Leniency and Post-Cartel Market Conduct: Preliminary Evidence from Parcel Tanker Shipping[1]

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Cartel enforcement continues to be a significant focus of competition authorities globally. In many jurisdictions involvement in a cartel carries with it the possibility of a jail sentence for individuals, in addition to fines for the companies involved. In October 1993, the US Department of Justice (DoJ) revised its original 1978 leniency program. The current program allows a company and its employees to gain immunity from prosecution if they are the first to alert the DoJ to the presence of the cartel and take 'prompt and effective action to terminate [the firm's] part in the anticompetitive activity being reported upon discovery of the activity'. This program has subsequently been adopted in several other jurisdictions.[3]

A significant body of research has arisen seeking to understand the incentives created by leniency and the optimal structure of these programs (see, for instance, Aubert et al. (2006), Chang and Harrington (2009), Chen and Harington (2005), Harrington (2008), Motta and Polo (2003) and the survey by Spagnolo (2008)). At the same time, a stream of recent empirical work on cartel activity has examined specific cartels leveraging high quality data on the internal structure of the cartel in an effort to gain an empirical understanding of how cartels' structure interacts with their impact on markets. For instance, in Asker (2009) a bidding cartel that operated in the auctions for collectable postage stamps was examined. This cartel used a knockout auction to coordinate ring activity, the design of which reflected the cartel design proposed by Graham, Marshall and Richard (1990), which considered a bidding cartel that used a mechanism implementing the Shapley value to arrive at a division of surplus within the cartel. An interesting implication of this cartel structure is that bidders in the auction who bid against the cartel appear to suffer damages of at least the same magnitude as the sellers of the stamps for sale. The detailed record of bidding in the knockout auction, sidepayments, and purchase prices at auction allows the quantification of these effects. Other recent studies of cartels that leverage similarly detailed data on the internal working of cartels include Genesove and Mullin (2001) and Roller and Steen (2006).

This paper provides preliminary observations from data that speak to both of these streams of the cartel literature. The data is drawn from one particular case, involving a cartel in the international maritime shipping of chemicals. This case is interesting in that there was a lag of nine months between one of the firms in the cartel discovering (and stopping) the illegal activity and applying for leniency. This provides a provocative setting in which to consider

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[3] Jurisdictions with similar programs include: the European Community (including most member states), Canada, Japan, South Africa and Brazil.

how the presence of a cartel affects market conduct following its dissolution and, in turn, how this might be affected by the obligations imposed on firms who seek leniency.

The paper proceeds by describing the cartel, then describing the data set used to examine post-cartel conduct. The patterns in the data are consistent with cartel distortions persisting in the post-cartel period due to the presence of long-term contracts. The corollary to this observation is that, in addition to terminating involvement in cartel activity, some social benefit may accrue from requiring firms seeking leniency to mitigate the harm caused by cartel actions.

The cartel and the parcel tanker industry

The cartel considered in this paper occurred in the parcel tanker industry. Parcel tankers are ships that transport a variety of chemical and liquid products. They are distinguished from commodity or bulk chemical tankers in that they have many holds on the one ship and carry many different types of chemicals or liquids at the same time. For instance, among the 59 ships in the deep-sea fleet operated by Odfjell Tankers (one of the conspirators) in 2002, ships had between 22 and 52 separate holds. Indeed, the Odfjell 2002 annual report claims that:

> 'Odfjell carries over 500 different generic products every year, ranging from various organic chemicals such as alcohols, acrylates, aromatics as well as fuel oil, lubricating oils, vegetable oils and inorganic chemicals like sulphuric and phosphoric acids and caustic soda.' [at p. 47]

Transported chemicals can require special handling conditions, including stainless steel tanks, and controlled temperatures and pressures.[4] Individual loads shipped via parcel tankers typically range from 150 tons to 40 000 tons. Ships collect and deliver chemicals at specialized terminals, some of which are owned by the same company as owns the ship.

Contracting for transportation services occurs in one of two ways: Companies seeking to ship chemicals can either buy transportation on a specific ship in a spot market or can enter into a contract of affreightment, which is an agreement to transport set quantities of cargo during a given time period, where the shipping company has discretion over the ships to be used to fulfill the contract. These contracts typically last for a year.[5]

Companies seeking to ship chemicals via contract of affreightment invite shipping companies to submit bids for the service. Subject to satisfying various quality measures, the lowest cost bidder wins.

Defining the scope of competitors in the parcel tanker industry is difficult. At the broadest level parcel tankers compete against all chemical and combined oil and chemical tankers, as well as providers of tank containers (the analog to the cargo container, for transporting liquid loads of less than 150 tons). By this definition the global market consists of just under 2000 ships. A more conservative measure is offered in the 2002 Annual Report of Stolt-Nielsen (another conspirator) who report that: 'the fleet of [Stolt-Nielsen]'s core

[4] The ships used to transport these chemicals on deep sea routes range from 10,000 to 45,000 deadweight tons (dwt) and average 170m long and 25m wide. Deadweight tons measure of the weight carrying capacity of the ship. The total dwt is the weight of the cargo the ship can carry plus fuel, fresh water, spare parts and similar operational needs. By way of comparison, the largest crude oil carriers are around 500,000 dwt, 420m long and 60m wide.

