Delivery and Manipulation in Futures Markets

Paul L. Fackler

INTRODUCTION

The delivery process on a futures contract provides the essential link between futures markets and markets for the underlying physical commodity. Futures contracts, however, unlike most forward contracts, allow for contract liquidation as a common and generally low-cost alternative to making or taking delivery. Indeed, most contracts are settled through liquidation rather than by delivery, and futures market participants often enter into these contracts with the intent to liquidate before contract maturity.

Unfortunately, the delivery process sometimes causes difficulties in these markets, with some traders being forced to make or take undesired deliveries. These problems are particularly acute when market power exists on either the long or short side of the market and is used to manipulate the market. Manipulation of futures markets has been illegal in the United States since the passage of the Grain Futures Act in 1922, but considerable confusion has existed concerning how the activity is defined. Johnson identified three characteristics used in legal proceedings to establish whether an illegal act of manipulation has occurred; (1) the ability to influence price; (2) the intent to do so; and (3) the creation of an artificial price. In economic terms, this clearly identifies manipulation with the exploitation of monopoly power, and the relationship between these concepts has been recognized for a long time [Easterbrook (1986); Edwards and Edwards (1984)].

Despite the attention the topic has received, there has been little explicit modeling of what occurs in a manipulation. This article provides such a framework by applying conventional microeconomic tools to the problem. In particular, the delivery process is viewed in the context of a decisionmaker choosing the fraction of the contracts held that will be settled through delivery. It is shown that a single agent holding all the open long contracts can be viewed as a monopolist in the market for futures contracts. Such an agent has an incentive to restrict the supply of liquidated contracts by standing for delivery on more contracts, resulting in a higher price than would be the case in a competitive market. Similarly, an agent controlling the short side of the market is a monopsonist in futures contracts and will restrict liquidation by making delivery on more contracts, causing a decline in price.

In either case, more deliveries are made than would be dictated by efficient usage patterns, resulting in a net social welfare loss. Such a framework is consistent with many of the observed phenomena associated with the delivery month manipulation. Important

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aspects of the delivery process and its manipulation can, therefore, be examined using fairly conventional economic tools.

The focus here differs in important respects from other explicit economic models of manipulation, which have tended to emphasize the anonymity of futures trading and the potential for exploiting asymmetric information as a means of acquiring monopoly power. For example, Kyle (1984) assumes the manipulator has privileged information concerning the nature of hedging demand for futures. Easterbrook (1986) goes as far as to declare that manipulation in futures markets is "a species of fraud." In the framework used here, the existence of informational advantages is only one rationale for the acquisition and exploitation of monopoly power. It is therefore neither necessary nor sufficient for manipulation. Furthermore, in Kyle's model, the manipulator is a speculator who has better information than other speculators. The manipulation does not center in any way on the delivery process itself.

The framework presented here shifts attention to commercial users of futures, who are in the best position to take extra deliveries and who might acquire a large position in futures in the normal operation of their businesses. A plausible mechanism for the acquisition of market power therefore exists. Furthermore, it is not necessary that the manipulator intended to acquire market power, but once it is obvious that such power has been acquired, the temptation to exploit it may be very strong. These points are discussed further after the theory of manipulation is developed.

A THEORETICAL FRAMEWORK

Consider first the situation faced by an agent currently holding the long futures contracts, with a single period left before contract maturity. This liquidate the contracts or take delivery on them. In the latter case, the some benefits from the physical goods received. The agent can also ob spot market. The decision concerning the number of contracts on which and the number of spot purchases can be formalized by writing the p this agent:

$$\pi = [v(d + s) - fd - Ps] + [(F - f)(C - d)]$$
$$= v(d + s) + F(C - d) - Ps - fC$$

where d is the number of deliveries taken on futures contracts, s is the $v()$ is the benefits function, F and f are the current and past futures current spot price, and C is the number of contracts held. The first b the net gains from the physical goods obtained and the second bracketed profit on the liquidated contracts. Note that the futures contracts are a therefore, the price obtained for delivery, f, is fixed. On the other hand liquidated, the amount received will be the difference between the curr F, and the original price, f. In this model the spot good refers to de At the delivery date the futures and spot prices must be equal to eli opportunities. Thus, $P = F$.

