



Gateways and intermodal pricing

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Agenda

- Introduction
- Overview over the study
- The basic model for integrated firms
- Numerical example
- The adjusted model for disintegrated firms
- Conclusions



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Introduction

Characteristics of the gateways and corridors initiative:

- Different transport modes are involved: sea, road, rail, air
- Transport modes are complementary or substitutable in nature
 - Complementary: Sea and road or rail
 - Substitutable: Sea and air, road and rail,...
- Focus is on the integration of transport systems, on specific ports, and on specific parts of the road/rail network
- Integration is considered to generate productivity gains (economies of scale)



Introduction

This study addresses the following questions:

- What is the effect of gateways on competition, prices, capacities and revenues?
- What are the incentives to create gateways?
- In other words, when should private firms invest in gateways?



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Overview over the study

- Two transport modes are considered: road and sea
- Analysis focuses on
 1. Two integrated firms that provide road and sea transportation services (*basic model*)
 2. Disintegrated firms that provide either road or sea transportation services (*adjusted model*)
 - a) 2 road firms and 2 sea firms
 - b) 2 road firms and 1 sea firm



The basic model for integrated firms

Individuals:

- Set of individuals with mass 2
- Individuals are uniformly distributed over the $[0,2]$ -interval
- Each individual wishes to send 1 good from its location to an overseas destination
⇒ **door-to-door services are considered!**
- Willingness to pay is constant and equal to 1



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The basic model for integrated firms

Demand:

- Two firms charge price $p_i \geq 0$ ($i \in \{1, 2\}$) for door-to-door services
- Capacities are $k_i \in [0, 2]$
- Demand is

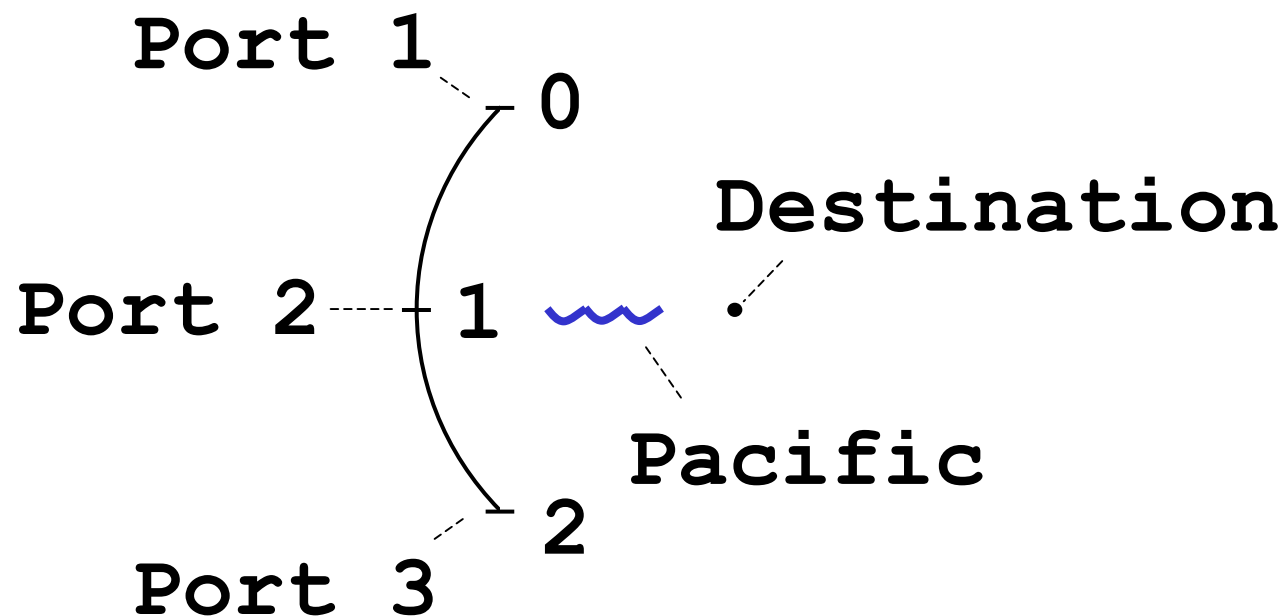
$$D_i(p_1, p_2) \equiv \begin{cases} 2 & \text{for } p_i < p_j \\ \max\{1, 2 - k_j\} & \text{for } p_i = p_j \\ \max\{0, 2 - k_j\} & \text{for } p_i > p_j \end{cases}$$

with $j \neq i$.

