The Economics of Commodity Market Manipulation: A Survey

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1 Introduction

The subject of market manipulation has bedeviled commodity markets since the dawn of futures trading. Allegations of manipulation have been extremely commonplace, but just what constitutes manipulation, and how charges of manipulation can be proven, have been the subject of intense controversy. The remark of a waggish cotton trader in testimony before a Senate Committee in this regard is revealing: "the word manipulation . . . in its use is so broad as to include any operation of the cotton market that does not suit the gentleman who is speaking at the moment." The Seventh Circuit Court of Appeals echoed this sentiment, though less mordantly, in its decision in the case *Cargill v. Hardin*: "The methods and techniques of manipulation are limited only by the ingenuity of man." Concerns about manipulation have driven the regulation of commodity markets: starting with the Grain Futures Act of 1922, United States law has proscribed manipulation, including

specifically "corners" and "squeezes." Exchanges have an affirmative duty to police manipulation, and in the United States, the Commodity Futures Trading Commission and the Department of Justice can, and have exercised, the power to prosecute alleged manipulators. Nonetheless, manipulation does occur. In recent years, there have been allegations that manipulations have occurred in, *inter alia,* soybeans (1989), copper (1995), gold (2004-2014) natural gas (2006), silver (1998, 2007-2014), refined petroleum products (2008), cocoa (2010), and cotton (2011). Manipulation is therefore both a very old problem, and a continuing one.

Despite the importance of manipulation in shaping market regulation, and broader attitudes towards commodity futures markets, the subject remains widely misunderstood, especially by legislators, regulators, and jurists. In this article, I attempt to summarize academic and legal understanding (or not) of this subject. Section 2 defines manipulation, and presents a taxonomy of different types of manipulation: market power manipulation (corners and squeezes); trade-based manipulation (e.g., "banging the close"); and information-based manipulation. Sections 3 through 5 analyze each of these forms of manipulation in turn, paying greatest attention to market power and trade-based manipulations. Section 6 discusses legal, regulatory, and exchange self-regulatory responses to manipulation. Section 7 summarizes and concludes

2 Manipulation: A Definition and a Taxonomy

It would only be a slight exaggeration to say that the number of definitions of price manipulation approximates, and perhaps even exceeds, the number of people who have written on the subject. Rather than venture into these definitional thickets, I propose a definition that is in broad agreement with a substantial portion of the scholarly and legal commentary on the subject.

> **Price manipulation** is intentional conduct that causes market prices to diverge from their competitive level (or, in the case of imperfectly competitive markets, exacerbates divergences between market prices and their competitive level).

The key idea is that manipulation *distorts* prices, because price distortions cause the inefficient allocation of resources, which is the proper focus of government policy.[1] Manipulation is almost always undertaken for the purpose of financial profit, and is therefore a form of rent seeking: resources are utilized to secure a private gain.

Even a showing that a particular action caused prices to move should not be sufficient to support a charge of manipulation, because in derivatives and securities markets, actions undertaken for the purpose of making a profit can cause prices to move, and indeed, these price movements can actually improve the allocation of resources: indeed, this is the norm. For instance,

[1] This formulation is similar in spirit to some legal definitions of manipulation. For instance, in *Cargill v. Hardin,* the 8th Circuit discussed "[m]anipulation of prices by means not reflecting basic supply and demand factors."

the entry of a large low cost producer reduces prices, and increases surplus. Similarly, trading on private information moves prices, and causes them to reflect that information. Therefore, a genuine manipulation *distorts* prices, rather than merely moves them.[2]

What forms of conduct can distort prices? Allen and Gale (1992) identify three categories:

- **Action-based Manipulation.** Here, a manipulator misuses assets in order to affect the value of those assets, or the prices of their outputs or inputs. Allen and Gale give the example of the American Steel and Wire Company. Its managers short sold the company's stock, then announced a shutdown of its mills which caused a large decline in the stock price. They then covered their short positions at the low price, and re-opened the mills. Another example could be an electricity generator that declares a plant outage in order to drive up the price of electricity in order to increase the payout on an electricity derivatives contract.

- **Information-based Manipulation.** This involves the release of false or misleading information that causes prices to change in a way that benefits the financial position of the fabricator.

[2]There are some nuances here that have caused dispute. For instance, should an action that foreseeably distorts a particular price, but which was not undertaken for the specific purpose of affecting that price, be considered manipulative? This was an issue in recent litigation involving aluminum warehouses who allegedly restricted the load-out of metal in order to inflate their storage earnings. The Defendants argued that even though their actions might have affected the price of aluminum futures, they did not manipulate the futures since they did not act specifically to effect their prices. These nuances are worthy of stand-alone treatment, but are irrelevant to most episodes of manipulation over the years, so I will not analyze them in detail here.

- **Trade-based Manipulation.** In this case, the manipulator buys or sells in quantity, knowing that due to asymmetric information and trade processing and inventory costs prices will move in the direction of his trades.

As will be seen, all three types of manipulation occur in commodities markets. Historically, the most important form of manipulation has been a market power manipulation ("MPM"), commonly referred to as a corner or squeeze. MPM is plausibly categorized as an action-based manipulation, since to effectuate one a manipulator takes the action of demanding excessive deliveries against a futures contract. However, this form of manipulation is so important in commodity markets that it is reasonable to consider it a distinct form of manipulation, as in Williams (1996).

3 Market Power Manipulation

3.1 Introduction

Market power manipulations–corners and squeezes–are practically the most important form of manipulation in commodity markets. Pirrong (1995b) documents 124 market power manipulations in the United States between 1867 and 1921 (the year prior to the outlawing of manipulation under the Grain Futures Act). These episodes often resulted in substantial price distortions, and distortions in trading patterns. For instance, in the Brown and Hayne cotton corners of 1903 and 1909-10 (Hahn and Baker, 2015), English spinners shipped cotton from Liverpool and other English textile centers to the United States because of the acute price distortions: after the end of

the corner, the cotton was immediately shipped back to England. Furthermore, these episodes have often shaped public perception of the commodity markets. When commodities represented a much larger share of income and consumption, major corners received front-page coverage in major metropolitan dailies. The Leiter wheat corner of 1898 was the inspiration of the famous naturalistic novel, Frank Norris' *The Pit,* (1903) which in turn was the inspiration for the board game "Pit," which has been in production for more than a century. The Leiter corner was also the inspiration for an early film by famous (or infamous) director D. W. Griffith.

As noted by Easterbrook (1986), the classic squeeze/corner is the exercise of monopoly power in an expiring futures contract. Thus, it can be understood using basic price theoretic tools. The primary issues that must be addressed are: (a) what economic factors make it possible to exercise market power?; (b) what are the observable effects of MPMs on prices and quantities?; (c) how can traders acquire market power from those whom they will use it against?; (d) can both longs and shorts engage in MPM?; (e) what are the welfare effects of this conduct?; (f) can MPMs occur in cash settled futures markets?; and (g) can corners occur in markets for non-storable commodities (such as electricity)? I consider each of these topics in turn. I will focus primarily on manipulations carried out by the holders of long futures positions; in my analysis of short manipulation, I will discuss why long MPM is likely to predominate in the markets for storable commodities.

3.2 The Economic Sources of Market Power in an Expiring Futures Contract

The holder of a long position is a seller of contracts as a future nears expiry. To exercise market power, a seller must face a downward sloping demand curve for his product. In the case of a liquidating long, there must be a downward sloping demand curve for the contracts he holds.

Fackler (1993) presents a reduced form analysis of how a large long facing a downward sloping demand curve would exercise market power, but does not provide a structural model that shows why the demand curve may slope down. Pirrong (1993) shows that "economic frictions"–notably transportation costs for bulk commodities that are expensive to ship relative to value–can produce a downward sloping demand curve.

Shorts of a delivery-settled contract have two choices to exit their futures positions: they can either deliver against their positions, or repurchase (i.e., offset) them. They will obviously choose the cheaper alternative, meaning that the cost of delivery bounds from above the price that they are willing to pay to repurchase the contracts they previously sold. Thus, the cost of delivery determines shorts' willingness to pay to repurchase their positions, and hence the demand curve for a large long's futures position.

Pirrong (1993) shows that if the marginal cost of delivery is upward sloping over some range of deliveries, the demand curve for futures contracts at expiration (i.e., the marginal willingness to pay of shorts to repurchase their positions) slopes down over this range. Furthermore, his formal model demonstrates that transportation costs for a commodity produced and consumed at multiple locations (i.e., a "spatial commodity") can produce such

an upward sloping supply curve.

Futures contracts specify delivery at a specific location (e.g., corn in Chicago), or at a relatively small subset of production or consumption locations. If a large long demands delivery of a quantity in excess of that available at the delivery location(s), shorts must bring in outside supplies to meet this demand. The more the long demands, the further afield shorts must go to find additional supplies, meaning that the cost of transporting the marginal unit rises with the number of units delivered. Moreover, since transportation costs often make it inefficient to return units shipped from outside locations to meet the long's demands, increased deliveries cause consumption to fall in some markets that are the source of additional deliverable supplies.[3] Thus, to acquire additional deliverable supplies, shorts have to bid the commodity away from consumers in non-delivery locations, and since those consumers have downward sloping demand curves, shorts must pay progressively higher prices to acquire progressively larger quantities.