This agent attempts to maximize profits by choosing nonnegative qua s, subject to the constraint that deliveries must be less than or equal t contracts currently held ($d \leq C$). This can be written in terms of the Lag

$$L(d, s, \lambda) = v(d + s) + F(C - d - s) - fC + \lambda(C -$$

where λ is a Lagrange multiplier associated with the constraint on deliveries. The necessary (Kuhn–Tucker) conditions associated with this problem are

$$\partial L/\partial d = v'(d + s) - F + (C - d - s)\partial F/\partial d + \lambda \leq 0$$

$$\partial L/\partial s = v'(d + s) - F + (C - d - s)\partial F/\partial s \leq 0$$

and

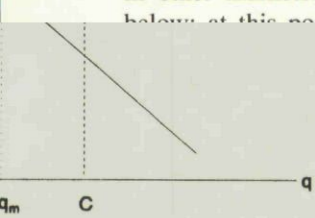
$$\partial L/\partial \lambda = C - d \geq 0$$

together with nonnegativity constraints on d, s, and λ and the complementary slackness conditions $(\partial L/\partial d)d = 0$, $(\partial L/\partial s)s = 0$, and $(\partial L/\partial \lambda)\lambda = 0$.

The nature of the responsiveness of price to the agent's actions is clearly an important factor. The agent faces some (inverse) excess supply of deliveries function:

$$F = S(d + s)$$

This excess supply function measures the total response of price (F) to changes in the amount delivered and purchased ($\partial F/\partial d$ and $\partial F/\partial s$). This is a mutatis mutandis rather than a ceteris paribus function in that it incorporates the equilibrium price responses in other markets. The factors influencing this function are examined more carefully below; at this point it suffices to note that it measures the responsiveness of price to



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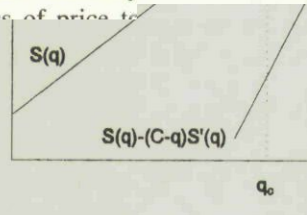

Figu
Equilibrium in a l

deliveries taken is lower. The manipulation would otherwise be the case, with the

$q) = F$

plicitly, two markets here, the market for ted futures contracts. It is in the latter that than in the market for deliveries. In the price up by refusing to liquidate, thereby racts.[3]

st's actions lies in the equivalence of the deliveries. When acting as a price taker, the o the marginal value of making deliveries. the marginal delivery is not equal to the nefficiency results. The deadweight loss in a deliveries. This can be interpreted as the roduct where it is not needed.

y, it is necessary to examine the nature of possible that this curve is flat (supply is r when physical supplies are abundant and ned, this case is equivalent to the perfectly

are scarce, the marginal costs of making vill therefore be upward sloping. There are

and demand for liquidated contracts. These demand

and, second, the marginal value of the extra results in more deliveries being made tha equilibrium number of deliveries satisfying

$$v'(q) < S$$

It is important to note that there are, in physical deliveries and the market for liquid the single long trader is a monopolist, rath role of monopolist this agent can drive the decreasing the availability of liquidated con

The welfare significance of the monopol supply function with the marginal cost of the marginal value of taking deliveries is equal When acting as a monopolist, the value of marginal cost of delivery and an economic Figure 1 represents the social cost of the ext cost of the resources expended to deliver a

To understand the nature of this inefficien the excess supply curve more carefully. It perfectly elastic: $S'(q) = 0$). This might occ in position to be delivered. As already menti competitive case in that $v'(q) = S(q)$.

At other times, especially when supplies deliveries will increase and the supply curve

[3]One could analyze the situation in terms of the supp and supply functions are derived from the demand and

several reasons for this. The first is due to search costs for deliverable supplies, which may increase if supplies are particularly scarce. The second has to do with the need to bring deliverable supplies from increasingly remote locations, thereby increasing the marginal transportation cost. The third is that, as supplies are demanded for delivery on futures contracts, the price of the goods in the supplying locations will also rise. Supply and demand functions incorporating equilibrium price effects in related markets are sometimes called general equilibrium or multimarket functions. Just, Hueth, and Schmitz (1982, Appendix D) contains a rigorous exposition of welfare analysis using general equilibrium functions. In particular, they show that the total inefficiency can be measured as the consumer and producer surplus loss in a single market when the supply and demand functions for that market allow for the equilibrium adjustments in other markets.

A short manipulation can be modeled in similar fashion. Assuming an interior solution, an agent holding all the open short contracts has optimal deliveries that solve

$$F - c'(q) - (C - q)\partial F/\partial q = 0$$

where $c'(q)$ is the marginal cost of making deliveries. The term $\partial F/\partial q$ is equal to slope of the demand for deliveries function,

$$F = D(q)$$

The market equilibrium is, therefore, the solution to

$$c'(q) = D(q) - (C - q)D'(q)$$

(this situation is illustrated in Figure 2). In general, it is assumed that $D'(q) \leq 0$.

