The Effectiveness of Collusion Under Antitrust Immunity

The Case of Liner Shipping Conferences

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FEDERAL TRADE COMMISSION

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The authors are economists with the Antitrust Division, Department of Justice and Ernst and Young, respectively. This study expands on work performed while the authors were staff economists with the Advisory Commission on Conferences in Ocean Shipping (ACCOS). ACCOS released its report in April 1992. Dr. Reitzes also was an author of "An Analysis of the Maritime Industry and the Effects of the 1984 Shipping Act," *Report of the Federal Trade Commission to Congress and ACCOS* (November 1989).

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Summary

Collusion, in the form of tacit or explicit price coordination, is a subject that has fascinated both policymakers and economists for many years. While collusion can certainly stem from formal price-fixing or market-sharing agreements, economists also have noted that *tacit* collusion can be achieved in a noncooperative setting through repeated contact. Chamberlin (1929), Stigler (1964), Orr and MacAvoy (1965), and others have identified several factors that determine whether collusion can be sustained; chief among these factors are the ability of the cartel to identify and punish defection from the collusive outcome, and the ability of the cartel to prevent entry.[1] This study analyzes data from the ocean shipping industry to examine empirically whether the provision of antitrust immunity for price-fixing agreements and the establishment of a costless mechanism for policing these agreements are sufficient to foster effective collusion when there are no regulatory restrictions on entry.

This study analyzes whether liner conferences in ocean shipping act as effective cartels by testing empirically whether the rate structure in ocean shipping is consistent with cost-based factors, the exercise of market power by conferences, or the exercise of market power by firms in a manner unrelated to the conference system. We find no statistically significant relationship between freight rates and the market share of the conference serving the route, which indicates that conferences do not act as perfect cartels maximizing the joint profits of their members. Nonetheless, we do find that the level of freight rates is significantly lower on routes where conference members are free to negotiate service contracts directly with shippers. In the routes included in this study, such freedom existed temporarily on two routes, both of which had conferences with market shares over 80%. This latter finding provides some support for the conclusion that some aspects of the conference system may contribute to higher shipping rates, particularly when the conference has a sizable market share. Finally, we find that increases in market concentration are

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[1] See also Green and Porter (1984), Abreu, Pearce, and Stachetti (1985), Rotemberg and Saloner (1986).

associated with statistically significant, but economically small, increases in freight rates.

I. Introduction

Policy concerns regarding possible collusion have been reflected in several legislative and administrative actions, beginning with the Sherman Antitrust Act's prohibition of any attempt to "combine or conspire ... to monopolize any part of the trade or commerce among the several States ...."[2] These concerns are still evident today, as a glance at the recent *Department of Justice and Federal Trade Commission Horizontal Merger Guidelines* (1992) will confirm. Economists, however, have provided relatively little empirical support for the existence of anticompetitive collusive behavior in particular industries. The development of such support has been stymied by the paucity of detailed firm and industry cost and demand data needed to assess empirically firm-specific or industry-specific conduct.[3]

Determining the effects of collusion would be greatly simplified if firms merely announced to the general public when they were colluding. This does not happen in most markets because collusive pricing behavior typically violates the antitrust laws. There are exceptions, though. The prime example is in certain transportation industries where firms are expressly exempt from the antitrust laws. These industries provide an excellent opportunity for studying the effectiveness of collusion in an environment where it is considered legal.

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[2] Section 2 of the Sherman Antitrust Act (1890).

[3] Ideally, cost and demand data can be used to estimate either *firm* conjectures or a parameter that measures the collusiveness of *industry* conduct. For a detailed discussion, see Bresnahan's (1989) chapter in *The Handbook of Industrial Organization*.

One industry in particular, the international ocean shipping industry, provides a fertile area for research into the effectiveness of collusive behavior. In most of the world, ocean carriers can enter into price-fixing agreements that are exempt from antitrust scrutiny and litigation. This exemption lowers the potential costs of entering into collusive arrangements. Hence, price-fixing agreements among ocean carriers, known as *conference agreements*, are widespread.[4]

On international routes involving the United States, conferences enjoy another significant advantage. An agency of the U.S. government, the Federal Maritime Commission (hereafter, FMC), polices conference pricing agreements at no cost to the cartel. The participants in a conference agreement must collectively file their freight rates with the FMC, and those rates are open to public inspection. Any secretive discounting on those rates is considered *"rebating,"* and a carrier involved in rebating is subject to a stiff fine by the FMC. The FMC devotes a significant portion of its resources to investigating alleged rebating activity, and fining any guilty parties.[5]

Members of conferences serving U.S. trade routes are, however, allowed to *deviate publicly* from the conference rate by taking *"independent action"* (hereafter, IA) and offering a freight rate that differs from the conference rate. Conference members must provide notification to the conference, however, of their intent to offer an IA rate. Moreover, since an IA rate is publicly available, it must be offered to all qualified shippers (although the *"qualified"* group may, in fact, be quite small). Given that secret rate discounting is illegal and inhibited by the actions of an outside agency, and that

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[4] In international shipping lanes, these agreements have existed since the 1870's (see Herman, 1983).

[5] In the period from 1985 through the middle of 1989, the FMC assessed over $12 million in penalties for rebating and other violations of tariff-filing provisions.

public rate deviations are immediately recognizable, one might suspect that it would be difficult to cheat profitably on a conference pricing agreement under the current regulatory structure.

Nevertheless, effective collusion in U.S. international ocean shipping may still be hindered by the ability of other carriers to enter the market,[6] the heterogeneity of carriers in the market,[7] and the presence of large customers.[8] Ocean carriers tend to be heterogeneous for a variety of reasons. In many trades, the major carriers have registered their vessels under different national flags. This, by itself, may lead to a divergence in cost conditions since the treatment of ocean carriers differs widely across nations with regard to subsidization and tax policy, crewing requirements, and other factors. These differences may supplement competitive differences stemming

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[6] The existing regulatory system for ocean shipping, unlike those of domestic aviation and trucking prior to their deregulation, allows any carrier to enter the market.

[7] When cartel members vary widely in their efficiency, a cartel may encounter difficulty in maintaining a collusive price. The more-efficient members receive relatively larger gains from cheating on a given cartel price, since their lower cost structure allows them to profitably expand output by a larger amount. This incentive may constrain the *sustainable* price level for the cartel, i.e., the maximum price level where firms no longer have an incentive to deviate from the cartel agreement. For further discussion, see Radner (1977), Osborne and Pitchik (1983), Choi, Menezes, and Tressler (1985), Schmalensee (1987), and Harrington (1991).

[8] When customers are heterogenous, cartel members may be tempted to discount selectively to those customers making relatively large purchases. This type of cheating may be more difficult to detect and punish than a situation where firms can significantly expand sales only by offering widespread discounts. Thus, the presence of big buyers may hold down the cartel's price.

from variations across firms in technology and entrepreneurial ability. Customers differ based on the size of their shipments and the quality of service desired. Purchasers of ocean transportation services (i.e., shippers) range from small manufacturers and importers to Fortune 500 corporations.

This study investigates whether the granting of antitrust immunity and the use of the FMC to enforce pricing agreements are sufficient for liner conferences to exercise market power in the U.S. international ocean shipping market. Alternatively, this analysis could be considered a case study of whether the possibility of entry and the existence of heterogeneity across firms and customers is sufficient to thwart effective collusion. If firms are not able to form an effective cartel under the relatively favorable conditions described above, one might expect that it would be difficult to form an effective cartel in many markets.

Controlling for other factors, we test whether an increase in the market share of a liner conference, which presumably occurs when additional firms join that conference, is associated with a change in the structure of freight rates. To our knowledge, previous empirical studies of liner shipping have not attempted this type of test.[9] Many of these studies argue that cartel market power exists based on their finding that freight rates increase as the *value* of the cargo increases. Given that ocean shipping is now widely containerized, so that diverse commodities are typically shipped in uniform boxes that are handled in a uniform manner, these *"value-based"* rate differences are considered

[9] Empirical research on the structure of freight rates includes Heaver (1973), Bryan (1974), Jansson (1974), Devanney, Livanos, and Stewart (1975), Zerby and Conlon (1983), and Jansson and Shneerson (1986).

evidence of price discrimination (i.e., *"value of service"* pricing) resulting from conference market power.[10]

Others note that value-based rate differences may still reflect cost differences related to the value of the commodity, such as differences in damage liability and service quality.[11] Thus, rates that are positively correlated with the value of the commodity do not necessarily indicate that conferences have market power. Instead, this type of rate structure may represent an efficient outcome generated by a competitive market.

Another explanation is also possible. Value-based rate differences may result from market power that arises independently of the conference system. In particular, these rate differences may stem from the type of pricing behavior that emerges from firm interaction in a *concentrated* market.[12] The presence of scale and network

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[10] This claim is based on a Hicksian derived-demand argument, where transportation services represent an input in the production of a *"delivered"* product. When passed through to consumers in entirety, a given increase in the freight rate will lead to a progressively smaller *percentage* increase in delivered price as the value of the transported product increases. Thus, if the *market* elasticity of demand is similar for a group of products, one would expect that the *derived* elasticity of demand for transportation services would be lower for relatively high-valued products. Recognizing this relationship, a conference with market power would generally charge higher freight rates for higher-valued commodities (unless, contrary to most empirical evidence, higher-valued commodities typically face a more elastic *market* demand than lower-valued commodities).

[11] See Sjostrom (1992) and Butz (1993).