The basic model for integrated firms

Ports:

- Three ports exist that charge zero-prices (for simplicity).
- Two are located at the borders of the $[0,2]$ -interval. The third is located in the middle:





The basic model for integrated firms

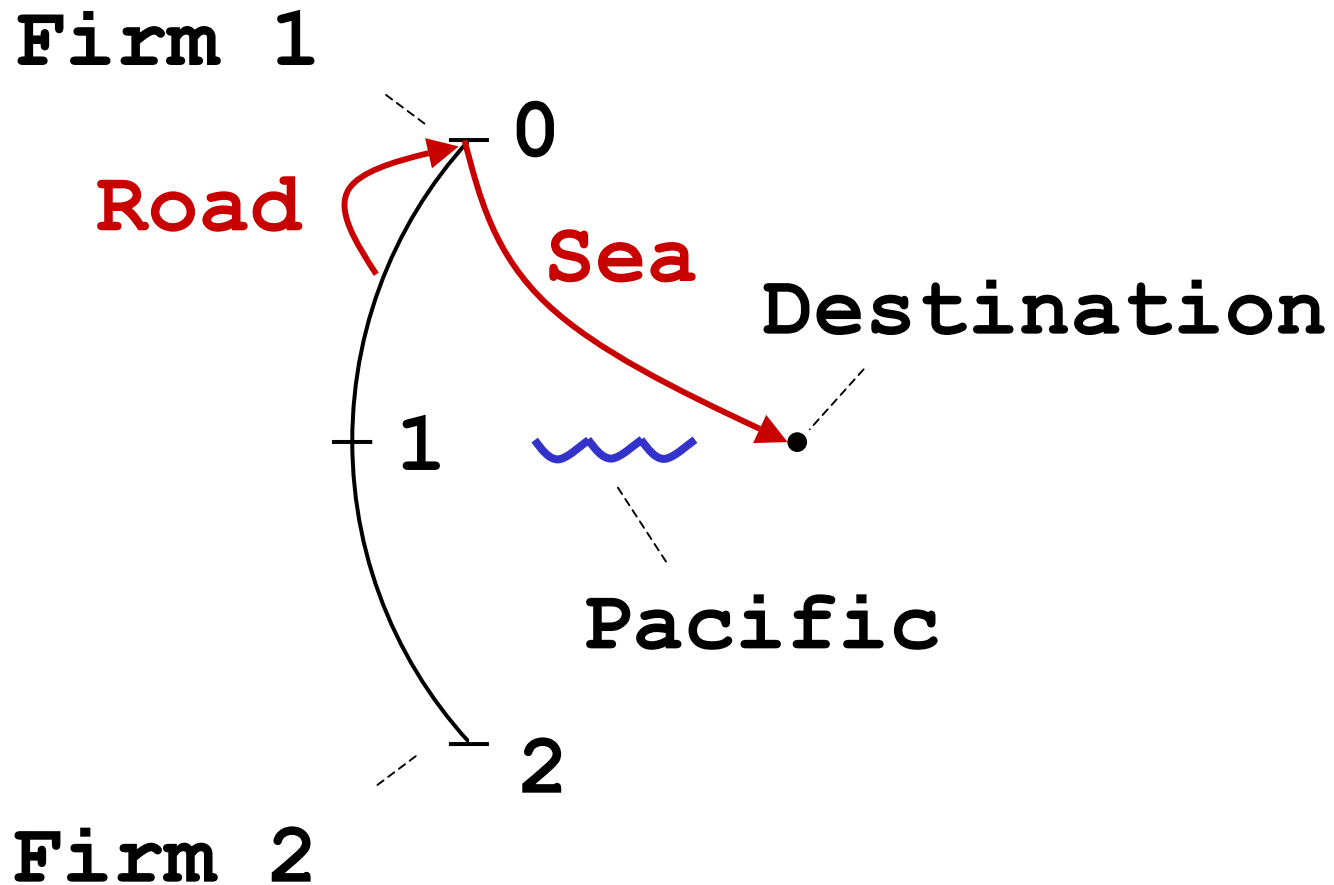
Three-stage game:

- Stage 1: Firms **cooperatively** choose locations
 - Firms locate at ports 1 and 3 (border case referred by index M1)
 - Both firms locate at port 2 (gateway case referred by index G1)
- Stage 2:
 - Border case M1: Firms choose capacities
 - Gateway case G1: Firms cooperatively choose total capacity k and share it evenly, i.e. $k_1 = k_2 = k/2$
- Stage 3: Firms **non-cooperatively** choose prices



