PRODUCT BUNDLING IN GLOBAL OCEAN TRANSPORTATION

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Abstract:
There are over 20 'components' in an international door-to-door transportation, ranging from warehousing and distribution, to forwarding, documentation, transportation, customs clearance, etc.

As tariffs in ocean transportation tend to converge due to competition and service homogenization, carriers, in competition with third party logistics service providers, strive to integrate door-to-door services under their control. In doing so, and among others, they invest heavily in logistics rather than ships that can nowadays be easily chartered in from institutional investors.

Integration efforts however have been met with varying degrees of success in the face of skeptical and suspicious shippers requiring cost break downs and more transparency.

With the use of game theory, this paper attempts to develop winning service bundling strategies for ocean carriers, i.e. global supply chain solutions under all-in prices. Preliminary results show that, under certain conditions, bundling can be an equilibrium strategy for one or more carriers, and despite leveraging around captive liner services and potentially enhanced profits, bundling does not necessarily lead to a loss in social welfare.

Keywords: Bundling; Liner Shipping; Vertical Integration; Integrated Logistics.

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1 INTRODUCTION

1.1 Developments of the liner industry and the role of logistics

As tariffs in ocean transportation tend to converge due to competition and service homogenization, carriers, in competition with third party logistics service providers, strive to integrate door-to-door services under their control. In doing so, and among others, they invest heavily in logistics rather than ships that can nowadays be easily chartered in from institutional investors.

Although carriers have been providing intermodal services since the 1980s, it is only since the mid-1990s that the major shipping lines have set up logistics branches and given logistics activities a more central role in their group strategies, as recently surveyed by Midoro and Parola (2005). In this way carriers have begun competing with some of their own customers.

Table 1: Main Logistics Branches of Shipping Lines' Groups.

Carrier	*Intermodal Entry*	*Logistics Branch*		*The role of the logistics branch within the group*
Sealand	Early '70s	Sealand Logistics[1]	mid-'90s	Taken over by Maersk in 1999
Maersk Line	Early '80s	Maersk Logistics[2]	2000	Under AP Møller Maersk control (container business unit)
NOL/APL	1979(1997)	APL Logistics[3]	1997	Under NOL control
NYK	1985	NYK Logistics	2000	Under NYK Line control
MOL	1985	MOL Logistics[4]	2001	Under MOL control
K-Line	1986	K-Line Logistics Holding	2000	Holding under K-Line control (K-Line Total Logistics brand)
Hyundai	1990	Hyundai Logistics[5]	1999	Under control of Hyundai M.M.
Hanjin	1989	Hanjin Logistics	2001	overseas operations[6] controlled by Hanjin Shipping
COSCO	mid-'90s	COSCO Logistics	2002	Jointly controlled by Cosco Group and Cosco Pacific
OOCL	'90s	OOCL Logistics[7]	1999	Under OOCL control

Notes:

(1) formerly Buyers Consolidators (taken over by Sealand's parent company in 1993)
(2) formerly Mercantile (established in 1977)
(3) AP Intermodal was established in 1985; the NOL group entered in intermodal and logistics activities only after the takeover on APL in 1997
(4) Formerly M.O. Air System Inc. (established in 1989)
(5) Formerly Asia Merchant Shipping Corporation (1988) and Hyundai logistics Corporation (1993)
(6) Domestic logistics operations are managed by Hanjin Corporation (independent from Hanjin Shipping)
(7) Formerly Cargo System, the group's international freight consolidation unit. OOCL China Domestic Ltd. (since 1998) is the logistics company for China (under OOCL control).

Source: Adapted from Midoro and Parola (2005)

The reasons behind the decision of carriers to step into the logistics sector may be connected to the increasing demand from the cargo owners for the provision of integrated supply chain services, the desire to product differentiate in the attempt to stabilise revenues or better control the market.

The increasing demand of cargo owners for integrated logistics solutions lies in the renewed importance of 'just in time' deliveries, control over inventory costs and the reduction o uncertainty in the supply chain that are a precondition for a successful global distribution and production strategy. Cargo owners that have strong relations with a carrier may naturally prefer the shipping line to walk the extra mile instead of having to involve other parties.

The provision of logistics services may have also offered the opportunity to carriers to product differentiate. The ability to product differentiate in a relatively homogeneous market like that of container transportation, presents a large number of advantages, among which the attempt to price discriminate. Price discrimination, that can be generalized to include quantity discounts, has been made possible by the development of individual contracts between shippers and carriers.

In addition logistics may represent an alternative source of revenues when the freight rates are at their low, allowing a sort of revenue portfolio management within the group.

Finally, a further reason is the attempt to better control the market by tying ocean transportation customers also in the upstream and downstream logistics services. This may increase the switching costs for the shipper and work as a deterrent for competitors, rising entry barriers.

The integration efforts however have been met with varying degrees of success. The various challenges imposed on carriers by the combination of ocean transportation with the services of a logistics provider can be summarised, not exhaustively, as:

- the strategic and operational difficulties deriving from the joint provision of two intrinsically different services: ocean transportation, characterised by large assets, tight cost control and in general a business focus on asset use maximisation, and logistics, typically asset-light, highly competitive and with a distinctive focus on customer demands;
- the sceptical and suspicious shippers requiring cost break downs and more transparency;
- the complications generated by the unusual situation of integrated carriers competing with global freight forwarders, de facto some of their major customers.

Notwithstanding some uncertainties and the aforementioned difficulties in providing ocean transportation within the logistics chain as an integrated service, the general perception of the industry seems positive, also encouraged by the successful examples of some leading carriers, such as Maersk and APL.

One of the possibilities offered by vertical integration is the ability of providing integrated supply chain solutions under a single price. This type of product, referred to as bundling or tying sales in the literature[1], has shown to be very successful in a variety of

[1] In the industrial organization literature a distinction is made between bundling and tie-in sales, whereas with the former it is meant that the combination of the two products is sold in fixed proportions, while tie-in sales schemes are less restrictive and the mix of goods is not so rigidly prescribed (Pepall, Richards and Norman, 2002). In the context of logistics and supply chain nevertheless, bundle and tie-in

industries, from the software industry, the tourism industry, to various sector of the manufacturing industry.

1.2 Bundling and vertical integration in the liner sector

The practice of bundling in general does not require the company to be vertically integrated. As a matter of fact many third party logistics service providers are non-asset based and provide the bundle of services by outsourcing part or all of its components. Similarly, shipping lines that provide for example an all inclusive rate between two inland locations, do not necessarily own the transport means from the port to the inland location, nor the terminal where the container is unloaded, but arrange with the inland transport operator or with the terminal operator for delivering the all-inclusive service to the customer.

It can be argued that shipping lines have always provided the service of integrating transportation services by means of selling intermodal transportation or quoting all inclusive rates. In this sense bundling is then not a new concept. What is new is the increased attention and the larger importance that has been given to the logistics business by the carriers and the change in strategy that has transformed logistics from a marginal activity to an important component, even if yet ancillary to ocean transportation, to the carrier's group strategies.