[12] The exercise of firm-based market power, however, does not imply that firms necessarily earn supranormal profits. The presence

(continued...)

economies may limit the number of sustainable firms on any route, thus allowing individual firms to exercise some power over price. It is also possible that the regulatory structure in ocean shipping, particularly mandatory tariff filing and enforcement for *all* carriers, facilitates anticompetitive interaction between carriers inside and outside of liner conferences. In fact, the distinction between conference members and *"outside"* carriers may be limited, since all carriers must make their freight rates publicly available and conference carriers either can set their own freight rates (through the *"independent action"* provision) or exit the conference with little advanced notice.[13] Freight rates may thus depend more on overall market concentration than on conference market share.

We try to contribute to the debate surrounding market power in liner shipping. *If, ceteris paribus, a conference's freight rates on a given route generally increase as the conference covering that route increases its market share, then this outcome is consistent with the notion that liner conferences exercise market power by themselves.* This result could be explained on an efficiency basis only if some cost variable can be identified that is positively correlated with conference

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[12](...continued)
of sunk costs could limit the number of firms in equilibrium, with each of these firms sufficiently large to realize some degree of market power under certain types of strategic behavior. Price discrimination may arise consequently, but the ability of firms to enter the market drives profits to a normal level. In this case, the equilibrium configuration would represent a "quasi" Ramsey-pricing outcome. For discussion of price discrimination under imperfect competition, see Katz (1984), Borenstein (1985), and Holmes (1989).

[13] Butz (1993) makes a similar point.

market share. At best, this is an unlikely proposition.[14] *In addition, if an increase in a conference's market share is associated with an increase in the dispersion of the conference's freight rates based on commodity values, then this result is consistent with the hypothesis that larger liner conferences can better discriminate in their pricing on the basis of commodity value.*

Our statistical specification measures the effect of a change in a given conference's market share on the level of freight rates and the dispersion of those rates on the route covered by the conference. In this fashion, we estimate the degree of market power possessed by liner *conferences*. Additionally, we explore the relationship between the freight rates on a given route and an index of market concentration for that route. This analysis sheds light on the importance of firm

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[14] An exception might occur if the conferences, themselves, offered transportation services to the customer. An increase in conference market share might then be associated with higher *quality*, and possibly more costly, transportation services. This might occur, for example, if conferences with higher market shares offered more frequent sailings. Due to the higher-quality service, consumers would be charged higher freight rates as conference size increased. Nonetheless, consumers might still benefit on balance if there were substantial improvement in service quality.

However, *with the exception of contract services*, no shipping services are offered by the conference. Instead, individual members sell their own shipping services to customers. Customers would generally be expected to judge quality on the basis of the service offered by the carrier instead of the conference. Because our sample specifically *excludes* freight rates for contract services, we believe that data are free of any methodological problems that would have resulted from the inclusion of conference-based shipping services.

size, as opposed to conference size, in explaining the rate structure in ocean shipping.[15]

This study is organized as follows. Section II describes the history and current status of U.S. regulation of international liner shipping. Section III provides a brief description of our theoretical model, and how we implement it empirically. Section IV contains the theoretical model that underlies our statistical specification, which is

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[15] Finally, we should mention that one strand of the economic literature on ocean shipping contends that cooperation among ocean carriers may be necessary to alleviate the problems associated with an *"empty core"* (see Sjostrom, 1989, and Pirrong, 1992). Under the empty-core hypothesis (see Telser, 1978), the presence of *"avoidable"* costs and lumpy production preclude the existence of a noncooperative equilibrium. As applied to ocean shipping, this theory would potentially justify the formation of liner conferences as a means of imposing stability in the market. Our analysis does not explicitly test the *"empty core"* hypothesis; instead, we focus on the rate-setting behavior of liner conferences. Since core theory does not predict which industry structure is likely to emerge, and offers little insight concerning the rate behavior under that structure, our results cannot be used to either affirm or refute the empty-core hypothesis.

Core theory does predict that unless a coalition of firms (or firms and customers) forms to impose a sustainable outcome, *"destructive competition"* will emerge with large swings in rates. Thus, if conferences form to alleviate an empty-core problem, one might observe more stable rate behavior than in the absence of conferences. However, it may also hold that in the face of demand uncertainty, a cartel acting solely for anticompetitive gain will exhibit more stable rate behavior than a competitive market. Notwithstanding this problem of interpretation, conferences are a longstanding institution, which prevents the assembling of a data set that contains periods where conferences are absent. Such data would be potentially useful in assessing the relationship between conferences and the stability of freight rates.

described in Section V. Section VI describes the data used in this study. Section VII examines the statistical results, and Section VIII offers concluding remarks.

II. History and Current Status of U.S. Regulation of International Liner Shipping

Conferences in ocean shipping have existed since the late 1800's on U.S. international routes. Since then, they have been granted varying degrees of antitrust immunity under the auspices of the Shipping Act of 1916, the 1961 Amendments, and the Shipping Act of 1984.[16]

The 1916 Shipping Act allowed ocean carriers to enter into price-setting agreements that were immune from antitrust action, but those agreements had to be filed and approved by the U.S. Shipping Board. The 1961 Amendments weakened this antitrust immunity by including a *"public interest"* standard in the approval process for conference agreements conducted by the U.S. Shipping Board's successor, the Federal Maritime Commission. The FMC was authorized to disapprove rates that were so "unreasonably high or low as to be detrimental to the commerce of the United States."

This stricter approval criteria for conference agreements was given practical meaning by the U.S. Supreme Court's *Svenska* decision in 1968,[17] which upheld the FMC's ruling that the *"public interest"* standard created the presumption that any conference restraint was invalid if it interfered with the policies of U.S. antitrust

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[16] This description of the regulatory structure and market characteristics of U.S. international liner shipping is derived from the *Report of the Advisory Commission on Conferences in Ocean Shipping* (April 1992), Chapters 2 and 3.

[17] See *Federal Maritime Commission v. Aktiebolaget Svenska Amerika Linien*, 390 U.S. 238 (1968).

laws.[18] Carriers claimed that this standard impeded the formation of ratemaking, joint venture, service rationalization, and other types of agreements.

By eliminating the *"public interest"* standard, the Shipping Act of 1984 reversed the trend toward greater antitrust scrutiny. The 1984 Act shifted the burden of proof so that conference agreements were no longer subject to an approval process, but instead could be contested by the FMC. Agreements automatically became effective after 45 days unless the FMC sought an injunction on the basis that the agreement was "likely, by a reduction in competition, to produce an unreasonable reduction in transportation service or an unreasonable increase in transportation cost."[19] To date, the FMC has never attempted to enjoin a conference agreement, although it occasionally has *"recommended"* changes in the language of an agreement.

The 1984 Shipping Act continued the tariff filing and enforcement provisions established by the 1961 Amendments. These provisions require *all* ocean carriers and conferences to file their rates with the FMC and publish their rate and schedule information. The FMC was authorized to enforce that the filed rates were actually charged; any secretive discounting on a published rate was considered illegal and subject to punitive action (i.e., fines) by the FMC. The tariff filing and enforcement provisions were intended to maintain "a nondiscriminatory regulatory process for the common carriage of goods by water...."[20] Apparently, Congress was concerned that

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[18] An exception occurred if the conference could establish a *prima facie* case that the restraint was required by "a serious transportation need, necessary to secure important public benefits, or in furtherance of a valid regulatory purpose of the Shipping Act."

[19] See Section 6(g) of the Shipping Act of 1984.

[20] Section 2 of the Shipping Act of 1984.

large shippers may be successful in obtaining lower rates than small shippers due to a superior bargaining position with carriers.

Given that the tariff structure in liner shipping permits differences in rates based on the type of cargo and the volume of shipment, the tariff filing requirement does not prevent effective price discrimination. However, the FMC's role in enforcing filed rates implies that conference agreements are policed by an outside agency at no cost to the conference. Thus, the tariff filing and enforcement requirements potentially facilitate the exercise of conference market power.

The Shipping Act of 1984 required that conferences be open; any carrier can join or exit a conference agreement with limited advance notice and without penalty. There were also no statutory restrictions on the ability of carriers to enter any given route (either as an independent carrier or as a member of a conference). Moreover, the 1984 Act mandated that any conference pricing agreement *must* allow members the right of *"independent action."* This right allows any conference member to offer a rate that differs from the conference rate, but it must notify the conference in advance (usually ten days prior) of its intention to do so.[21]

In the post-1984 period, independent action has been used frequently in specific trade lanes. Data compiled by the FMC also indicate that the filed independent-action rates are frequently matched by other conference members.[22] While the use of independent action

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[21] Before 1984, a conference member could take independent action only if the conference agreement permitted it.

[22] For instance, in the 1985-88 period, members of the Transpacific Westbound Rate Agreement (outbound from the U.S. Pacific Coast to Japan) used independent action to *initiate* 69,775 rate filings. During the same period, there were 45,401 additional filings

(continued...)

may imply that there have been *"defections"* from conference rate agreements, the evidence of matching behavior may indicate that some of these defections have been *"punished."*

The 1984 Shipping Act also specifically authorized the use of *"service contracts,"* i.e., contractual arrangements whereby a shipper commits to providing a minimum quantity of cargo or freight revenue over a fixed time period, and the ocean common carrier or conference commits to a certain rate or rate schedule as well as a defined service level (such as assured space, transit time, or port rotation).[23] Prior to 1984, the issuance of a service contract could be challenged as *"unjustly discriminatory."* Although the 1984 Act liberalized the contracting environment in ocean shipping, certain constraints remain. Service contracts must be filed with the FMC, and their *"essential terms"* are publicly available. Moreover, other shippers that can adhere to the terms of the contract (known as *"similarly situated"* shippers) are entitled to the identical arrangement from the carrier or conference issuing the contract.