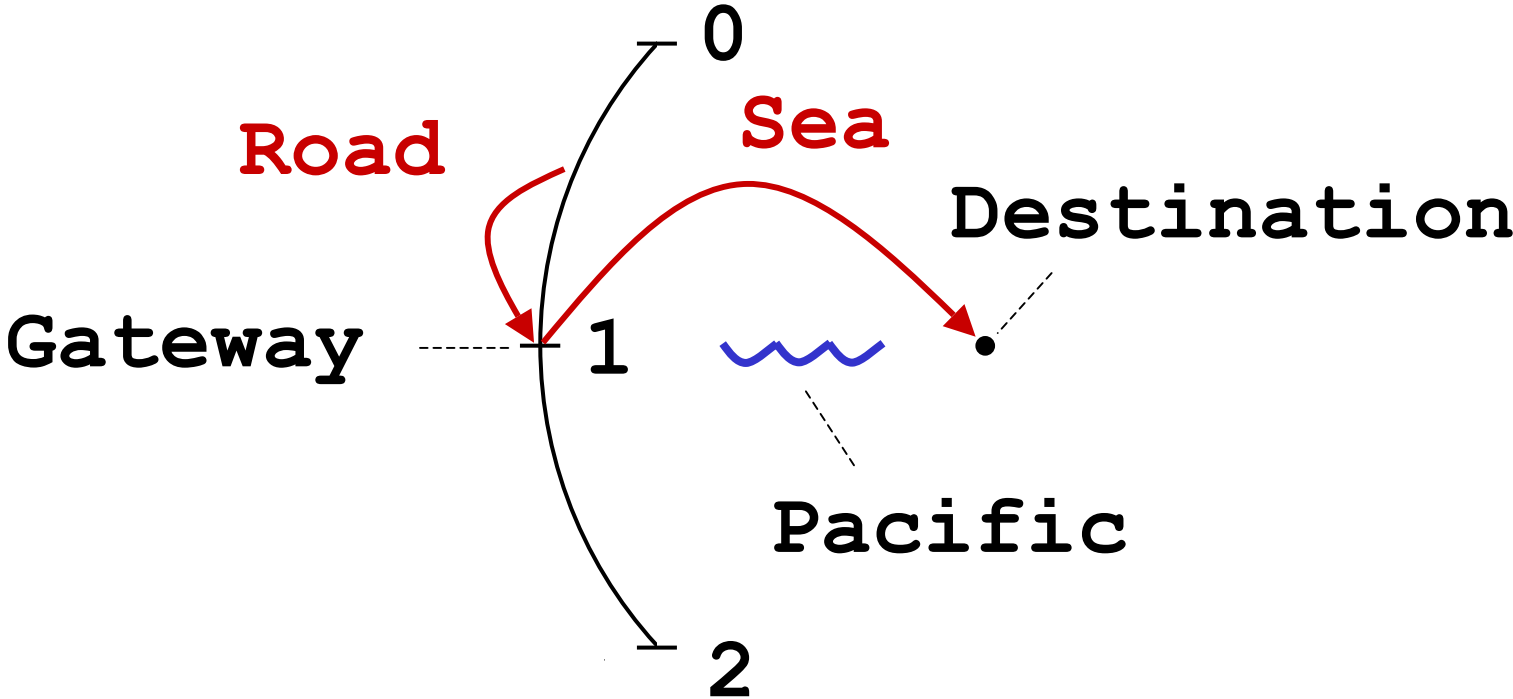
The basic model for integrated firms

Border case M1:



The basic model for integrated firms

Gateway case G1:



The basic model for integrated firms

Variable road transportation costs (sea transportation costs = 0, no capacity limits there):

- Transportation costs per marginal distance unit are 1
- Denote $q_i \equiv \min \{ k_i, D_i(p_1, p_2) \}$
- Transportation costs C_i depend on the firm's location

- Border case M1:

$$C_i^{M1}(q_i) \equiv q_i^2 / 2$$

- Gateway case G1:

$$C_i^{G1}(q_1, q_2) \equiv \begin{cases} q_i^2 / 4 & \text{for } p_i < p_j \\ q_i (q_1 + q_2) / 4 & \text{for } p_i = p_j \\ ((q_1 + q_2)^2 - q_j^2) / 4 & \text{for } p_i > p_j \end{cases}$$