Bundling in the supply chain from an ocean transportation perspective naturally includes the provision of services such as terminal operations, feedering or hinterland transportation. As a matter of fact we observe that carriers tend to extend their business scope integrating the aforesaid services. It is difficult to argue then that vertical integration is not partially a direct consequence of the carriers' decision to provide bundles, and analogously that bundles constitute the most logical outcome of a vertically integrated carrier.

Bundles involving ocean shipping may be provided in the following contexts, all competing with each other to a certain extent.

- Ocean transportation may be sold jointly with logistics services by a third party logistics not under the control of the shipping line. In this case the logistics operator may or may not be asset based.
- Ocean transportation may be sold jointly with logistics services by the third party logistics within the shipping line group. In this case the shipping line presents a certain degree of vertical integration (at least within the group), but the other logistics services may or may not be provided within the shipping line group.
- Ocean transportation may be sold jointly with other logistics services by the shipping line directly. In this case the shipping line may or may not be vertically integrated. If vertically integrated the company will use its own trains or trucks or dedicated terminal, alternatively it will outsource these services.

This distinction highlights clearly the complex market structure that the provision of bundles creates. As shown in the figure below, the ocean carrier may be facing competition not only from other (integrated and non-integrated) ocean carriers, but also by (asset and non-asset based) logistics service providers, that are also their customers,

will be used as synonyms, also in view of the fact that generally it is assumed that each bundle is uniquely targeted to one shipper only.

by cargo owners, that may provide logistics solutions through their own logistics departments, and even by the logistics service provider within their own group.

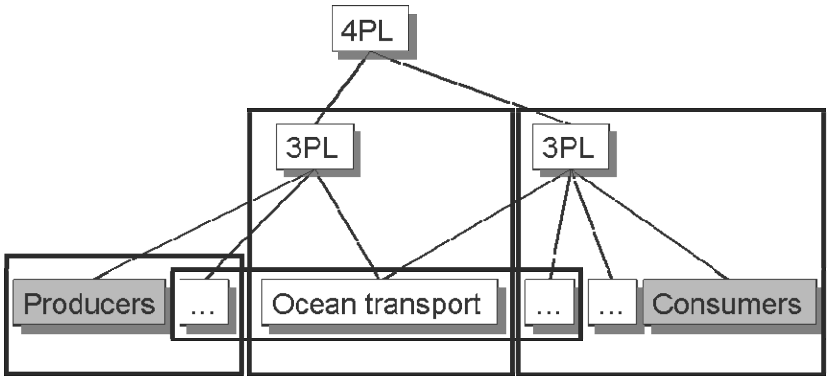

Figure 1: Bundle Alternatives in the Supply Chain.

It is clear that the degree of competition is related to the nature of the components of the bundle. Some bundles, for example ocean transportation and terminal handling, are more likely to be provided at more competitive price by the ocean carrier than by the logistics department of large manufacturer, but in many cases this is not necessarily so.

The competition in providing the bundle then boils down to the main question on how good is the bundler in assembling the bundle. This involves not only essential aspects such as marketing, promotion, market image, market share, etc, but also more eminent efficiency aspects such as how cheaply can every single component of the bundle be produced or outsourced and how cheaply can the bundle be assembled.

This relates to the ability of a bundler to obtain lower prices when outsourcing certain services and to its production efficiency, i.e. its ability to produce the bundle component such as ocean transportation, feedering, terminal handling, trucking, etc. at a lower cost.

The present paper aims at analysing the competitive interactions between integrated carriers focussing on their pricing decisions and their ability to provide bundles. The article will combine the results obtained by the authors during a preliminary study on the role of bundling in ocean transportation and will propose a simple game theory model based on the industrial organization literature in the attempt to identify the major competition issues.

Before presenting the results of the study and introducing the model, the next paragraph will present a short literature overview on bundling in the general economic literature and in liner shipping.

1.3 Bundling and liner shipping industry: existing literature

Even if the provision of bundles has developed along with the container transportation industry since its beginning, as discussed in the first part of this introduction, it has not been the objective the academic literature. For this reason this literature overview will present concepts and findings from complementary research areas and applications from other industries, trying to infer the distinctive traits of the shipping industry from the limited recent literature on vertical integration in the liner sector.

A first area of research is the industrial organization literature that has dedicated relatively large attention to bundling and tie-in sales. The first attempt to formalize the concept of bundling as a pricing strategy and provide a graphical representation of bundles is due to Adams and Yellen (1976), even if seminal references are to be found in the work on transaction costs of Coase (1960) and Demsetz (1968) and Stigler (1963).

A distinction is done in the literature on the basis of the availability of the separate components once the bundle is offered. The situation in which only the bundle is made available to customers is referred to as pure bundling (Adams and Yellen, 1976), while if the bundle is offered contextually to the separate components, it s the case for mixed bundling.

The attractiveness of bundling is said to derive from the reduction in production costs or reduction in complexity costs (Fuerderer *et al.*, 1998; Ringbeck *et al.*, 1998), in the possibility to economies of scale and scope (Paroush and Peles, 1981) that can be connected to the extensive logistics literature on quantity discounts or from the complementarity in consumption of goods (Venkatesh and Kamakura, 2003).

Another interesting stream in the literature is the impact that the practice of bundling has on competition. The majority of the literature focuses on monopolies that try to control the production of upstream or downstream industries (Adams and Yellen, 1976, Schmalensee, 1984; McAfee, McMillan and Whinston, 1989). Those authors identify as the main rationale for bundling the attempt to extract, more effectively, consumer surplus from heterogeneous customers through price discrimination. Adams and Yellen (1976) in particular demonstrate that product bundling achieves the objective of sorting consumers on the basis of their reservation prices thus, allowing price discrimination. Some authors have discussed the impact that bundling may generate by increasing barriers to entry (Burstein, 1960; Kühn *et al.*, 2004), as in the well debated case of Microsoft and Internet Explorer.

The literature on bundling in duopoly or oligopoly situations is more limited and seems to point in two directions. On the one side there are those, such as Carbajo *et al.*(1990) that emphasize the reduction of aggressiveness in duopolistic competition and in general find that bundling tends to decrease competition. On the other side others emphasize the beneficial consequences of bundling. In certain cases the practice of bundling may be a necessary condition for the existence of (Nash) equilibria (Liao and Unbano, 1998). In general is seems that mixed bundling equilibria are social optimums in a variety of settings and types of analyses (Tauman et al., 1997; Liao and Unbano, 1998; Matutes and Regibeau, 1992; Anderson and Leruth, 1993; Economides, 1993; Farrell *et al*, 1998).