The short manipulator can be viewed as a monopsonist in the market for futures contracts who can decrease the number of contracts bought (liquidated) and thereby drive down the price. This, in turn, increases the number of deliveries made by the monopsonist. Longs, facing deliveries at prices that outweigh their marginal value, will be willing to liquidate at a lower price.[4] When this occurs the equilibrium number of deliveries satisfies

$$F = D(q) < c'(q)$$

The marginal value of the deliveries made therefore will be lower than the marginal cost of making the deliveries, resulting in the deadweight loss shown in Figure 2.

Discussion

The model presented here can be used to clarify the conditions favorable for a manipulation. The long monopolist attempts to maximize the area under his or her marginal valuation curve $v'(q)$ evaluated from 0 to q plus the area $S(q)(C - q)$ (see Fig. 3). Consider the case in which both the demand and supply curves are neither perfectly elastic nor inelastic, as in the figure. The price and number of contracts settled by delivery in the competitive case are F_c and q_c

For the monopolist on the long side, there is an advantage to be gained by insisting on taking delivery on q_m contracts, thereby pushing the futures price to F_m. Geometrically, the difference in profits is equal to the difference between area A, which is gained at the higher price, and area B, which is lost. Intuitively, areas A and B represent the competing forces the manipulator attempts to balance. Area A represents the increased profits from

[4]In actual practice, the short can deliver early in the delivery period and thereby create a credible threat to the longs.

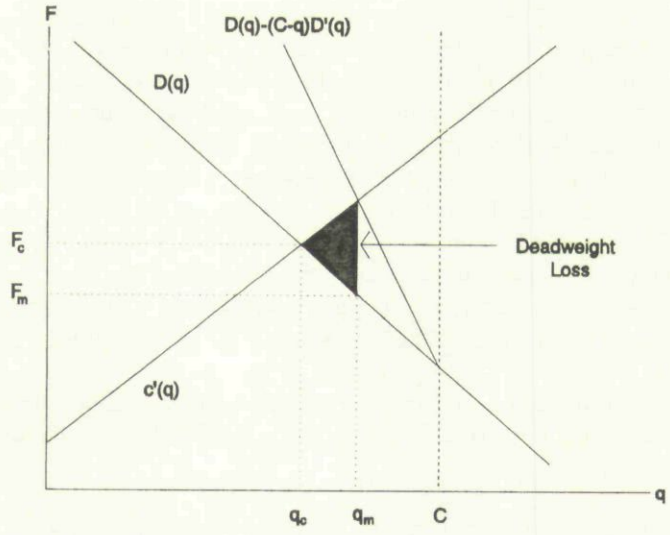

Figure 2
Equilibrium in a short manipulation.

liquidating contracts at a higher price, whereas area B represents the decrease in value of the extra deliveries taken.

Long manipulations are considered most likely when supplies are scarce. In this situation, for reasons discussed earlier, the supply of deliveries is likely to be relatively inelastic. To see how this affects the manipulator's profits, consider a monopolist on the long side contemplating forcing deliveries beyond the competitive equilibrium point. In a situation of completely inelastic supply, there are no incentives to do this, as it will result in decreased profits (assuming $v'' < 0$). An increase in elasticity can be viewed as a counterclockwise rotation of the supply curve. For a given increase in deliveries, such a rotation will result in a higher liquidation price, thereby increasing area A, the gain in profit, while not affecting area B.[5]

The long manipulator also benefits more from a manipulation when his or her marginal valuation function is relatively flat. This can be seen by considering a counterclockwise rotation of $v'(d)$. In this case the change in profits relative to the competitive situation occurs solely in area B, which shrinks in size. Recall that this area is a net loss to the long; therefore, the flatter (more elastic) the marginal valuation curve, the smaller the decline in the value of the deliveries taken for any given increase in deliveries.[6]

[5]Evaluated at the competitive equilibrium, the response of marginal profits to a change in supply elasticity ($\epsilon = [1/S'(q)][F/q]$) is

$$\frac{d\left(\frac{\partial \pi}{\partial q}\right)}{d\epsilon} = -\left(\frac{C}{q} - 1\right)\frac{S(q)}{\epsilon^2} < 0$$

Thus, marginal profits increase as supply elasticity decreases.

[6]In this case, the marginal affects at the competitive equilibrium are vanishingly small. The second order effects, however, are given by

$$\frac{d\left(\frac{\partial^2 \pi}{\partial q^2}\right)}{d\epsilon} = \frac{S(q)}{q\epsilon^2} > 0$$

where: $\epsilon = -[1/v''(q)][F/q]$ is the negative of the demand elasticity. Thus, marginal profits increase in q faster the more elastic the demand.