Consequently, when supplies of a commodity are spatially dispersed; a large long has a futures position in excess of the supply at the contract delivery location; and the commodity is costly to ship, the marginal cost of delivery is increasing with the quantity of deliveries (in excess of the supply in the delivery market at the competitive price). This upward sloping supply curve of the commodity in the delivery market translates into a downward sloping demand curve for futures contracts at expiration.[4]

[3]In fact, it is an implication of the Pirrong model that in the monopoly equilibrium, consumption falls at the source of the marginal delivery.

[4]An upward sloping supply curve of the commodity translates into a downward sloping demand curve for futures contracts because a one unit increase in the number of deliveries implies a one unit decline in the number of futures contracts repurchased by shorts. Thus,

Although transportation costs are the most important economic friction that cause the demand curve for futures contracts to slope down, they are not the only potential friction. Increasing deliveries can require transformations other than transportation, and the costs of these transformations may be increasing in the quantity transformed due to decreasing returns or capacity constraints. For example, although silver is very cheap to ship relative to value (as compared to, say, wheat) the silver market was successfully cornered in 1998 because constraints on the ability to assay silver in London limited the supply that could be made deliverable in a short period of time. Bottlenecks and delays in loading-out commodities from non-delivery warehouses has also constrained the ability to enhance deliverable supplies.

3.3 Price and Quantity Effects of MPM: The Delivery End Game

Fackler (1993) and Pirrong (1993) show formally how the exercise of market power by a large long at the expiration of a futures contract affects prices and quantities. Their results are intuitive and straightforward to explain.

First, *ceteris paribus,* the long's demand for deliveries in excess of the quantity available in the delivery market causes the price of the expiring, and manipulated, futures contract to rise because (a) shorts are willing to pay the inflated marginal cost of delivery to liquidate their futures position, and (b) the price in the delivery market must rise relative to other locations in order to attract additional supplies from those locations. That is, the

at the margin, shorts are willing to pay a higher price for a smaller number of futures contracts because that corresponds to a larger number (and hence high price at the margin) number of deliveries.

price in the delivery market must rise relative to prices at other locations in order to attract additional supplies from these locations. Thus, *ceteris paribus* manipulation causes the spot and futures prices to rise absolutely, and relative to prices in other markets.[5] This further implies that manipulation causes a decline in the basis.

Second, the manipulative demand increase is expected to be temporary. Therefore, the price of the expiring future tends to rise relative to the futures prices for deferred delivery (which do not experience the manipulative demand increase). Furthermore, and crucially, the price rise in the delivery market and the increased flow of the commodity to that market inflate the supply in the delivery market after the corner is over: this reduces the price in the delivery market after the MPM, and anticipation of this effect depresses deferred futures prices (because future supplies are inflated). Thus, MPM causes the nearby-deferred spread to rise. That is, manipulation causes contango to decline, and or backwardation to increase.

Third, and relatedly, the termination of the MPM often causes the price in the delivery market to fall precipitously because of the abrupt end of the inflated demand for the commodity, and the inflation of supplies caused by the excessive flow of the commodity to the delivery point.[6] Traders sometimes

[5]The *ceteris paribus* condition is important. It is possible, and indeed has occurred in some instances, that exogenous shocks (e.g., a decline in demand) that tend to reduce prices occur at the same time as a MPM. The exogenous shock can cause an absolute decline in price during the manipulation, even if the price of the expiring future and the spot price in the delivery market are above the competitive level. For this reason, relative price comparisons tend to be a far more effective way of detecting manipulation: Working (1933, 1934) made this point long ago. I discuss this in more detail below.

[6]Pirrong's (1993) model assumes that the long immediately dumps the deliveries onto the spot market at the end of the corner. The long may not choose to do this. For example, a long that has cornered the market and acquired all of the most economically delivered

refer to this as the effect of "burying the corpse" of the manipulation–the "corpse" being the large supply of the commodity attracted to the delivery point. Burying the corpse is one of the main costs and risks associated with MPM: the cornerer sometimes must sell the units delivered to him at a depressed price (i.e., a price below the price that would have prevailed absent the manipulation). Unless the gains realized from liquidating long futures positions at a supercompetitive price exceed the losses incurred from burying the corpse, manipulation is unprofitable. Thus, the manipulator has to trade-off the benefits of demanding more deliveries (selling some futures positions at a higher price) against the cost (selling the physical commodity at a depressed price after the manipulation).

Sometimes the manipulator misjudges the elasticity of supplies into the delivery market, and demands a price to liquidate that results in an unexpectedly large number of deliveries. Such misjudgments can make manipulation attempts unprofitable, sometimes ruinously so. This happened during the Leiter wheat corner mentioned above, and more recently during the BP corner of the propane market in 2004.[7]

supplies is in a strong position to corner upcoming futures contracts, and therefore may defer selling the deliveries. This would tend to temper the burying the corpse-related price decline. This is least likely to occur for a seasonal commodity for the last old crop futures contract, as new crop supplies will make future corners more difficult. But a trader who corners, say, a May contract may hold onto the units delivered to him in order to enhance his ability to corner the July contract. The manipulator may have also have previously made sales outside the delivery market, and uses the delivered commodity to fulfill these obligations: this would mitigate the burying-the-corpse effect. Alternatively, the long may render what is delivered to him undeliverable before selling it. For example, in some corners in the ribs market in Chicago in the 19th, the long taking delivery would cut the ribs in a way that made them undeliverable against futures, and then sell them.

[7]Jarrow (1992) defines manipulations as arbitrages, i.e., strategies that never lose money and earn money with a positive probability. This is unduly limiting: many trading strategies that distort prices are quite risky. Furthermore, in equilibrium one would expect

The effect of corners on nearby-deferred spreads, and the burying-the-corpse effect mean that a cornerer who is long this spread has a stronger incentive to manipulate, because he profits not just from the rise in the price of the expiring future, but from the decline in the price of the deferred future as well (Working, 1933, 1934; Pirrong, 1993). Similarly, a long that has fixed-price cash sales contracts has effectively locked in the price at which he buries the corpse, and can therefore manipulate more profitably and has a stronger incentive to do so.

Fourth, the price distortions cause quantity distortions. Notably, there are excessive flows *into* the delivery market prior to the end of the corner. After the corner is over, there is an incentive to ship out some of the excessive supplies attracted to the delivery market by the price distortions, resulting in large shipments *out of* the delivery market after the corner ends. Furthermore, the attraction of excessive supplies to the delivery market inflates inventories there. Notably, this increase in inventories resulting from a MPM occurs when the MPM causes the nearby-deferred spread to rise, and indeed, large stocks may be held in the delivery market in the presence of a large backwardation. This is very different from what happens in a competitive market, where "the supply of storage" relationship means that (a) delivery stocks and nearby-deferred spreads move inversely, and (b) large stocks are associated with full-carry or near full-carry spreads (Working, 1933; Wright-Williams, 1991; Pirrong, 2011a).

the entry of manipulators would eliminate arbitrages. Huberman and Stanzl (2004) and Gatheral (2010) derive conditions for price impact functions that do not permit manipulation. These analyses imply that even if trade-based manipulation does not occur in equilibrium, the potential for it affects market prices.

One complicated question is when these price and quantity movements will occur. Williams (1996) says that they will occur when "the trap of the corner is sprung," and Easterbrook (1986) says it occurs when there is an unexpected demand for deliveries, but determining *a priori* when this will occur is not trivial. Fackler (1993) and Pirrong (1993) finesse this question by assuming that all trading for liquidation occurs on the expiration of a futures contract. In reality, of course, traders can and do liquidate their positions starting some time prior to expiration. Cooper and Donaldson (1998) and Pirrong (2011b) present models of the liquidation process when trading can take place prior to expiration.

These papers point out a challenge a would-be cornerer must overcome: selling contracts prior to expiration reduces his market power in subsequent trading periods. Pirrong (2011b) shows that if all shorts are atomistic, the only equilibrium outcome is for liquidation to be delayed until the very end of trading: liquidating early provides a positive externality to those who do not liquidate, so all shorts prefer that others liquidate first (the "Alphonse and Gaston" equilibrium). However, if (a) there is a large short or shorts, and (b) shorts do not know the long's position exactly, but only its distribution, some of the externalities are reduced, and the cornerer and the large short(s) can negotiate a mutually beneficial early liquidation. This early liquidation is mutually beneficial, Pirrong shows, because a negotiated settlement reduces some of the deadweight costs of manipulation (discussed in more detail below).

These analyses imply that shorts are most likely to learn of their predicament when they attempt to liquidate their positions, only to find that they

can only do so at a high price demanded by the long with market power. Thus, the price impacts of a corner are most likely to occur when it is typical to "roll" positions in expiring contracts some weeks before expiration. Moreover, these analyses imply that corners can cause contracts to liquidate more slowly than normal, especially when shorts are relatively small and numerous (because externalities and the resulting incentive to delay liquidation are most acute under these circumstances).