Another interesting conclusion is that in some of the models firms are worse off as a result of the practice of mixed bundling, as some of the games clearly present prisoner dilemma situations (Economides, 1993). In general though, the theoretical literature is far from conclusive and widely open to discussion. In particular worth mentioning are the relatively restrictive hypotheses that characterise some of the models in terms of functional demand specifications or production costs. Nevertheless these models represent a theoretical formalization of the bundling decision in a strategic context and are a useful starting point for analysing the impact of bundling in the container industry.

While product bundling in the service sector is well documented, (see for example the airline industry, the joint provision of hotel accommodation and air travel, as well as air travel in conjunction with bus transfers, or insurance packages), the bundling of logistics and transportation services has been relatively neglected, maybe because logistics services, such as warehousing, distribution packaging, labelling, etc. have traditionally been priced separately.

The attempts in the industry to tie-in those services, such as in the case for example of ocean transportation and terminal handling services, have been perceived with diffidence by the customers. This is partially because of the incongruence of certain tariff designs, e.g. terminal handling charges in the same departure port substantially different on the basis of the port of destination. This has caused the perception to customers of unclear and unjustifiable pricing practices, and it has increased their preference for cost transparency. In spite of the above, the necessity for better responsiveness in the supply chain; the increasing demand for just in time logistics; and the general tendency towards a “one-stop-shop” could open opportunities for product bundling.

To approach the issue of bundling in the ocean transportation and logistics sectors, a brief description of the two markets may be necessary. Liner shipping typically involves a relatively small number of players providing a fairly homogenous product (Haralambides and Veenstra, 2000). The degree of competition in the market is subject to extensive scientific debate (see or example the Sjostrom, 1989; Franck and Bunel, 1991; Haralambides and Veenstra, 2000).

The logistics market, which for the purposes of bundling here could be considered as the secondary market, is on the contrary characterised by a larger number of products and suppliers. If liner companies dominate the market on the sea leg of the supply chain, on the land side the scene is set by third-party logistics operators (3PL) who provide, coordinate and oversee land transportation, often extending their role to the ocean leg as well. The general tendency observed in the liner sector of an increased participation in the provision of land based logistics services is counteracted by the practice of 3PLs of offering services as Non Vessel Operating Common Carriers (NVOCC). The borderline and the definition of the markets becomes somewhat more blurred.

The literature on the changing role of liner companies in the provision of logistics services, and the increasing importance of integrated logistics in global supply chains is rather limited. In general, attention has been given mostly to vertical integration around shipping, but this has strangely not led to the provision of differentiated services under a single price. Even if the first attempts can be traced back to the 60’s and 70’s, the first structured approach to frame ocean transportation in a more complex (vertical) system has been proposed by Casson (1986). In this paper, the author concludes that vertical integration is clearly a trend in the shipping industry, stemming mostly from the necessity to maintain the continuity of the flow of production and from the carriers’ desire to market a larger range of products to respond to customers’ need (Casson, 1986).

Casson also argues that, in the shipping industry, many of the advantages of vertical integration can and are obtainable by means of contractual arrangements. In the last thirty years, however, the number of carriers that have indeed pursued the strategy of integrating vertically within the supply chain has increased, following the lead of certain rather successful examples. Whether and to what extent the success of a carrier and its degree of vertical integration are connected is yet to be proven, but it seems that the benefits of vertical integration have actually been exploited by carriers more than what Casson had expected.

Literature on vertical integration in shipping has been scant and descriptive, rarely including -in the analysis of carriers' strategy decisions- the role, the economic drivers and the possible market outcomes of vertical integration. This lack of scientific output on the topic could be justified by the limited availability of data and by a certain resistance, on behalf of the carriers, to disclose information perceived as commercially sensitive.

On the other hand, scale and network economies considerations have placed noticeable attention on global shipping alliances and similar forms of horizontal integration. The increasing recent interest of the industry and the academia in the possibilities offered to carriers by vertical integration finally undermines this perception and reaffirms the necessity of a new paradigm in the analysis of carriers strategic decisions. This paradigm should aim at analysing carriers' strategic decisions mostly in the context of the supply chain, of which ocean transportation is an essential component.

A good example of an analysis of carriers' decisions within the supply chain paradigm just introduced is represented by the joint analysis of liner shipping and terminal operations in the phenomenon called dedicated terminals. The provision of transport together with terminal operations is one of the obvious forms of vertical integration in the shipping industry and represents the most immediate example of natural bundle in the industry. The role of dedicated terminals in the provision of container transport has been discussed by Haralambides *et al* (2002) and by Cariou (2001). The authors identify as a major driver behind the development of dedicated container terminals the greater flexibility, reliability, short turnaround times and enhanced efficiency in the management of the global supply chain.

As correctly pointed out by Midoro and Parola (2006), the implications of the entry into the logistics market by carriers should be analysed in the context of how this developments occurred. In the early stages of containerisation, intermodal services, consolidation and warehousing were the first logistics services offered to shippers. The introduction of the land bridge concept in the US and the development of the West Coast ports boosted intermodality, with operators like Maersk, APL and Sealand in the front run. Immediately after this, in the 80's, Asian companies like NYK began expanding their logistics activities as well. It is only in the 90's that the scope of the term logistics was extended to include the idea of managing and optimising the different stages of the supply chain (Midoro and Parola, 2006).

As clearly discussed by Heaver (2002), even if shipping lines are increasingly becoming vertically integrated, the management of logistics services remains distinct from the management of shipping and so does pricing. This has also been observed in a survey conducted by Fremont (2006): even though a large number of shipping lines provide logistics services, these services are in most cases neither priced nor offered in conjunction with ocean transportation.

2 BUNDLING IN THE LINER SECTOR[2]

2.1 Market description and the *rationale* for bundling

Four major groups of players seem to exist in the provision of bundles involving ocean transportation and logistics services.

[2] This paragraph summarises the preliminary findings of a research project on bundling in the liner and logistics sectors, supported by the NOL Fellowship Research Programme, of Erasmus University and Singapore Management University.

- *Pure liner companies.* These are companies whose sole scope is ocean transportation. Although the number of these companies is decreasing, as the majority of carriers provide other services too, they may exist separately in the same holding group, together with a sister company that specialises in the provision of third party logistics services and to which the demand for logistics services of the liner company is channelled.
- *Integrated liner companies.* Some companies have extended their operations vertically so that they provide logistics services to some of their customers and these services are performed and charged directly by the liner company itself next to ocean transportation. These activities have traditionally included hinterland transportation and feedering.
- *Third party logistics service providers connected to a liner company.* Some liner companies have created a subsidiary or a sister company within the same holding group that operates as an independent third party logistics (3PL) business, such as NYK Logistics, Maersk Logistics, APL Logistics, etc. In general, these companies are independent operators and as such are not required to combine their logistics services with the ocean transportation provided by the group and vice versa. From the viewpoint of the logistics provider, ocean transportation is just another logistics service, and it might well be that in some cases, for some customers, this service may not be even required. The fact that the companies are under the same controlling holding, even if this clearly facilitates cooperation and the provision of joint services, does not necessarily constitute a basis for an obligatory joint provision of services.
- *Pure third party logistics service providers.* These are logistics providers who are not connected to a specific liner company and purchase ocean transportation independently from all the carriers in the market.

