

The Failure of Electronic Markets in the Air Cargo Industry: A Core Theory Explanation

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A b s t r a c t

In this study, we re-examine the failure of formation of electronic markets for the air cargo industry. Using an economic theory called Core Theory, we provide an alternate explanation. Core theory explains why: a) such a failure might have been anticipated and b) the failure to form an electronic market may in fact be beneficial for the industry as a whole.

Keywords: electronic market, core theory, empty core, air cargo industry

INTRODUCTION

It is argued that Internet and related electronic commerce (e-commerce) communication technologies (ICT, henceforth) allow firms to form unrestricted relationships with one another by substantially bringing down the transaction costs (Malone *et al.* 1987). In the extreme case, firms can substitute one to one or one to few relationships with many to many relationships, called Electronic Markets (EM). It is believed that EMs will intensify competition in many industries. It is also believed that more competition brought about by ICT can only lead to beneficial outcomes, at least for consumers (buyers) (Bakos 1991).

In this paper, we use core theory to study the formation of electronic markets. Core theory suggests that, under some conditions, the ability of ICT to form unrestricted relationships, in fact makes everyone in the market worse off. We use core theory to re-examine the failure of electronic markets to evolve in the air cargo industry.

This paper is organized as follows. The next section provides a brief introduction to the concept of the core and its applications. This is followed by a description of two case studies in the air cargo markets and provides an alternative explanation as to why an electronic market did not

emerge. The final section provides a summary of the main points of the paper.

BASIC CONCEPTS AND DEFINITIONS OF CORE THEORY

Core theory concepts are closely related to coalitional games theory (Osborne and Rubinstein 1994). In this section we provide a brief description with an example.

1. There is a group of n individuals (or firms) in a market; some of whom are buyers and others are sellers. They can all trade with each other in a single market, or in sub markets, or may decide not to trade at all.
2. The buyers and sellers can measure the *gains from trade*. For the buyer it is the maximum amount the buyer is willing to pay for the quantities purchased less the amount actually paid. For the seller, it is the amount actually received less the amount the seller would have been willing to accept.
3. The buyers and sellers can contract with each other and form groups called *coalitions* to maximize their gains from trade. Such a process of contracting can be either unrestricted or restricted depending on the nature of the

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industry. What the members of the coalitions get is called an *allocation*.

4. An allocation is *dominated* if some members of the coalitions can do better for themselves by leaving one coalition and joining another coalition. If the members cannot do better by leaving their existing coalition then the allocation is un-dominated.
5. In a market with N traders, there are a total of $2^N - 1$ possible coalitions. Each trader (buyer or seller) can choose to be a member of a coalition (it is important to point out that deciding not to trade or being alone is also a possible coalition).

The approach is to consider all possible coalitions of traders, recognizing that any coalition of traders will only participate in the market as a whole if and only if they can do at least as well as they could in another coalition. In the decision of a member as to which coalition to join, the maximum payoff available in all other coalitions provides the lower bound.

6. If we have a coalition with all the buyers and sellers in it (called the *grand coalition*) then it means that the each buyer and seller feels that this is the coalition that would maximize their gains otherwise they would not be in the coalition.

The grand coalition is analogous to a single electronic market in which all traders choose to participate. Such words as exchanges, virtual communities of interest, junction boxes, hub and spoke networks, butterfly-patterns of relationship etc may all be descriptions of a grand coalition.

7. The grand coalition should therefore offer to each buyer and seller at least as much as they could get in any other coalition they can form ie, it should be an *un-dominated allocation*. The allocation from each possible coalition therefore imposes a lower bound on the payoff for each member, which must be satisfied for the grand coalition to exist.
8. If there exists no other coalition, which can make at least one person better off without making another person worse off, then economists call such a situation '*Pareto Optimum*'. An allocation is an *efficient* allocation if it is a Pareto optimal allocation.
9. If such a 'grand coalition' exists, then we say that a core exists. The core therefore consists of all the un-dominated allocations. If a grand coalition is the core, then members will join to form a single electronic market, rather than forming sub-markets or groups.
10. Sometimes, it is possible that there may not be any allocation in the core. This is called an *empty core*. The empty core implies that there is no *stable coalition*. Whatever coalition can be formed, there is always an incentive for some subgroup to benefit by leaving it.