Between late 1984 and early 1986, some conferences in the Asian trades allowed their members to enter autonomously into service contracts. All other conferences prohibited their members from doing so, and would only issue a conference-wide service contract. In 1986, those Asian conferences allowing their members to enter independently into service contracts revoked that privilege. Casual empiricism reveals that this change in the contracting environment had

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[22](...continued)
where conference members *matched* independent-action rates initiated by other members. By contrast, members of the Japan, Atlantic, and Gulf conference (inbound from Japan to the U.S. Atlantic and Gulf Coasts) initiated only 266 independent-action rate filings, and there were 167 additional filings of matching rates.

[23] This description of a service contract is based on that provided in Section 3(21) of the Shipping Act of 1984.

a significant effect on market behavior; consequently, the entire structure of freight rates may have been affected.[24] Our empirical analysis below examines this question in detail.

III. A Brief Description of the Theoretical and Empirical Models

Our objective is to determine whether liner conferences can effectively collude, that is, set shipping rates as if the conference members were a unified, profit-maximizing firm. Before presenting rigorously the theoretical model and how we implement it empirically, we briefly describe our conceptual approach, focusing on the assumptions underlying it.

As mentioned above, we wish to test the hypothesis that members of a conference perfectly collude. Our theoretical model, therefore, assumes that conference members can do so; this permits our empirical work to test directly this hypothesis. We also assume, consistent with observed practice, that conferences transport a variety of commodities of varying values, and that they can set different freight rates for different commodities. Based on this paradigm of perfect collusion, our model predicts that as a conference on a given route becomes larger (due to outside firms joining the conference), the conference will be better able to exercise market power. This increased market power will result in an increased ability by conferences to discriminate in their pricing on the basis of commodity value. Consequently, as conferences increase in size relative to the share of their nonconference rivals, freight rates are expected to increase in general and the differential between the freight rates of two

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[24] For instance, when members of the Transpacific Westbound Rate Agreement were allowed to independently enter into service contracts in 1985 and 1986, 40% of their cargo was carried under contract. In 1988, after independent contracting was revoked in favor of a conference-wide service contract, only 1% of the cargo was carried under contract.

commodities of different value is expected to increase (i.e., the dispersion of freight rates across commodity values is expected to become greater.)

In setting freight rates across the various commodities, a profit-maximizing conference will attempt to equate the marginal profitability from shipping the last container of each commodity. Basic economic principles establish that there is an inverse relationship between the profit-maximizing price for a particular service (in this case, transporting a particular commodity on a particular route) and the elasticity of demand for the service. Our theoretical model combines this relationship with three additional assumptions: (1) that increases in shipping rates are entirely passed through to final consumers; (2) that the market demand elasticity for any final good is constant with respect to price and invariant over time; and (3) that "fringe" firms do not alter their outputs in response to changes in the conference's output.[25] The result is an equation[26] that relates the conference's profit-maximizing price for shipping a particular commodity on a particular route to five factors: (1) the value of the commodity, (2) the conference's market share with respect to transporting the commodity on that route, (3) the elasticity of demand for the commodity, (4) the marginal costs incurred in shipping the commodity on that route, and (5) the "shadow value" of conference capacity on that route. The "shadow value" of capacity is a measure of the value to the conference of adding more capacity; this value is

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[25] While invoking these assumptions simplifies significantly the derivation of the theoretical model, they actually are stronger than necessary to support our ultimate empirical specification. For example, the same empirical specification emerges if the degree of pass-through is independent of commodity value and/or if the supply elasticity of the nonconference "fringe" firms is similar across the various transported commodities.

[26] This is equation **(3)** in Section IV below.

positive when the conference is capacity-constrained, and it equals zero when the conference has excess capacity.

Two testable hypotheses emerge from this analysis. First, the theory predicts that, holding all other factors constant, freight rates on a given route are, in general, positively related to the conference's market share on that route. Second, the theory predicts that, holding all other factors constant, the dispersion of rates across commodity values becomes greater as the conference's market share on that route increases.

This theoretical construct need only be modified slightly to test the additional hypothesis that increases in overall market concentration (as opposed to increases in the conference's market share) contribute to increased freight rates. The only difference is that an index of market concentration would replace the conference's market share as an independent variable explaining the level of freight rates.[27] As before, the two testable implications that emerge are as follows: (1) freight rates generally increase with overall market concentration on a given route, and (2) freight rates will become more dispersed across commodity values as market concentration increases.

Transforming the theoretical model described above into a specification that can be estimated empirically requires some final modification. First, we assume that the conference's market share of total capacity on a particular route is a very good proxy for its market share in transporting any given commodity on the route. Second, we assume that the elasticity of demand for any particular commodity is independent of the commodity's value (or, that there is not a strong positive relationship between a commodity's value and its elasticity of demand.) Third, we need to estimate the "shadow" value of capacity. Since the "shadow value" depends on the total capacity level on the route, the conference's market share on the route, and cost and

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[27] The market concentration index treats each firm individually, whether the firm is a member of the conference or not.

demand factors, we include these variables in our empirical specification.

Lastly, the specification requires an estimate of the marginal cost of shipping a specific commodity on a specific route. We resolve this by noting that the cost factors specific to transporting a given commodity along a given route (such as, shipping audio equipment from Japan to the United States) are not likely to vary over the time period covered by this analysis. Thus, we can control for differences in transportation costs specific to a given commodity on a given route by including dummy variables for each commodity on each route. Incorporating the four modifications above, we obtain the specification that is empirically estimated.[28]

In sum, our empirical specification stems from the hypothesis that liner conferences set prices as if the member carriers colluded perfectly. We can test statistically whether the rate behavior of liner conferences is consistent with the behavior predicted by this hypothesis. As mentioned previously, the results would be consistent with this hypothesis if we observed the following: (1) freight rates generally increasing as conferences increase in size relative to their nonconference rivals, and (2) the dispersion of freight rates across commodity values increasing as conferences become relatively larger. Our empirical approach also can test whether market concentration, as opposed to conference market share, affects freight rates.

IV. The Theoretical Model

We base our statistical specification on a model where a liner conference on a given route acts as a residual monopolist, facing competition from a fringe of carriers that have refrained from joining

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[28] This is represented by equation **(4)** in Section V below.

the conference.[29] In this section, we derive an expression for freight rates that is consistent with joint profit maximization by a cartel competing with outside (i.e., fringe) firms. As shown in the following section, we can econometrically estimate this expression to test whether the rate behavior of liner conferences conforms with that predicted by our model. Our statistical specification also considers the possibility that market power stems from market concentration, and not from the conference system.

A profit-maximizing cartel operating on a given route would attempt to equate the marginal contribution to its profits that it receives from transporting an additional container of any given product. Hence, for a cartel transporting good i on route j, it holds that:[30]

$$MP_{ij} = MR_{ij} - MC_{ij} = k_j, \quad (1)$$

where MP_{ij} (MR_{ij}, MC_{ij}) = *marginal contribution to profits (marginal revenue, marginal cost) from transporting an additional container of good i on route j*

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[29] The existence of fringe carriers competing with the cartel may be attributable to a variety of factors. As more carriers join the cartel, the benefits increase from remaining outside the cartel and free-riding off of the relatively high cartel prices. Among others, Donsimoni (1985) and Deneckere and Davidson (1985) find that *"stable"* cartels are typically incomplete. Firms outside the cartel have no incentive to enter, and cartel members have no incentive to leave.

[30] The subscripts denoting time have been dropped for expositional convenience.

In equation (1), MC_{ij} refers to short-run marginal cost. It is assumed that the cartel maximizes profits subject to its capacity limitation; hence, the term, k_j, represents the shadow value of capacity. If the cartel's capacity equalled that level needed to maximize long-runprofits, then the shadow value of capacity, k_j, would equal the marginal cost of capacity.[31]

Note that $MR_{ij} = r_{ij}(1 - 1/n_{ij}^{C})$, where r_{ij} is the freight rate for commodity i on route j, and n_{ij}^{C} is the elasticity of demand that the cartel perceives it faces in transporting commodity i on route j. Substituting into equation (1), we obtain:

$$MP_{ij} = r_{ij}(1 - 1/n_{ij}^{C}) - MC_{ij} = k_j. \qquad (2)$$

Under appropriate assumptions, we can express n_{ij}^{C} as a function of the *market's* elasticity of demand for good i and the market share of the cartel on route j. First, it is assumed that any increase in transportation costs is *entirely* passed through to consumers. In other words, $dp_{ij}/dr_{ij} = 1$, which implies that $dq_{ij}/dr_{ij} = [(\partial q_{ij}/\partial p_{ij})(dp_{ij}/dr_{ij})] = (\partial q_{ij}/\partial p_{ij})$, where q_{ij} is the total quantity of good i (from the origin country) demanded in the destination country on route j, and p_{ij} is the delivered price of good i in that country. Second, it is assumed that the market's elasticity of demand for a given good is constant with respect to price and invariant over time. Hence, $\partial q_{ij}/\partial p_{ij} = -n_{ij}^{M}(q_{ij}/p_{ij})$, where $n_{ij}^{M} \equiv -(\partial q_{ij}/\partial p_{ij})(p_{ij}/q_{ij})$ is the market's elasticity of demand for good i in the destination country on route j. Together, these two assumptions imply that $dq_{ij}/dr_{ij} = -n_{ij}^{M}(q_{ij}/p_{ij})$. Under the further assumption that there is no supply response by fringe firms, we then obtain $n_{ij}^{C} \equiv -(dq_{ij}/dr_{ij})(r_{ij}/s_{ij}q_{ij}) =$

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[31] Hence, our model is sufficiently flexible to allow for either short-run or long-run profit maximization.