Several articles perform statistical analyses of various historical episodes to test for the existence of these various effects. Pirrong (2004) studies the May and July 1989 soybean corners in great detail. That article adapts standard event study methods to test the hypothesis that the expiring May and July 1989 soybean futures prices were at supercompetitive levels. The first and second implications above imply that during a manipulation, (a) the expiring future should rise relative to the prices of deferred futures (e.g., the September and November futures prices), (b) the cash of soybeans outside the delivery point (e.g., in Central Illinois or NOLA), and (c) the prices of related products (e.g., soybean oil and meal futures). Controlling for the movements in these other prices using a regression estimated for a sample period ending prior to the time of the alleged manipulation,[8] Pirrong calculates the unpredicted (i.e., residual) percentage changes (returns) in the May and July soybean futures, and cumulates these residuals: the cumulative residuals

[8]The regressions utilize a variety of control variables. For example, in the study of the July futures, separate regressions are estimated using the following control variables: (a) September soybean futures returns; (b) November soybean futures returns; (c) the return on the value of crushed soybeans calculated based on soybean oil and meal futures prices; (d) the Central Illinois spot return; and (e) variables (a)-(d) in a multivariate regression. The return on the July soybean futures is the dependent variable in each regression.

are large, positive, and statistically significant at very high confidence levels, which rejects the null hypothesis that the prices of the expiring futures were not at supercompetitive levels. The third implication above can be tested in the same framework and with the same control regression. Pirrong shows that the May and July futures prices, and the Chicago cash soybean price, fell precipitously by amounts that were extremely unlikely to have occurred by chance in a competitive market, when the corners ended: for example, the NOLA-Chicago basis fell from 0 to -50 cents per bushel when the July 1989 contract expired.

Figure 1 presents the cumulative residuals for the July, 1989 contract. The pronounced rise and fall of the cumulative residual (a measure of the distortion in the July price) is clearly visible.[9]

Echoing Working (1933, 1934), the analysis in Pirrong (2004) emphasizes the importance of focusing on *relative* price movements to detect manipulative distortions. The flat price of soybeans actually fell at the same time that spread relationships indicated pronounced distortion in the prices of the expiring July futures contract.

Pirrong (2004) also presents evidence on quantity distortions consistent with the predictions of the theory sketched above. Receipts of soybeans into Chicago rose sharply during the delivery months, then dropped to very low levels afterwards. Shipments of soybeans from Chicago exhibited the opposite pattern. Some of these movements were extremely anomalous, and

[9]The ordering of the residuals is also consistent with the theory of MPM. Calendar spreads are inflated more than the basis because (a) manipulation depresses deferred futures prices, but (b) increases spot prices outside the delivery market because shorts bid up prices at these locations in order to secure additional supplies.

provide further evidence of manipulative influences. For example, Chicago elevators received soybeans *via* barges shipped up the Illinois River at the same time they were loading soybeans for shipment down the river. Upriver shipments were extraordinary in any event: barges full of beans passing in the night were a sure sign that prices were distorted.

Other articles have examined specific manipulative episodes. Barnhart, Kahl Barnhart (1996) also study the Ferruzzi episode. Gilbert (1997) examines the Sumitomo copper corner. Many articles analyze manipulations of government security derivatives markets. These include Cornell and Shapiro (1989), Cornell (1993), Jagdeesh (1993), and Merrick, Naik and Yadav (2005). Allen, Litov, and Mei (2006) study 15 stock market corners in the 19th and early-20th centuries. Allen *et al* also study the Hunt 1980 silver episode, as does Williams (1996), although there are reasons to doubt whether this was a classic MPM (or at least that it was solely a classic MPM).

All of these articles utilize information on relative price movements during the periods of alleged MPMs to determine whether prices were in fact distorted. The details differ because of differences in the instruments involved, and the data available. For instance, articles examining manipulations of government bond securities markets utilize yield spreads–in particular between the cheapest-to-deliver bond and similar bonds–to detect pricing distortions.

3.4 The Acquisition of Market Power

The models of the MPM "end game" presume that a long has already accumulated a large position. But how is it possible for someone to acquire market power? After all, in a futures market, the large long acquires mar-

ket power from those against whom he will exercise it: why would they put themselves in this position? In this way, MPM is different than the exercise of market power in other circumstances, for example when a firm acquires market power as a result of a technological innovation and patent, merger, or because of a government favor. In more conventional settings, market power is *not* obtained from those victimized by it.

Easterbrook (1986) states that manipulation is a form of fraud, because market power is obtained by stealth and concealment. It is true that stealth is necessary: if shorts realized that a large long was going to corner them, they would only sell futures at a price equal to the expected monopoly price, and this would make a corner unprofitable because the large long would pay this price for each contract that he buys, but would only be able to sell a fraction of his position at this price (because he would have to take deliveries on some contracts, which he would sell at a lower price). Put differently, absent stealth, the cornerer would suffer a loss equal to the deadweight cost of the manipulation, and would have no incentive to attempt a MPM.

But it is too strong to say that concealment is fraud *per se.* Traders routinely conceal their trading for reasons other than a desire to accumulate a position that they plan to use to execute a MPM.

Moroever, Easterbrook does not spell out in a formal model how a trader can conceal the accumulation of a position large enough to corner the market, without paying a price that makes the manipulation unprofitable. Pirrong (1995a) does so, by adapting the canonical Kyle (1985) market microstructure model. In the Pirrong model, there are two trading rounds. In the first round, there are noise traders (who could be hedgers or speculators) who

submit orders to buy or sell to a market maker. The net noise trader order flow is (as in the Kyle model) random. This noise trading provides concealment that a manipulator can exploit. In equilibrium, the manipulator utilizes a randomized (mixed) trading strategy: a deterministic strategy to buy a position sufficiently large to corner the market would be unprofitable, because the market maker would charge a price equal to the expected price at contract expiration (the second trading round). The market maker is unable to detect exactly the randomized manipulative order in the noise trader order flow, and therefore does not charge a price that is high enough to make all corners unprofitable.

In equilibrium, the manipulative trader both buys and sells with positive probability, and sometimes his purchases are in an insufficiently large quantity to manipulate *ex post.* However, manipulation does occur with positive probability. Thus, in the model, MPM occurs periodically and randomly.

Jarrow (1992) shows that an asymmetric response to buy and sell orders is a necessary condition for manipulation to occur. In Pirrong (1995a) the asymmetry derives from the information environment. At the contract initiation stage, the manipulator's trading is not observed and the market maker can only make noisy inferences about it. Further, the manipulator takes the market maker's ignorance into account when formulating his trading strategy. Conversely, during the delivery end game, the manipulator has no need to conceal, and reveals his market power by demanding excessive deliveries (or, equivalently, to set a supercompetitive price at which he is willing to liquidate).

One important implication of the model is that the potential for manip-

ulation reduces market depth. That is, prices are more sensitive to order flow when manipulation is possible than when it is not. When all non-manipulative order flow is pure noise (i.e., there is no informed trading), in equilibrium the market is infinitely deep (i.e., prices do not respond to order flow fluctuations). However, when manipulation is possible, prices in the first round of trading co-vary positively with order flow. This occurs because order flow provides information about the likelihood of an manipulation: a big positive order flow could occur because the manipulator is attempting to accumulate a large position.

This implies that even the *potential* for manipulation can distort prices. It further implies that noise traders pay the costs of manipulation in the form of higher trading costs at all times. In the model, the market maker breaks even, so noise traders bear all costs of manipulation. Further, they do so in the form of higher trading costs caused by reduced market depth. Indeed, some of the costs of manipulation are borne by noise traders who buy.

A further implication of the model is that, perhaps counter-intuitively, *more* liquid markets are more vulnerable to MPM than less liquid ones. More precisely, markets with larger non-manipulative order flow are more vulnerable to manipulation. This occurs because with a larger and more volatile order flow, it is easier for the manipulator to accumulate a large position without detection: it is easier to conceal his trading in the noisy order flow. As an example, Ferruzzi was able to accumulate a position five times deliverable supply by trading less than one percent of the volume in the July contract. Thus, a contract with a large trading volume, and a constrained deliverable supply, is acutely vulnerable to manipulation. The more constrained deliv-

erable supply (or, more exactly, the less elastic the supply of the commodity in the delivery market) the smaller the position needed to corner. The larger the trading volume, the easier it is to conceal the accumulation of a large position.

These considerations imply that a contract that serves as the hedging and speculative vehicle for a world-wide market, but which has a relatively constrained delivery mechanism, is most vulnerable to manipulation. The Chicago Board of Trade grain and soybean markets in the 1980s arguably satisfied these criteria: world production was hedged through these markets, but delivery was restricted to a shrunken cash market–Chicago. The Brent crude contract in the 1990s (prior to the expansion of deliverable supply) was arguably similarly vulnerable. Given that liquidity considerations favor the concentration of trading activity on a single contract, and that cash markets for physical commodities tend to be highly dispersed (meaning that any individual market that could serve as a delivery point is likely to account for only a small fraction of world supplies), the potential for manipulation is a chronic problem.

Allen, Litov and Mei (2006) derive a model of corners in which another information environment permits the acquisition and exercise of market power. There are three types of traders–uninformed investors, arbitrageurs, and a manipulator. There is uncertainty about the supply of a stock, and the payoff to the stock. Risk neutral arbitrageurs observe the payoff, but investors do not. Since there are two sources of uncertainty, there are pooling equilibria in which the uninformed investors cannot infer the payoff variable from the stock price: the price may be high (low) because supply is low (high) or the

payoff is high (low).

