



Unified container shipping industry data from 1966: Freight rate, shipping quantity, newbuilding, secondhand, and scrap price

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ABSTRACT

We construct a new unified panel dataset that combines route-year-level freight rates with shipping quantities for the six major routes and industry-year-level newbuilding, secondhand, and scrap prices from 1966 (the beginning of the industry) to 2009. We offer detailed instructions on how to merge various datasets and validate the data's consistency by industry experts and former executives who have historical knowledge and experience. Using this dataset, we provide a quantitative and descriptive analysis of the industry dynamics known as the container crisis. Finally, we identify structural breaks for each variable to demonstrate the impact of the shipping cartels' collapse.

"When we think about technology that changes the world, we think about glamorous things like the Internet. But if you try to figure out what happened to world trade, there is a strong case to be made that it was the container ..."

– Krugman, Paul.¹

"[W]ithout [the container], the tremendous expansion of world trade in the last forty years—the fastest growth in any major economic activity ever recorded—could not possibly have taken place."

– Drucker, Peter F.²

1. Introduction

1.1. Research background, motivation and purpose

Container shipping is a crucial component of global trade that has revolutionized the world. According to IHS Markit and Descartes Datamyne, container shipping accounts for 45.4% of amount-based imports to the U.S., 21.3% of amount-based exports from the U.S., and 10.12% of quantity-based world trade are shipped in 2021. Additionally, the container shipping industry offers a fascinating opportunity to explore industry dynamics. Since the industry began global shipping operations in 1966, the market's initial state can be determined with a significant entry and exit of firms. Furthermore, many countries have competition laws that exempt international

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¹ Citigroup Foundation Special Lecture, Festschrift paper in honor of Alan V. Deardorff, University of Michigan IPC working paper 91, 2009.

² Innovation and Entrepreneurship, Butterworth-Heinemann, 2007 (p.28).

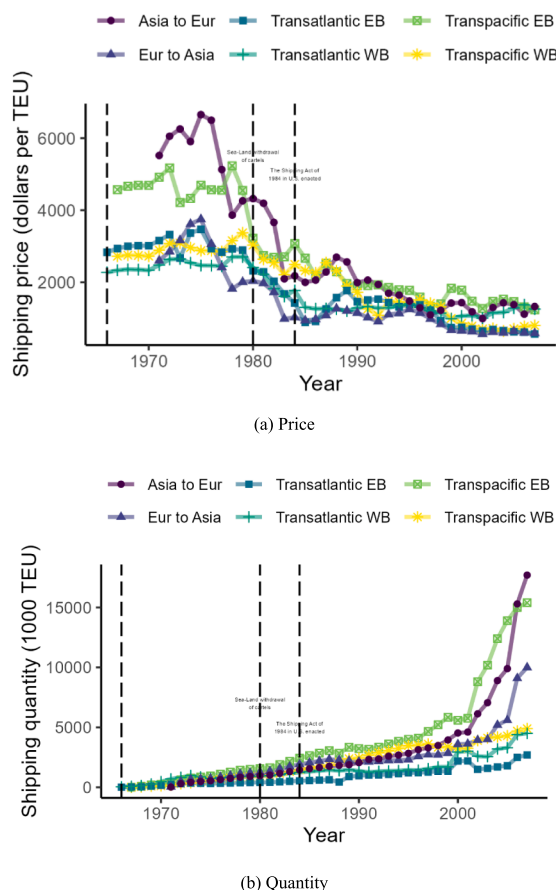


Fig. 1. Trends in route-year-level shipping prices and quantities. Note: Container freight rates before 1992 refer to conference prices. The container freight rates after 1993 are unified prices based on conference and non-conference prices, and the difference between them is known to vanish because of the Shipping Act of 1984. The latter are standard data often used in the literature, such as Jeon (2022). Prices were adjusted to the CPI in the U.S. in 1995.

cartels and consortia, which are called “shipping conferences” and “shipping alliances”³ in the shipping industry.⁴ Despite its significance, there is a lack of a panel dataset for the route-year-level freight rate and shipping quantity in the container shipping industry, particularly for the years 1966 to 1990, which limits quantitative research during this period.⁵ This study provides a unified dataset based on published books and publicly available data sources to the extent possible, combining route-year-level data with new industry-level data regarding shipbuilding, secondhand, and scrap prices.⁶

To construct the freight index, we adopted the tractable imputation approach, which involves linking multiple data sources that overlap information for some years. This approach is simpler than formal but complicated processes or estimation approaches that assume the AR(1) process under stationary assumptions (Jeon 2002). We also validated our approach by presenting interview-based

³ Transport Policy Council (2007) of the Ministry of Land, Infrastructure and Transportation in Japan defines a shipping conference as an agreement on freight rates and other business matters to restrain competition among container shipping lines along the same route. A consortium is a technical agreement between several shipping lines to form a group and operate a joint service for the diversification of services and cost reduction in the liner service. Consortia include alliances that are widely used.

⁴ There is an important difference between shipping conferences and alliances: conferences are organized by specific routes and directions, while alliances are formed globally. There may exist one conference covering trade on the Transatlantic route and another covering trade between Northern Europe and the U.S. Gulf ports. In addition, firms do not always participate in conferences on all routes and directions they serve. Thus, conferences are heterogeneous in their structure and membership.

⁵ As other related studies focus on the container freight rate panel data, Luo et al. (2009) use shipping demand and freight rate data between 1980 and 2007. As shipping demand, they used the world container throughput reported in the Drewry Annual Container Market Review and Forecast. The container freight rate is calculated as the weighted average of the Transpacific, Europe-Far East, and Transatlantic trades from the same data source. Due to data limitations, they calculated the missing period (1980–1993) from the General Freight Index in the Shipping Statistics Yearbook 2007, using a simple statistical equation between the container freight rate and the general freight index from 1994 to 2008.

⁶ The data sources are listed in Appendix B.

evidence from ex-executive officers of shipping companies. This confirms that our Twenty-foot Equivalent Unit (TEU)-based price data provide a reasonable benchmark measure, even though container freight rates were not determined by container units in the 1970s.

Using our new dataset, we have conducted an analysis of the historical shipping price reductions in the 1980s, known as the “container crisis” (Broeze 2002), by implementing the unknown multiple structural breaks test (Bai and Perron 1998, 2003). It is anecdotally known that the crisis was triggered by two events: (1) the withdrawal of Sea-Land, which was the biggest cartel member from shipping cartels in 1980, and (2) the enactment of the Shipping Act of 1984. The first event changed the market share of shipping cartels, whereas the second event neutralized the shipping cartels. We also applied the test to industry-year-level newbuilding, secondhand, and scrap prices to determine the relationship between shipping markets and shipbuilding markets.

Based on the test, we found that the container crisis occurred on all six routes by 1980, which was triggered by the withdrawal of Sea-Land, although non-U.S. routes reacted earlier than U.S. routes. Additionally, we found that industry-year-level newbuilding, secondhand, and scrap prices displayed a relatively stable trend during the container crisis, unlike shipping prices. We interpret these differences as naturally capturing the distinctions between shipping markets with shipping conferences and shipbuilding markets without cartel groups. Thus, the container crisis was a specific event in the shipping market.