$n_{ij}^{M}(r_{ij}/p_{ij}s_{ij})$, where s_{ij} is the cartel's market share in transporting good i on route j. Incorporating this last result into equation (2), we obtain:

$$r_{ij} - p_{ij}s_{ij}/n_{ij}^{M} - MC_{ij} = k_j$$
$$or \qquad (3)$$
$$r_{ij} = k_j + MC_{ij} + p_{ij}s_{ij}/n_{ij}^{M}$$

Consider equation (3). Within a group of commodities facing a similar *market* elasticity of demand (i.e., $\eta^{M}_{ij} = \eta^{M}\ \forall\ i$), a profit-maximizing cartel would generally set higher freight rates for the higher-valued commodities (since $dr_{ij}/dp_{ij} > 0$).[32] This occurs because although the *market* elasticity of demand is the same for this group of commodities, the *derived* elasticity of demand for transportation services decreases (in absolute terms) as the value of the commodity increases. When passed through to consumers, a given increase in freight rates raises product price by a smaller *percentage* for those products that are relatively high-valued. This implies that consumers of high-valued commodities are potentially less sensitive to changes in freight rates. Recognizing this relationship, a profit-maximizing cartel sets freight rates that are generally increasing with respect to commodity value.

Based on equation (3), as the cartel's market share expands due to *"outside"* firms joining the cartel, the rate differential should increase between two commodities of different value (since $d^2r_{ij}/dp_{ij}ds_{ij} > 0$). This behavior would not occur if the rate differentials across commodities were based purely on cost factors.

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[32] More generally, freight rates would increase with respect to commodity value whenever p_{ij}/η^{M}_{ij} is positively correlated with p_{ij}. This behavior necessarily arises unless p_{ij} and η^{M}_{ij} are positively correlated (i.e., unless high-valued goods face relatively elastic demand). There is no empirical support that such correlation exists.

The above specification can also be obtained using more general assumptions. For instance, instead of assuming *"full pass-through"* of transportation costs to the product's delivered price, we can merely assume that the degree of pass-through is independent of commodity value. Also, instead of assuming that fringe firms do not change their supply of transportation services, we can assume that these firms respond to changes in the quantity of transportation services supplied by the cartel, but their response is similar across all transported commodities.

The above model allows for the possibility that liner conferences exercise effective market power. However, another *independent* source of market power should also be considered. The presence of scale and network economies may imply that the ocean shipping industry can sustain a limited number of firms in equilibrium. Additionally, there may be sunk costs involved in serving a given route (i.e., costs of warehouses, cargo-handling equipment, and other terminal facilities) that may constrain further the number of firms able to serve that route. Depending on their strategic behavior, the few firms operating on a given route may exercise market power sufficient to permit discriminatory pricing, regardless of whether a conference system exists. If high levels of market concentration allow firms to exercise this type of market power, the associated first-order condition is identical to equation **(3)**, except that an index of market concentration (i.e., the Herfindahl index) replaces the cartel's market share.[33]

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[33] In a static oligopoly setting, Cowling and Waterson (1976) and others have shown that market price is related to the Herfindahl index of market concentration (H_j). In these circumstances, equation **(3)** becomes:

(continued...)

V. The Empirical Specification

In equation **(3)**, freight rates are assumed to be a linear function of the shadow value of capacity (k_j), marginal cost (MC_{ij}), and an expression that includes the value of the transported commodity (p_{ij}), conference market share (s_{ij}), and the market elasticity of demand for the commodity (η^M_{ij}). The term, $p_{ij}s_{ij}/\eta^M_{ij}$, can be approximated by assuming that the conference's market share is the same for transporting any commodity on a given route (i.e., $s_{ij} = s_j$), and that the market elasticity of demand is similar across commodities (i.e., $\eta^M_{ij} = \eta^M$).[34] Incorporating these assumptions into equation **(3)**, we obtain:[35]

$$r_{ij} = k_j + MC_{ij} + p_{ij}s_j/n^M. \qquad (4)$$

Under the assumption that market concentration, in addition to conference market share, might affect freight rates, equation **(4)** would be modified slightly to:

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[33](...continued)

$$r_{ij} - p_{ij}H_j/n^M_{ij} - MC_{ij} = k_j$$

or

$$r_{ij} = k_j + MC_{ij} + p_{ij}H_j/n^M_{ij}$$

[34] We could instead assume that p_{ij}/η^M_{ij} is positively correlated with p_{ij}. See footnote 32.

[35] Note that p_{ij} represents the import price in the destination country. Since this price is essentially inclusive of transportation costs, we use the export price in the origin country to avoid spurious correlation.

$$r_{ij} = k_j + MC_{ij} + p_{ij}s_j/n^M + p_{ij}H_j/n^M, \qquad (5)$$

where H_j is the Herfindahl measure of market concentration on route j. To transform the above equation into a usable statistical specification, we must devise a methodology that: (i) estimates k_j, (ii) circumvents the data problems involved in estimating MC_{ij}, and (iii) considers possible alternative sources of market power other than liner conferences.

The shadow value of capacity on a given route (i.e., k_j) depends on the demand for ocean shipping services on that route, the amount of capacity on that route, the conference's market share on that route, and (possibly) the degree of overall market concentration on that route. More specifically, with respect to equation **(5)**, we assume that $k_j = f(CAP_j, Y^d_j, P^d_j, P^o_j, s_j, H_j)$ where f is a linear function, CAP_j is *total* capacity on the route, Y^d_j and P^d_j are (respectively) the destination country's income and price level, P^o_j is the origin country's price level, s_j is the conference's share of total route capacity on route j, and H_j is the Herfindahl measure of market concentration on route j. As capacity increases on the route, the shadow value of capacity is expected to decrease until it finally reaches zero (where capacity is no longer binding). An increase in the destination country's income or its domestic price level (relative to the foreign price level) is expected to raise import demand, and consequently, the demand for shipping services on the route. Thus, when capacity is a binding constraint, we expect k_j to be positively related to Y^d_j and P^d_j, and negatively related to P^o_j. Finally, as the conference's market share (or the index of market concentration) increases on the route, the benefit to conference carriers (or carriers in the market generally) of increased output becomes progressively smaller, for the same reason that the marginal revenue is lower for a monopolist than for a perfect competitor. The shadow value of capacity is therefore expected to *decrease* as conference market share and overall market concentration increases.

The effect of these variables on freight rates is identical to that described above, since freight rates are positively related to the shadow value of capacity (see equation **(5)**). Of course, if the capacity constraint is not binding (i.e., $k_j = 0$), these variables would not affect freight rates.

The short-run marginal cost of transporting commodity i on route j (i.e., MC_{ij}) depends on such factors as the distance traveled, the value and weight of the cargo, and the need for special handling (e.g., refrigeration). Note that these variables are practically invariant over time for a given commodity on a given route,[36] implying that differences in marginal cost arise across commodities and routes. Thus, we can account for the impact of these variables by using a model which includes dummy variables for each commodity on each route.[37] This approach not only circumvents the data problems involved in accurately estimating marginal costs, but as we discuss later, it also eliminates potential biases involved in examining the relationship between freight rates and conference market share (or market concentration) from data covering multiple commodities and multiple routes.

Dummy variables for each year ($1985,\ldots,1988$) are also included in the specification, and an additional dummy variable (IA_j) denotes those routes for which conference members were allowed to enter independently into service contracts in that specific year. While our data excludes rates on service contracts, we hypothesize that allowing conference members to autonomously enter into service contracts could have altered the entire rate structure.

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[36] From year to year, cargo values may change moderately for a given commodity on a given route. Since annual data for cargo value were not available for this study, we assume that relative cargo values across commodities and routes are constant over time.

[37] For a discussion of such "fixed-effects" models, see Judge, et al. (1982), pp. 477-502.

In addition to considering the possibility of joint profit-maximizing cartel behavior, our specification allows that, independently of the conference system, market concentration may lead to market power. Since this hypothesis implies that a relationship exists between freight rates and market concentration, we have included a Herfindahl index of market concentration (hereafter, H_j) in our specification. This variable is included by itself and interacted with cargo value.

The complete specification is described as follows:[38]

$$r_{ij} = \beta_1 s_j + \beta_2 s_j p_{ij} + \beta_3 H_j + \beta_4 H_j p_{ij} + \beta_5 CAP_j + \beta_6 Y^r_j + \beta_7 P^d_j + \beta_8 P^o_j + \beta_9 IA_j + \beta_{10} 1985 + \beta_{11} 1986 + \beta_{12} 1987 + \beta_{13} 1988. \quad (6)$$

In the above specification, *we avoid using dummy variables for each commodity on each route by instead expressing each observation on a given variable in terms of its deviation from the variable's respective mean for that commodity on that route.* This approach is statistically equivalent, and can be interpreted analogously, to the regression where all variables are expressed in terms of their levels and dummy variables are included for each commodity on each route (see Judge, et al., 1982, pp. 478-481).