In this pooling equilibrium, arbitrageurs short sell if the payoff variable is low. If the manipulator also observes the payoff variable, he knows when the arbitrageurs are short, and therefore vulnerable to being cornered. The manipulator then buys all of the stock owned by the uninformed investors. Unless there is a sudden increase in supply ("float") of the stock (an outcome that occurs with some probability in the model), the manipulator corners the arbitrageurs, and forces them to close their positions at a supercompetitive price.[10]

Kyle (1983) presents a model in which, like in Allen, Litov, and Mei, an informed trader has private information about the trading of others, and can use this to squeeze. Specifically, a trader with superior information about hedger order flow exploits this advantage by amassing a large long position (which allows him to squeeze the market at delivery) when hedgers sell large numbers of contracts. Hedgers and other traders, who can only observe combined hedger-informed net order flow cannot detect his presence in the market, so his presence does not affect prices. This allows the informed trader to earn profits, and to squeeze with positive probability.

[10]This model has the peculiar implication that no one is worse off, and some are better off, as a result of manipulation. This occurs because the manipulation equilibrium transfers ownership of the stock from risk averse investors to a risk neutral manipulator, and thus improves the allocation of risk. Although Allen *et al* also assume that the uninformed investors will not demand from the manipulator a high price that reflects the possibility of a corner, but instead, are willing to part with their stock at a price that makes them as well off as if they held it. This is problematic.

3.5 Market Power Manipulation by Large Shorts

The same economic frictions that make a long MPM possible can facilitate a MPM by a large short as well. Indeed, such short MPMs are the mirror image of a long MPM.

Pirrong (1993) shows that short MPM exploits the burying-the-corpse effect. Whereas a large long demands excessive deliveries to manipulate, the large short makes excessive deliveries. These excessive deliveries drive down prices in the delivery market, thereby increasing the value of the short position.

Short MPMs of this type are not unknown, but they are far rarer than corners or squeezes. Perhaps the best-known example is in the onion market in 1955-1956, when speculator Vincent Kosuga sold large quantities of onion futures, bought large quantities of onions, and delivered them into Chicago. This caused the price of onions to fall precipitously, at one point to a level below the cost of the bags that the onions were delivered in. Shipments to Chicago were so excessive that large quantities of onions were dumped into Lake Michigan.

Pirrong (1993) demonstrates why one type of manipulation is likely to predominate. A large burying-the-corpse effect reduces the profitability of long manipulation but enhances the profitability of short manipulation. Conversely, long manipulation is more profitable, the less elastic the supply curve in the delivery market, whereas short manipulation is more profitable, the more elastic this supply curve (because this allows the short to obtain large quantities to dump on the market without bidding up the cost of doing so substantially). Thus, if factors in a particular commodity favor one type of

manipulation, they disfavor the other.

The ability to store increases the elasticity of demand (Wright-Williams, 1991; Pirrong, 2011a) and thereby mitigates the burying-the-corpse effect. Therefore, costlier to store commodities–specifically, relatively perishable commodities–are likely to be more vulnerable to short MPM. The few examples of short MPM in the record (notably, onions and potatoes) support this prediction.

3.6 Welfare Effects

Market power manipulation causes deadweight losses. These arise from two separate sources.

First, excessive deliveries distort the spatial and temporal patterns of production and consumption (Fackler, 1993; Pirrong, 1993). Specifically, there is too much consumption in the delivery market, and too little in markets that ship additional supplies there. Relatedly, excessive shipments to the delivery market utilize real resources, notably transportation assets.

Second, the price effects of manipulation undermine the utility of futures markets as a hedging and price discovery mechanism. Recall that a long MPM causes a decline in the basis: since such movements are not fully predictable at the time that hedgers establish their positions, when long MPM is possible short hedgers face an elevated risk of a loss (because short hedgers are long the basis).[11] The increased variability of the basis due to

[11]These losses can be severe. A commodity merchant suffered a $330 million loss in cotton trading apparently due in large part to the sharp decline in the basis in the May and July 2011 cotton futures contracts. Jack Farchy, Cotton trading costs Glencore $330 million, Financial Times, February 7, 2012. The Glencore 2011 Annual Report states "[t]he year-on-year decline was significantly impacted by the cotton activities, where extreme

MPM reduces futures contract hedging effectiveness, and therefore reduces the utility of risk averse hedgers. Since short hedging predominates in most markets, and long MPM is the predomiant form of MPM, this loss in hedging effectiveness can be very deleterious.

Moreover, MPM increases futures price volatility. This occurs at expiration when a manipulation occurs, but not only then. Recall that the possibility for manipulation causes futures prices prior to expiration to be more sensitive to fluctuations in uninformative order flow, and hence when MPM is possible futures prices are noisier even prior to expiration, even for contract months that are not manipulated. Furthermore, since MPM, and the potential for MPM, increase the noisiness of the price of the deliverable commodity relative to non-deliverable varieties and locations, it also reduces the utility of a futures contract as a pricing benchmark.

These deadweight losses provide a justification for regulation or legislation to deter or prevent manipulation. Indeed, the Commodity Exchange Act specifically cites these losses as the motivation for requiring exchanges to utilize contracts that "permit the delivery of any commodity . . . at such point or points and at such quality and locational price differentials as will tend to prevent or diminish price manipulation, market congestion, or the abnormal movement of such commodity in interstate commerce."

market volatility produced an outcome of ineffective hedging due to the dislocation of physical and paper markets." USDA cash price and futures price data show large declines in the basis in late-April and late-June.

3.7 Market Power Manipulation of Cash Settled Contracts

The models analyzed above, and most of the historical examples of MPM, involve delivery-settled contracts. In the models and the historical episodes, large longs manipulated by demanding excessive deliveries.[12] This has led to a belief that replacing delivery settlement with cash settlement could eliminate MPM. Several papers demonstrate that this belief is chimerical.

Paul (1985) sets out the basic logic in a contract with a single deliverable commodity (e.g., #2 corn in Chicago) that is replaced by a cash settled contract based on the cash price of the same commodity. If a large long could profitably manipulate the delivery-settled contract by taking delivery of Q units of the commodity, a long with the same futures position in a cash-settled contract based on the price of that commodity could have the same impact on prices, and hence earn the same manipulative profit, by buying Q units of the commodity on the cash market.

Pirrong (2000a) extends the argument to delivery-settled contracts where shorts have delivery options (e.g., the ability to deliver in Chicago, Toledo, and St. Louis), and cash-settled contracts based on the cash prices of the same commodities. This article shows that for any given cash-settled contract, it is possible to design a delivery-settled contract that is less profitable for a large long to manipulate. The intuition behind this result is straightforward. With a delivery-settled contract with delivery options, the large long demands a total amount of deliveries, and shorts concentrate the purchases

[12] Equivalently, large longs refused to sell their futures positions except at high prices, which induced some shorts to settle by making excessive deliveries because it was cheaper to acquire and deliver outside supplies rather than liquidate.

to accommodate the long's demands in the markets with the most elastic supply, in order to mitigate the impact of their purchases on prices. Conversely, the large long can concentrate purchases in the markets with the least elastic supply in order to maximize price impact–and therefore maximize the profit of manipulation. Put differently, giving shorts delivery options allows them to protect themselves from a large long's predation by mitigating the impact of his demand for excessive deliveries: cash settlement deprives shorts of such protections.[13]

The flip side of this is that cash-settled contracts are less susceptible to manipulation by a large short than a delivery-settled contract based on the same commodities. Again, this is intuitive: a large short can use the delivery options to his benefit by concentrating deliveries in the markets where the burying-the-corpse effect is most acute.

In sum, whatever the reasons for adopting cash settlement, reducing the frequency and severity of long MPM is not one of them. Indeed, it should be noted that in addition to exacerbating (or at least not reducing) long MPM problems, cash settlement creates other manipulation opportunities. For example, with cash-settled contracts based on self-reporting of cash prices used in futures settlement, market participants can submit false prices in an attempt to move the settlement price in their favor. Further, as discussed below, cash settlement creates opportunities for trade-based manipulations.

[13]Kyle (2007) incorrectly claims that Pirrong (2000a) and Kumar-Seppi (1992) (which I discuss below) err "by analyzing cash-settled contracts in a manner which avoids confronting the equivalence which they all recognize and which I discussed above."

3.8 Manipulation of Non-Storable Commodities

The models described above, and virtually all episodes of MPM, relate to storable commodities like corn and copper. Given that one of the most infamous episodes of alleged manipulation–the California electricity crisis of 2000-2001–involved electricity, which is non-storable, it is worthwhile to investigate whether MPM is feasible for such commodities, and if so, whether it differs from MPM of storable commodities.[14]

The short answer is that a classic corner or squeeze is not possible in electricity. The reason for this resides in a technical detail that is often implicit in models of MPM. Specifically, for a storable commodity, a long can take delivery and store it, thereby making it unavailable to shorts (and others) for some finite time period. Indeed, the long has an incentive to do this: selling the delivered units prior to the completion of the sale of his position would allow the shorts to re-deliver the same units, which would undercut his market power. Thus, storage allows the large long to take delivery at a price that exceeds the price at which he sells what is delivered to him. In effect, the large long is exercising market power by temporarily withholding the commodity from the market.