1.2. Literature review

This study contributes to two strands of the literature: the historical connection to the recent growing empirical research on the shipping industry and the effect of an explicit cartel on the price in the shipping industry.

First, this study provides the necessary data to connect the history of the container shipping industry from its beginning to its development after 2000, a topic that has gained attention in the industrial organization literature (Aguirregabiria et al. 2021). The most relevant paper in this regard is Jeon (2022), in which she examined the relationship between demand uncertainty and firm-market-year-level investment decisions using container shipping demand and freight rate data for the years 1997 to 2014. To facilitate her learning-based model, she needed to obtain the initial prices and demand in the container industry. However, due to data limitations, she had to resort to imputation and truncation approaches for missing shipping demand data from 1966: Q2 to 1996: Q4.⁷ Our study overcomes this limitation and complements the findings of previous studies.

Second, this study examines the effect of explicit shipping cartels on shipping prices.⁸ Shipping cartels have been recognized in survey papers, such as Levenstein and Suslow (2006) and Asker and Nocke (2021). Some studies, such as Morton et al. (1997) and Podolny and Morton (1999), examine specific shipping cartels in the U.K. in the 1800s. The most relevant studies are Wilson and Casavant (1991), Pirrong (1992), and Clyde and Reitzes (1998). Wilson and Casavant (1991) provided evidence of regime change by the Shipping Act of 1984 using data on quarterly freight rates and shipping quantities of five selected commodities only on the Transpacific route. Pirrong (1992) tested the model prediction of the core theory surveyed in Sjostrom (2013) using data from two specific trade routes between 1983 and 1985. Clyde and Reitzes (1998) studied the relationship between market power and the market share of shipping conferences after the act. However, they did not exploit cross-sectional variations, especially between non-U.S. and U.S. routes. Our study is the first empirical research to detect the effect of shipping cartels on the six main routes after global containerization in the 1970s, and it overcomes data limitations to complement the findings of previous studies.

The remainder of this paper is organized as follows. Section 2 summarizes the data and institutional background of the container shipping industry. Section 3 presents interview-based evidence from an ex-chairperson and an ex-vice chairperson to demonstrate the consistency of our recovered data. Section 4 implements structural break tests to detect price reductions in market variables. Finally, Section 6 presents our conclusions, and Appendix B presents the details of data construction.

2. Data and institutional details

We provide details of the data source in Section 2.1. Next, we provide graphical interpretations in Section 2.2 and summary

⁷ On cartel issues in a similar industry, the most relevant paper is by Asker (2010). He studied how the presence of a cartel affects market conduct following its dissolution and how the dissolution might be affected by the obligations imposed on firms that seek leniency in the tanker shipping market between 2001 and 2002. Kalouptsi (2014), Brancaccio et al. (2020), and Greenwood and Hanson (2015) investigated the bulk shipping market after 2000. Bai and Li (2021) studied the tanker market during 2017–2020 and investigated how the imbalance between the demand for and the supply of shipping services determines congestion. Although these industries are closely related to the container shipping industry, each of the industries is characterized differently because the market structure and competition are different. In addition, Kalouptsi (2017) and Barwick et al. (2019) studied the shipbuilding industry, which is an upstream industry for the container and bulk shipping industries. These papers rely on the use of Clarksons Research database and focus on the period after 2000. In the literature on international trade, Bernhofen et al. (2016) use country-level panel data regarding containerization adoption for the period 1962–1990. They focused on the effect of containerization adoption on the trade quantity; therefore, they refer to the Containerization International Yearbook only for obtaining the first presence of container technology in each country. Rua (2014) added port-level data to their study and investigated the diffusion of initial adoptions of containerized transportation. Coşar and Banu (2018) exploited rich Turkish export data and examined modal choice between containerization and breakbulk shipping.

⁸ The ongoing study of one of the authors of this paper investigates the effect by constructing a structural model and focuses on the shipping conferences as a single explicit cartel entity and departs from the traditional focus on tacit collusion in the literature, e.g., Porter (1983), Bresnahan (1987), Miller and Weinberg (2017), and Byrne and De Roos (2019). The institutional background is similar to Igami (2015)’s findings. He studied the impact of market power on international coffee prices and evaluated the impact of a cartel treaty on coffee prices and its global welfare consequences under counterfactual competition regimes, that is, collusion versus Cournot–Nash in a single homogenous good market.

statistics for the variables in Section 2.3. We also introduce institutional details. For clarification, in this industry, a market refers to a non-directional location pair. For instance, if a firm operates a container ship in the eastbound of the transpacific, it should also operate the ship in the westbound. A route refers to a directional round-trip between two locations. For example, both the westbound and eastbound of the transpacific. An industry refers to the entire market consisting of all six routes.

2.1. Data source

We constructed route-year-level and industry-year-level data for the container shipping industry.⁹ First, we collected route-year-level data on container freight rates and shipping quantities. Collecting data, particularly before 1994, was not trivial because no single data source covers the period from 1966 to 1993. Thus, we needed to carefully combine data from multiple sources carefully.¹⁰ In Appendix B, we provide the data source and a detailed guide with some assumptions on data construction for each container freight rate and shipping quantity on the six major routes: mainhaul and backhaul (separately) on the Transpacific (Asia and North America), Transatlantic (North America and Europe), and Asia-Europe routes. Finally, we used price and quantity data from the six routes between 1966 and 2009. The price was adjusted according to the CPI in the U.S. in 1995. To check the accuracy and validity of our data, in Section 3, we provide interview-based evidence on the consistency of our recovered data with the historical experience of industry experts, Akimitsu Ashida and Hiroyuki Sato.

Second, we utilized industry-year-level data for newbuilding, secondhand, and scrap prices.¹¹ Specifically, we used newbuilding and scrap prices per TEU between 1966 and 1998 and the secondhand price per TEU between 1968 and 1998. These prices were adjusted to the CPI in the U.S. in 1995.

It is worth noting that recent data on newbuilding, secondhand, and scrap prices after 1998 and shipping prices and quantities after 2009 are available for purchase from companies such as Clarksons and IHS Markit. While our data can be merged with proprietary data, this study does not include such data in order to provide public access to our data.

2.2. Graphical interpretation

2.2.1. Route-year-level shipping price and quantity data

Fig. 1 illustrates the nonstationary trends in container freight rates and shipping quantity between 1966 and 1990. The container freight rate decreased with fluctuations, and suddenly dropped significantly, with the transition of freight rates on the Asia-Europe eastbound and westbound routes being more unstable than those on Transpacific and Transatlantic routes in the 1970s and 1980s. This was mainly due to the reopening of the Suez Canal in 1976, which increased the supply of container shipping services (Saito et al. 2022). Additionally, freight rates for the Asia to Europe trade were higher than for other trade routes, possibly due to the strong influence of shipping conferences on Asia to Europe trade in the 1970s and early 1980s. The figure shows a sharp decline in freight rates in the second half of the 1980s, possibly because of the significant impact of the conferences' loss of power in the early 1980s.¹²

The shipping quantity on all routes increased monotonically between 1973 and 1990 due to the increase in containerized cargo and the increase in the size of ships.¹³ In response to the rapid increase in cargo exported from Asian countries, especially China, to Europe and the U.S., the number of vessels deployed on the Trans-Pacific East and Asia-Europe East routes has increased exponentially since 2000. Jeon (2022) has examined these characteristics in detail since 2000.