[5] See Stolt-Nielsen Annual Report 2002, at p. 20.

competitors, which includes a total of 16 operators including [Stolt-Nielsen], is composed of 327 ships totaling 8.6 million dwt."[6]

In the late 1990's, through 2001 and 2002, the two largest parcel tanker operators were Stolt-Nielsen and Odfjell Tankers ('Stolt' and Odfjell hereafter). A third company, Jo Tankers, was a smaller, but active market participant. In August 1998 executives from Stolt and Odfjell met to establish a cartel to rig the bidding for contracts of affreightment. This was done by dividing existing clients between the two companies according to the various trade routes that the companies operated. This market division agreement was recorded in a set of lists. Each company was able to bid for the affreightment contract of the companies allocated to them, on the routes indicated, without competition from the other. For instance, in this first set of lists Stolt was allocated Dupont on US Gulf to Far East routes. This meant that Stolt could bid an Dupont contracts to ship chemicals from US Gulf ports to Far East ports without competitive pressure from Odfjell. In practice this would work by Odfjell not entering a bid. In the event that they were specifically asked to bid, Odfjell would contact Stolt first to make sure that their bid would not win. The customer lists were revised in 2000 and again in March through May of 2001.[7]

Some time shortly after the 1998 agreement between Odfjell and Stolt, Jo Tankers began participating in the cartel, although on a less formal basis, without explicit customer lists being drawn up.

Importantly, the bid rigging was only for contracts of affreightment and only for existing customers. New customers' contracts were competitively bid. Similarly, regional trade, on routes not covered by the customer lists, was competitively bid.

In April 2001, the chairman of the tanker division of Stolt asked an employee to evaluate the profitability of the cartel agreement of Odfjell. The report, concluding that the agreement was profitable, was discovered by the Stolt general counsel in mid January, 2002. After reading the report the general counsel reported his concerns about a potential antitrust violation to the chairman of the Stolt tanker division. On March 1st the general counsel resigned and filed a constructive-discharge lawsuit. In a subsequent revision, on November 1, 2002, of the claims made in pursuit of this lawsuit the general counsel alleged 'ongoing criminal conduct in violation of antitrust laws'.

In February 2002, Stolt terminated their collusive conduct, rewrote their antitrust compliance guidelines, and engaged in a series on internal seminars that communicated the importance of antitrust compliance. This compliance activity occurred through April 2002. The effectiveness of this activity was disputed by the US Department of Justice in *US v Stolt-Nielsen et al*; however, the judge in that matter found that 'The Antitrust Compliance Policy was effective in transforming Stolt-Nielsen's corporate culture and reforming its business practices. It drastically altered the nature of Stolt-Nielsen's contacts with its competitors. While competitors continued to initiate collusive contacts, Stolt-Nielsen employees repeatedly refused to engage in anticompetitive discussions with them, and reported any

[6] Ibid, at p. 17.

[7] This account of the cartel's conduct is taken from the transcript of the criminal trial *US* v. *Stolt-Nielsen et al*, in the US District Court for the Eastern District of Pennsylvania (docket #06-cr-466), the US pleadings in that case (where facts were undisputed), and the finding of fact in the judgment of Kauffman J., dated November 6, 2007.

such contacts to their superiors in compliance with the Antitrust Compliance Policy.[8] In March 2002, Stolt executives met with Odfjell and Jo Tanker executives to inform them of their exit from the cartel.

Importantly, there is no evidence that clients of any of Stolt, Odfjell or Jo Tanker were aware of the cartel at the time that Stolt ceased to participate in the cartel. Indeed, the first evidence of clients' being aware of the cartel followed an approach by a class-action attorney to a Stolt client, prompted by the revised claims in the dismissal case initiated by the Stolt general counsel on November 1, 2002.

On November 22 Stolt external counsel contacted the US Department of Justice regarding the alleged cartel activity.[9] A 'marker' was granted on December 17, 2002.[10] On January 15, 2003 the US Department of Justice granted leniency to Stolt in relation to the cartel activity. As a result of the subsequent investigation, Odfjell was fined USD42.5 million, two Odfjell executives were fined and served jail time, Jo Tankers was fined USD19.5 million and one Jo Tankers executive was fined and served jail time. Fines were also imposed by the European Commission in a parallel investigation.

Data

To investigate how the dissolution of the cartel affected subsequent market conduct, data were obtained from Lloyds Maritime Intelligence Unit (LMIU). LMIU maintain a proprietary database of all ships in commercial use in the world (any ship eligible for an International Maritime Organization registration number). These data cover the ownership of each ship, ship characteristics (size, capacity, flag, etc.), and a detailed record of the ships' movements. LMIU maintains a network of agents that record the date of arrival and departure of all vessels entering and exiting over 3000 ports around the world.

Data on all tanker movements in 2001 and 2002, together with ownership data and ships characteristics, were obtained from LMIU. The tankers in this data range from Very Large Crude Carriers (VLCC's) to chemical tankers to the more obscure specialist fruit juice and wine tankers. 528,717 movements of 6,367 vessels in and out of 2,926 ports are described in these data.