The above specification is capable of estimating the relationship between conference market share and freight rates. It can also determine whether the relationship between conference market share and freight rates is different for high-valued commodities and low-valued commodities. From the above specification, the change in freight rates associated with an increase in conference market share depends on the estimated coefficients from two variables: conference market share (s^j) and conference market share multiplied by commodity value ($s_j p_{ij}$). The first of these estimated coefficients is β_1;

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[38] Table 1 defines each of variables used in the analysis.

the second is β_2.[39] Note that the sign of this effect may depend on commodity value, p_{ij}. If conference pricing is consistent with the joint profit-maximizing behavior in our model, then the degree of price discrimination should increase with conference market share (implying that $\beta_2 > 0$). In addition, when capacity *is not* a binding constraint, an increase in conference market share should raise freight rates for all commodity values. In that case, we would expect that $\beta_1 = 0$ and $\beta_2 > 0$.[40] However, when capacity *is* a binding constraint, an increase in conference market share should raise rates only for higher-valued commodities. This occurs because, ceteris paribus, an increase in the cartel's market share (due to an outside firm joining the cartel) lowers its perceived marginal revenue. This drop in marginal revenue is relatively larger for those commodities where the *derived* demand for transportation services is relatively inelastic. To put its price structure back in equilibrium, a capacity-constrained cartel would *raise* rates for those commodities with a relatively *inelastic* derived demand for transportation services (i.e., *higher-valued* commodities), and *lower* rates for those commodities with a relatively *elastic* derived demand (i.e., *lower-valued* commodities). Thus, we would expect that $\beta_1 < 0$ and $\beta_2 > 0$. Note that this discussion presupposes that conferences act as profit-maximizing cartels and are able to price discriminate, which may not hold in reality.

In fact, conferences may *not* be able to price discriminate if *nonconference* carriers act as *"cream skimmers."* In this case, if a conference attempts to set different freight rates for commodities that bear the same transportation cost, *nonconference* carriers would

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[39] Algebraically, the change in freight rates associated with an increase in conference market share is: $dr_{ij}/ds_j = \beta_1 + \beta_2 p_{ij}$.

[40] As explained above, the coefficient β_1 measures the effect of an increase in conference market share on the shadow value of capacity. When capacity is not a binding constraint, this effect necessarily equals zero.

choose to transport only those commodities with relatively high freight rates. This *"arbitrage"* activity prevents conferences from discriminating across commodities in setting freight rates. When conferences act as profit-maximizing cartels under these conditions (and capacity is not a binding constraint), we would expect that an increase in conference market share would lead to a *uniform* rate increase across all commodities (i.e., $\beta_1 > 0$ and $\beta_2 = 0$).

Now, consider the possibility that market power stems instead from *market concentration.* According to our model, the degree of price discrimination should increase as the market becomes more concentrated (i.e., $\beta_4 > 0$ in equation **(6)**). When capacity *is not* a binding constraint, freight rates should generally increase as market concentration increases.[41] We would thus expect $\beta_3 = 0$ and $\beta_4 > 0$. When capacity *is* a binding constraint, an increase in price discrimination should lead to higher freight rates for higher-valued commodities and lower freight rates for lower-valued ones. This implies that $\beta_3 < 0$ and $\beta_4 > 0$ if capacity is binding.

Due to limited data, no attempt was made to formulate an instrument for conference market share or market concentration.[42]

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[41] That is, the derivative of freight rates with respect to market concentration ($dr_{ij}/dH_j = \beta_3 + \beta_4 p_{ij}$) should assume a positive value for all commodity values.

[42] The reported results also treat total route capacity as exogenous. Industry participants indicated that ocean shipping and shipbuilding are highly subsidized industries, and that capacity decisions may be heavily influenced by government policies. To see whether capacity was more heavily influenced by traditional market forces or national policies, we regressed capacity on a variety of cost and demand factors (relative prices, gross domestic product, etc.) as well as route-specific dummy variables. Consistent with information gathered in interviews, all of the route dummies were statistically

(continued...)

This econometric approach is therefore subject to some of the same criticisms that have been aimed at prior empirical research treating market structure as exogenously determined.[43] However, our fixed-effects model does avoid potential sources of bias that would arise if our analysis compared rate behavior *across* routes instead of *within* routes. Our specification examines the relationship between deviations over time in the freight rate for a given commodity on a given *route* and deviations in other variables pertaining to that *route*, such as conference market share and market concentration on the *route*. Accordingly, we avoid any examination of the relationship *across routes* between the level of freight rates and the level of conference market share (or market concentration). Much of the past criticism of the exogenous treatment of market shares and market concentration relates to its use in the cross-sectional analysis of behavior *across* markets, which is avoided in our treatment of the data.

As a final point, we note that changes in conference market share on a given route are measured *holding market concentration constant on the route*. Our analysis is therefore designed to capture the movement of *"outside"* firms into a given liner conference. Our examination of the sample data confirmed that most of the variation in a given conference's market share over time was attributable to carriers entering or leaving the conference.

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[42](...continued)
significant, but few cost and demand factors were statistically significant. It might be possible to construct an appropriate instrument for route capacity from the subsidy levels for ocean shipping (and shipbuilding) in various countries. Unfortunately, such data were unavailable.

[43] For discussion, see Bresnahan's and Schmalensee's (1989) chapters in the *Handbook of Industrial Organization*. See also Froeb and Werden (1991).

VI. Data

The sample consists of *port-to-port* freight rates charged by liner conferences serving the United States between 1985 and 1988. Pursuant to Section 18 of the Shipping Act of 1984, the FMC collected conference freight rates for the most popular commodities on a given route, accounting for at least 50 percent of the volume on that route. The data covered fourteen conferences carrying outbound and inbound freight between the U.S. Atlantic and Pacific coasts and Japan, Germany, Italy, and Australia.[44] Freight rates (r_{ij}) were expressed as total charges per *twenty-foot-equivalent* (i.e., *TEU* - the standard measure of container volume), including all relevant surcharges, such as bunker-adjustment, currency-adjustment, terminal-handling, and container-yard fees. Due to the use of *"independent action"*, conference carriers occasionally offered more than one rate for the transportation of a given commodity. In that situation, we used the rate under which the majority of the cargo was transported.

Commodity value (p_{ij}) was derived from export and import data collected by the Bureau of the Census and compiled by the Maritime Administration of the U.S. Department of Transportation. From these data, we used standard conversion factors to translate from commodity value per long ton to commodity value per TEU.

Capacity (CAP_j), conference market share (s_j), and market concentration (H_j) were compiled from data furnished by Lloyd's Maritime Information Services. Lloyd's collects capacity data (in TEUs) for each carrier on a given route, and identifies whether the carrier belongs to the conference covering that route.[45] Conference

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[44] Appendix A lists the routes and the commodities used in our sample.

[45] To determine carrier capacity on a given route, each vessel's capacity is multiplied by the number of voyages it made on that route (continued...)

market share is the proportion of total capacity operated by conference carriers. Market concentration is measured by the Herfindahl index, that is, each carrier's share of total capacity is squared and then these figures are summed for all carriers serving the route.

The destination country's gross domestic product and price deflator (Y^d_j and P^d_j, respectively) and the origin country's price deflator (P^o_j) were obtained from *International Financial Statistics*, published by the International Monetary Fund. The price indices were adjusted for exchange rate movements.

The final data set, containing 620 observations, is one of the largest ever used to analyze rate behavior in international ocean shipping. Since there are four annual observations (from 1985 to 1988) for each commodity on each route, our sample contains 155 commodity-route combinations. Table 1 contains a description of each variable and its data source, while Table 2 contains summary statistics for key variables.

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[45](...continued)
during that year. These *"adjusted"* vessel capacities are then summed over all vessels used by a given carrier on that specific route.

VII. Results

Table 3 presents regression results for the entire sample of 620 observations.[46] The results offer some support for the hypothesis that increased *market concentration* leads to higher freight rates. The total effect of market concentration on freight rates (i.e., $dr_{ij}/dH_j = -.026 + .0000018p_{ij}$) is positive and statistically significant at the 10%*(5%)* level for commodity values exceeding $77,268*($103,172)*, representing 24%*(19%)* of the total sample. Since the coefficient on the variable that interacts market concentration with commodity value is positive and statistically significant (at the 10% level), our results are also consistent with the hypothesis that increased market concentration leads to greater price discrimination on the basis of commodity value.[47]

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[46] Note that the R^2 statistic in Table 3 is based on the regression where each observation on a given variable is expressed in terms of its deviation from that variable's respective mean for that commodity on that route. In other words, R^2 omits the explanatory power provided by the dummy variables for each commodity on each route. However, the calculation of the degrees of freedom must recognize that these 155 dummy variables are implicitly included (see Judge, et al., 1982). Hence, the degrees of freedom equal 620 - 13 - 155 = 452.

[47] Since the coefficient on market concentration alone *is not* statistically significant, and the coefficient on market concentration interacted with commodity value *is* statistically significant, our results are consistent with profit-maximizing behavior in a concentrated market *when capacity is not a binding constraint.* Additional statistical tests further support that capacity is not binding; in particular, an F-test *does not reject* the null hypothesis that the coefficients equal zero on all variables (i.e., CAP_j, Y^d_j, P^d_j, P^o_j) relevant to determining the shadow value of capacity.

(continued...)