⁹ Based on the firm-level data, each route is divided into conference and non-conference routes. For example, the Transatlantic eastbound conference route is a single route and the Transatlantic conference market is a single market. A conference market is a market where all conference firms conducted collusive behavior under the shipping conferences before the Shipping Act, but have competed since the act, whereas a non-conference market is a market where all non-conference firms have competed throughout the whole period. In the interview with practitioners in shipping companies, they told that container freight rates for nonmember carriers are 20% to 30% lower than conference firms on the same routes. However, as far as we know, there was no data available on the trends in freight rates offered by the non-conference carriers. In addition, although we checked *The Japan Maritime Daily*, the newspaper of the maritime industry, we could not find any articles that continuously reported on the level of freight rates offered by the non-conference carriers.

¹⁰ For reference, we merge "Issues of Our Ocean Shipping" ("Wagakuni no Gaikou Kaiun Ni Tsuite," in Japanese), *Global Container Markets Drewry Shipping Consultants*, *Review of Maritime Transport*, *Containerization International 1973*, *World Sea Trade Service*, *Container transportation cost and profitability 1980/2000*, *The Container Crisis 1982*, *World Container Data 1985*, and *World's sea trades*. Then, we converted merged data into TEU-based data.

¹¹ For reference, we merged *Review (1971–1998)* and *Lloyd's Shipping Economist (1983–1990)*. Then, we converted merged data into TEU-based data.

¹² In the interview with an ex-executive of a Japanese shipping company, he pointed out the difference between conferences. Conferences related to Asia-Europe had a strict membership screening process, and the number of voyages by member companies was clearly defined (closed conference). In addition, some members in the conference pooled their freight and then redistributed them. In contrast, the conferences for Transpacific routes were free to join or leave (open conference), and freight pooling was explicitly prohibited under the Shipping Act of 1916 in the U.S.

¹³ When Sea-land began container transport services in 1966, 226 35-foot containers were deployed. In the 1970s, with the development of international maritime container transport, container vessels began to increase in size, with vessels of approximately 2000 TEU becoming the mainstay of liner services. Owing to increased competition following the Shipping Act of 1984, shipping companies wanted to introduce even larger vessels. In 1988, American President Lines (APL) opened a 39.1-meter wide, 4300 TEU vessel, the first container vessel that could not pass the Panama Canal. Further, in the 1990s, 6000 TEU-class vessels come into the container shipping market.

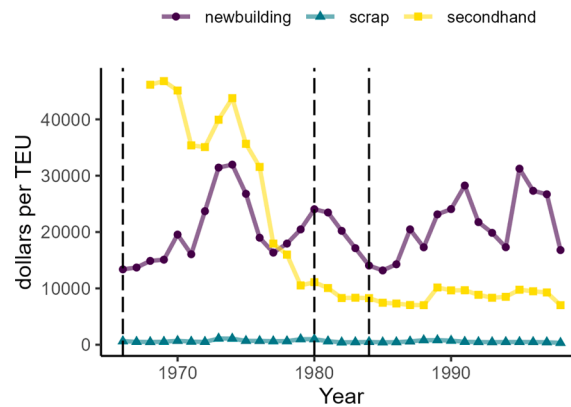


Fig. 2. Trends in industry-year-level newbuilding, secondhand, and scrap prices. Note: The data span 33 years (1966–1998) for the entire container shipping industry. The data cover newbuilding and scrap prices between 1966 and 1998 and secondhand prices between 1968 and 1998. All prices were adjusted according to the CPI in the U.S. in 1995.

The enactment of the Shipping Act of 1984 in the U.S. sharply divided the conference market regime into two periods, before and after 1984, as illustrated by the trend of the container freight rate in Fig. 1. The Shipping Act of 1984 in the U.S. made it much easier to form shipping conferences. As a result, after 1984, the Transpacific and Transatlantic routes saw significant price reductions due to market competition.¹⁴ The change in the market regime played a significant role in shaping the container crisis.

2.2.2. Industry-year-level newbuilding, secondhand, and scrap prices data

Fig. 2 illustrates the transitions of newbuilding, secondhand, and scrap prices. First, we observe four peaks in the newbuilding price in 1974, 1980, 1987, and 1991, indicating that the newbuilding price peaks at similar times to the shipping price. Surprisingly, the shipping price, after adjusting CPI, did not decrease significantly, which means that the trend of the newbuilding price did not decrease unlike the shipping price. This is a new finding because it is commonly known that vessels themselves were expensive in the 1970s and the shipbuilding price per TEU decreased in the 1990s due to the gradual increase in the size of ships. We find that the increasing CPI corresponds with a seemingly decreasing shipbuilding price in the nominal sense.

Second, the secondhand price sharply decreased between 1974 and 1979. However, after 1980, it remained relatively stable compared to shipping and newbuilding prices. In the 1970s, when full container vessels started operating on liner routes, the number of vessels was insignificant, leading to a small number of vessels traded in the secondhand market, which resulted in more fluctuation in secondhand prices. However, since the 1980s, the number of vessels traded in the secondhand market has increased, leading to more stable secondhand freight rates and a more significant correlation with new building prices.

Third, the scrap price remained stable, without significant fluctuations relative to other price variables. Moreover, the scrap price level was smaller than that of the newbuilding and secondhand prices because the scrap price is linked to the input price, such as the steel price. Thus, the trend in scrap price reflects the dynamics of the input price.

2.3. Graphical interpretation

2.3.1. Route-year-level shipping price and quantity data

Panel (a) in Table 1 presents the summary statistics of the route-year-level variables for the shipping price P_{it} and quantity Q_{it} . The data cover the Transatlantic routes that opened in 1966, the Transpacific routes that opened in 1967, and the Asia-Europe routes that opened in 1971.¹⁵ On average, the shipping price was \$2105.35 per TEU and the shipping quantity was 2.34 million TEUs.

2.3.2. Route-year-level shipping price and quantity data

Panel (b) in Table 1 shows the summary statistics of industry-year-level variables for the newbuilding price P_t^{new} , scrap price P_t^{scrap} between 1966 and 1998, and secondhand price P_t^{second} between 1968 and 1998. The average newbuilding price per TEU was \$20633.82. The average secondhand price per TEU was \$18371.82, which was less than the newbuilding price after 1971. The average scrap price per TEU was \$609.97.

¹⁴ This is consistent with an interview article to ex-executives of Japanese shipping companies (Ishida and Sato 2006) that were in charge of container trades in the 1980s.