To extract the Odfjell and Stolt fleets from these data, fleet lists in Annual Reports and SEC 20F filings were used. Consultation of these sources is necessary since chartering is a common practice in this industry and using ownership data is not enough to extract complete fleet lists. Jo Tankers, being a private company, does not have to make these disclosures and hence the analysis focuses on the interaction between Odfjell and Stolt, who are, in any case, considerably larger operators. In 2002, including chartered ships, the Stolt fleet numbered 133 ships and the Odfjell fleet numbered 87 ships. By contrast, in 2009 Jo Tankers operated around 40 vessels.[11]

[8] *US* v. *Stolt-Nielsen et al*, in the US District Court for the Eastern District of Pennsylvania (docket #06-cr-466). Memorandum and order dated November 6, 2007, at p. 3.
[9] This coincided with a Wall Street Journal article about the allegations made by the Stolt ex-general counsel.
[10] A "marker" gives an applicant first place in line for leniency.
[11] The Jo Tanker fleet is described on the company website.

Data on the customer allocations under the cartel agreement were obtained from the customer lists submitted as evidence in court.[12]

Preliminary observations

Examination of the data begins by looking at worldwide shipping patterns during the cartel and then examines specific routes that are of particular interest given the structure of the cartel agreement.

FIGURE 1 HERE

Figure 1 shows the (5-day moving average) number of vessels departing a port on each day in 2001 and 2002. A departure involves a ship leaving a port for any destination. The data are represented as a 5-day moving average to extract the trends over weeks (the data are hard to understand visually without this smoothing). The top panel shows departures by Stolt vessels. The number of departures oscillates around 16 (smoothed) departures per day. The middle panel shows the Odfjell departures which oscillate around 10 (smoothed) departures per day. The grey shaded region in all figures indicates the period during which Stolt was implementing a new compliance policy and extracting itself from the cartel.

By comparison, the bottom panel plots the same 5-day moving average for all vessels (excluding the Odfjell and Stolt ships) classified by LMIU as either a chemical or a combined chemical and oil tanker. The Stolt and Odfjell fleets include both classes of tanker. There are between 1773 and 1781 of these other tankers, depending on the date. The bottom panel of figure 1 shows the number of (smoothed) departures, which fluctuate around 300 per day. The pattern is consistent with some seasonality, with shipping activity declining in late December and early January. This is less apparent in the end of 2002, possibly reflecting the movement of the global economy out of a slowdown in 2001/2002.

Figure 1 is striking in that there appears to be little evidence of a change in the intensity of activity of Odfjell and Stolt in the period before and after the cartel activity. For both companies, departures are remarkably constant.

Table 1 examines shipping activity of Stolt and Odfjell by region. LMIU categorizes ports by region, resulting in 25 regional classifications. For each of these regions the number of departures from a port in that region (regardless of destination) is recorded for the first and second half of each of 2001 and 2002, for each of Stolt and Odfjell. The most active port in each region is also recorded.[13]

TABLE 1 HERE

The first half of 2002 was when Stolt exited the cartel. Since this took some time to implement, comparing activity in the second halves of 2001 and 2002 gives an appropriate

[12] *US* v. *Stolt-Nielsen et al*, in the US District Court for the Eastern District of Pennsylvania (docket #06-cr-466). Exhibits GX-37 through GX-42.

[13] Activity is measured by the number of times that a Stolt or Odfjell ship departs that port.

indication of the impact of the cartel's dissolution on shipping activity by region. Of particular interest are changes in shipping activity that lie outside the usual change in shipping activity from one period to the next. To obtain a measure of normal variation, the proportional change in shipping activity was computed for both companies between the first and second halves of 2001, in each region. The average of the absolute value of this change, across regions is 33%. Any proportional change larger than this in absolute value is termed a 'large' change.

Setting aside regions with low shipping volumes (less than 25 departures in every period), there are eight regions in which large changes occurred: Odfjell experienced large increases in regions 2 and 24 and a large decrease in region 6; while Stolt experienced a large increase in region 20 and large decreases in regions 5, 10, and 13. It is notable that none of these changes in activity suggest that the market share of one firm was being increased at the expense of the other. This suggests that fluctuations were due to demand changes, changes in competition by other competitors, or some other factor.

The preceding analysis gives an overview of shipping activity at a global and regional level. The results are consistent with the dissolution of the cartel having little impact on shipping activity by Stolt and Odfjell. Ideally, these aggregated measures should be followed by more detailed market-level analysis. Given that the cartel operated by defining markets (shipping routes) and dividing clients seeking affreightment contracts on these routes, the dissolution of the cartel may have affected the pattern of activity on specific routes in ways that may not appear in aggregated measures.

