

Port Automation and Risks:

Problem, Case, Policy recommendation

AS0092



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1. Introduction & Research Question

Handled 10 million twenty-foot cargoes by February 2025, the world's largest fully automated container terminal, Tuas Port in Singapore, attracts people's attention to the maritime industry and its automation. (PSA Singapore, 2025) Regarded as the backbone of globalization, the maritime industry transports more than 80% of global trade. (UNCTAD, 2025)

Tuas Port is one of 63 semi- or fully automated ports worldwide (Knatz et al., 2022), and the trend toward automation continues to grow. The trend, however, creates structural shifts that pose challenges, namely market concentration, raising concerns for policymakers. Using microeconomic analysis through deductive reasoning, this essay examines how automation drives market concentration, analyzes the resulting structural shift and welfare impact, and recommends relevant policy.

2. Key concepts & Model and Analytical Framework

The essay's key economic concepts are market power, which is central to the analysis of automated ports. Market power, or pricing power, refers to a firm's ability to raise and sustain prices above the allocative-efficiency level, where price exceeds marginal cost ($P > MC$), typically arising in highly concentrated markets with substantial barriers to entry. In this case, automation confers market power on PSA Singapore, enabling it to charge high port charges, thereby leading to several issues.

The essay adopts economies of scale and network externalities as its primary models. Economies of scale explain how high fixed costs of automation can be spread over large volumes of transshipment, lowering average costs for dominant ports. Network externalities illustrate

how the value of a transshipment hub increases as more shipping lines and routes concentrate in the same port, resulting in a positive feedback loop.

Besides, this essay utilizes the Structure–Conduct–Performance (SCP) framework as its primary analytical lens.

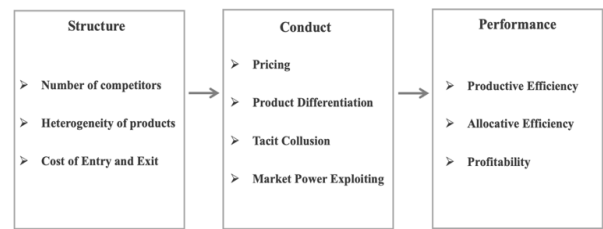


Figure 1: Diagram for SCP Paradigm

The SCP framework is applied by first analyzing how port automation alters the market structure of Southeast Asia's container transshipment market, leading to high market concentration, and then examining how this structural change affects firm conduct, focusing on pricing behavior under conditions of market power and information asymmetry. Finally, the framework is used to assess market performance, with particular attention to allocative efficiency and social welfare.

3. Case Study

3.1 Theoretical Mechanism

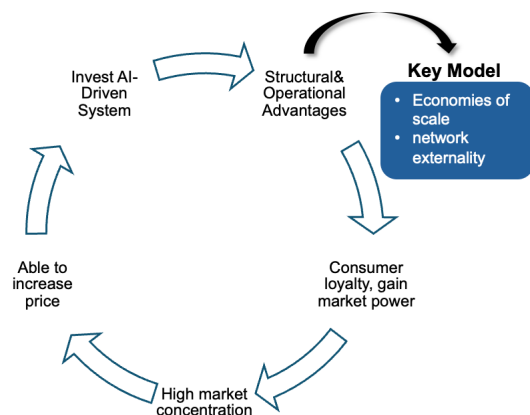


Figure 2: Diagram of Mechanism.

Figure 2 visualizes the mechanism overview of the Singapore Port case study.