Carriers may decide to expand vertically either by providing logistics services directly within the liner company, or in-sourcing them from the group 3PL, or a combination of the two. In the former case, the carrier may choose to set up their own operations, by, for example, buying and operating trains, or outsource the services to external operators. All examples and different degrees of vertical integration are present in the industry. It appears however that it is not yet clear which of the market configurations presented above will ultimately prevail.

Irrespective of this, it is generally acknowledged within the sector that logistics does represent the direction in which business is expanding. Even Mediterranean Shipping Co (MSC), which has been traditionally looked at as a company not interested in logistics, recently announced that it is looking into possibilities of expansion offered by the logistics sector.

In any case, it is hard to consider *logistics* as the core business of liner operators, and even if there is an indication that shipping lines are investing in logistics, we are surely still far away from considering this as the core component of the liner business in general. The logistics business is in general perceived to constitute less than 15% of the total revenues of liner companies, and generally no more than the 30% of the revenues of the group (EUR and SMU, 2006). These findings conform to the general intuition that the involvement of shipping lines in logistics, even if this is a rapidly growing trend, still offers plenty of room for expansion, and the two should be seen as complementary activities.

Shipping companies do seem to be willing to expand their logistics activities as long as this brings in a revenue increase to the group and affords the company a strategic advantage over competitors. The expansion of liners into logistics is not perceived as a cost saving strategy, but as performing a support function to ocean transportation in the attempt to provide a better service to customers and differentiate the liner product.

On the basis of the relevance of logistics in company strategy, shipping lines may be categorised at least in the following three groups:

- *Logistics enthusiasts:* those companies that have heavily invested in logistics in an attempt to differentiate their service over that of their competitors. Among the logistics enthusiasts we can list companies such as Maersk Line and the NOL group.
- *Logistics functionalists:* these are companies that have invested in logistics in order to support the demand of some of their major customers. These include for example some of the major Japanese carriers such as MOL and K Line, that entered the logistics market in the early nineties to support the operations of their major Japanese customers in Europe and in the USA.
- *Logistics cautious:* are those companies that have invested in logistics, or are planning to do so, having realised that some of the market leaders are expanding in the sector and are thus gaining competitive advantage.

This categorization is similar to the one provide by Midoro and Parola (2005), that distinguish among *Highly Integrated*, *Latecomers* and *De-verticalized* carriers, that points more in the direction of the stage of development of the level of integration, instead of the strategic motivation.

Although the reasoning behind the decision to provide bundles seems to be motivated by a number of factors, it was never suggested by the companies interviewed in the context of this research that bundles were used strategically to improve market control (EUR and SMU, 2006).

Specifically, the reasons mentioned as being behind bundling and vertical integration strategies were:

- the necessity to accommodate the demands of the large customers that prefer making use of the liner company also for their logistics operations in export countries;
- the attempt to compensate cyclicality in the liner industry with a steadier source of revenue, as, in general, revenues generated in the logistics sector are less dependent on the volatility of freight rates;
- the possibility of obtaining higher margins by jointly offering ocean and hinterland transportation (contrarily to general belief, it did not appear during the interviews that margins in the ocean transportation sector are too small);
- the necessity to improve coordination with hinterland connections, as increased coordination is required for effective delivery of door-to-door services, by shippers and logistics operators with whom the carrier works.

2.2 Bundling in practice

Before discussing how bundles are composed in practice, it is important to highlight the difficulty in univocally establishing the range of services that are provided in the logistics industry and their economic characteristics. In the current research (EUR and SMU, 2006), the following categorisation has been proposed, a brief description of which is provided next to each term.

- *Terminal Handling*: includes loading and unloading operations from ship to shore; to another vessel; to an inland-going vessel, or another means of transport; stacking of containers in the yard; yard movements; other operations, characteristic of a container terminal;
- *Warehousing*: includes storage; components retrieval; sorting; and (limited) assembling operations that are usually performed in a warehouse;
- *Stuffing/Stripping of containers and cargo consolidation*: this includes the loading and emptying of cargo in the container and the collection of cargo from various shippers and vendors;
- *Container services*: they include all services that are necessary for the container itself, such as cleaning; pest control; fumigation; general maintenance; repairing; painting; etc. These services were traditionally performed by carriers, but they are also now carried out by terminal operators or specialised companies;
- *Container logistics*: they comprise all movements of containers from the terminal to the consignor/consignee and vice versa;
- *Cargo logistics*: involve all movements of cargo, from the moment it is unloaded from the container to its final destination; distribution centre or consumer. Cargo logistics also involve movements of cargo before it is stored in the container, from the production facility or the origin;
- *Value added logistics services*: these include logistics operations on the cargo, such as the instalment of chips, barcodes, RFID labels, labelling, dating, packaging, sorting, etc;
- *Hinterland transportation*: this refers to the simple movement of containers inland by means of truck, train or barge, as opposed to any other type of logistics activities performed on the container or the cargo.

The above categorisation is the first necessary step for all analyses on bundling. Bundles are feasible as long as they reduce costs for the customers, either by increasing the efficiency of the control of the transportation chain, or by lowering carrying (inventory) costs; in other words, by reducing transaction costs.

Ocean transportation can be provided successfully together with cargo handling, container services, hinterland transportation and container logistics. Other services such as stripping and stuffing of containers; cargo consolidation; warehousing, etc., are often provided by logistics operators and not by the lines themselves. Cargo logistics and value added logistics do not seem, so far, to fall within the scope of bundling with ocean transportation.

Supply chain components that are priced jointly with liner services are cargohandling, container services and hinterland transportation. Warehousing appears to be priced jointly with liner services only upon request and in general very rarely.

Stuffing/stripping of containers and cargo consolidation services are provided by specialised companies, and although they can be priced together with ocean transportation, this also happens infrequently.

The frequency of certain types of bundles, compared to others, may also depend on customer preferences, common practice, geography and law. For example it is common practice for shipping lines to provide city-to-city rates in the US. These differences may be substantial even within the same region.

2.3 Bundle pricing in the liner sector

From the interviews performed during the aforementioned research project (EUR and SMU, 2006), it became fairly clear that the major determinants in *bundle pricing* are the value the bundle delivers to the customer and the cost of providing the bundle. One interviewee mentions: '*Provided the value our bundled service brings [to the customer] exceeds the cost of our offering, we can sell*'. Another interviewee mentions that bundles should be priced 'taking full recognition of the costs and revenue potential for all individual components. The intention of bundling is that this isn't a discount'.