¹⁵ For Table 1, the shipping prices before 1992 refer to conference prices, while the shipping prices after 1993 are unified prices based on conference and non-conference prices, while the difference between them vanished in the *Containerization International Yearbook*. Thus, we observe the full history of the conference market.

2.4. Institutional details

Here, we introduce the institutional background of the shipping conference, the early history of the container shipping industry, and two key events triggering the change in competition regime.

Table 2 summarizes the historical events of the liner shipping industry before and after global containerization.

2.4.1. Shipping conferences

The world's first shipping conference, the "Calcutta Conference," was formed in 1875 on the route between England and Calcutta to establish a unified freight rate.¹⁶ In 1879, the Chinese Alliance, the ancestor of the Far East Freight Conference, was formed on routes between Asia and Europe.¹⁷ The shipping conferences appeared 15 years before the enactment of the Sherman Antitrust Act in 1890, one of the first competition laws in the modern world, so cartels themselves were not illegal at that time. Table 2 summarizes the history of the liner shipping industry before 2000, with related studies and key legislative changes.

Internal mechanism to conference firms. The internal mechanism of conference firms is mainly aimed at market stabilization by controlling entry via excess capacity (Fusillo 2003), predatory pricing (Morton et al., 1997, Podolny and Morton, 1999), price discrimination (Fox 1992, Clyde and Reitzes 1998), and loyalty contracts (Marin and Sicotte 2003), among other things. To achieve this, shipping conferences agreed on various matters, in addition to freight rates. The content of the agreements covered: (1) alternatives to suppress freight rate competition among member shipping companies, (2) alternatives to prevent shippers from moving to non-conference shipping companies, and (3) alternatives to directly exclude non-conference vessels.

To avoid freight rate competition, rate agreements and vessel allocation agreements were concluded among the member shipping companies. Rate agreements are signed by members to agree on rates for each product and to update the rates jointly. Vessel allocation agreements adjust the amount of tonnage to be allocated, the number of voyages, ports of call, operation schedules, and cargo to be loaded. These features were modeled as price and quantity-fixing cartels.¹⁸

External mechanism for non-conference firms. The conference tariff rates, or freight rates, determined by these agreements had been publicly noticed, and no entry restrictions imposed non-conference container shipping market. The market was, however, subject to competition from non-conference vessels and new entrants. Consequently, shipping conferences introduced the Dual Rate System, the Fidelity Rebate System, and the Differed Rebate System to ensure effectiveness of freight rate agreements and prevent shippers from flowing to non-conference shipping companies that offer lower rates than the conferences' rates.¹⁹ These entry deterrents promoted the stability of freight rates and liner services.²⁰

Conferences also utilized "fighting ships," which are vessels that temporarily put into service at a similar schedule as non-conference shipping companies and at lower rates.²¹ Fighting ships were used to force non-conference shipping companies to leave routes, and all members shared the associated operational losses.

Since the 1960s, the nature of shipping alliances have changed. Technological innovation centered on containerization, and pro-competitive amendments to shipping laws in the United States, particularly, have had an impact on the functioning of shipping alliances and market competition in the shipping market.

¹⁶ In this subsection, we refer to *The Actual State of Competition in Oceangoing Shipping and Problems with Competition Policy* ("Gaikoukaian no Kyousoujittai To Kyousouseisakujou no Mondaiten ni Tsuite," in Japanese) reported by Study Group on Government Regulation and Competition Policy (2006) of the Japan Fair Trade Commission, Branch and Stopford (2013), and Sjostrom (2013). In particular, Sjostrom (1989) discusses the economic insights of the shipping conferences from an historical viewpoint. Morton (1997) provides detailed historical evidence on British shipping industry before 1900.

¹⁷ Sjostrom (2004) conducted a survey on shipping conferences and pointed out that systems similar to shipping conferences had existed in Atlantic shipping and British coastal shipping before the Calcutta Conference.

¹⁸ For example, Clyde and Reitzes (1998) model the market with the shipping conference as a collusion equilibrium.

¹⁹ In the Dual Rate System, a shipper and a shipping conference conclude an exclusive patronage contract/loyalty agreement and provide transportation service for the specific route. The contract rate is lower than the spot rate on the condition that the shipper uses only conference member carriers' service within a specific contract period. The Fidelity Rebate refunds a portion of the freight if the shipper uses only the conference carriers within a specified period (4–6 months). The Differed Rebate System is also an incentive to use conference carriers. Under the system, if a shipper had used only members' services for a specified refundable period (4–6 months), and if it does not use any non-conference members' service for the deferment period following the refundable period, a certain amount of money is refunded upon the shipper's request. The refund amount was usually around 10% of the freight. Fox (1992) uses the U.S. port pair-level data in 1977 to examine the effect of the dual rate contract and consumer loyalty.

²⁰ For instance, Marin and Sicotte (2003) examine the economic effects of exclusive contracts of ocean shipping cartels during the 1950s between firms and the ultimate consumers of their product. They record that, "During the congressional investigations of shipping conferences in the late 1950s and early 1960s documents obtained from an ocean carrier contained an admission that 'the entire contract system is a fighting measure to get rid of outside competition'" (p.198).

²¹ See Marshall and Marx (2014) (page 148) and Harrington Jr et al. (2018) for reference to put the strategy of shipping conferences in general cartel literature. Harrington Jr et al. (2018) classify the general response of cartels to the expansion of noncartel supply into four strategies: takeover, starvation, coercion, and bribery. The fighting ships are classified into coercion strategy.

Table 1
Summary statistics.

(a) Route-year-level variables (1966–2008)					
	N	mean	sd	min	max
Price (\$ per TEU): P_{rt}	240	2105.35	1250.84	561.86	6654.79
Quantity (1 mil TEU): Q_{rt}	240	2.34	2.75	0.00	17.70
(b) Industry-year-level variables: (P_t^{new} , P_t^{scrap}) (1966–1998) and P_t^{second} 1968–1998)					
	N	mean	sd	min	max
Newbuilding price (\$ per TEU): P_t^{new}	33	20633.82	5555.70	13186.28	31966.62
Secondhand price (\$ per TEU): P_t^{second}	31	18371.82	14502.46	7020.96	46792.94
Scrap price (\$ per TEU): P_t^{scrap}	33	609.97	196.54	334.25	1098.38

Note: Panel (a) of the six routes covers a data span of 44 years (1966–2009). The Transatlantic routes opened in 1966, Transpacific routes opened in 1967, and Asia-Europe routes opened in 1971. The shipping prices before 1992 in Panel(a) refer to conference prices, while the shipping prices after 1993 are unified prices based on conference and non-conference prices. The difference between them vanished because of the Shipping Act of 1984. The latter are standard data that are often used in the literature such as Jeon (2022). Panel (b) of the container shipping industry covers a data span of 33 years (1966–1998). The data cover newbuilding and scrap prices between 1966 and 1998, and secondhand prices between 1968 and 1998. All prices were adjusted according to the CPI in the U.S. in 1995.

Table 2
The historical background of the liner shipping industry.