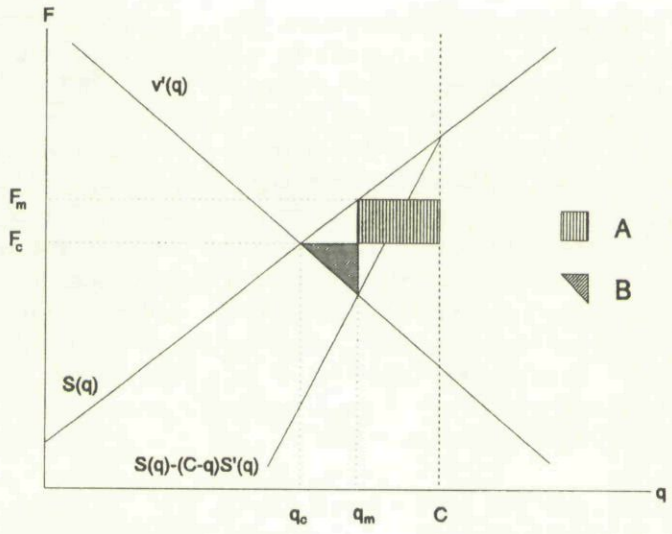

Figure 3
Comparative statics of a long manipulation.

By focusing on the supply and demand of the deliverable commodity, this framework serves to highlight the role of the commercial trader in manipulations. Such traders are in the best positions to assess the potential benefits from a manipulation through their knowledge of the marginal delivery costs. The manipulator must be willing to take deliveries and will, in fact, end up holding more of the deliverable supply during a manipulation than otherwise would be the case. In virtually all the important legal cases of alleged manipulation, the defendants have had extensive commercial dealings in the physical commodity.[7] Indeed, alleged manipulators often hold large percentages of the deliverable stock prior to the start of the delivery period. Such a situation usually is termed a corner as opposed to a squeeze, which occurs when a long trader exploits a natural shortage of the commodity by refusing to liquidate. The corner can be thought of as an attempt to alter the characteristics of the delivery supply curve. By reducing the supply available for delivery, the manipulator causes the supply curve to become more inelastic, thereby increasing the profitability of exploiting monopoly power.

It is important to distinguish a manipulation from the situation known in the trade as a congestion. Congestion occurs when unanticipated shortages in the cash market at delivery points lead to excess demand for deliveries on futures contracts, causing prices to increase during the delivery period. In spite of their similarities, however, it is reasonable to distinguish between congestion and manipulation. In a congestion, the price rise is simply an economically efficient rationing mechanism and no deadweight social cost is incurred. In a manipulation, on the other hand, an artificial price is created. This can be defined as a price at which the marginal value of the delivered good is lower than its marginal cost. In this situation deadweight social costs are incurred.

[7]It is noteworthy that legislation regulating futures trading in the U.S. has focused on the dangers inherent in excessive speculation. This reflects, in part, a divergence between the common usage of the term speculation, which would doubtless include attempts at manipulation, and the more limited usage in the futures trade to the activities on noncommercial traders.

Exchanges and regulators do express concern about congestions as well as manipulations. The rationale for this concern is that the deadweight social costs are only part of the costs imposed by these phenomena. Pacelli points out (1983, p. 40) that there are three sources of social costs attributable to manipulation: the disruption of normal flows of physical commodities, the breakdown of the price discovery process, and the reduction of the hedging effectiveness of the futures contract. In the case of a congested delivery situation, there is not a disruption in the flows of the physical commodity, but the hedging effectiveness of the contract may suffer and the prices discovered may not be relevant outside the delivery area. To the extent that such situations discourage futures market participation, they can adversely affect exchange members' profits, which depend on high trading volume. Market liquidity and transactions costs, which also depend on trading volume, would be similarly affected. Thus the deadweight loss, which measures the costs attributable to the delivery of goods where they are not needed, is the aspect of the costs that are unique to manipulation.[8]

PREVIOUS TREATMENTS OF MANIPULATION

A natural question concerning the approach taken here is the extent to which it accords with previous treatments of manipulation, especially treatments by courts and legal scholars. As already mentioned, legal scholars have identified the ability to influence price, the intent to do so, and the creation of an artificial price as the three elements in a successful manipulation.[9] The economic framework used here takes account of the first and third of these factors; the first requirement essentially is that the agent has a dominant position on one side of the futures market, whereas the third is that the price does not reflect the marginal cost or marginal value of the delivered good.