Although a bundle is expected generally to afford shippers a lower or at least equal price than the sum of the prices of the individual components, this is often not the case in the logistics sector, where the price of the bundle may be slightly above the sum of the prices of the individual components, being the bundled service in principle a better proposition for the customer than the provision of separate services[3]. In those cases in which the price of the bundle is below the sum of the prices of the individual components, this is the result of the opportunity afforded to the liner company, through a bundle, to 'play' with profit margins, as well as the advantages obtainable from lower costs and better coordination. This is, in the end, the comparative advantage of those companies that have the skills to provide a larger set of services, *vis a vis* those whose capabilities are limited to the provision of a single service, either transportation or any other logistics service.

In practice the price of a bundle is set in various ways, ranging from the sum of the costs of the single component parts plus a margin, to the contribution margin each component is able to deliver, or to what the market can bear. In each case, minimum margin levels are required (EUR and SMU, 2006).

Of course this price increase can only be possible if the shipper values the provision of a bundle as a higher quality service than the pure combination of the stand alone services. Often, this is because of a reduction in transaction- and coordination costs and in this way the shipper may be willing to give up some of the savings obtained and compensate the 'risk' taken up by the carrier.

An additional point worth noting is that certain bundles may be unfeasible i.e. bundles whose cost is higher that the linear sum of component costs. Naturally, these bundles would not be offered. It seems though that the feasibility and profitability of bundles might depend on the characteristics of the supply chain in terms of cargo, geography, time sensitivity and policy related issues in most cases.

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[3] The case in which the price of the bundle is higher that the price of the individual components is known in the literature as *premium bundling* (Cready, 1991).

3 A MODEL OF STRATEGIC BUNDLING

3.1 Description of the model

The paper uses a simple game theory approach, based on Economides (1993), in an attempt to formulate a strategic decision process that could lead to the provision of a bundle.

The major differences with the previous model is that the game here is a single stage game, for, in the specific context under analysis, the *a priori* decision of a carrier not to provide bundles is unrealistic and, in any case, the focus of the present model is limited to those carriers that do provide bundles (*exclusive liner companies* are kept out from the analysis). In addition, we introduce a parametric representation, in order to distinguish among the different abilities of carriers and shippers in providing the bundle. These parameters, which we will refer to as transaction costs, in reality summarise the differences among carriers in performing integrator tasks. The latter are seen as a function of the carrier's marketing ability; the resources dedicated to logistics; production efficiency; or the carrier's bargaining power. The disadvantage of those extensions is that calculations become tedious and formulas less elegant[4].

We can simplify the analysis by assuming that each transaction is the result of a game between two carriers, C1 and C2. The supply chain is assumed to consist of two components, ocean transportation (O) and a logistics service (S). The services are provided by the two carriers either on their own or as a bundle.

The bundle can be provided by C1 either by assembling its own services, or combining one of his own services with the services provided by his competitor. Naturally every service implies a cost, but in the analysis here the technical costs of producing the two services have been kept out, as they would make it impossible to obtain (analytically) equilibrium.[5]

In addition, if the shipper does not buy the bundle from either carrier but buys only the separate components instead (eventually by the same carrier), she is penalized by an additional cost component (t_S) deriving from the transaction costs of assembling the bundle herself. Analogously, the carriers have to bear their own transaction costs when providing the bundle (t_1 and t_2 respectively).

Implicitly we are assuming that if the carriers diverge in their ability to provide the bundle, the difference in the bundle prices will also increase, while the difference in the price of the individual components will be proportionally reduced. In other words, the ability of each carrier in providing the bundle is reflected in the price charged to the consumer.

The game can be thought of as a single stage game, where the players (the carriers) decide a set of prices for the bundle and the unbundled services. Following are the possible situations in the game:

1. The shipper buys the bundle either from C1 or C2;
2. The shipper buys the services separately;
    A. The shipper buys ocean transportation from C1 and the logistics service from C2;

[4] In what follows, we acknowledge use of Wolfram's *Mathematica*.
[5] The impact of introducing costs on the competitive outcome is reserved for a forthcoming paper.

B. The shipper buys ocean transportation from C2 and the logistics service from C1;
C. The shipper buys both ocean transportation and logistics from C1, but does not buy the bundle;
D. The shipper buys both ocean transportation and logistics from C2, but does not buy the bundle;

Let's now define the set of strategies available to C1 and C2, given the set of coefficients, t_S, t_1, t_2. The strategy for the carriers is defined as the set of prices $P_i = \{r_i; o_i; s_i\}$, i=1,2.

Given a set of prices, $P_i = \{r_i; o_i; s_i\}$, a demand system is next required on order to determine the payoffs of the players. Assuming a linear demand in (r_i ; o_i; s_i), we can express the demand system as:

$D(B_1) = a - br_1 + c(o_1 + s_1) + d(o_1 + s_2) + e(o_2 + s_1) + f(o_2 + s_2) + g(r_2)$
$D(B_2) = a - br_2 + c(o_1 + s_1) + d(o_1 + s_2) + e(o_2 + s_1) + f(o_2 + s_2) + g(r_1)$
$D(N_{1,1}) = a - b(o_1 + s_1) + c(o_1 + s_2) + d(o_2 + s_1) + e(o_2 + s_2) + f(r_1) + g(r_2)$
$D(N_{1,2}) = a - b(o_1 + s_2) + c(o_1 + s_1) + d(o_2 + s_1) + e(o_2 + s_2) + f(r_1) + g(r_2)$
$D(N_{2,1}) = a - b(o_2 + s_1) + c(o_1 + s_1) + d(o_1 + s_2) + e(o_2 + s_2) + f(r_1) + g(r_2)$
$D(N_{2,2}) = a - b(o_1 + s_2) + c(o_1 + s_1) + d(o_1 + s_2) + e(o_2 + s_1) + f(r_1) + g(r_2)$

The demand system is similar to the one used by Economides (1993)[6], with the difference that in this case it has been adapted to a single stage game, where the prices of the bundle and the separate components are set simultaneously.

In general we will have b > c + d + e + f + g, so that an increase in the prices of all 6 systems will decrease the demand for each system. Without loss of generality we can assume c = d = e = f = g. so that the demand system becomes:

$D_{B1} = a - br_1 + c(2o_1 + 2s_1 + 2o_2 + 2s_2 + r_2)$
$D_{B2} = a - br_2 + c(2o_1 + 2s_1 + 2o_2 + 2s_2 + r_1)$
$D_{N11} = a - b(o_1 + s_1) + c(o_1 + s_1 + 2o_2 + 2s_2 + r_1 + r_2) - t_S$
$D_{N12} = a - b(o_1 + s_2) + c(o_1 + 2s_1 + 2o_2 + s_2 + r_1 + r_2) - t_S$
$D_{N21} = a - b(o_2 + s_1) + c(2o_1 + s_1 + o_2 + 2s_2 + r_1 + r_2) - t_S$
$D_{N22} = a - b(o_2 + s_2) + c(2o_1 + 2s_1 + o_2 + s_2 + r_1 + r_2) - t_S$

For the carrier i (i =1,2), the payoff will be defined as the difference between the price obtainable from selling the individual services at price (o_i, s_i) or the bundle (r_i), and the cost of assembling the bundle (t_i).