Timing / Period	Event	Related Study
1875	the first liner shipping conference (The U.K.-Calcutta) established	Morton et al. (1997) Podolny and Morton (1999)
1916	The Shipping Act of 1916 prohibited deferred rebate	
1918	The end of WW1	Deltas et al. (1999)
1936	U.S. Maritime Commission established	
1945	The end of WW2	
1956	The world's first container ship sailed	
1961	The 1961 Amendment enacted Federal Maritime Commission (FMC) established Technical Committee on Cargo Containers established (ISO/TC104)	
1964	ISO adopted seven sizes of containers as ISO standards	
1966	The first Full-container (FC) ship sailed the Transatlantic route	
1967	The first FC ship sailed the Transpacific route	
1971	The first FC ship sailed the Asia-Europe route	
1973	Oil shock	
1974	The UNCTAD Code of Conduct for Liner Conferences adopted	Fox (1992, 1995)
1980	Withdrawal of Sea-Land from shipping conferences	Sjostrom (1989)
1983. April	The UNCTAD Code of Conduct for Liner Conferences accomplished	
1984. June	The Shipping Act of 1984 in the U.S. enacted, conference breakdown	Clyde and Reitzes (1995, 1998) Wilson and Casavant (1991) Pirrong (1992)
1985. Sep	Yen appreciation due to the Plaza Accord	
1991	Strategic alliance boom started	
1998. Oct	The Ocean Shipping Reform Act (OSRA) of 1998 , effective in 1999	Reitzes and Sheran (2002) Fusillo (2006, 2013)

Note: This table is based on unified survey papers such as Sjostrom (2004, 2013) and Martin (2012) and specific papers (Clyde and Reitzes 1995, 1998). Industry and legislative changes after 1990 are beyond the scope of this study. For reference, see Reitzes and Sheran (2002), which states that “OSRA alters the role of the Federal Maritime Commission as a cartel enforcer. Under the Shipping Act of 1984, all carriers, both conference carriers, and independent carriers, had to file their tariffs with the FMC. The FMC then policed these rates, issuing fines to carriers that engaged in secret discounting, known as “rebating.” Under the OSRA, carriers are obliged to make their freight rates publicly available, but the FMC’s enforcement obligations are eliminated. OSRA’s elimination of tariff-filing requirements and rate enforcement by the Federal Maritime Commission raises the cost of monitoring their members’ pricing activities. (page 56).

2.4.2. The inception of the container shipping industry

The history of container shipping began with Malcolm P. McLean, the founder of the U.S. Land Transportation Company Sea-Land Service.²² The world’s first container ship sailed from the Port of Newark, New Jersey, to the Port of Houston, Texas in 1956. The first international container ship was employed by Sea-Land Service for the Transatlantic Route in 1966, and for the Transpacific route in 1967. However, for the Asia-Europe route, the first international semi-container ship, Cornelia Maersk, was employed in 1967. The

²² Bernhofen et al. (2016) and Rua (2014) explain the detailed history of the container shipping industry from the viewpoint of the global trade and country-level development. Levinson (2016) provides an overview of the industry with anecdotal and qualitative evidence.

first international full-container ship, Kamakura-maru, was delayed in 1971.

Global containerization induced several market changes between 1966 and 1990, including transforming the cost structure, lowering barriers to entry, stimulating the rise of non-conference shipping companies in developing countries, shifting from “closed” conferences to “open” conferences, and forming a consortium. [Appendix A](#) provides further details on each of these changes.

2.4.3. Withdrawal of Sea-Land from shipping conferences in 1980

In the late 1970s, the increase in competition for Transpacific routes led to pressure on shipping rates. To address this, Sea-Land introduced eight SL-7 high-speed container vessels with a speed of 33 knots. However, the high operation costs of these vessels negatively impacted the company’s profitability. Consequently, Sea-Land withdrew from shipping conferences to avoid tonnage-based cargo allocation imposed by the conferences and secure profitability. Former executives of a Japanese shipping company stated that Sea-Land had to increase loaded cargo but could not achieve its goals without leaving the conference that set freight rates and that it felt it had no choice but to become a non-alliance carrier and establish its own freight rate to retain customers ([Ishida and Sato 2006](#)).

After Sea-Land’s withdrawal from shipping conferences, shippers with contracts with conference carriers hesitated paying the penalty to switch to Sea-Land under the conference’s Dual Rate System. Sea-Land focused on import shippers and intermodal cargoes not covered by the Dual Rate System. The company also paid the freight cost of returning inland containers to the port instead of passing them on to shippers, decreasing freight rates.

2.4.4. The Shipping Act of 1984 in the U.S.

In June 1984, the United States enacted the new Shipping Act as part of the Reagan administration’s deregulation policy to allow member carriers to make individual agreements with shippers on freight rates and services, and to unbind shippers from shipping conferences to enable them to make more appropriate choices in shipping companies. This drastically changed the competition regime.²³

The Shipping Act of 1984 included the right to Independent Action (IA), allowing member firms to define freight rates or services that deviate from the conference tariff rates and guaranteeing of members carriers in the shipping conferences to set their own rates or services. It required conferences to allow the right to form service contracts (SCs), which are contracts in which the shipper commits in advance to load a specific quantity or more of cargo to the shipping company during a specific period. Under this contract, the shipping company reserves the space necessary to carry cargo and applies discounted freight rates.²⁴

The act explicitly prohibited the Dual Rate System and the shipping conference lost its binding power over shippers, and individual shipping companies frequently exercised their right to independent action, which encouraged competition and led to a significant decline in freight rates on U.S.-related routes.²⁵

Stabilization agreement. Containerization and the Shipping Act of 1984, weakened the price-binding power of shipping conferences by increasing contracts based on IAs and SCs. Shipping companies thus set their freight rates, leading to intense price competition and sharp drops in Transpacific freight rates. To stabilize shipping routes, conference shipping companies formed a “stabilization agreement” inviting most shipping companies, including non-conference ones.

Agreements shared information on supply and demand trends and agreed guidelines for rate restoration and surcharges, but binding power on rates. The Transpacific Stabilization Agreement (TSA) was formed in 1989 by 13 shipping companies to stabilize shipping routes from Asia to North America.²⁶

3. Interviews

In this section, we provide interview-based evidence on the consistency of our recovered data on container freight rates with the historical experience of industry experts, Akimitsu Ashida and Hiroyuki Sato.²⁷

3.1. Akimitsu Ashida, an ex-chairperson of Mitsui O.S.K Lines

Concerning the increase in freight rates in Transatlantic and Asia-Europe routes in the 1980s, Mr. Akimitsu Ashida, former chairman of Mitsui O.S.K. Lines (MOL), answered about the situation on liner routes. He served as the company’s European Division Manager from 1985-86 and responded to our e-mail inquiry on February 28, 2022. We asked him about his thoughts and related

²³ Wilson and Casavant (1991) provide anecdotal evidence and a case study of the effect of the Shipping Act of 1984.

²⁴ The minimum number of containers promised by the shipper to the shipping company is called the MQC (Minimum Quantity Commitment).