Determining if and when a manipulation has occurred is not a trivial task, however. Large position reporting requirements generally make it possible to conclude whether a dominant position has been established, but determining that an artificial price has been established is more difficult. It is common to examine the behavior of the deliverable cash price before and after the end of the delivery period [e.g., Federal Trade Commission (1926)]. A large drop is taken as an indication that the cash price (and consequently the expiring future price) had been driven up above its marginal value. Examination of the prices of related but nondeliverable goods also provides an indication of manipulation. For example, in the Great Western egg manipulation case [Edwards and Edwards (1984); Pacelli (1983); Johnson (1981)], the price of deliverable refrigerator eggs was abnormally high relative to that of fresh eggs and the December futures (the deliverable contract) was abnormally high relative to the January contract.

Price evidence must be interpreted carefully, however. It is possible for the price to rise toward the end of trading in a contract because shorts have not prepared for delivery. It is generally true that immediacy in delivery comes only at a cost. In the Volkart cotton case, the courts ruled that no manipulation had occurred because the shorts could have prepared for delivery but waited until such a time that delivery within the delivery month would have been very expensive [Pacelli (1983); Johnson (1981)]. The supply of deliverable goods became highly inelastic at the end of the trading period because available stocks could not be inspected and certified for delivery in time to deliver them. This caused the shorts to be willing to liquidate at rather high prices. The social costs in this case

[8]To the extent that the willful nature of a manipulation has a more negative publicity impact on the market than does a congestion, the deadweight loss will underestimate these unique costs.

[9]It should be pointed out that an attempted manipulation is illegal. The effect of potential legal sanctions is not considered here, however.

are better attributed to mismanagement by the shorts than to wilful manipulation by the long. This case brought out the tension that will always exist in the legal handling of manipulation between the rights of longs to insist on delivery and the problems that can ensue from the exercise of those rights.

The second characteristic of a manipulation, intent, while perhaps legally important, is not essentially an economic issue. Indeed, the intent of the agent makes little difference in the determination of the harmful effects of the exercise of monopoly power. The question of intent, however, is related to the issue of how the would-be monopolist is allowed to acquire the monopoly position in the first place. In many economic situations a would-be monopolist finds that prices are bid up to a point at which any exploitation of monopoly power is no longer profitable. This generally will occur as long as the agent's intentions have been made public and are credible. This has led some observers to equate manipulation with fraud and to stress the importance of secrecy in a manipulation [Easterbrook (1986)].

In futures markets, however, it is quite possible to acquire a large position on either side of the market without having much impact on prices, even with full knowledge of other market participants. Commercial users of futures often acquire such positions, either short or long, but they act as temporary substitutes for cash market transactions and generally are liquidated as these transactions are made. Indeed, a large commercial concern need not have prior intent to manipulate but could find itself with a large position because it has been unable to offset that position in the cash market. Thus, while asymmetric information considerations may come into play in manipulation, they are not necessary for manipulation to occur.

One important reason why asymmetric information is not necessary for the acquisition of a dominant position in a futures market involves institutional features of these markets that distinguish them from spot markets. In particular, futures markets operate as world markets in which participants far removed from the physical delivery market can usefully hedge in the course of their business operations. The number of contracts traded, therefore, far exceeds the number on which physical transactions are intended. Indeed, many market participants use futures to hedge products that are not and cannot be made deliverable (e.g., sorghum using the corn contract). Such traders intend to liquidate their contracts prior to the delivery period but may be prevented from doing so in the event of a manipulation. As a contract matures it takes on the characteristics of a local cash market for the delivery points. When traders use the market to hedge a product that is expensive or impossible to use for delivery, the dual nature of the futures market creates the possibility for manipulation.

CONCLUDING COMMENTS

In summary, important aspects of manipulation, including the degree to which deliveries are increased, the size of the deadweight loss, and the conditions favoring manipulation can be analyzed using fairly straightforward microeconomic tools. The framework provides an explicit model of the use of market power in delivery-month manipulation of futures markets. It demonstrates the importance of the elasticity of the supply and demand for deliveries in determining the potential gains from manipulation. It also clarifies the meaning of certain terms that have been used in ambiguous ways, in particular the meanings of artificial price, squeeze, corner, and congestion.

An important implication of the analysis is that commercial firms that hedge and that have facilities to take deliveries may routinely hold a long position well into the delivery period in anticipation of a possible squeeze. This suggests the need to consider

delivery specifications carefully and the possibility of inadequate competition among the commercial firms with product handling capabilities at delivery locations. Such concerns are discussed in Peck and Williams (1991) and have led, in part, to recent changes in the Chicago Board of Trade grain delivery specifications.

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