It is not possible for a market participant that has only a paper electricity position, and no generating assets, to distort prices merely by taking delivery on this position, because electricity must be consumed precisely when it is

[14]Many of the alleged manipulative acts in California were MPM. Indeed, many were arguably not manipulation at all. Rather, many of the actions routinely described as "manipulation" were in fact attempts to arbitrage price differences caused by the design of electricity markets in California, and the West generally. These strategies often involved no quantity distortions.

produced.[15] Pirrong (2000b) demonstrates this formally, and the intuition is readily explained. A short is willing to pay no more than the spot price at delivery to exit her futures position. Regardless of how many megawatts the long demands shorts deliver, a purely paper long must immediately sell these units, (a) this spot price equals the marginal value of the electricity to consumers, and (b) these units are available to shorts for delivery. Thus, even if the long forces delivery of a quantity in excess of the competitive equilibrium quantity, this will only drive down the spot price of power, and drive down the price shorts are willing to pay: in essence, the long receives the bury-the-corpse price not just on the sale of the megawatts delivered to him, but on his sales of futures contracts too. Thus, the large long faces an *upward* sloping demand curve for his contracts, rather than a downward sloping one, and has no incentive to take excessive deliveries (i.e., deliveries in excess of the competitive quantity).

Pirrong shows that manipulation of a power market requires the manipulator to control generating assets, and for the supply of generation by other producers to be increasing in price. In this case, a firm can exercise market power by withholding generating capacity. Derivatives positions affect the profitability of withholding. A long futures or forward position increases the profitability of withholding output, because the long derivatives position profits from the higher price. Conversely, a short derivatives position reduces the incentive to withhold output, and can actually make it profitable for the generator to produce too much: the excess production drives down the price

[15] Battery storage, or other forms of storage (e.g., pumped storage) are extremely costly, and these costs almost certainly exceed the benefit that could be achieved by using storage to distort temporal production and consumption in order to distort prices.

of power, and thereby enhances the profitability of the short derivatives position.

Thus, power market manipulations are action-based. The manipulator cannot cause distortions in production and consumption merely by standing for delivery on a futures position (as is possible in a storables market), but if he controls production or consumption assets, he can distort production and consumption directly. These distortions affect prices, which in turn can affect the profits of the manipulator's derivatives positions.[16]

There were widespread allegations that generators in California followed these strategies, including for instance claiming that they had to idle generators for maintenance. Joskow (2001) provides evidence consistent with this allegation, but Harvey and Hogan (2001) disputes this.

The salience of action-based manipulation in electricity markets raises the question of whether it is an issue in other commodities. Theoretically, the owner of assets used to make delivery of a commodity could influence the marginal cost of delivery, and hence the futures price, by withholding that asset. That said, there are few reported instances of this in storable commodity markets. Perhaps the most prominent example occurred in the May 1976 NYMEX potato futures contract, when longs leased all of the railcars on the Bangor and Aroostook Railroad, in which shorts had to make delivery. By withholding these cars, the longs made it impossible for the shorts to deliver, and they defaulted.

[16]The owner of generation may have an incentive to exercise market power and withhold output even if he does not have a derivatives position.

4 Trade-Based Manipulation

The extensive market microstructure literature has demonstrated empirically that trades impact prices, and provided theoretical explanations for this empirical fact. Temporary price impacts arise because accommodating investors' demands to buy or sell on short notice (i.e., their demand for "immediacy") requires intermediaries to take on and subsequently liquidate positions. This requires the intermediaries to bear risk, incur the costs of processing trades, and deploy capital, all of which they must be compensated for. Buying from (selling to) an investor at a lower price and selling (buying) subsequently at a higher (lower) price to cover provides this compensation.

Permanent price impacts arise because some trade on the basis of private information. Market makers and other investors therefore infer that a buy (sell) order may reflect that the submitter of the order has favorable (unfavorable) private information about the instrument, and based on this inference, update their estimate of the value of the instrument. Since information causes rapid but permanent price changes (in order to prevent arbitrage profits), when private information can drive transactions, trades can cause rapid and permanent price changes.

The fact that trades cause movements in prices provides a possible opportunity for trade-based manipulation. It is no mystery that a trader *can* move prices: the challenge is to determine how she can make a profit by doing so.

A good deal of the literature in this area focuses on stock markets, where the following problem arises: how can a manipulator profit by driving up the price of a stock through purchases, when her subsequent sale will cause prices

to go down? As Cherian and Jarrow (1998) discuss, if prices respond symmetrically to purchase and sales, this strategy cannot be profitable. Therefore, some asymmetry in the impact of buys and sells must exist, and various articles identify potential reasons for such asymmetries.

Allen and Gorton (1992) argue that purchases are more likely to be driven by private information than sales, and that as a result, an uninformed trader can manipulate by buying to mimic an informed trader, which drives up the price. Due to the asymmetry in price impacts, a manipulator can then liquidate her position without driving down prices as much as her purchases drove them up. Allen and Gale (1992) present another model in which an uninformed trader operating in a particular information environment can profitably mimic an informed trading: this particular information environment leads to an asymmetric price impact between purchases and sales. These articles do not present a full equilibrium, however: the existence of manipulative profit opportunities will result in trading that changes the informativeness of order flow (namely, more uninformative buying), and hence the sensitivities of prices to purchases and sales.

Trade-based manipulative opportunities may also exist when some market participants employ positive-feedback strategies (Chernian and Jarrow, 1998). For instance, if there are herding/trend-following/momentum investors, by purchasing a large quantity and causing an initial price increase, a manipulator may trigger further buying by the trend followers. The manipulator then sells to the trend followers at the higher prices their buying causes. As an example, see Cherian and Kuriyan (1995).

Stop loss trading is also a form of positive feedback trading that a manipu-

lator can exploit. A "gunning the stops" strategy works when a manipulator knows (or suspects) that there are large number of stop orders at a price slightly above the current market. With a large number of buy stops slightly above the prevailing market, the manipulator buys to force the price up to the level of the stops. This triggers the stops, leading to additional buying and upward price pressure: the manipulator sells at these higher prices. (A symmetric analysis holds for resting sell stops.) Other positive feedback trading phenomenon that make some manipulative trading strategies possible include the dynamic hedging and replication of options (e.g., portfolio insurance) and information cascades (Bihkchandani, Hirshleifer, and Welch, 1998).

Financial frictions also create the potential for trade-based manipulation. In Brunnermeier and Pedersen (2005) some traders are financially constrained and have to liquidate positions rapidly if prices move sufficiently against them. For instance, if the constrained investors are long, a manipulator can sell in large quantity, drive down prices, and if the price decline is large enough, the constrained investors will be forced to sell. This drives down prices further, allowing the manipulator to close his trade by buying at a lower price than she sold.

Jarrow (1994) argues that derivatives markets create other opportunities for manipulation. Indeed, these are of particular importance in commodity markets. The most important example is "banging the close" (or "punching the settlement price"). In this strategy, a trader enters a position that has a payoff that depends on the price of another "underlying" instrument. On the payoff date, the manipulator trades to move the price of the underlying

instrument in the direction that increases the payoff of the first instrument.

As a practical example, the hedge fund Amaranth entered into large volumes of natural gas swaps that settled against the final settlement prices of the February, March, and April 2006 natural gas futures contracts. During the settlement period of each contract (the last half-hour) of trading, Amaranth sold large volumes of the expiring futures contract, thereby driving down prices and increasing the payoff to its short swaps. There have also been allegations that London Bullion Market Association gold and silver fixings and Brent crude oil market pricing windows have been subject to trade-based manipulations because these prices are used to settle derivatives transactions.

Kumar and Seppi (1992) present a model that demonstrates how this strategy can be profitable. Specifically, there is a temporal asymmetry in the information environment: no one has private information about value at the time that the initial trades in the derivative instrument whose payoff depends on the future price of the underlying take place, but there is privately informed trading in the underlying instrument at the time the settlement price for the derivative is determined. The lack of informed trading at the contract initiation stage, and its existence at settlement, means that the price impact of trades is smaller then than at the time the settlement price is determined: informed trading reduces liquidity and increases the sensitivity of prices to trades because market makers need to protect themselves against trading against those with better information. Therefore, a manipulator can put on a derivatives position without causing a large movement in the price against her. At settlement, the manipulator trades in the underlying in the

same direction as her position in the derivative. Since market makers cannot distinguish her trades from either informed trades or noise trades, her trade in the underlying moves its price, thereby increasing the value of the derivative position.[17]

The literature suggests other kinds of asymmetries that can make such a strategy viable. For instance, uninformed traders sometimes try to identify themselves as such using "sunshine trading strategies" that reduce the price impact of their orders (Admati-Pfleiderer, 1991). Similarly, they may use certain kinds of orders or trading mechanisms (e.g., crossing markets) that are unappealing to informed traders (especially those with a short-lived information advantage due to the impending public release of the information, or competition between the informed which accelerates the incorporation of information into prices).[18] Alternatively, since when traders have discretion regarding when to trade, the intensity of informed trading can differ systematically by time-of-day (Admati-Pfleiderer, 1988), initiating positions when informed trading is less likely (and hence market depth is greater) and closing them when it is more likely (and hence depth is lower) would result in an asymmetry similar to that in Kumar-Seppi. Relatedly, a dealer entering into a bilateral transaction with a customer for a cash-settled product (for instance, a barrier option) might have some information about the client's motivation, which mitigates the dealer's adverse selection risk: the dealer

[17] The manipulator randomizes between purchases and sales in the derivatives instrument.