The payoff (profit) functions for C1 and C2 are given by:

$\pi_1 = (r_1 - t_1) D_{B1} + (o_1 + s_1) D_{N11} + o_1 D_{N12} + s_1 D_{N21}$
$\pi_2 = (r_2 - t_2) D_{B2} + s_2 D_{N12} + o_2 D_{N21} + (o_2 + s_2) D_{N22}$

The non-cooperative equilibrium is characterized by the following conditions:

[6] As rightly pointed out for example in Liao and Taumann (2002), liner demand systems have some undesirable characteristics. A refinement of the analysis will be presented in a forthcoming paper.

$\partial\pi_1/\partial r_1 = D_{B1} + (r_1 - t_1)\, D'_{B1} + (o_1 + s_1)\, D'_{N11} + o_1\, D'_{N12} + s_1\, D'_{N21} = 0$
$\partial\pi_1/\partial o_1 = (r_1 - t_1)\, D'_{B1} + D_{N11} + (o_1 + s_1)\, D'_{N11} + D_{N12} + o_1\, D'_{N12} + s_1\, D'_{N21} = 0$
$\partial\pi_1/\partial s_1 = (r_1 - t_1)\, D'_{B1} + D_{N11} + (o_1 + s_1)\, D'_{N11} + o_1\, D'_{N12} + D_{N21} + s_1\, D'_{N21} = 0$

$\partial\pi_2/\partial r_2 = D_{B2} + (r_2 - t_2)\, D'_{B2} + (o_2 + s_2)\, D'_{N22} + o_2\, D'_{N21} + s_2\, D'_{N12} = 0$
$\partial\pi_2/\partial o_1 = (r_2 - t_2)\, D'_{B2} + D_{N22} + (o_2 + s_2)\, D'_{N22} + D_{N21} + o_2\, D'_{N21} + s_2\, D'_{N12} = 0$
$\partial\pi_2/\partial s_2 = (r_2 - t_2)\, D'_{B2} + D_{N22} + (o_2 + s_2)\, D'_{N22} + o_2\, D'_{N21} + D_{N12} + s_2\, D'_{N12} = 0$

This, simplified, leads to the following system of equations:

(1) $\partial\pi_1/\partial r_1 = 4c\, o_1 + 2c\, o_2 - 2b\, r_1 + c\, r_2 + 4c\, s_1 + 2c\, s_2 + a + b\, t_1 = 0$
(2) $\partial\pi_1/\partial o_1 = 4(c - b)\, o_1 + 4c\, o_2 + 4c\, r_1 + 2c\, r_2 + 2(3c - b)\, s_1 + (3c - b)\, s_2 + 2(a - t_S - c\, t_1) = 0$
(3) $\partial\pi_1/\partial s_1 = 2(3c - b)\, o_1 + (3c - b)\, o_2 + 4c\, r_1 + 2c\, r_2 + 4(c - b)\, s_1 + 4c\, s_2 + 2(a - t_S - c\, t_1) = 0$
(1') $\partial\pi_2/\partial r_2 = 2c\, o_1 + 4c\, o_2 + c\, r_1 - 2b\, r_2 + 2c\, s_1 + 4c\, s_2 + a + b\, t_2 = 0$
(2') $\partial\pi_2/\partial o_2 = 4c\, o_1 + 4(c - b)\, o_2 + 2c\, r_1 + 4c\, r_2 + (3c - b)\, s_1 + 2(3c - b)\, s_2 + 2a - 2c\, t_2 - 2\, t_S = 0$
(3') $\partial\pi_2/\partial s_2 = (3c - b)\, o_1 + 2(3c - b)\, o_2 + 2c\, r_1 + 4c\, r_2 + 4c\, s_1 + 4(c - b)\, s_2 + 2a - 2c\, t_2 - 2\, t_S = 0$

From the comparison of equations 2, 3, 2' and 3' we know that $o_1 = s_1$ and $o_2 = s_2$.
Solutions are $r_1, r_2, o_1, o_2, s_1, s_2$:

$$(4)\quad \begin{aligned}
r_1 &= \frac{7a}{(14b - 55c)} + \frac{\left[c(35b - 88c)\, t_2 - (352bc - 352c^2 - 70b^2)\, t_1\right]}{(14b - 55c)(10b - 11c)} - \frac{24c}{(14b - 55c)(b + c)}\, t_S \\
r_2 &= \frac{7a}{(14b - 55c)} + \frac{\left[c(35b - 88c)\, t_1 - (352bc - 352c^2 - 70b^2)\, t_2\right]}{(14b - 55c)(10b - 11c)} - \frac{24c}{(14b - 55c)(b + c)}\, t_S \\
o_1 = s_1 &= \frac{4a}{(14b - 55c)} + \frac{2c\left[3(4b - 11c)\, t_2 - 2(b - 11c)\, t_1\right]}{(14b - 55c)(10b - 11c)} - \frac{2(2b - c)}{(14b - 55c)(b + c)}\, t_S \\
o_2 = s_2 &= \frac{4a}{(14b - 55c)} + \frac{2c\left[3(4b - 11c)\, t_1 - 2(b - 11c)\, t_2\right]}{(14b - 55c)(10b - 11c)} - \frac{2(2b - c)}{(14b - 55c)(b + c)}\, t_S
\end{aligned}$$

From (4) we can work out the prices of the unbundled services observed by the shippers:

$$(5)\quad \begin{aligned}
o_1 + s_1 = 2o_1 = 2s_1 &= \frac{8a}{(14b - 55c)} + \frac{4c(3(4b - 11c)\, t_1 - 2(b - 11c)\, t_2)}{(14b - 55c)(10b - 11c)} - \frac{(2b - c)}{(14b - 55c)(b + c)}\, t_S \\
o_2 + s_2 = 2o_2 = 2s_2 &= \frac{8a}{(14b - 55c)} + \frac{4c(3(4b - 11c)\, t_2 - 2(b - 11c)\, t_1)}{(14b - 55c)(10b - 11c)} - \frac{(2b - c)}{(14b - 55c)(b + c)}\, t_S \\
o_1 + s_2 = o_2 + s_1 &= \frac{8a}{(14b - 55c)} + \frac{2c(t_1 + t_2)}{(14b - 55c)} - \frac{4(2b - c)}{(14b - 55c)(b + c)}\, t_S
\end{aligned}$$

The difference $(r_1 - r_2)$ is linear in $t_1 - t_2$ and is given by:

$$r_1 - r_2 = \frac{5b - 8c}{10b - 11c}(t_1 - t_2)$$

While the difference (o_1-o_2=s_1- s_2) is given by:

$$o_1 - o_2 = s_1 - s_2 = \frac{-2c}{10b - 11c}(t_1 - t_2)$$

These differences comply with the assumption of the model that if the companies diverge in their ability to provide the bundle, the difference in the bundle prices will also increase, while the difference in the price of the individual components will be proportionally reduced.