The basic model for integrated firms

Capacity costs:

$$\frac{k^\beta}{\alpha^{1-\beta}}$$

- $\beta \geq 0$ determines the **constant elasticity of capacity costs**
- Increasing economies of scale for $\beta < 1$ (in this case integration (/concentration) can lead to productivity gains)
- α is used to adjust the cost function such that average capacity costs are decreasing in β



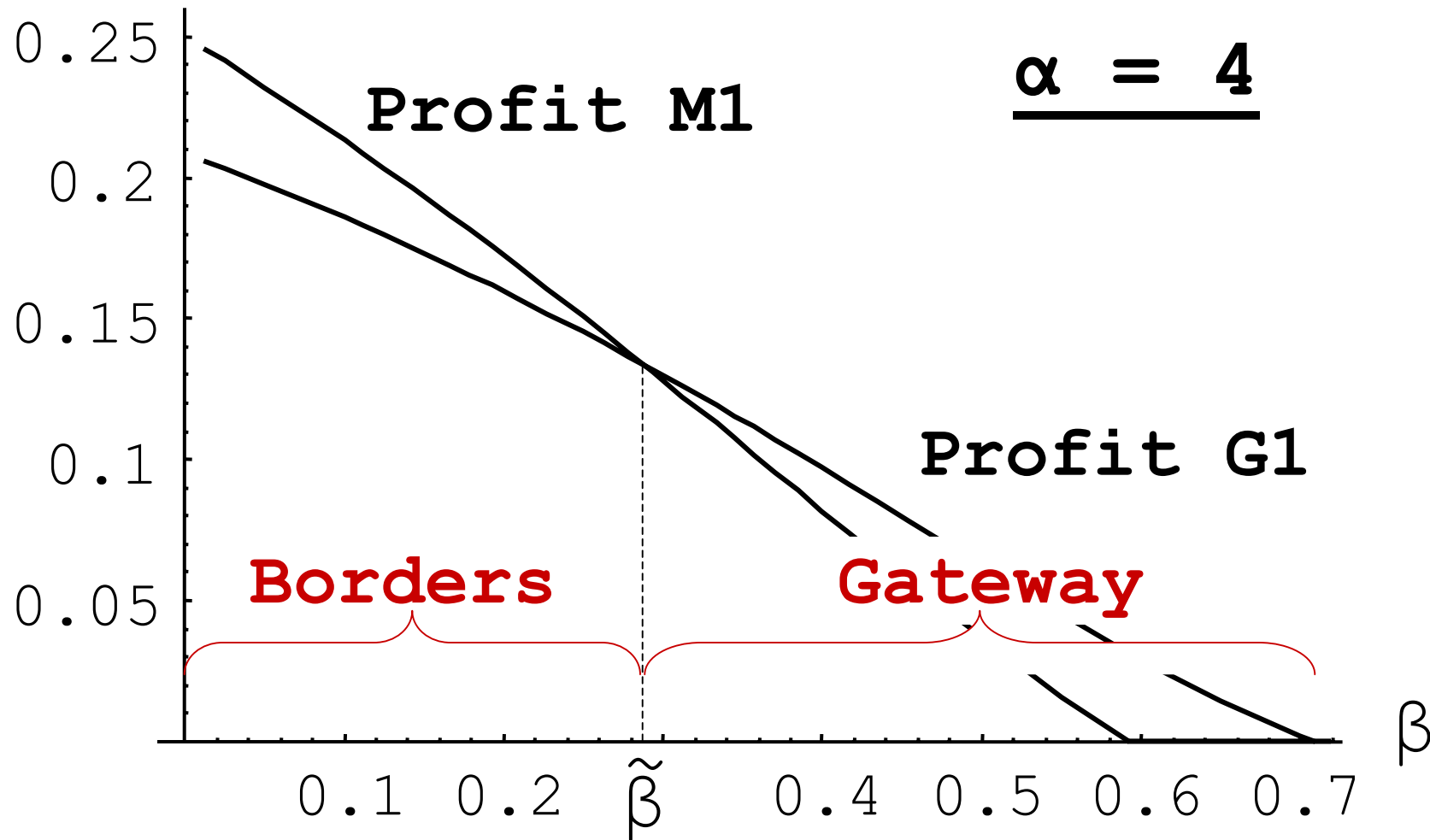
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The adjusted model for disintegrated firms

2 road firms and 2 sea firms:

Price competition between seaside firms

⇒ 0-prices in both cases (border and gateway case)

⇒ For road firms the situation is similar to the model with 2 integrated firms

⇒ Above results can be applied to this situation!