The results in Table 3 do not support the hypothesis that an increase in *conference market share* leads to higher rates or greater price discrimination. Neither of the variables that include conference market share are statistically significant; moreover, an F-test does not reject the null hypothesis that the coefficients equal zero on both of these variables.

Despite the apparent lack of a statistical relationship between conference market share and freight rates, our results indicate that changes in conference rules, such as those pertaining to service contracts, are associated with changes in freight rates. Specifically, the coefficient is negative and statistically significant for the IA_j variable, which identifies those routes where conference members could enter independently into service contracts within a given year.[48] Ceteris paribus, freight rates were approximately $590 lower (on average) on those routes allowing *"independent action"* on service contracts during that particular year. This reduction represents about 19% of the mean freight rate in our sample.

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[47](...continued)

It should be noted that, contrary to the predictions of our model, the coefficient on the origin country's price level is *positive* and statistically significant at the 5% level. Our model posits that this variable affects the destination country's *demand* for the products of the origin country. It is quite possible that this variable instead captures movements in wages and input prices in the origin country that are relevant to the *cost* of transportation services on that particular route.

[48] Two outbound routes fit this categorization. In 1985, the conferences on the U.S. East Coast - Japan and the U.S. West Coast - Japan routes permitted their members to enter independently into service contracts with shippers. The conferences on these routes had market shares of 82% and 85% in 1985.

"Independent action" on service contracts allowed an individual conference carrier to enter into an agreement with an individual shipper without any conference restriction on the terms or services provided under the agreement. These contracts were then filed with the FMC, but certain elements of the contract were not publicly available (i.e., the name of the shipper and the carrier, and certain information relating to service provisions). Consequently, the advent of independent action on service contracts could have increased the cost to the conference of monitoring the rate and service offerings of its members. Further, unlike independent action on regular tariff rates where the *"discount"* must be offered to all shippers of that commodity on that route, contracts could be written in a manner which effectively allowed the conference carrier to offer a *"selective"* discount to that particular shipper (or a small group of *"similarly-situated"* shippers). Due to these circumstances, permitting *independent action* on service contracts could have increased the attractiveness of cheating and inhibited the ability of the conference to detect and punish cheating. The associated reduction in conference market power might have resulted in lower freight rates for all types of transactions, including the *"spot" (i.e., noncontract)* transactions that comprise our sample.

The above findings are consistent with three primary conclusions: 1) conference rate behavior is not consistent with the joint profit-maximizing behavior predicted by our model; (2) conference rules nonetheless may affect the exercise of market power, given that rates were lower when conference members were allowed to enter independently into service contracts with shippers; and, 3) an increase in market concentration is associated with increased freight rates, particularly for high-valued commodities. With respect to the third conclusion, it is important to consider whether the positive relationship between market concentration and freight rates is economically significant, as well as statistically significant. Table 4 shows the effect on freight rates of a one-standard-deviation (hereafter 1-s.d.) increase in market concentration, evaluated at various

commodity values.[49] At the median commodity value (of $31,912), a 1-s.d. increase in market concentration is associated with a rate increase of $12, which represents only 0.4% of the average freight rate. Calculated at the highest commodity value (of $415,493), a 1-s.d. increase in market concentration is associated with a $277 increase in freight rates, or about 8.9% of the average freight rate.

Because the substantial U.S. trade deficit between 1985 and 1988 led to considerably heavier ocean traffic on inbound routes, we decided to examine whether the results change qualitatively when inbound and outbound routes were analyzed separately. Table 5 presents summary statistics, and Table 6 presents the regression results.[50]

According to Table 6, the results from the pooled data stem largely from behavior observed on inbound routes. For those routes, market concentration is a statistically significant determinant of freight rates, while conference market share is not. On outbound routes,

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[49] Our fixed-effects model essentially measures the relationship *over time* between the freight rate for a given commodity on a given route and the variables relevant in determining that rate. Since freight rates for a given route are influenced only by changes in market concentration on that route, we derived the standard deviation of market concentration used in Tables 4 and 7 from an *average* of the *individual* standard deviations of market concentration calculated for *each* route (based on changes in the route's concentration over time). In Table 4, which includes all routes, this average value is 384; in Table 7, which includes outbound routes only, it is 407.

[50] As shown in Table 6, we omitted from these regressions certain variables that were invariant across outbound routes (i.e., origin-country price index) or inbound routes (i.e., destination-country price index and GDP). Since these variables only changed from year-to-year, they were perfectly collinear with the yearly dummy variables.

neither market concentration nor conference market share is a significant determinant of freight rates.[51] During the period covered by this analysis, significant excess capacity existed on outbound, but not inbound, routes. It seems likely that the presence of this excess capacity prevented the exercise of market power on outbound routes.

The results on the inbound routes are qualitatively similar to those obtained from the pooled data. One difference is that an increase in market concentration is associated with a statistically significant increase in freight rates for a larger portion of commodities in the inbound sample than in the pooled sample (e.g., at the *10%(5%)* level of significance, *45%(40%)* of the sample as compared to *24%(19%)*). A comparison of Tables 4 and 7 also shows that this increase in freight rates is relatively larger in magnitude in the inbound sample. For instance, a 1-s.d. increase in market concentration on inbound routes is associated with an $50 increase in the freight rate at the median commodity value, representing about 1.4% of the average inbound freight rate (see Table 7). At the highest commodity value, this increase in market concentration is associated with a rate increase of $439, or about 12.6% of the average inbound freight rate.

In closing this section, we acknowledge Stigler's (1964) hypothesis that a cartel's ability to reach a joint profit-maximizing pricing agreement may be facilitated as the number of colluding firms declines. In other words, his model predicts that prices may be higher when the cartel contains firms with large market shares instead of

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[51] An F-test does not reject the hypothesis that the coefficients on the inbound and outbound regressions are the same; however the results on the outbound routes are qualitatively different from those previously mentioned.

small ones.[52] To test this hypothesis, we constructed a *"conference"* Herfindahl index, which represented the sum of the squared values of each conference member's share of conference capacity. We added this variable, by itself and multiplied by cargo value, to the specification in equation **(6)**. This variable was found *not* to be statistically significant in either the full sample or the samples of inbound and outbound routes only. Thus, we found no apparent relationship between the concentration of the conference and the behavior of freight rates.

VIII. Concluding Remarks

The U.S. international ocean shipping industry enjoys antitrust immunity and a conference system that allows carriers to enter into pricing agreements which are then monitored and enforced by a government agency. Previous empirical analysis has concluded that this system allows the exercise of cartel-based market power, based on evidence that freight rates are increasing with respect to cargo value. This finding has been interpreted as consistent with discriminatory pricing by an effective cartel, but the literature has ignored the possibility that these rate differences stem from cost differences or other sources of market power. In this study, we attempt to address these shortcomings by directly examining the relationship between freight rates and both conference market share and market concentration. Our statistical approach controls for cost differences across commodities and routes.

Although we find no significant relationship between conference market share and freight rates, our evidence indicates that

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[52] Another effect may work in the opposite direction of that suggested by Stigler. Firms with relatively large market shares may face lower costs (or flatter marginal cost curves). This result suggests that relatively large firms may gain more from cheating on a given cartel price. Consequently, as firms become larger, the *sustainable* cartel price may decline.

freight rates were significantly lower on those routes where individual conference carriers were allowed to enter into service contracts with individual shippers. These results suggest that some conference rules, perhaps when combined with relatively high conference market share, may allow carriers to maintain rates at levels higher than they would otherwise. Market power is undermined when carriers within a conference are allowed to independently contract with shippers.

Our results show that an increase in market concentration is associated with increased rate levels and increased rate dispersion on the basis of commodity value; this is consistent with the hypothesis that greater market concentration leads to greater market power. Nonetheless, a one standard deviation increase in concentration increases rates only 0.4% of the median freight rate for the entire sample.[53]

When we divided the sample between inbound and outbound routes, the above results continued to hold for the inbound routes only. Relative to the entire sample, the increase in freight rates associated with increased market concentration was larger in magnitude and statistically significant for a wider range of commodities in the inbound sample. At the median freight rate for outbound routes, a one standard deviation increase in market concentration increases freight rates approximately 1.4%. On outbound routes, where there may have been considerable excess

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[53] Even when firms apparently wield market power (i.e., set price above marginal cost), there may still be a cost-based explanation for the positive relationship between market concentration and price. As applied to ocean shipping, it is likely that there are some fixed (but, not sunk) costs involved in serving a given route. If those costs were to rise, some carriers would exit the route. Consequently, both market concentration and freight rates would increase, but the rate increase might only be sufficient to allow firms to again cover their fixed costs. Thus, the exercise of market power by individual firms does not necessarily imply that those firms earn supranormal profits.

capacity, the analysis could not identify a significant statistical relationship between freight rates and either market concentration or conference market share. Perhaps the presence of substantial excess capacity eliminated any sources of market power.[54]

In general, our results show that a perfectly-collusive outcome is unlikely even under the favorable conditions that exist in ocean shipping. Liner conferences do not, or cannot, maximize joint profits, even when rate information is publicly available and a government agency attempts to prevent cheating on collusive pricing agreements. The *"sustainable"* cartel pricing structure apparently diverges considerably from that which maximizes the joint profits of its members. A cartel's market power may erode in the presence of excess capacity, firm heterogeneity, and multidimensional competition, which all arise in liner shipping. In particular, this study shows that collusive prices may be adversely affected by increased contracting, which allows firms to expand service offerings and engage in selective discounting.