The notion of an empty core is an important one. When the core is empty, a market may not emerge because a subgroup of traders may feel that they are better off in

a sub-market. If an industry has an empty core, then a 'competitive equilibrium' does not exist. This condition is characterized by Telser (1987, 1994) as one of 'chaos' ie, one where competition is excessive, and both buyers and sellers lose.

Much of MIS theoretical work on the impact of ICT is based on standard notions of competition. Typically, it is argued that, by lowering the transaction costs involved, ICT enables markets to become more efficient. Core theory makes this prediction conditional on the presence of a core. Specifically, core theory suggests that, when an industry has an empty core, ICT may actually lead to 'chaotic' conditions by encouraging competition. However, if a competitive core exists in the market, ICT may actually make the market more efficient.

Symptoms and Conditions for Empty Core

It is important to be able to identify whether or not an industry has an empty core, before trying to predict the impact of ICT on the industry. Telser (1987) characterizes chaos, a symptom of empty core, as 'when price cutting is extreme, most firms in the industry are losing money, and yet it is plain that buyers want the product and are willing to pay higher prices than those currently prevailing'. The Airline industry in the 1980s is a perfect example.

A literature review provides several conditions, which may point to an empty core for a given industry. For industries with U-shaped average costs and increasing marginal costs (called Viner industries), the core may generally be empty. Sjostrom (1989) suggests that large, avoidable costs could lead to an empty core. Pirrong (1992) suggests large avoidable costs as well as finely divisible demand as possible causes for an empty core. Specifically, he states 'core is frequently empty when demand is finely divisible but production costs are not'. Explicit modelling may usually be necessary to identify whether the core is empty for a certain industry.

As an illustration, consider two segments of the shipping industry, which will be used to describe avoidable costs and finely divisible demand. In the ocean liner segment of the industry, vessels typically carry small 'packets' of cargo such as mails and valuable commodities. This is an example of finely divisible demand. Ocean liners also have large, avoidable costs ie, a vessel can completely avoid the cost by not sailing at all. In contrast to the ocean liner segment, the bulk-shipping segment carries indivisible demand, even though it also has large avoidable costs. Bulk shipping industry, therefore satisfies one but not both conditions for a core to be empty.

Consistent with Core Theory, Pirrong finds that a variety of non-competitive practices are prevalent in the ocean liner industry - including collusion in terms of co-operative pricing, cargo tonnage quotas, revenue and profit pools and consortia. Both Pirrong and Sjostrom, who also studied the ocean liner segment, find evidence to suggest that the

longevity of collusion can be attributed to the empty core for this industry. Pirrong finds that, in contrast, the bulk shipping industry, which has indivisible demand, does operate competitively.

Resolving Empty Core

A natural question is: What should be done when the core is empty? An empty core suggests that one or more members have an incentive to deviate from a grand coalition. Therefore, imposing restrictions that prevent formation of some specific coalitions can actually lead to an equilibrium. Core theory suggests that restrictions on freedom of contracting may thus be beneficial to the industry as a whole. Such an equilibrium may be inefficient, but is an improvement over the chaotic situation that will persist if core is left empty.

The next question is: Who imposes such restrictions on the formation of coalitions? Government may be one possible choice. Most often, however, the members of an industry voluntarily restrict their own choices by mutual consent. In the ocean liner industry for example, cartels (known as shipping conferences in the industry) have existed for a very long time. Such cartels have existed despite free entry into the industry and Sjostrom suggests, 'The extensiveness of their use, their longevity, and their apparent customer support suggest that they may be efficient arrangements rather than merely devices for extracting monopoly rents'. Other mechanisms, such as formation of a monopoly, vertical integration, long-term contracts, price discrimination and deferred rebates may also serve to restrict contracting among members and create a core.

THE AIR CARGO CASE

Damsgaard (1998) provides an excellent description of the functioning of the air cargo market. Briefly, the air cargo market has several stakeholders, such as shippers, freight forwarders, airports and airlines, with each performing one or more complementary functions. Efficient co-operation requires a balancing of interests of all the parties in this industry.