The relations between r_1, r_2, o_1+$o_{1,}$ o_1+s_2, o_2+ s_1 are given in the following formula, where the term G is provided in Table 2.

$$D = \frac{-a}{(14b - 55c)} + \frac{G}{(14b - 55c)(10b - 11c)} + \frac{4(2b - 7c)t_S}{(14b - 55c)(b + c)}$$

Table 2: G term in the differences between the bundle prices and the prices of the separate components

r_1	–	o_1+s_1	$\Rightarrow G =$	$70\,b^2\,t_1 + 44\,c^2\,(11\,t_1\text{-}4\,t_2) + bc\,(\text{-}400\,t_1\text{+}43\,t_2)$
		$o_1+s_2 = o_2+s_1$		$70\,b^2\,t_1 + 3\,bc\,(\text{-}124\,t_1 + 5\,t_2) + 22\,c^2\,(17\,t_1\,\text{-}3\,t_2)$
		o_2+s_2		$70\,b^2\,t_1 + 44\,c^2\,(6\,t_1\text{+}t_2) - bc\,(344\,t_1\text{+}13\,t_2)$
r_2		o_1+s_1		$bc\,(43\,t_1\text{-}400\,t_2) + 70\,b^2\,t_2\text{+}\,44\,c^2\,(\text{-}4\,t_1\text{+}11\,t_2)$
		$o_1+s_2 = o_2+s_1$		$3\,bc\,(5\,t_1\text{-}124\,t_2) + 70\,b^2\,t_2 + 22\,c^2(\text{-}3\,t_1\text{+}17\,t_2)$
		o_2+s_2		$bc\,(13\,t_1\text{+}344\,t_2) + 70\,b^2\,t_2 + 44\,c^2\,(t_1\text{+}6\,t_2)$

The differences between o_1+$o_{1,}$ o_1+s_2, o_2+ s_1 are given in Table 3.

Table 3: Differences between pairs of combined prices

o_1+s_1	–	o_1+s_1	=	0
		$o_1+s_2 = o_2+s_1$		$2\,c\,(t_2\text{-}t_1)/\,10\,b\text{-}11c$
		o_2+s_2		$4\,c\,(t_1\text{-}t_2)/\,10\,b\text{-}11c$
$o_1+s_2 = o_2+s_1$		o_1+s_1		$2\,c\,(t_1\text{-}t_2)/\,10\,b\text{-}11c$
		$o_1+s_2= o_2+s_1$		0
		o_2+s_2		$2\,c\,(t_2\text{-}t_1)/\,10\,b\text{-}11c$
o_2+s_2		o_1+s_1		$4\,c\,(t_2\text{-}t_1)/\,10\,b\text{-}11c$
		$o_1+s_2= o_2+s_1$		$2\,c\,(t_1\text{-}t_2)/\,10\,b\text{-}11c$
		o_2+s_2		0

The model allows for the specification of *t*, and we can see that the bundle price is affected by the difference in the transaction costs of the two carriers in assembling the bundle, allowing only the company with the lowest assembling cost to bundle.

Let's start with the simplest case where $t_1 = t_2 = t_S = 0$. In this case clearly $r_1 = r_2 = r$ and $o+s=o_1+s_1=o_1+s_2=o_2+s_1=o_2+s_2$. The non-cooperative equilibrium prices are given by:

$$r = \frac{7a}{14b - 55c}$$

$$o + s = \frac{8a}{14b - 55c}.$$

It is clear that the price of the bundle will be always lower than the price of the unbundled alternatives (o+s). This conclusion is also in line with economic theory, for, in a duopoly, the bundle will be the Nash equilibrium of the game if no transaction costs are taken into account.

Let's consider now the case where $t_1=t_2=t$ with $t > 0$, while t_S is still equal to 0. We know that clearly $r_1=r_2$, and $o_1+s_1=o_1+s_2=o_2+s_1=o_2+s_2=o+s$, so the consumer is indifferent between carrier 1 and carrier 2. In this case though, the price of the bundle is not necessarily the lowest. The introduction of transaction costs *t* affects the outcome of the game.

$$r = \frac{7a + (7b - 24c)t}{14b - 55c}$$

$$o + s = \frac{8a + 4ct}{14b - 55c}$$

As long as *t* is relatively small, the bundle will remain attractive. If *t* is greater than $\frac{a}{7(b - 4c)}$, then the price of the bundle will be higher than the price of the separate components and the equilibrium in the game will shift to the provision of separate components. It will here be more profitable for the shipper to buy the non bundled alternatives[7].

In general, as long as t_S is small relatively to *t*, the price of the bundle will remain above that of the sum of the individual components. In case *t* is also positive, the equilibrium prices are given by:

$$r = \frac{(b + c)(7a + (7b - 24c)t) - 24ct_S}{(14b - 55c)(b + c)}$$

$$o + s = \frac{4(b + c)(2a + ct) + 4(c - 2b)t_S}{(14b - 55c)(b + c)}$$

Specifically, as long as $t > \theta\, t_S$, where θ is the following quantity,

$$\theta = \frac{a}{7(b - 4c)} + \frac{(4(7c - 2b)}{7(14b - 55c)(b - 4c))}$$

[7] Note that we are assuming that $b \geq 5c$, then the quantity $a/7(b-4c)$ is always positive.

then the price of the bundle is greater than the sum of the prices of the individual components. Clearly if t_S is significantly greater than *t*, then the bundle will be always preferred.

We can extend this analysis to the case where the carriers incur different costs in assembling the bundle, so that $t_1 \neq t_2$, i.e. one of the two carriers is better at providing the bundle. We can assume that $t_1 < t_2$.

Let us start with the case where $t_1 < \theta\, t_S$. In this case, the bundle to be sold will be the one provided by carrier 1, at price

$$r_1 = \frac{(b+c)(7a + (7b - 24c)t_1) - 24\,c\,t_S}{(14\,b - 55\,c)(b+c)}$$

which is clearly lower than r_2 (the opposite will of course be the case when $t_2 < t_1$ and $t_2 < \theta\, t_S$)

If t_1 is greater than $\theta\, t_S$, i.e. $\theta\, t_S<t_1<t_2$, then the bundle will not be sold and $\min\{o_1+s_1, o_1+s_2, o_2+s_2\} = o_1+s_1= 2o_1 = 2s_1$. If on the contrary $t_1 > t_2$ and $t > \theta\, t_S$ then the equilibrium price will be $\min\{o_1+s_1, o_1+s_2, o_2+s_2\} = o_2+s_2= 2o_2 = 2s_2$. Finally the for the carriers to sell a component each in the unbundled alternative, it will have to be $\min\{o_1+s_1, o_1+s_2, o_2+s_2\} = o_2+s_1= o_1+s_2$, this implies that at the same time,

$$t_1 < \frac{2(12-5a)b + 11(a-6)}{2(2+5a)b - 11(4+a)c}\, t_2$$

$$t_1 < -\frac{2(2+5a)b - 11(4+a)c}{2(12-5a)b + 11(a-6)}\, t_2$$

These conditions clearly cannot hold, given that both t_1 and t_2 are both non-negative. This implies that if $t_1 \neq t_2$ then equilibrium exists only if the shipper consumes service 1 and service 2 of the same carrier or one of the bundles is provided.