The structure of the cartel agreement between Stolt and Odfjell allows more detailed analysis to be conducted on specific routes. When Stolt and Odfjell split markets occasionally the client divisions were very unequal. Three routes are particularly striking in this regard: Far East to South America (exclusively served by Stolt); Middle East to the Far East (exclusively served by Odfjell); and the US Gulf to the Mediterranean (exclusively served by Stolt);. On each of these routes, under the cartel agreement, either Stolt or Odfjell were allocated clients while the other firm had none. The extreme imbalance in client allocations under the cartel agreement suggests that these would be natural markets in which to see readjustments (either entry or increased activity) following the cartel's dissolution. The Far East to South America route does not carry enough traffic to support any conclusions.[14] Hence, attention is directed to the remaining two routes.

Figure 2 shows voyages from US Gulf ports to Mediterranean ports. US Gulf ports are defined as region 23 (as per table 1) and Mediterranean ports are defined as ports in region 20.[15] The vertical axis plots the deadweight tonnage departing each day. On this route, under the cartel agreement, Stolt was assigned clients for affreightment contracts and Odfjell was assigned none. It is striking that Odfjell has no shipping activity on this route, either before or after the cartel's dissolution. This is despite having an active presence at both US Gulf

[14] Defining the Far East as regions 12, 7 and 19 of table 1 and South America as regions 16 and 17, Stolt makes 3 voyages on this route in 2001 and 2002, Odfjell makes 6 and all other chemical and combined chemical and oil tankers make 26.

[15] Occasionally a ship will depart a US Gulf port (say, New Orleans) and stop for a day at a port such as Cadiz en route. Since this may be to take on fuel or shelter from weather, voyages with one short stop en route, that are no slower than direct voyages, are counted in this set. Similarly considerations are taken into account in evaluating Middle East to Far East routes.

and Mediterranean ports (see table 1). The bottom panel of figure 2, which plots the activity of other chemical tankers, indicates that other firms were also servicing this route.

FIGURE 2 HERE

The fact that Odfjell has no activity on this route is doubly striking when it is recalled that the cartel agreement only covered bidding for contracts of affreightment, which typically last one year. Activity in the spot market for chemical shipping was not prohibited by the agreement. Indeed in the the 2002 Annual Report Odfjell claims that 55% of shipping was covered by a contract of affreightment, leaving 45% for the spot market.[16] Nonetheless, Odfjell was not active in the US Gulf to Mediterranean market during 2001 or 2002.

FIGURE 3 HERE

Figure 3 shows voyages from the Middle East (regions 1 and 15) to the Far East (regions 7, 12 and 19). Here Odfjell was allocated clients while Stolt was allocated none. The pattern in the data, in which Stolt has a consistently lower activity level, is consistent with this allocation. Although less extreme than figure 2, there is no indication in figure 3 of activity changing after the dissolution of the cartel.[17]

Implications

The patterns in the data outlined above are consistent with the dissolution of the cartel having little impact on market conduct. Other data may be available, which may either support or reject this working hypothesis. For instance, the US Census keeps data on exports gathered from customs forms, which are sufficiently detailed so as to allow shipments, shipper and ship to be matched.[18] This would allow the shipping activity of the individual clients mentioned in the cartel agreement to be tracked, and hence the distortion, if any, caused by the cartel to be viewed at a more granular level on routes originating in the US.[19] A related empirical difficulty is raised by Harrington (2004), who considers the possibility that firms manipulate conduct post-cartel to minimize damages arises from subsequent litigation. This disturbing identification problem confronts most empirical studies of cartel damages.

With these caveats in mind, and given that the data at hand suggests little immediate impact on market conduct from the dissolution of the cartel, this section considers why cartel-like

[16] Similarly, in their 2002 Annual Report Stolt claims that in 2002 67% of all tanker revenue was collected under a contract of affreightment. In 2001 the figure was 54%.
[17] The lack of Odfjell activity on this route in January 2001 is odd and, other than being consistent with a drop in activity industry wide, has no easy explanation.
[18] Given that these customs forms are in the public record it is unclear whether normal census confidentiality limits apply.
[19] In line with this cautionary note, Stolt reports, in the 2002 Annual Report, that ship capacity utilization rates increased from 68% in 2001 to 75.8% in 2002. However, this is attributed to an investment in new logistics software.

activity may persist post-cartel and the implications that this persistence has for the enforcement of anti-cartel laws.[20]

At least three possible reasons for the persistence of cartel-like activity are suggested by the parcel shipping case (and doubtless others exist, especially in other contexts). Each raises the concern that a cartel may yield benefits to cartel members even after it has been dissolved, albeit through different channels.

First, the affreightment contracts are long term agreements lasting, typically, one year. This means that, should these contracts persist, inefficiency generated by the cartel may continue until the contract terminates.[21] It is worth being clear about the source of distortion arising from these contracts. The affreightment contract is for the shipment of a fixed quantity over a set period of time in exchange for a lump sum payment. This means that the cost is sunk once the contract is entered into. Hence, after the contract comes into effect, the marginal cost of shipping units up to the contracted quantity is zero. Beyond that quantity, the marginal cost is set by the spot rate. A distortion will arise when the expectation of a high cartel-induced affreightment price results in the client contracting for the shipment of a quantity lower than would otherwise be the case. This raises the marginal cost of shipping units in the range between the quantity contracted under cartel conditions and the quantity contracted in the absence of the cartel. This distortion may be further exacerbated if firms plan future production before the affreightment cost is sunk or if risk associated with volatility in the spot price of shipping imposes additional costs. This source of distortion can be mitigated post-cartel if the affected contracts can be renegotiated. For renegotiation to be initiated, affected parties must be made aware of the cartel's existence.