²⁵ [Japan Maritime Center \(2008\)](#) pointed out that the Dual Rate System was the most effective way in which shipping companies kept their shippers when the conference system was functioning.

²⁶ TSA was dissolved in 2018.

²⁷ We obtained additional interview-based evidence. Mikio Tasaka, who belonged to the Nittsu Group and worked in the U.S. in the 1980s, stated that there was no discrepancy in the development of freight rates. In addition, Carolyn Almquist experienced pricing and conference division in the container shipping business at American President Lines, stated that provide a reasonable basis for analysis. Professor Yutaka Yamamoto (University of Nagasaki), who had 20 years of experience in the container shipping business at American President Lines, stated that the trend was generally reasonable. We also received responses from Kwon Oh In who worked for 40 years at Korea Maritime Transport Company, a major Korean container shipping company. He said that our graphs seemed convincing as a general trend of the container shipping industry during that period.

memory on the figures and tables.

3.1.1. Regarding Shipping Quantity in Asia-Europe routes

Ashida: Unlike Transpacific routes (where U.S. Customs publishes data), European routes did not have a system whereby customs authorities published statistics on container transport volumes. Therefore, the FEFC did not have to compile and notify its members of actual container transport volumes. Consequently, it is not easy to find the data even today.

3.1.2. Regarding Freight Rates in Asia-Europe routes

Ashida: Freight rates were rising regularly in nominal terms. One of the reasons was that shipping conferences had relatively strong power on Asia-Europe routes. In addition, surcharges such as the Bunker Adjustment Factor (BAF) and Currency Adjustment Factor (CAF) were collected without fail. Under these circumstances, the Plaza Accord of 1985 raised the yen-dollar exchange rate from 240 yen to approximately 140 yen. This caused dollar-based freight rates to rise sharply, especially for cargoes originating in Japan. Non-Japanese carriers earned even higher profits because their yen-based costs were relatively small.

3.1.3. The reason why the shipping conferences were still functioning on the Asia-Europe routes

Ashida: One reason is that there were no powerful non-conference member shipping lines. At that time, Japanese shippers avoided non-conference members when exporting cargo from Japan. The exports accounted for 50 % of all cargo shipped from Asia. Therefore, the export cargo was mainly assigned to conference member firms. This trend was disrupted by the introduction of large newly built vessels by non-conference members from 1990 onward.

I recall that about 35 % of cargo on the Asia-Europe routes was handled through forwarders, unlike the Transpacific routes. Furthermore, the Asia-Europe routes were less active in discount negotiations than the Transpacific routes because the inland transport distances were shorter and lower ocean freight rates would reduce the profit for the company.

3.2. Hiroyuki Sato, an ex-president of Mitsui O.S.K Lines

We interviewed Mr. Hiroyuki Sato, former vice president of MOL, about the shipping conferences in the Transpacific routes and the situation in liner routes in the 1970s and the 1980s. He had been in charge of sales for Asia-Europe service routes from 1969 and Transpacific service routes from 1974. We conducted onsite interview with Mr. Sato on November 17, 2021, and our e-mail inquiries were responded by him on December 15, 2021 and February 28, 2022. We asked him about his thoughts on the figures and tables used in this study.

3.2.1. Regarding freight rate

Sato: In the 1970s, containerization was progressing on all routes, but freight rates were determined based on weight or measured in the same way as conventional vessels, instead of box rates (rates per container). There was also an arrangement called “minimum revenue per container.” In addition, a few percent of discounts were applied to long-term contract shippers using a double freight contract with the shipper.

In the 1980s, there was a shift to box rates; the enactment of the Shipping Act of 1984 was a significant reason for this shift. The period after the Act was when space charters were no longer viable, leading to the formation of alliances in the 1990s.

4. Results of structural breaks test

We test multiple unknown structural breaks for each route using [Bai and Perron \(1998, 2003\)](#), to confirm anecdotal evidence of container crises between the 1970s and the 1980s, documented in [Broeze \(2002\)](#), and to find when the container crisis started and how long it lasted. Methodologically, we follow [Bai and Perron \(2003\)](#) to address the problem of estimating the break dates and the number of breaks and present an efficient algorithm.²⁸

We consider a multiple linear regression with k breaks ($k + 1$ regimes) as follows:

$$y_t = z_t' \delta_j + u_t \quad t = T_{j-1} + 1, \dots, T_j \quad (1)$$

for $j = 1, \dots, k + 1$. In this model, y_t is the targeted price at time t , $z_t(q \times 1)$ is a vector of q -dimensional covariates, δ_j ($j = 1, \dots, k + 1$) is the corresponding vector of coefficients, and u_t is the disturbance at time t . We allow serial correlation in the errors and variances of the residuals across segments. The indices (T_1, \dots, T_k) , that is, the breakpoints, are explicitly treated as unknown (we use the convention that $T_0 = 0$ and $T_{k+1} = T$).

The purpose of this section is to estimate the unknown regression coefficients together with the breakpoints and the number,

²⁸ The most relevant paper is [Fan and Yin \(2016\)](#), which applies [Bai and Perron \(2003\)](#)'s method to the semi-annual data on the newbuilding price index, the time charter rate index, and the second-hand price index for each ship size (i.e., Feeder, Feedermax, Handy, Sub-Panamax, and Panamax) between October 1996 and July 2013. They focus on the unknown structural breaks in the relationship between the three abovementioned global-level indices, whereas we are interested in the unknown structural breaks in the route-level container freight rate corresponding with competition regime changes.

therefore we specify $z_t = 1$ as the simplest case. Bai and Perron (2003) suggested that the trimming parameter $\varepsilon = h/T = 0.10$ holds where h is the minimum distance between each break. Following Bai and Perron (2003), we assume a minimum length equal to 10% of the sample size, given that we allow for a maximum of four breaks. Our data specify $T = 40$ (i.e., yearly data between 1966 and 2007), thus we impose $h = 4$ for the route-year-level analysis of the shipping price. For consistency, we also impose $h = 4$ for the industry-year-level analysis of newbuilding, secondhand, and scrap prices.

4.1. Route-year-level shipping price data

Fig. 3 illustrates the estimated breakpoints \hat{T}_j and 95% confidence intervals for route-year-level analysis of shipping freight rates. The bottom table shows BIC for all possible number of breaks under $h = 4$, where the minimizer of the BIC is the optimal break number \hat{k} . First, we find that the 95% confidence intervals of the structural break cover the period between 1979 and 1980 on the U.S. routes (left and center panels), whereas the intervals cover the period between 1976 and 1978 on the non-U.S. routes (right panels). This indicates that the container crisis occurred on all six routes by 1980, triggered by the withdrawal of Sea-Land, although non-U.S. routes reacted earlier than U.S. routes. The reason for the response in non-U.S. routes may be related to the reopening of the Suez Canal in 1976, which increased the supply of container shipping services (Saito et al. 2022).