[18] Klöck, Schied, and Sun (2014) analyze how dark pools might create the potential for manipulation. Pirrong (2002) presents a model in which alternative trading venues that screen out informed traders have lower price impact coefficients than "lit" markets that serve both informed and some uninformed traders.

can then mimic an informed trader by trading aggressively (hitting bids or lifting offers) in the market where the settlement price on the instrument is determined. By using these mechanisms to mimic uninformed traders when initiating positions, and then closing them using the markets and order types favored by informed traders, a manipulator could profit from asymmetric price impacts.

One implication of this model is that less liquid and less deep markets are more vulnerable to trade-based manipulation.

Although temporary price impacts of trades could also potentially make such manipulative strategies possible, the fact that the manipulator exploits price impact resulting from information asymmetries in the Kumar-Seppi model means that in that theory, the manipulative trades in the underlying have permanent impacts on price.

There is evidence that this can occur in practice. Specifically, the CFTC brought an enforcement action against the trading firm Optiver relating to its trades in gasoline, heating oil, and crude oil futures in 2008. The CFTC alleged that Optiver entered into Trade at Settle ("TAS") contracts, and then traded large quantities of the underlying futures contracts starting a few minutes before the two-minute settlement window, and continuing through that window. The trades in the underlying were in the opposite direction of the TAS trades, and the total volume of trading in the two instruments was approximately the same.

The strategy profited because the TAS trade allowed Optiver to offset all of its manipulative trades at the settlement price, and make profits on the trades done right before the settlement window. For example, after buying

TAS contracts, and then selling before and during the settlement window, Optiver could buy to cover its entire position at the settlement price, which was (due to the selling before and during the window) lower than the prices at which it sold prior to the window.

TAS contracts are unlikely to be appealing to informed traders, especially those with short-lived information advantages because (a) they are passive, price-taking orders whereas informed traders tend to prefer to submit aggressive orders when their information indicates that prevailing bids and offers are mispriced, and (b) there is a delay between the execution of a TAS order, and the determination of the ultimate transaction price, meaning that the ultimate price may reflect some or all of an informed trader's information, thereby reducing the profit earned from that information. Since uninformed traders are more likely to use TAS orders, TAS trades should have a lower price impact than trades in the underlying: this creates an asymmetry that a manipulator can exploit.

Figure 2 illustrates that Optiver's actions caused permanent price movements. It depicts the second-by-second bid/ask midpoint of RBOB gasoline futures prices on the days that the CFTC alleged Optiver manipulated this market. The market moved in the direction of Optiver's trading on most of the days of alleged manipulation, and as the chart indicates, some of these movements were quite large. Furthermore, prices remained elevated or depressed long after the trading ended at 2:30 Eastern Time, indicating that the movements were permanent (as this is measured in the the empirical microstructure literature). Thus, this episode fits the Kumar-Seppi model quite well.

It also raises two issues that relate to the costs of manipulative conduct. First, trades in one futures contract can convey information that is relevant for the prices of others. In the case of Optiver, even though it concentrated its trades in the April futures contract, the prices of May and later contracts also moved when it was trading. Moreover, when Optiver traded heavily during the settlement window of one commodity (e.g., RBOB) the prices of others (e.g., heating oil and crude oil) moved in the same direction during the same time frame. Thus, in a futures market, the cost of manipulative trading can spill over to contracts other than the one in which the trade-based manipulation occurs.

Second, in this instance, as in others, the wealth transfers caused by such trades dwarfed the profits of the trader. According to the CFTC, Optiver earned a profit of approximately \$1-\$2 million as a result of its activities. However, as just noted, the trades in the front month of one contract impacted prices in the forward curves of the entire petroleum futures complex. Given the magnitude of the open interest in these markets (which was in the hundreds of billons of dollars), the price changes resulting from Optiver's trades caused changes in the values of open positions that were orders of magnitudes larger than Optiver's profits.

Although the efficiency effects of trade-based manipulation are probably limited to a reduction in the informativeness of prices and a decline in market liquidity, the large distributive effects drive a demand for regulation of this form of conduction.[19] I discuss regulatory issues in Section 6 below.

[19]The efficiency analysis is complicated by the fact that although this type of trading likely reduces the amount of informed trading, and hence the informativeness of futures prices, informed trading can be a form of rent seeking and hence excessive (Pirrong, 2003;

5 Information-Based Manipulation

Fraud or manipulation through the release of false or misleading statements can be understood without formal modeling. They have also been widely practiced since the dawn of futures trading. Accounts of the earliest days of futures trading in Chicago include allegations of traders using rumors about grain in elevators getting out of condition to cause price reactions that they profited from (Taylor, 1917). Later examples include spreading of rumors about crop diseases or infestations (e.g., "green bugs"; Ferris, 1988). It is fair to say that this phenomenon is ubiquitous, and likely to remain so. This explains the fact that the Commodity Exchange Act requires Contract Markets to:

> [provides for] the prevention of dissemination by the board or any member thereof, of false or misleading or knowingly inaccurate reports concerning crop or market information or conditions that affect or tend to affect the price of any commodity in interstate commerce.

More recent examples of information-based regulation that have had extremely far-reaching consequences are the submission of false information to price reporting agencies (e.g., Platts) that create price indexes that are used to determine payoffs on derivatives contracts (e.g., natural gas swaps) or other financial instruments. This practice was evidently rife in U.S. energy

Kyle and Viswanathan, 2008). In such a second best world, unambiguous evaluations of the welfare effects of trade-based manipulation are challenging, and arguably impossible. Trade-based manipulation strategies could also raise the cost of using strategies intended to signal that trades are not information-driven: the welfare implications of such strategies are ambigious.

markets in the 1990s and early-2000s: the CFTC collected $445 million in settlements on attempted manipulation and false reporting cases from 2004 through 2009 (Sackheim, 2009). This sum pales in comparison with the billions of dollars in settlements involving authorities in the U.S., EU, and UK for manipulation of submissions of LIBOR and other money market rates: Deutsche Bank alone agreed to pay $2.5 billion. European Commission antitrust authorities launched investigations of price reporting practices in oil in 2013, and biofuels in 2015.

These scandals have led to major changes in price reporting practices, including the replacement of the British Banking Association by the Intercontinental Exchange as the calculator of LIBOR rates, and the adoption of principles for price reporting agencies by the International Organization of Securities Commissioners. Regulators are also moving to replace reported prices with transaction prices where possible. For instance, regulators are considering transactions-based measures like the Overnight Bank Funding Rate as a LIBOR replacement (Federal Reserve Bank of New York, 2015).

Transactions-based measures can be less susceptible to manipulation if the underlying market is sufficiently liquid. However, as demonstrated in Section 4 above, transactions-based measures are sometimes subject to trade-based manipulation.

6 The Regulation of Manipulation

6.1 Anti-Manipulation Provisions of US Law

Beliefs that commodity markets were routinely manipulated in the post-Civil War period–beliefs strongly supported by facts–were a major impetus for calls to regulate (and in the extreme, ban) commodity futures markets in the United States (Cowing, 2015). These efforts came to fruition in 1922, with the passage of the Grain Futures Act ("GFA").[20] The GFA allowed futures trading to occur only on "contract markets" designated by the Secretary of Agriculture. Among the requirements to maintain designation was: "The prevention of manipulation of prices or the cornering of grain by the dealers or operators on the Board." Note that corners are explicitly identified, but that the concept of "price manipulation" is broader than corners.

The GFA was challenged in Court. The Supreme Court decision upholding the law relied heavily on the prevention of manipulation as justifying its Constitutionality under the Commerce Clause:

> Congress having reasonably found that sales of grain for future delivery (most of which transactions do not result in actual delivery, but are settled by off-setting with like contracts), are susceptible to speculation, manipulation, and control, affecting cash prices and consignments of grain in such wise as to cause a direct burden on and interference with interstate commerce therein, rendering regulation imperative for the protection of such commerce

[20] The Futures Trading Act of 1921 contained similar anti-manipulation language as the GFA, but the Supreme Court struck down this act as an unconstitutional use of the taxing power.

> and the national public interest therein – had power to provide in the Grain Futures Act, supra, for placing grain boards of trade under federal supervision and regulation as "contract markets," as a condition to dealing by their members in contracts for future delivery.
>
> . . . .
>
> The government did not, in this hearing and argument, maintain that, by manipulation, the operators can permanently depress the prices of grain, but insisted and cited the actual quotations from time to time, some as late as the summer of 1922, showing violent fluctuations through "deals" of large operators engaged in manipulating the futures market at intervals since 1900, before which corners were ever recurring but since which they have been infrequent. Much evidence was adduced before congressional committees that the sales of futures on the Chicago Board dominated the prices of wheat in this country and the world. The injurious effect of these recurring fluctuations in such futures upon the consignment of grain by owners and producers was asserted by witnesses.[21]

In 1936 Congress expanded and strengthened the GFA. The resulting law, renamed the Commodity Exchange Act, stated that futures transactions are:

> affected with a national public interest . . . . The transactions and prices of commodities on such boards of trade are susceptible

[21] Board of Trade of the City of Chicago v. Olsen, 262 U.S. 1 (United States Supreme Court, 1923).

> to excessive speculation and can be manipulated, controlled, cornered or squeezed .... rendering regulation of such transactions imperative for the protection of such commerce and the national public interest.