In the parcel tanker case, Stolt benefited from leniency granted by the Department of Justice. A condition of leniency is that the party receiving leniency takes 'prompt and effective action to terminate its part in the anticompetitive activity being reported upon discovery of the activity'. In the Stolt case the judge noted that the range of conduct required to be undertaken to fulfill this obligation is unclear. However, it is clear that making the anticompetitive conduct public knowledge and unraveling existing, affected contracts is not required. While Stolt informed Odfjell and Jo Tankers of their withdrawal from the cartel in March 2002, it appears that clients did not learn of the cartel until it became public in November 2002.

The obligation to cease collusive conduct, coupled with a lack of any obligation to mitigate any ongoing harm, creates a lacuna in anti-cartel policy and in the administration of the leniency program in particular. If a firm such as Stolt stops colluding on bidding for new contracts, but retains all existing contracts, then the distortive harm from the collusive activity persists. It is also worth noting that competitors continued to attempt to collude with Stolt after Stolt withdrew from the cartel. If this resulted in less competition in bidding for new contracts in the post-cartel period, these contracts may also be affected. The extent to which this harm persists must depend, at least to some extent, on whether clients know of

[20] If demand for shipping were very inelastic the cartel may still have been able to raise prices dramatically without distorting quantity in any significant way. Thus, to the extent that cartel policy reflects a distributive agenda, as well as the promotion of economic efficiency, enforcement may be warranted solely on those distributive grounds.

[21] The rule in Kelly v. Kosuga, 358 U.S. 516, 520-521 (1959) suggests that these affected contracts are not enforceable, although to be contested in time to avoid distortions a necessary condition is that the affected party must be aware of the cartel.

the cartel and the extent to which the relevant law allows the existing contracts to be rescinded and renegotiated.[22,23] The effect of merely informing the market as to the existence of previous cartel activity is dramatically illustrated in Christie and Schultz (1995), who show that publicity regarding implicit collusion among NASDAQ market makers caused spreads to halve overnight.

Requiring immediate disclosure to affected parties, once a firm has discovered collusive conduct, amounts to publicizing the conduct before leniency is given. This suggests that such a duty would, at the very least, increase the cost of applying for leniency by increasing the probability of private antitrust suits.[24,25]

A more palatable alternative may be to create incentives to get parties to seek leniency as soon as possible after conduct is discovered. This would allow leniency to be granted together with a condition that long-term contracts be renegotiated in a timely fashion. Incentives for the quick application for leniency may be created if the extent of leniency were related, in some fashion, to the delay in applying for leniency.

Any adjustment to the leniency program is not without cost. The harder, more complicated, or more costly it is to meet the requirements of leniency, the fewer firms may seek it. While, as a matter of theory, the effects of leniency provisions on cartel formation are somewhat uncertain (see, for instance, Chang and Harrington (2009)), there seems to be some consensus that some form of leniency is socially beneficial, a conclusion supported in recent empirical work (Miller 2009). To this end, changing the terms of leniency involves evaluating delicate trade-offs between deterrence, detection, prosecutorial success and harm mitigation.

Two other possible reasons for the lack of change in market conduct following the Stolt-Odfjell cartel dissolution suggest themselves.

First, investment may lead to capacity constraints, which in turn retard adjustment to the new equilibrium. The parcel tanker industry requires large fixed assets (ships) that are relatively specialized. To the extent that re-equilibrating requires more or different ships, it may take time to adjust. In the meantime, seemingly collusive patterns of conduct may persist.[26]

Second, the cartel may have operated as an equilibrium selection device. That is, firms need to choose where to enter and how. In this environment the cartel may operate to coordinate play so that a particular equilibrium in the entry game is selected. Whether this gives rise to any antitrust harm depends on the theory of equilibrium selection in the absence of a cartel.

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[22] Damages are also create an incentive to mitigate harm ex-ante, albeit an imperfect one. In addition, damages, by virtue of being an ex-post lump sum, do nothing to redress allocative inefficiency ex-post.

[23] Knowledge of the cartel would also facilitate the updating of beliefs as to future affreightment costs.

[24] That said, sooner or later the matter will become public after leniency is granted. Hence, the burden is likely to be greater as the grant of leniency becomes more uncertain.

[25] Grasso (2008) suggests a similar disincentive arising from the discoverability of EC leniency notices in US courts in private antitrust actions. He argues that applying for leniency in the EC makes it easier to get sued in the US.

[26] Fershtman and Pakes (2000) present a somewhat related dynamic model, in which firms set prices and invest in product quality. In this market a cartel, operating using a grim-trigger strategy, can generate a Markov Perfect equilibrium that is less concentrated and generates higher consumer surplus than does a competitive counterpart.