In light of the liner shipping industry's unique regulatory structure, there may be another explanation for the above results. The required public filing of freight rates and the associated enforcement of those rates, which applies to *all* carriers and conferences, may facilitate anticompetitive interaction between firms inside and outside

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[54] Ocean carriers have been particularly concerned with excess capacity in recent years, spawning both formal and informal agreements to reduce capacity. These agreements include the Transpacific Stabilization Agreement, a so-called *"discussion agreement"* between conference carriers and nonconference carriers to voluntarily limit capacity on U.S.-Far East routes. The Trans-Atlantic Agreement, a ratemaking agreement involving liner transportation between the United States and Northern Europe, also contains provisions to reduce capacity. It is quite possible that these agreements are intended to inhibit any procompetitive pricing behavior that stems from the existence of excess capacity.

of liner conferences. At the same time, conferences may be inhibited in maintaining internal pricing discipline by their members' ability to autonomously set rates (through the *"independent action"* provision) and exit the conference at any time with limited notice. This reasoning suggests that the importance of conference market share as an indicator of market power in ocean shipping may be less important than market concentration.[55]

What does our analysis imply about the costs and benefits from the regulation of liner shipping? Our finding that freight rates were significantly lower when conference carriers were free to negotiate directly with shippers provides some support for the proposition that the conference system imposes costs on consumers through higher freight rates. At the same time, however, it is important to point out that this finding is based on routes where the conference's market share is relatively high (over 80%), and that freight rates are not directly related to the market share of the conference serving the route. Further, it is also possible that conferences provide some offsetting benefits, such as increased efficiency in providing a network of ocean transportation services.

Coordinated activities among ocean carriers may be beneficial when those activities lead to improved rationalization of resources (e.g., through vessel-sharing and space-chartering arrangements) or induce efficiency-enhancing investments (e.g., through consortia that offer additional transportation services). It is unclear, however, that collective pricing behavior actually facilitates those coordinated activities which improve efficiency. Moreover, even if collective pricing is required to encourage efficiency-enhancing investment, the associated anticompetitive harm may still outweigh the efficiency benefits. Certain regulatory aspects of the *open* conference system, particularly the ability of carriers to enter or leave the conference with limited notice, would presumably discourage carriers from using

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[55] For further discussion of this point, see Butz (1993).

conferences to engage in efficiency-enhancing joint investment and rationalization activities.[56]

It is this tradeoff between the potential for anticompetitive harm and the potential for increased efficiency that should form the basis for analyzing coordinated activities in ocean shipping and assessing whether antitrust immunity should be continued. A similar cost-benefit test could be usefully applied to other aspects of the regulatory structure in ocean shipping, such as tariff filing and enforcement and restrictions on contracting.

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[56] Butz (1993) and Reitzes (1993) consider these issues in detail.

APPENDIX A
ROUTES AND COMMODITIES CONTAINED IN THE SAMPLE

Australia - U.S. Atlantic Coast

1. Apples
2. Beef (frozen)
3. Beer
4. Casein
5. Cheese
6. Canned Fruit
7. Gluten
8. Nickel
9. Pears
10. Wine
11. Wool

U.S. Atlantic Coast - Australia

1. Automobile Parts
2. Boxboard
3. Candy
4. Cigarette Tow
5. Citric Acid
6. Clay
7. Glass (flat)
8. Glassware
9. Magazines
10. Plastic Sheeting
11. Tires
12. Tobacco
13. Whiskey

Australia - U.S. Pacific Coast

1. Automobile Parts
2. Beef (frozen)
3. Beer
4. Casein
5. Glassware
6. Gluten
7. Steel Sheets
8. Steel Tubes
9. Tin Plate
10. Wire Rods
11. Zinc

U.S. Pacific Coast - Australia

1. Automobile Parts
2. Borax
3. Citrus
4. Dried Fruit
5. Lubricating Oil
6. Marine Engines
7. Nuts
8. Pulses (beans)
9. Roadmaking Equipment
10. Salmon
11. Vegetables (frozen)

Germany - U.S. N. Atlantic Coast

1. Apple Juice
2. Automobile Parts
3. Beer
4. Chemicals
5. Engines
6. Furniture
7. Glassware
8. Ham (canned)
9. Iron Castings
10. Metal Working Machinery
11. Moulding Machines
12. Offset Presses
13. Plastic Foils
14. Tires
15. Wine
16. Wine Gums

U.S. N. Atlantic Coast - Germany

1. Automobile Parts
2. Corn Seed
3. Electrodes
4. Engines
5. Lumber
6. Medical Supplies
7. PhotographicEquipment
8. Pork Offals
9. Roadmaking Equipment
10. Rubber (synthetic)
11. Tobacco
12. Yarn (synthetic)
13. Veneers

Germany - U.S. S. Atlantic Coast

1. Automobile Parts
2. Beer
3. Engines
4. Furniture
5. Ham
6. Steel Pipes
7. Steel Strips
8. Textile Machines
9. Titanium Dioxide
10. Wine

U.S. S. Atlantic Coast - Germany

1. Automobile Parts
2. Clay
3. Ferns
4. Grapefruit
5. Lumber
6. Peanuts
7. Pork Offals
8. Rubber (synthetic)
9. Tobacco
10. Wood Pulp

Italy - U.S. Atlantic Coast

1. Automobile Parts
2. Ceramic Tiles
3. Footwear
4. Furniture
5. Macaroni
6. Marble Tiles
7. Paper (for printing)
8. Textiles
9. Tomatoes (peeled)
10. Tractor Parts
11. Tractor Tracks
12. Vermouth
13. Wine

U.S. Atlantic Coast - Italy

1. Copper and Brass Scrap
2. Corn Seed
3. Hides
4. Lumber
5. Peanuts
6. Rags
7. Tobacco
8. Waste Paper
9. Wood Pulp

Japan - U S. Atlantic Coast

1. Aluminum Sheets
2. Audio Equipment
3. Auto Parts (of iron and steel)
4. Auto Parts (other)
5. Auto Parts (panel group)
6. Bolts, Nuts, and Screws
7. Electrical Goods
8. Machine Tools
9. Motorcycles
10. Porcelain
11. Textiles
12. Tires
13. Tractors
14. Transportation Equipment
15. TV Cameras
16. Video and TV Receiving Sets

U.S. Atlantic Coast - Japan

1. Butterfish
2. Lubricating Oil
3. Peanuts
4. Tobacco
5. Wood Pulp

Japan - U.S. Pacific Coast

1. Auto Parts (other)
2. Auto Parts (panel group)
3. Audio Equipment
4. Electrical Appliances
5. Motorcycles
6. Photocopying Equipment
7. Porcelain
8. Tires
9. TV Cameras
10. Video and TV Accessories
11. Video and TV Receiving Sets

U.S. Pacific Coast - Japan

1. Beef
2. Cotton
3. French Fries
4. Milk Carton Stock
5. Salmon
6. Wood Pulp

References

Abreu, D., Pearce, D., and E. Stachetti, "Optimal Cartel Equilibria with Imperfect Monitoring," *Journal of Economic Theory*, Vol. 39 (1985), pp. 251-269.

Borenstein, S., "Price Discrimination in Free Entry Markets," *Rand Journal of Economics*, Vol. 16 (1985), pp. 380-397.

Bresnahan, T., "Empirical Studies of Industries with Market Power," in R. Schmalensee and R. Willig, eds., *The Handbook of Industrial Organization*, Vol. 2., (Amsterdam: Elsevier Science Publishers, 1989), pp. 1011-1057.

Bryan, I., "Regression Analysis of Ocean Liner Freight Rates on Some Canadian Export Routes," *Journal of Transport Economics and Policy*, Vol. 8 (1974), pp. 161-174.

Butz, D., "Ocean Shipping Economics: Free Trade and Antitrust Implications," *Contemporary Policy Issues*, Vol. 11 (1993), pp. 69-80.

Chamberlin, E., "Duopoly: Value Where Sellers Are Few," *Quarterly Journal of Economics*, Vol. 43 (1929), pp. 63-100.

Choi, E., Menezes, C., and J. Tressler, "A Theory of Price-Fixing Rings," *Quarterly Journal of Economics*, Vol. 100 (1985), pp. 465-478.

Cowling, K. and M. Waterson, "Price-Cost Margins and Market Structure," *Economica*, Vol. 43 (1976), pp. 267-274.

Deneckere, R. and C. Davidson, "Incentives to Form Coalitions with Bertrand Competition," *Rand Journal of Economics*, Vol. 16 (1985), pp. 473-486.

Devanney, J., Livanos, V., and R. Stewart, "Conference Ratemaking and West Coast of South America," *Journal of Transport Economics and Policy*, Vol. 9 (1975), pp. 154-177.

Donsimoni, M-P., "Stable Heterogeneous Cartels," *International Journal of Industrial Organization*, Vol. 3 (1985), pp. 451-466.

Froeb, L. and G. Werden, "Endogeneity in the Concentration-Price Relationship: Causes and Consequences," Department of Justice Working Paper No. EAG 91-7, 1991.

Green, E., and R. Porter, "Non-cooperative Collusion Under Imperfect Price Information," *Econometrica*, Vol. 52 (1984), pp. 87-100.

Harrington, J. Jr., "The Determination of Price and Output Quotas in a Heterogeneous Cartel," *International Economic Review*, Vol. 32 (1991), pp. 767-792.

Heaver, T., "The Structure of Liner Conference Rates," *Journal of Industrial Economics*, Vol. 21 (1973), pp. 257-265.