Second, we find remarkable differences between U.S. routes and non-U.S. routes between 1984 and 1990. The 95% confidence intervals of the structural break cover some period between 1984 and 1990 on the U.S. routes, whereas there were no breaks on the non-US routes in the period. This implies that the enactment of the Shipping Act of 1984 generated some structural breaks in the treatment group — the U.S. routes. Surprisingly, we also find that the container crisis lasted heterogeneously, even along the U.S. routes. For example, Transpacific routes seemed to recover in 1986, whereas Transatlantic routes remained sour until 1990. This result may support the fact that the supply–demand relationship on the Transpacific and Transatlantic routes changed differently in the late 1980s. The substantial change in exchange rates after the Plaza Accord in 1985 led to a recovery in the demand for transportation on the Transpacific route. However, no such situation was observed between Europe and the U.S.

4.2. Industry-year-level newbuilding, secondhand, and scrap prices data

Fig. 4 illustrates the estimated breakpoints \hat{T}_j and 95% confidence intervals for industry-level analysis of newbuilding, secondhand, and scrap prices. First, we find that 95% confidence intervals of the structural break cover the period between 1974 and 1976 for newbuilding and secondhand prices. These results correspond with the shipping price trend in the Asia-Europe market. Second, downward structural breaks in prices were not detected between 1984 and 1990. These results imply that, unlike route-level shipping prices, the container crisis did not significantly decrease industry-level prices in the shipbuilding market. We interpret these differences as naturally capturing the differences between shipping markets with shipping conferences and those without cartel groups.

5. Practical Implications, Discussion, and future research

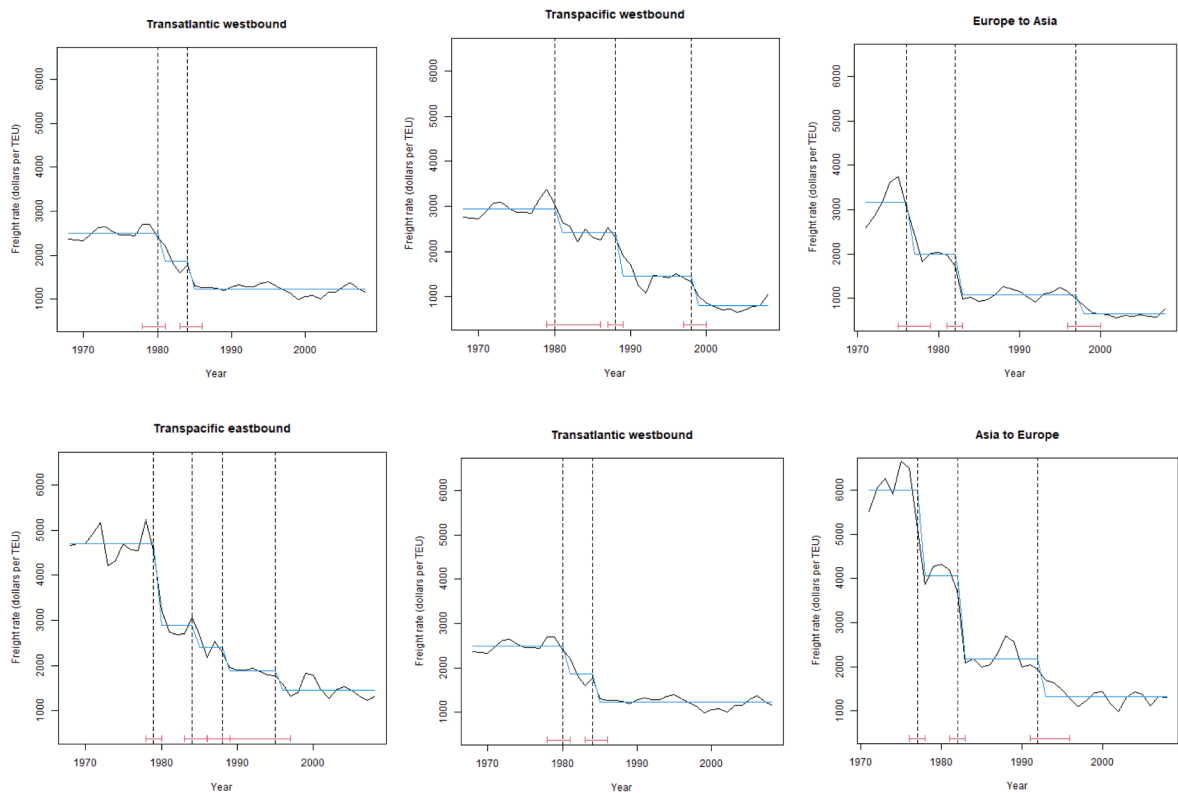
5.1. Practical implications

Our study makes an important contribution to the development of consistent data on the history of the container shipping industry and policy discussions for practitioners. The data contribution enables practitioners to obtain empirical knowledge on the main container transport markets, as well as to develop a methodology to construct container market trends on other routes, where information such as freight rates and vessel volumes deployed is only partially available. For example, container transport market trends on routes between the Indian subcontinent, Africa and Europe, South East Asia and the U.S. are important information for manufacturing companies to establish their supply chains and respond to specific policies, but the available information is fragmented. Thus, our data contribution sheds light on the calculation of partially known logistics costs for shippers.

5.2. Discussion

We summarize the potential concerns for the data and structural break tests. First, our imputation approach is ad hoc, which potentially makes the data sensitive to other imputation approaches or assumptions. However, we believe that our approach is the best alternative among feasible approaches because other data-driven imputation approaches require a large sample size, several overlapping years, and the no-structural-break assumption of the data, which our data does not satisfy (discussed in Section 2.4 and Appendix B). Second, we may face a small sample problem for the structural breaks tests because we use route-year-level data between 1968 and 2008. If route-quarter-level data for a longer period can be consistently constructed, the results of the structural breaks may change.

Regarding the possibility of combining our data with data from 2009 and beyond, we have a couple of reasons for not doing so. First, our main data source, Review of Maritime Transport, only provides route-level price data up until 2009. Second, there are some challenges with merging our data with Drewry's data for a fee since their price data is based on a different observation unit than ours. Drewry's data includes monthly port-to-port level price data, while our data is route-year-level. Third, the industry experienced significant changes around 2009, such as the Global Financial Crisis and the Repeal of the EU's competition law exemption for shipping conferences in October 2008. These industry changes not only make it inappropriate to simply merge data from 2009 and beyond with



	BIC($m = 0$)	$m = 1$	$m = 2$	$m = 3$	$m = 4$	$m = 5$	$m = 6$	$m = 7$	$m = 8$
Transatlantic westbound	647.86	555.88	538.08	538.10	538.89	538.95	545.65	552.91	560.26
Transatlantic eastbound	685.71	620.56	596.29	582.23	581.03	584.06	587.28	592.78	598.48
Transpacific westbound	679.59	609.32	592.63	568.14	568.96	573.59	579.50	586.58	593.87
Transpacific eastbound	714.70	640.64	599.18	592.70	592.22	595.82	600.01	606.82	614.56
Asia to Europe	684.17	620.42	593.91	567.82	571.46	576.96	584.01	591.20	627.68
Europe to Asia	631.38	581.33	553.76	539.17	545.08	551.75	558.62	566.59	588.79

Fig. 3. The estimated breakpoints and 95 % confidence intervals with BIC. Note: Each segment shows the estimated breakpoints and the 95% confidence intervals for \hat{T}_i for $i = 1, \dots, 4$ for each route. Following [Bai and Perron \(2003\)](#), the number of breakpoints is selected by minimizing BIC, as shown in the bottom table. The estimated parameters $\hat{\delta}_j$ and standard errors for all $j = 1, \dots, k+1$ for all possible numbers of breakpoints are omitted. We use the sample between 1968 and 2008 for the Transatlantic and Transpacific routes and the sample between 1971 and 2008 for the Asia-Europe routes. We used the strucchange R-package developed by [Zeileis et al. \(2002\)](#).

our existing data, but they can also contaminate the results of structural break tests. These concerns are beyond the scope of this study and are left for future research.