These two hypotheses are distinct from the earlier focus on long-term contracts in that they suggest little adjustment to current practice in granting leniency but rather present some conceptual challenges in assessing damages. That is: how should lengthy adjustment times and equilibrium selection be treated when assessing damages from cartel behavior? Tackling these issues raises challenging modeling and measurement problems.[27]

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[27] Harrington (2004) raises a related point when observing that cartels have an incentive to manipulate prices post-cartel to minimize damages estimates in litigation.

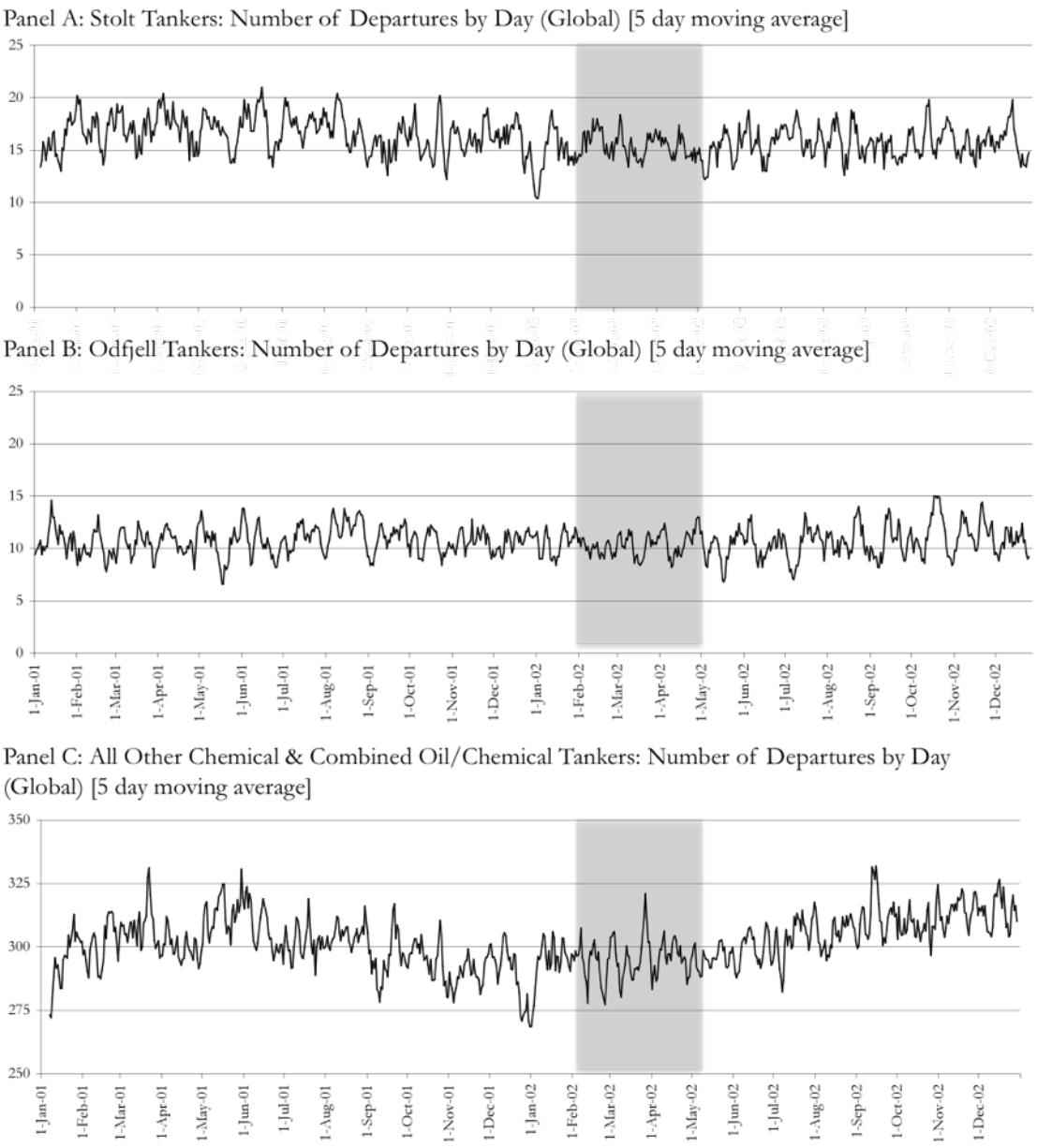

Figure 1: Number of departures from all ports (5 day moving average), by firm, by day.