Some characteristics of this industry point towards an empty core. Since cargo is flown in containers or 'pallets', for efficiency reasons, the pallets are loaded with a suitable mix of high volume-low weight and low volume-high weight cargo. Freight forwarders do this. In core theory terms, the demand for space is *finely divisible*. On the supply side, we have *large, avoidable costs*. After acquiring the aircraft, each time the aircraft flies, the airline may incur costs such as fuel cost, crew costs, costs of paperwork and maintenance required by regulator etc, regardless of whether it carries any cargo or not. This is what we call avoidable cost, because an airline can avoid this cost by

not flying at all. This is different from the initial cost of acquiring the aircraft, which is a one-time cost. Finally variable cost deals with costs relating to loading/unloading cargo, packing containers etc. These costs become relevant only after the airline decides to fly. Overall, the cost and demand conditions that point to an empty core, namely, finely divisible demand and large, avoidable costs are intrinsic to this industry.

Even in the absence of a true electronic market, some non-competitive practices are prevalent in the industry. Demand for cargo services is highly seasonal, which means that many members face over and under capacity during the year and this exacerbates the problem. *Deferred rebates* are offered by airlines under which they guarantee to provide space in the peak season if freight forwarders promise to book a certain amount of space in the low season. Deferred rebates should be seen as a restriction on contracting, specifically spot markets, and are necessary if core is empty.

Christiaanse and Daamsgard (2000) investigate two initiatives in the air cargo industry towards creating electronic markets: the Traxon initiative, which took place in the Hong Kong market and the Reuters initiative in the Amsterdam market. The Traxon initiative was launched by major airlines and created a system that was deliberately limited in supporting operations. Interestingly, the system 'does not carry any information about prices' and 'leaves the market opaque for outsiders and preserves the roles and power balance between the airlines and the freight forwarders'. The Reuters initiative was launched by a third-party firm with the intent to create a spot market for air cargo space. The Reuters initiative failed when the potential participants did not find it in their interest to join the initiative.

Christiaanse and Daamsgard provide an insightful analysis of the two initiatives. Specifically, they note that 'the market transparencies are in the interests of some of the parties in this market place'. They also explicitly distinguish between the market for air cargo space, consisting of airlines and the market for air cargo service consisting of freight forwarders and other integrators. They suggest that 'Complex, interdependent institutional and technical choices by the initiators of the system' can explain the two initiatives.

Core theory arguments would provide a succinct explanation for the two initiatives. To the extent that the airlines face large, unavoidable costs and freight forwarders/integrators have finely divisible demand, any market which allows unrestricted contracting between the two parties will have an empty core. The Reuters initiative failed because it tried to use technology to create, essentially, a market in which unrestricted trade can take place. The industry members might have intuitively realized that, in the long run, all of them would be worse off due to the excessive competitive chaos, which such a system could create.

The Traxon initiative was launched in the Hong Kong market by four international airlines and was deliberately

limited in the services it provided. The initiative subsequently specialized for each local market, with a leading local air carrier taking control of the market. In Hong Kong, for example, Cathay Pacific was in charge of the local rollout of the system. Christiaanse and Daamsgard (2000) summarize the Traxon initiative as follows: 'A number of airlines gave up their defensive actions and they have now joined [Traxon] which essentially gives Traxon a de-facto monopoly in the air freight community in the Hong Kong hub.' In core theory terms, the Traxon initiative worked because it evolved into a 'de-facto monopoly' ie, a restriction on free trading, and therefore resolves the empty core.

DISCUSSION AND CONCLUSIONS

The air cargo industry, given its cost and demand conditions, has a high probability of having an empty core. This would suggest that a 'market', in the sense of all buyers of space (freight forwarders etc) and sellers of space (airlines etc) engaging in unrestricted trade with one another, is not in the interest of everyone. Core theory helps point towards the root of the problem in air cargo industry – *it is the cost and demand conditions prevailing in the industry that cause an empty core*. With an empty core, some forms of restrictions on free trade are required for equilibrium to exist. Core theory explains why: a) both Reuters and Traxon did not generate competitive outcomes for air cargo markets and b) why, even though Traxon is a

monopoly, it is still efficient in the sense that the alternative could have been 'chaotic competition'.

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