5.3. Future research

Our data are useful for understanding the related historical policy debates in the container shipping industry. In ongoing research, one of the authors merge our data with the firm-market-level shipbuilding data between 1966 and 1990; then construct a dynamic structural model of firms' entry, exit, and shipbuilding investment decisions in homogenous good markets under collusive and perfect competition regimes, which are exogenously determined by the enactment of the Shipping Act of 1984. Understanding the effect of shipping conferences based on the structural model makes the specific features of the inner allocation mechanism of shipping conferences contributable to the general literature on competition law and industrial policy which have been investigated in the shipbuilding and shipping industry ([Kalouptsi, 2017](#), [Barwick et al. 2019](#)). Thus, our data sheds light on the historical questions of future

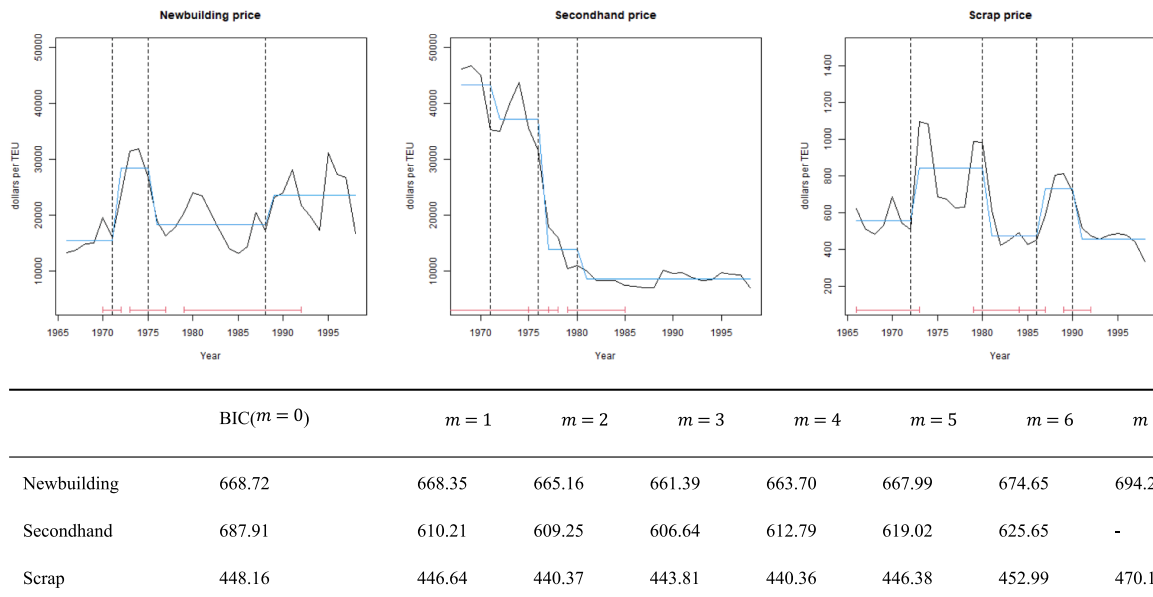


Fig. 4. The estimated breakpoints and 95 % confidence intervals with BIC. Note: Each segment shows the estimated breakpoints and the 95% confidence intervals for \hat{T}_i for $i = 1, \dots, 4$. Following Bai and Perron (2003), the number of breakpoints is selected by minimizing BIC, as shown in the bottom table. The estimated parameters $\hat{\delta}_j$ and standard errors for all $j = 1, \dots, k+1$ for all possible numbers of breakpoints are omitted. We use the sample between 1968 and 2008 for the Transatlantic and Transpacific routes and the sample between 1971 and 2008 for the Asia-Europe routes. We used the strucchange R-package developed by Zeileis et al. (2002).

research in the container shipping industry.

Our data are also useful for understanding the current policy debates in the container shipping industry. For example, we merge our data with post-1990 firm-market-level shipbuilding data to evaluate the effects of EU competition law exemptions (by Regulation (EEC) No 4056/86) for liner shipping firms, which terminated in 2008, on merger waves after 1990. Jeon (2022) uses data from 2006 to 2014 and conducts counterfactuals with respect to competition and industry consolidation by simulating the industry under a multi-plant monopolist and a merger of the top two firms. Kalouptsi (2017) and Barwick et al. (2019) investigated the Asian shipbuilding market in the 2000s to study China's expansion. Thus, our data fill the gap between prior studies focusing on the 2000s and the 2010s and future research examining the 1980s and the 1990s.

Our data provides a historical benchmark of shipping prices for updated issues in the container shipping industry. First, our data enables us to make quantitative comparisons between price increase during Covid period and historical prices that were under active shipping conferences. For instance, during the Covid period, the highest peak of shipping prices per TEU from Shanghai to Los Angeles was recorded in February 2022, adjusted according to the CPI in the U.S. in 1995, and amounted to \$4462. This level is comparable to the highest peak of cartel prices observed in the Transpacific eastbound route, as illustrated in Fig. 1. This will offer valuable insights into how prices have evolved over time, as well as how significant the shipping price increase during Covid was. Second, our 1966–2009 data provides a helpful benchmark for predicting the impacts of significant industry changes that are expected to occur, such as the updates to the EU competition law exemption for consortium in 2024 and the breaking of the 2 M alliance between Mediterranean Shipping Company (MSC) and Maersk in 2025. By using our data, we can gain a better understanding of the potential effects of these changes on shipping prices.

6. Conclusion

This study provides a new unified panel dataset of route-year-level freight rate and shipping quantities for the six major routes and industry-year-level newbuilding, secondhand, and scrap prices from 1966 (beginning of the industry) to 2009. The data provide a fundamental basis for understanding the container shipping industry. The data and structural break tests provide historical insights into the nonstationary dynamics of these price variables, known as the container crisis. We find that the container crisis was a specific event in the shipping market. Our data shed light on the industry dynamics of shipping cartels. We leave a detailed analysis based on these data for future work.

CRedit authorship contribution statement

Suguru Otani: Conceptualization, Methodology, Software, Investigation, Writing – original draft, Writing – review & editing.
Takuma Matsuda: Data curation, Resources, Writing – original draft, Writing – review & editing, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on github.

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.tre.2023.103186>.

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