Table 4 summarizes the cases just discussed.

Table 4: Transaction costs and equilibrium outcomes

Situation	Conditions	*Selection of the shipper*	*Lowest price*
A1	$\begin{cases} \theta\, t_S<t_1 \\ t_1<t_2 \end{cases}$	Separate components	$o_1 + s_1$
A2	$\begin{cases} \theta\, t_S<t_2 \\ t_2<t_1 \end{cases}$	Separate components	$o_2 + s_2$
B1	$\begin{cases} t_1 < \theta\, t_S \\ t_1 < t_2 \end{cases}$	Bundle provided by carrier 1	r_1
B2	$\begin{cases} t_2 < \theta\, t_S \\ t_2 < t_1 \end{cases}$	Bundle provided by carrier 2	r_2
C	$\begin{cases} t = t_1 = t_2 \\ t> \theta\, t_S \end{cases}$	Separate components	$o + s$
D	$\begin{cases} t = t_1 = t_2 \\ t< \theta\, t_S \end{cases}$	Bundle	$r = r_1 = r_2$

The model shows that the carriers in reality are competing on the bundle not only among themselves but also with their customer.

3.2 Results of the model

The theoretical model described above is an attempt to discuss the implications of bundling of separate activities that involve a certain cost of producing the bundle. Intuitively we would expect the transaction costs of the carrier to be lower than those of the shipper (t_S). In reality the model may apply to a situation where those demanding the separate services are the freight forwarders. For some of them t_S may actually be lower than the transaction costs of the carriers.

In real markets, then, the carrier who has the possibility to offer bundles is exposed to competition from two sides. On the one hand, he is forced to reduce his bundle price, for he is competing directly with other carriers. This pressure stems from the competitiveness of each carrier in assembling the bundle. On the other hand, the carrier faces competitive pressure generated from the demand side.

In previous papers it has been shown that mixed bundling is a dominant strategy in duopoly for both firms, even if its outcome is not the best possible (Prisoner Dilemma). In the situation outlined in our model we show that, in reality, differences in the ability to provide the bundle -wrt the ability of providing the bundle from the demand side, may justify the decision of a company not to provide bundles. If a carrier knows that compared to his competitors, or alternatively to his customers, the costs of providing bundles are too high (implying that the competitor will provide a cheaper bundle or the customer will be able to assemble the bundle cheaply herself) then the best strategy available will be not to provide bundles and focus only on the separate components.

In the specific case of the model used here, mixed bundling is a dominant strategy for carriers depending on the distribution of transaction costs. The analysis shows though that the equilibrium elasticity to a change in transaction costs of the carriers is much higher than that of a change in the transaction costs of the shipper.

3.3 Welfare effects

Welfare calculations are omitted in the paper, as the results are analogous to those obtained in the existing literature on bundling in oligopoly, albeit much more tedious. The addition of transaction costs does not add anything to the results obtained for example in the aforementioned article of Economides (1993) or Liao and Taumann (2000). For the purpose of our discussion it should be noticed that mixed bundling is socially beneficial as it lowers consumer prices and increases choice for consumers.

4 CONCLUDING REMARKS AND FURTHER RESEARCH TOPICS

4.1 Sum-up of the paper

The paper provides a contribution to understanding the decisions that may lead to the provision of bundles of ocean transportation and logistics services. The authors summarise the finding of a preliminary market research among shipping lines and analysed bundling specifically from an industry perspective, with the help of a game theoretic model.

Among the major conclusions of the paper is that bundling seems in practice to be motivated by: cost advantages; demand drivers; differentiation strategy; the possibility of obtaining higher margins by jointly offering ocean and hinterland transportation; the necessity to better control coordination costs with hinterland connections.

The model tries to complete the picture, evaluating the outcomes of competition in a duopoly where carriers compete on prices, can sell individual components or bundles and both carriers and the shipper incur a cost in assembling the bundle. Similarly to some of the models presented previously in the literature, our paper shows that price competition between carriers is increased due to the existence of the bundled product. Another interesting result is that the equilibrium elasticity is higher to changes in the shipper's ability of providing the bundles (t_S) than with respect to a change in the carriers' ability to assemble the bundle (t_1 and t_2).

4.2 Further research topics

The paper raises a variety of questions and research issues that need to be investigated further. Firstly, further research is needed on the specific issues of shippers' perception of bundles and bundle pricing strategies of carriers.

The model presented is far from complete and may require further testing. In addition one of its major limitations is the assumption on the demand form. The authors are in the process of modifying the underlying assumptions of the model and extend it to the case of oligopoly in industries characterised by increasing returns to scale. This represents an additional research direction that is interesting *per se*.

The understanding of bundling is of great interest to the industry as well, as it remains unclear whether the expansion of the scope of services of shipping lines from a terminal-to-terminal service to a warehouse-to-warehouse and finally a door-to-door service is the best path to follow for all companies. The question on what are the limits of vertical integration and what are the most profitable ways going forward is still pertinent. The industry understands the idea behind this but the implications and the effects that this may have on the profitability and the characteristics of the sector are still not fully understood and deserve further research.

Further research is also needed to understand the competitive advantage that is achieved by the expansion of the scope of the business of carriers. If bundles are priced at a lower rate than the stand alone services, this in the end will increase competition both in the shipping and in the logistics markets, and this is the outcome of our simplified model. In addition, from a purely practical perspective, if shipping is still profitable by itself, the question remains why a shipping line should move into a new business that requires specific competences and market knowledge.

Shipping lines are traditionally more concerned with control of costs and equipment, while the extended use of bundling requires a shift of business approach to a more customer oriented one. So maximising asset utilisation and at the same time increasing customer satisfaction seems the necessary approach for a successful implementation of bundling, but how to achieve this in practice is still not yet understood.

Further research areas include:

- The potential in terms of efficiency gains and higher revenues obtainable by shipping lines from the provision of logistics services and the ability to better coordinate the supply chain. From a purely operational point of view it seems it would be important to investigate what are the limits of vertical integration and what is the best model to follow in expanding the liner business to the logistics sector and if this is the right way to go;

- What is the market impact of bundling and what type of competitive advantage does it generate, both in terms of competition among shipping lines and between shipping lines and logistics providers;
- What are the benefits obtainable for shippers from the provision of bundles of ocean transportation and other logistics services, how can optimal bundles be identified, marketed and priced and how can policy constraints be removed in order to facilitate the creation of effective bundles.

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