The adjusted model for disintegrated firms

2 road firms and 1 sea firm:

Border case (referred by index M2):

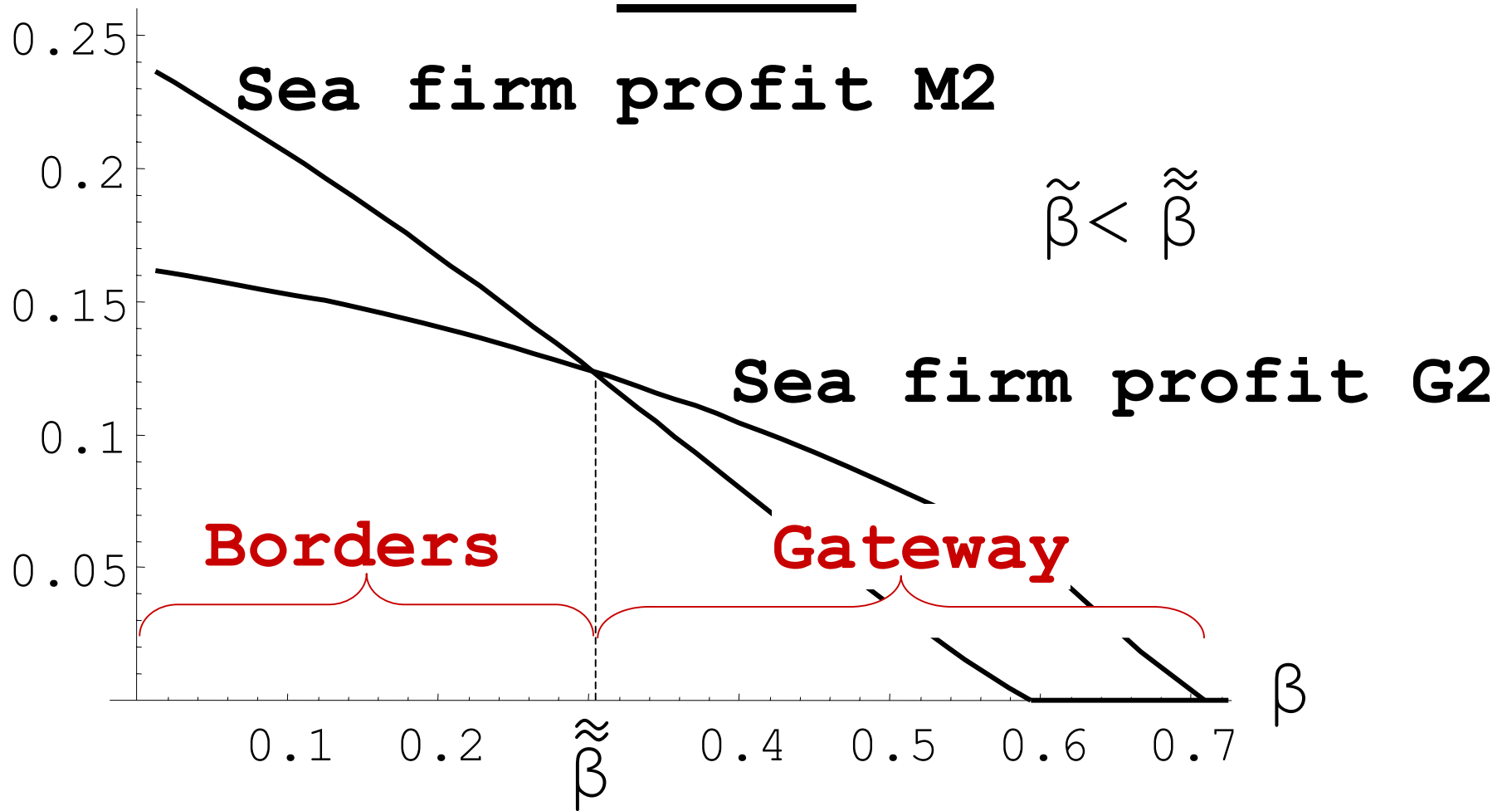
- Sum of prices is 1
- Total price is shared such that profits net of capacity costs are equal

Gateway case (referred by index G2):

- Sum of prices is 1
- Liners are Stackelberg-leaders in prices

The adjusted model for disintegrated firms

$$\underline{\alpha = 4}$$





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Conclusions

- Gateways are chosen when economies of scale are low or, respectively, capacity costs are high
- Integrated firms tend to favor gateways compared to disintegrated firms
- Incentives to invest in gateways strongly depend on the market structure



Thank you!