Region Codes	Name	Odfjell				Stolt				Most Frequent Port
		H1 2001	H2 2001	H1 2002	H2 2002	H1 2001	H2 2001	H1 2002	H2 2002	
1 ARA	Gulf States	90	93	83	97	34	38	37	45	Jubail, Saudi Arabia
2 AUS	Australia, New Zealand, New Guinea etc.	44	45	30	64	217	235	238	222	Melbourne, Australia
3 BLK	Black Sea Coast	3	2	4	2	13	7	10	13	Diliskelesi, Turkey
4 CAM	Central America incl. Mexico to Panama	61	61	38	48	101	95	78	86	Altamira, Mexico
5 CAN	N.E. Canada and Great Lakes	8	9	3	5	22	40	19	26	Montreal, Canada
6 CAR	Caribbean Islands	33	35	35	19	18	22	10	10	Hovensa, US Virgin Islands
7 CHI	China, Korea and Russia	325	329	325	351	241	229	227	231	Ulsan, Korea
8 EAF	South & East African Coast	43	59	46	59	86	82	81	89	Durban, South Afrika
9 EMD	Eastern Mediterranean incl. Cyprus, Turkey	4	1	1	3	23	20	13	12	Ashdod, Israel
10 IBE	Spain / Portugal incl. Atlantic Islands	12	18	29	21	46	48	29	23	Algeciras, Spain
11 IND	India, Pakistan and Burma	72	74	42	56	76	92	54	94	Kandla, India
12 JPN	Japan	59	50	48	62	131	110	107	108	Kobe, Japan
13 NAF	North African Coast	11	23	21	17	28	36	21	21	Safi, Morocco
14 NEU	North European Atlantic Coast	104	120	98	92	437	488	455	503	Rotterdam, Netherlands
15 RED	Red Sea Coast incl. up to the Persian Gulf	18	17	15	18	25	21	6	13	Yanbu, Saudi Arabia
16 SAA	South America Atlantic Coast	252	289	307	272	129	131	101	102	Santos, Brasil
17 SAP	South America Pacific Coast	123	159	133	124	50	43	48	46	Mejillones, Chile
18 SCN	Scandinavia incl. Baltic, Greenland and Iceland	20	15	17	21	17	26	24	28	Skelleftea, Sweden
19 SEA	Vietnam, Thailand, Malaysia and Indonesia	234	190	162	215	400	342	328	307	Singapore, Singapore
20 SEU	European Mediterranean Coast	34	30	30	29	73	60	62	99	Tarragona, Spain
21 UKE	United Kingdom incl. Ireland	12	8	4	11	391	342	354	332	Liverpool, UK
22 USA	U.S, Atlantic Coast including part of Canada	75	77	70	65	126	102	94	95	New York, USA
23 USG	Gulf of Mexico	260	264	254	258	379	385	336	393	Houston, USA
24 USP	West North America incl. USA, Canada & Alaska	20	44	57	67	7	17	6	7	Long Beach, USA
25 WAF	Africa, Atlantic Coast	3	9	11	16	2	7	11	15	Dakar, Senegal

Table 1: Number of port departures by region, by firm and half-year.