Herman, A., *Shipping Conferences*, (Deventer: Kluwer, 1983).

Holmes, T., "The Effects of Third-Degree Price Discrimination in Oligopoly," *American Economic Review*, Vol. 79 (1989), pp. 244-250.

Jansson, J., "Intra-Tariff Cross-Subsidization in Liner Shipping," *Journal of Transport Economics and Policy*, Vol. 8 (1974), pp. 294-311.

_____ and D. Shneerson, "The Effect of Capacity Costs and Demand Elasticities on the Structure of Liner Freight Rates," *Logistics and Transportation Review*, Vol. 22 (1986), pp. 3-25.

Judge, G., Hill, R., Griffiths, W., Lutkepohl, H., and T-C. Lee, *Introduction to the Theory and Practice of Econometrics*, (New York: John Wiley & Sons, 1982).

Katz, M., "Price Discrimination and Monopolistic Competition," *Econometrica*, Vol. 53 (1984), pp. 1453-1472.

Orr, D. and P. MacAvoy, "Price Strategies to Promote Cartel Stability," *Econometrica*, Vol. 33 (1965), pp. 186-197.

Osborne, M. and C. Pitchik, "Profit-Sharing in a Collusive Industry," *European Economic Review*, Vol. 22 (1983), pp. 59-74.

Pirrong, S., "An Application of Core Theory to the Analysis of Ocean Shipping Markets," *Journal of Law and Economics*, Vol. 35 (1992), pp. 89-131.

Radner, R., "Excess Capacity and Sharing Profits: A Game-Theoretic Approach," mimeo, Bell Laboratories, 1977.

Reitzes, J., "Ocean Shipping Economics: Comment," *Contemporary Policy Issues*, Vol. 11 (1993), pp. 81-85.

Rotemberg, J. and G. Saloner, "A Supergame-Theoretic Model of Price Wars During Booms," *American Economic Review*, Vol. 76 (1986), pp. 390-407.

Schmalensee, R., "Competitive Advantage and Collusive Optima," *International Journal of Industrial Organization*, Vol. 5 (1987), pp. 351-367.

_____, "Inter-Industry Studies of Structure and Performance," in R. Schmalensee and R. Willig, eds.,*The Handbook of Industrial Organization*, Vol. 2., (Amsterdam: Elsevier Science Publishers, 1989), pp. 951-1009.

Sjostrom, W., "Price Discrimination by Shipping Conferences," *The Logistics and Transportation Review*, Vol. 28 (1992), pp. 207-216.

_____, "Collusion in Ocean Shipping: A Test of Monopoly and Empty Core Models," *Journal of Political Economy*, Vol. 97 (1989), pp. 1160-1179.

Stigler, G., "A Theory of Oligopoly," *Journal of Political Economy*, Vol. 72 (1964), pp. 44-61.

Telser, L., *Economic Theory and the Core*, (Chicago: University of Chicago Press, 1978).

Zerby, J. and R. Conlon, "Joint Costs and Intra-Tariff Cross-Subsidies: The Case of Liner Shipping," *Journal of Industrial Economics*, Vol. 31 (1983), pp. 383-396.

TABLE 1

Definitions of Variables and Data Sources

VARIABLE		
r_{ij}	=	freight rate per container for commodity i on route j (from conference rate data collected by the Federal Maritime Commission)
s_j	=	conference market share on route j (from Lloyd's Maritime Information Services)
p_{ij}	=	value per container of commodity i on route j (from export and import data collected by Bureau of the Census and compiled by the Maritime Administration of the U.S. Department of Transportation)
H_j	=	Herfindahl index of market concentration on route j (from Lloyd's Maritime Information Services)
CAP_j	=	total capacity on route j (measured in TEU's – i.e., containers) (from Lloyd's Maritime Information Services)
Y_j^d	=	gross domestic product in destination country on route j (in dollars) (from *International Financial Statistics* of the International Monetary Fund)
p_j^d	=	price index for destination country on route j (converted into dollars) (from *International Financial Statistics* of the International Monetary Fund)
p_j^o	=	price index for origin country on route j (converted into dollars) (from *International Financial Statistics* of the International Monetary Fund)
IA_j	=	dummy variable denoting whether conference on route j allows its members to independently enter into service contracts
1985,1986,1987,1988	=	dummy variables for years 1985-88

TABLE 2

Summary Statistics For Entire Sample
(620 observations)

Variable	mean	standard deviation	minimum	maximum
Freight Rate (Revenue per TEU)	3,104	1,598	722	14,239
Commodity Value	60,814	70,628	568	415,493
Conference Market Share	63	17	13	92
Market Concentration (Herfindahl)	1,906	990	528	4,285
Capacity	580,026	693,365	50,644	3,048,461
Destination Country GDP (in billions of dollars)	2,848	1,836	160	4,435
Destination Country Price Index	118	26	100	190
Origin Country Price Index	124	30	100	190

TABLE 3
Estimation of the Determinants of Ocean Freight Rates

Variable	Coefficient (t-value)
Conference Market Share (s_j)	-3.18 (-1.23)
Conference Market Share x Commodity Value ($s_j p_{ij}$)	0.000017 (0.70)
Market Concentration (H_j)	-0.026 (-0.31)
Market Concentration x Commodity Value ($H_j p_{ij}$)	0.0000018 (1.80)*
Capacity (CAP_j)	-0.000032 (-0.17)
Destination Country GDP (Y^d_j)	0.25 (1.07)
Destination Country Price Index (P^d_j)	3.41 (1.14)
Origin Country Price Index (P^o_j)	8.94 (2.93)**
Independent Action Dummy (IA_j)	-590.47 (-2.09)**
1985	243.53 (2.05)**
1986	-43.93 (-0.78)
1987	-70.14 (-1.14)
1988	-129.46 (-1.14)
number of observations (degrees of freedom)	620 (452)
R^2	0.18

*(**) indicates significance at the *10%*(*5%*) level in a two-tailed test

TABLE 4

The Effect on Freight Rates of a One-Standard-Deviation Increase in Market Concentration (Evaluated at Various Commodity Values)

Commodity Value (in dollars)		568	17,078	31,912	73,345	415,493
percentile*		0%	25%	50%	75%	100%
Change in freight rates:	**in dollars**	-9	+2	+12	+41	+277
	as a % of the mean freight rate	-0.3%	+0.1%	+0.4%	+1.3%	+8.9%

* **percentage of commodity values in the sample that lie below the specified dollar level (i.e., $568 ($415,493) is the minimum (maximum) commodity value)**

TABLE 5
Summary Statistics For Samples of Inbound and Outbound Routes

Variable	mean	standard deviation	minimum	maximum
Inbound (352 obs.)				
Freight Rate (Revenue per TEU)	3,482	1,673	991	14,239
Commodity Value	68,193	80,512	8,178	415,493
Conference Market Share	66	14	31	92
Market Concentration (Herfindahl)	1,956	1,116	528	4,285
Capacity	623,862	725,997	50,644	2,899,698
Origin Country Price Index	140	32	100	190
Outbound (268 obs.)				
Freight Rate (Revenue per TEU)	2,607	1,344	722	7,087
Commodity Value	51,123	53,638	568	276,754
Conference Market Share	59	19	13	85
Market Concentration (Herfindahl)	1,841	792	544	3,127
Capacity	522,450	644,832	72,687	3,048,461
Destination Country GDP(in billions of dollars)	835	711	160	2,849
Destination Country Price Index	136	31	100	190

TABLE 6
Estimation of the Determinants of Ocean Freight Rates on Inbound and Outbound Routes

Variable	Inbound Coeff. (t-value)	Outbound Coeff. (t-value)
Conference Market Share (s_j)	-6.75 (-1.58)	-1.81 (-0.56)
Conference Market Share x Commodity Value ($s_j p_{ij}$)	0.000017 (0.55)	0.000047 (1.02)
Market Concentration (H_j)	0.039 (0.35)	-0.15 (-1.09)
Market Concentration x Commodity Value ($H_j p_{ij}$)	0.0000025 (1.85)*	0.00000061 (0.40)
Capacity (CAP_j)	-0.00034 (-1.29)	0.00035 (1.21)
Destination Country GDP (Y^d_j)		0.38 (1.13)
Destination Country Price Index (P^d_j)		3.35 (0.79)
Origin Country Price Index (P^o_j)	9.51 (2.15)**	
Independent Action Dummy (IA_j)		-284.19 (-1.06)
1985	149.62 (0.81)	189.63 (1.54)
1986	-112.98 (-1.52)	-9.66 (-0.15)
1987	-25.44 (-0.26)	-70.82 (-1.00)
1988	-11.21 (-0.07)	-109.14 (-0.93)
number of observations (degrees of freedom)	352 (254)	268 (189)
R^2	0.21	0.20

*(**) indicates significance at the *10%(5%)* level in a two-tailed test

TABLE 7

The Effect on Inbound Freight Rates of a One-Standard-Deviation Increase in Market Concentration (Evaluated at Various Commodity Values)

Commodity Value (in dollars)		8,178	17,172	33,625	79,765	415,493
percentile*		0%	25%	50%	75%	100%
Change in freight rates:	**in dollars**	+24	+33	+50	+97	+439
	as a % of the mean freight rate	+0.7%	+1.0%	+1.4%	+2.8%	+12.6%

* **percentage of commodity values in the sample that lie below the specified dollar level (i.e., $8,178 ($415,493) is the minimum (maximum) commodity value)**