Further, it made it a misdemeanor offense to:

> manipulate or attempt to manipulate, the price of any commodity in interstate commerce, or for future delivery on or subject to the rules of any board of trade, or who shall corner or attempt to corner any such commodity.[22]

In the 1968 Amendments to the CEA, Congress made manipulation a felony. Further, under the CEA, manipulation is subject to private rights of action, meaning that those who believe they have been harmed by manipulation can sue.[23] The CEA also contains other manipulation-related provisions, including giving exchanges the power to declare a market emergency in the event of a manipulation of a corner or squeeze.

In 2010, believing that the CEA's existing anti-manipulation provisions were inadequate, Congress added language to the law as part of Dodd-Frank that effectively incorporated the anti-manipulation provisions of the Securities Act:

> **Prohibition against manipulation.** It shall be unlawful for any person, directly or indirectly, to use or employ, or attempt

[22]Note that the anti-manipulation is not related to futures, but extends to any commodity traded in interstate commerce.

[23]Futures Trading Act of 1982, Pub. L. No. 97-444, 235, 96 Stat. 2294, 2322 (1983) (codified at 7 U.S.C. 25 (1982)).

> to use or employ, in connection with any swap, or a contract of sale of any commodity in interstate commerce, or for future delivery on or subject to the rules of any registered entity, any manipulative or deceptive device or contrivance, in contravention of such rules and regulations as the Commission shall promulgate by not later than 1 year after July 21, 2010, provided no rule or regulation promulgated by the Commission shall require any person to disclose to another person nonpublic information that may be material to the market price, rate, or level of the commodity transaction, except as necessary to make any statement made to the other person in or in connection with the transaction not misleading in any material respect.

Other federal agencies have adopted anti-manipulation rules. The Federal Energy Regulatory Commission adopted its anti-manipulation rule (Rule 670, applicable in the natural gas and electricity markets FERC regulates) in 2006, and the Federal Trade Commission implemented a rule proscribing manipulation in petroleum markets in 2009. Both rules focus on information-based manipulations. The FERC rule is patterned on the SEC anti-manipulation rule: it makes it an offense "to use or employ any device, scheme, or artifice to defraud." Similarly, the FTC rule proscribes:

> a) knowingly engaging in any act, practice, or course of business including making any untrue statement of material fact that operates or would operate as a fraud or deceit upon any person; or b) intentionally failing to state a material fact that under the

> circumstances renders a statement made by such person misleading, provided that such omission distorts or is likely to distort market conditions for any such product.

US courts have also found market power manipulation to be actionable under the Sherman Act (Schacter, 1986). Notable cases include *United States v. Patten* (226 U.S. 525, 541-43 (1913)), *Peto v. Howell* (Peto v. Howell, 101 F.2d 353, 356-57 (7th Cir. 1938)) and *Strobl v. New York Mercantile Exchange* (768 F.2d 22, 23 (2d Cir.), cert. denied, 106 S. Ct. 527 (1985)).

6.2 Anti-Manipulation Law in Europe

Europe adopted anti-manipulation laws long after the United States. The Market Abuse Directive ("MAD"), passed in 2003, encompassed both securities and derivatives. It defined market manipulation to include transactions "which give, or are likely to give, false or misleading signals as to the supply of, demand for or price of financial instruments, or which secure, by a person, or persons acting in collaboration, the price of one or several financial instruments at an abnormal or artificial level."[24] The Directive included a defense of legitimate trading purposes. The Directive also banned "transactions or orders to trade which employ fictitious devices or any other form of deception or contrivance" and the "dissemination of false information." An implementing Directive adopted at the end of 2003 identified several types of manipulation, most of which are trade-based manipulations: it did not specify corners or squeezes.[25]

[24]Directive 2003/6/EC.
[25]Directive 2003/24/EC.

Individual countries were required to pass legislation to implement MAD. As an example, in the UK (home of the largest commodity exchanges in the EU) incorporated MAD into law through Section 118 of the Financial Services and Markets Act 2000. This law took what could be called a subjective "reasonable market user" or the "dear boy that's just not done" standard to define manipulation. For example, it banned conduct "which is likely to be regarded by a regular user of the market . . . as a failure . . . to observe the standard of behanvior reasonably expected of a person in his or their position in relation to the market." It also proscribed conduct that a would "give regular user of the market a false or misleading impression as to the supply of, or demand for, or as to the price or value of, investments of the kind in question." The UK's Financial Services Authority's Code of Market Conduct, based on Section 118, indentified several types of trades as manipulative. These include banging the close, and "an abusive squeeze."

Due in large part to the inadequacies of MAD revealed by the Financial Crisis (notably the LIBOR scandal), the EU adopted the Market Abuse Regulation ("MAR"). It broadened the scope of coverage of the MAD to additional trading venues, and to additional instruments, most notably OTC instruments based on, or inputs to, pricing benchmarks. It also included a non-exhaustive list of manipulative behaviors, including an "abusive squeeze," "momentum ignition," and "smoking."[26]

The European approach to manipulation differs from the American. Whereas the latter defines manipulation broadly and relies on courts and regulatory agencies to apply this broad definition to case-specific facts, the Europeans

[26]Commission Delegated Regulation 2016/522.

supplement their broad definition with illustrative (but non-exhaustive) examples of types of manipulative conduct.

Insofar as commodities are concerned, few cases have been brought under MAD. (MAR came into effect only in July, 2016.) In the UK, successful cases involve a bang-the-settlement episode in the coffee market, and trading of Brent oil futures in large volume by a drunken trader. There have been no MPM cases, even though there is strong evidence of powerful squeezes in some markets (namely cocoa in July, 2010).

6.3 The Enforcement of Anti-Manipulation Laws

Although corners and other forms of manipulation have been against the law for almost a century, the enforcement of these laws has had a checkered history. There is a fairly extensive legal commentary about enforcement of the anti-manipulation provisions, and the cases brought under the CEA.[27] The overall judgment of this literature is well-summarized by the title of one article: "Manipulation: The Unprosecutable Crime" (Markham, 1991).

Most of the manipulation cases arising under the CEA have related to corners. The most notable of these was *Cargill v. Hardin,* (452 F. 2d 1154 (8th Circuit, 1971)), relating to events in the May, 1963 CBT wheat futures contract. Others decided by federal courts include *Great Western Food Distributors, Inc. v. Brannan,* (210 F.2d 474 (7th Circuit, 1950)), *G. H. Miller & Co.,* (260 F.2d (7th Circuit, 1958)), and *Volkart Brothers, Inc.,* (311 F.2d (5th Circuit, 1962)). Since the 1970s, the major corner cases have been

[27]See, *inter alia,* Hieronymous (1977), Bianco (1979), McDermott (1979), Van Smith (1981), Davidson (1985), Johnson (1985), Perdue (1987), Johnson and Hazen (1988), Lower (1991), Fischel and Ross (1991), Friedman (1991), and Harrington (2012).

decided by the CFTC, and therein lies the rub.

The most problematic Commission decisions are *in re Cox & Frey,* ([1986-1987 Transfer Binder] Commodity Futures Law Reporters(CCH) ¶23,786 (CFTC 1987)), *in re Cox,* ([1982-1984 Transfer Binder] Commodity Futures Law Reporters (CCH) ¶21,267 (CFTC 1989)), and *in re Indiana Farm Bureau* ([1982-1984 Transfer Binder] Commodity Futures Law Reporters (CCH) ¶21,796 (CFTC 1982)). Pirrong (1997) discusses these (and other cases) in detail, but a few serious problems with Commission reasoning stand out. In brief, the decisions fly in the fact of the economics analyzed above.

For example, in *Cox & Frey,* the Commission determined that the respondents could not have caused the price of wheat futures to become artificially high because their position was smaller than deliverable supply, in which the Commission included wheat in Kansas City. However, since shipment to Chicago was not the most efficient use of this wheat (export *via* the Gulf was), attracting this wheat to Chicago required shorts to bid it away from a higher value use. This diversion would have been costly, and as the analysis in Section 3.2 above shows, such costly diversions cause the supply curve to be upward sloping in the delivery market, which confers market power on a large long.

Echoing *Volkart, Cox & Frey* also faulted shorts for causing price distortions by failing to prepare to make delivery while holding positions late into the delivery month. This analysis is flawed for several reasons. First, since many shorts are out-of-position hedgers, it is inefficient for them to make delivery, and requiring them to deliver or prepare to deliver creates deadweight losses. Second, they have no unilateral option to liquidate their positions:

shorts with positions equal to those held by the large long can only exit by repurchasing their contracts from, or delivering to, him. Third, as discussed at Section 3.3 above, it is individually rational for cornered shorts to delay liquidation because of free rider problems. It is therefore inefficient, and/or impossible, and/or economically irrational for shorts to exit their positions at a non-manipulated price. If failure of shorts to do so exculpates the large long there is no legal obstacle to a long MPM because in successful corners some shorts will not exit.[28]

In *Indiana Farm Bureau,* the Commission ruled that a manipulator has to act with the "specific intent" of distorting prices. This is defensible, but the Commission's criteria for establishing intent is not: it evaluated intent at the time the respondent initiated its futures position, rather at expiration, when it allegedly exercised market power, and required that the defendant do something more than stand for excessive deliveries. The Commission's opinion stated

> where a long has not intentionally created or exploited a congested situation, the long has a contractual right to stand for delivery or exact whatever price for its long position which a short is willing to pay in order to avoid having to make delivery.[29]

The Commission also stated:

> where a long does not intentionally create the conditions for a squeeze, and a congested futures market arises from other causes,

[28] Commissioner West recognized this in his dissent in *Cox & Frey.*
[29] *In re Indiana Farm Bureau,* CFTC Docket No. 75-14, 21.