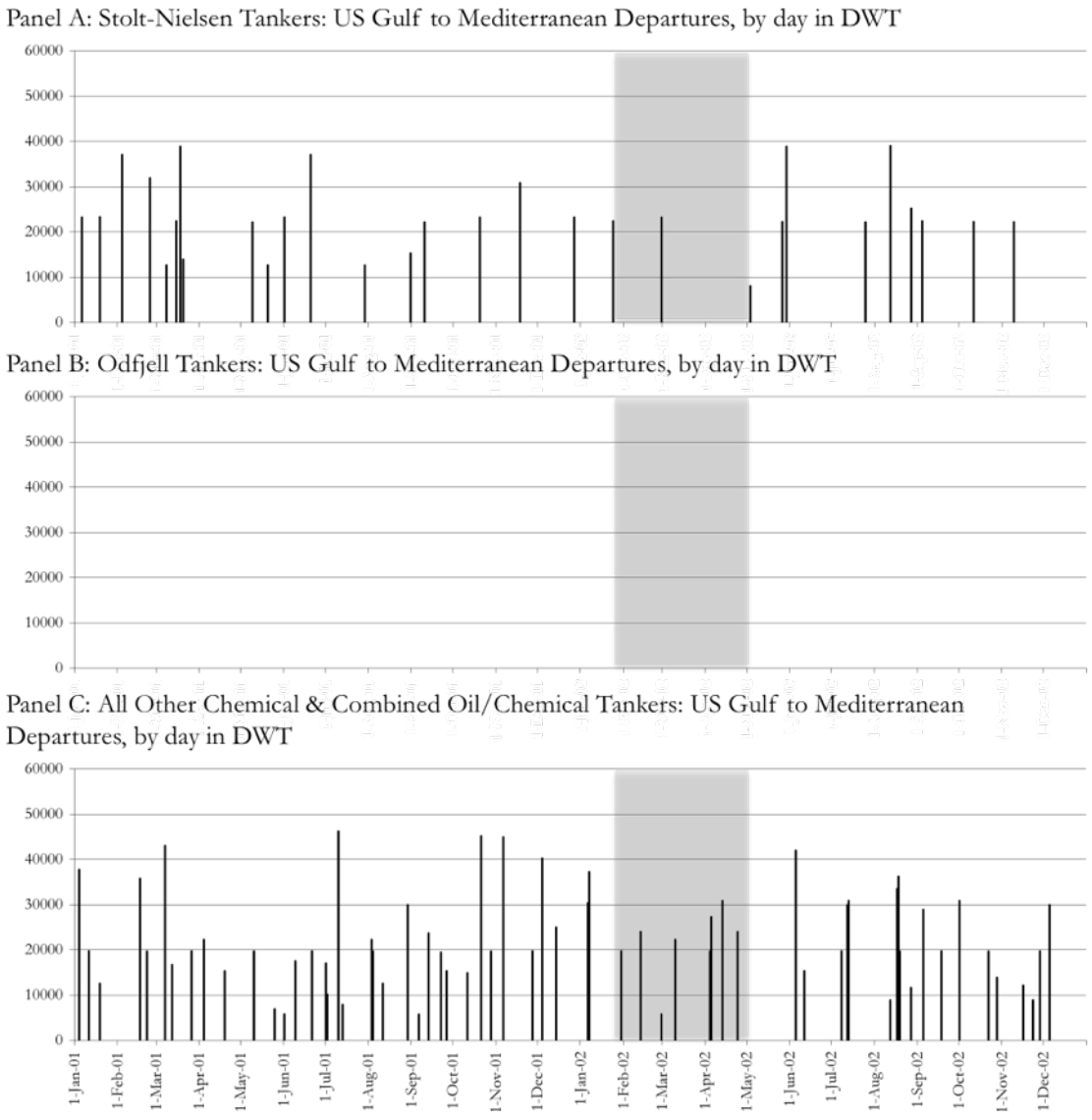

Figure 2: Departures from US Gulf ports to Mediterranean ports, by firm, by day in DWT.

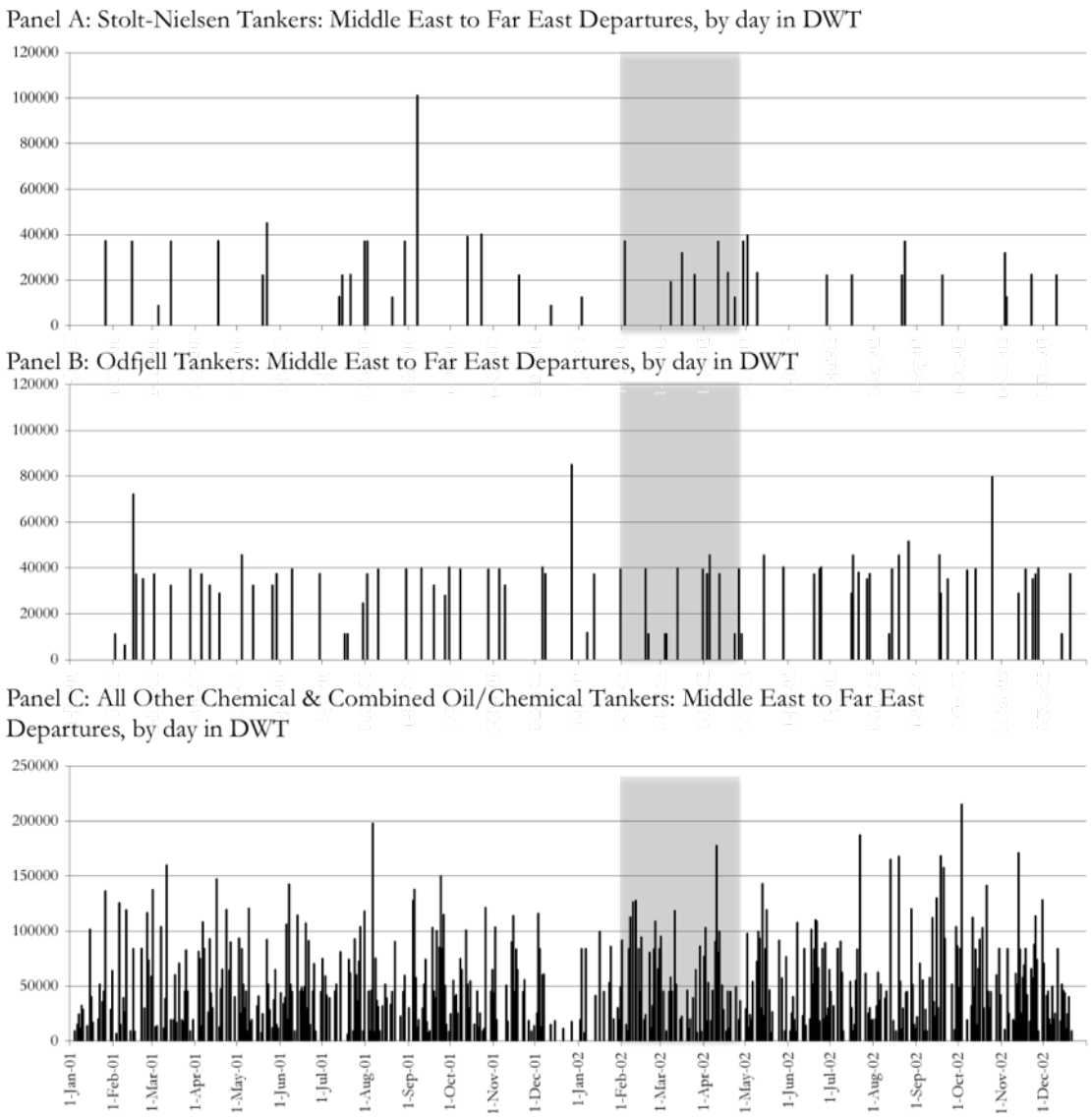

Figure 3: Departures from Middle East ports to Far East ports, by firm, by day in DWT.