & MARITIME STUDIES
物流及航運學系

Innovation-driven Education and Scholarship

Emission reduction increase the interest to build more larger ships.

- Increase newbuilding and scrapping
  - Incremental environmental impacts.
- Increase pressure on port development
  - With larger ships, ports are urged to expand to accommodate it. This may lead to port concentration.
    - It may contribute to the number of smog days in big port cities.

Question?

- Meifeng.Luo@polyu.edu.hk