> often a 'natural' corner or low deliverable supply, manipulative intent may not be inferred where a long does not exacerbate the congestion itself but simply seeks the best price from the existing situation.

Since taking excessive deliveries or demanding a supercompetitive price is the essence of a MPM, and a long with a large enough position can exercise market power without creating a "congestion" (i.e., a small deliverable supply) or increasing his position near expiration, this decision effectively permits the most common form of MPM.

In recent years, the Commission has lamented that the strict intent standard of *IFB* has made it difficult to prosecute manipulations. Pirrong (2004) shows that this is not true in the case of corners, if intent is evaluated at the appropriate time, i.e., when an alleged manipulator exercises market power.[30] A comparison of the cost of acquiring soybeans for purported export and domestic process needs *via* delivery with the cost of acquiring them on the cash market shows that no competitive merchant would have chosen to take delivery, because these soybeans were around $.30/bu. more expensive than cash market soybeans. Ferruzzi's taking delivery of costlier soybeans provided strong evidence of its manipulative intent. As a general matter, manipulators must do things that are "uneconomic"–i.e., costlier than available alternatives–in order to manipulate. Identifying such uneconomic acts permits the determination of manipulative intent.

Prosecutions of trade-based manipulations have been somewhat more ef-

[30]In some circumstances, it is possible to evaluate manipulative intent at the time an alleged manipulator initiates a position. For instance, if its position actually increases its risk, it may be inferred that the position was not intended to be a hedge.

fective. The Commission's single courtroom victory in a manipulation case involved a trade-based manipulation (*DiPlacido v. CFTC,* 2009 US App. LEXIS 22692 (Second Circuit, 2009)). The Federal Energy Regulatory Commission prevailed against the head trader in Amaranth for his "bang-the-settlement" manipulations undertaken in 2006.

6.4 Improving Manipulation Law

Although there is considerable agreement among scholars that manipulation law has many weaknesses, there is little consensus on how to fix it. Divides occur on a variety of issues.

One divide relates to definitions: should manipulation be defined more precisely in order to provide regulators and jurists with better guidance? Many (including notably some legislators and regulators) prefer the open-ended definition, because of the problem identified by the *Cargill* court: if "the methods and techniques of manipulation are limited only by the ingenuity of man," an I-know-it-when-I-see-it-standard has its virtues. Others, including Markham (1991) and Williams (1996) argue that a definition lacking in specificity is a recipe for failure: generality increases the likelihood of both Type I and Type II errors. They advocate proscribing very specific forms of conduct, rather than a broad (and in their view unenforceable) ban on manipulation. Markham, for one, offers a long list of specific offenses that should be identified in statute as opposed to a broad ban on manipulation.

The Dodd-Frank Act's new anti-manipulation language takes the generalist approach: it proscribes "any manipulative or deceptive device or contrivance" without defining "manipulative," "device," or "contrivance." In

some sense, it therefore compounds the imprecision problem by adding more imprecise words.

Furthermore, as Pirrong (2011c) argues, it is particularly inappropriate in a commodity markets context, because it is adapted word-for-word from securities laws. As such, it is directed at information-based manipulations that are a primary concern in securities markets, and is ill-suited to target the MPMs that are the most acute concern in commodities markets, and which have flummoxed the CFTC and many courts. This is also the case of the FERC and FTC anti-manipulation rules. Moreover, there is always the temptation to contort fraud-based anti-manipulation rules in an attempt to prosecute MPM, which creates a substantial risk of yet more legal confusion, and increases the likelihood that market power manipulators will escape punishment.[31] Pirrong (2011c) argues that since MPM is the main concern in commodities markets, that the offense of cornering be defined more specifically in order to guide better the CFTC and courts.

Despairing of success in deterring manipulation by imposing penalties *ex post,* some scholars and practitioners have advocated *preventing* manipulation *ex ante* (Markham, 1991; Williams, 1996). Preventive measures include position limits, designing contracts that include delivery options, and giving exchanges the authority to intervene in the market when a manipulation ap-

[31]The case of *United States v. Radley,* 659 F. Supp.2d 803 (S.D. Tex. 2009), illustrates the problems with attempting to utilize a statute targeted at fraud and information-based manipulations to MPM. In that case, the United States Department of Justice argued that BP used fraud and deception to manipulate the propane market in February, 2004, and specifically declined to allege the offense of cornering, even though the case was a classic MPM. The presiding judge dismissed the charges on various grounds, including that the exercise of market power did not represent fraud, deceit, or misrepresentation. The judge's criticism of the DOJ's arguments was scathing.

pears to be in progress. Citing the criteria for establishing the superiority of prevention or deterrence identified by Shavell (1993), Pirrong (1995c) argues that done properly, *ex post* enforcement is preferable, in large part because much better information is available after the fact that permits more accurate judgments, i.e., a lower rate of both Type I and Type II errors. In particular, in the case of MPM, the ability to test for the existence of the burying the corpse effect provides a much more accurate appraisal of price impact, intent, and artificiality than a regulator or exchange would have when a manipulation is in progress. Further, as the Ferruzzi case demonstrates, exchange or regulatory intervention is only likely to occur when price distortions have become manifest.

With respect to position limits, Pirrong (1995c) argues that since limits tend to remain static for extended periods even though the susceptibility of a commodity to an MPM varies over time due to changes in supply-demand conditions, they will be unduly low and constraining at some times, and too big to prevent manipulation at others. Furthermore, position limits must exempt hedgers, lest they undermine the role of the futures market as a risk transfer mechanism. But commercial traders who would benefit from the exemption are often the most dangerous manipulators, and indeed, most of the major MPMs that have occurred in recent decades were carried out by large commercial traders, rather than speculators who would be subject to speculative limits.

Delivery options expand deliverable supply, and this can constrain market power. Furthermore, as shown by Gay and Manaster (1986) and Helmer (1990), they change the behavior of futures prices. Pirrong, Haddock, and

Kormendi (1994) show that these pricing changes can improve the hedging effectiveness of a futures contract.

Another matter of contention is whether futures exchanges have the efficient incentives and ability to prevent and deter manipulation, or whether government regulation and enforcement is necessary as well. A long line of scholars, including Easterbrook (1986), Edwards and Edwards (1984), Fischel (1986), Fischel and Ross (1991), Abolafia (1985), Kyle (1988), and Miller (1991) argue that self-regulation by exchanges is efficient. In broad strokes, these scholars argue that exchanges that adopt inefficient rules on manipulation suffer losses in trading volume as customers trade less, or shift business to exchanges offering more efficient rules. Easterbrook puts the point forcefully:

> It is plainly in the interest define the terms of contracts and establish rules that reduce of monopoly and manipulation . . . exchanges will do a great deal to police transactions. An exchange that neglects to take precautions-to find ways to certify that it will make these precautions cannot long survive.

Pirrong (1995b) objects to these claims on theoretical and empirical grounds. To the extent that an exchange's inframarginal customers bear the costs of manipulation, inadequate exchange precautions does not cause reductions in volume. Moreover, the nature of liquidity dulls competition between exchanges. Liquidity increases in volume, meaning that an entrant that attempts to compete against an incumbent exchange with a large volume but which fails to take adequate precautions against manipulation is

more expensive to trade on, and faces substantial entry barriers as a result. Furthermore, exchange intervention in a corner has large distributive effects, and raises questions about impartiality of the exchange as an enforcer of contracts. Abstaining from intervention reduces the rent seeking incentives and limits the role of the exchange to being an impartial arbiter of contract performance.

Consistent with these theoretical arguments, in the absence of government regulation, exchanges seldom took measures to prevent or deter MPM, even when it was rife: during the heyday of corners (1867-1914), the Chicago Board of Trade repeatedly turned back attempts to pass corner rules. In the US, regulation *mandated* exchanges to prevent and diminish manipulation because of widespread political pressure exerted by parties who believed that exchanges would not do so if left to their own devices.

7 Summary and Conclusions

Commodity market manipulation will always be with us, because fundamental economic considerations make it possible, and profitable. Economic frictions (such as transactions costs) that create fragmented cash markets, and liquidity considerations that favor consolidated (and often monopoly) futures markets, make market power manipulation feasible from time to time. Information asymmetries mean that trades move prices, and temporal asymmetries in information asymmetry, and trading strategies, mechanisms, and order types result in differences in price impact that trade-based manipulators can exploit. Information moves prices, and since lies are sometimes believed, fraud-based manipulation is also possible. These factors have been

present in commodity markets in varying degrees since their inception, and their very basic nature means that they are certain to remain so in the future.

The economic literature on manipulation has identified the analytical challenges to understanding manipulation, and has gone a long way towards addressing many of these challenges. Market power manipulation is particularly well understood because standard price theoretic tools and conventional empirical methods can be used to study it. Market microstructure theory and empirics shed light on what makes trade-based manipulation possible, and how to test for its existence and quantify its effects in particular instances.

Manipulation is an important public policy issue because of its potential efficiency and distributive impacts. These effects have resulted in the adoption of anti-manipulation measures in the United States almost a century ago, and more recently in Europe. Unfortunately, the regulatory and judicial treatment of manipulation does not adequately reflect, and in some cases contradicts, scholarly research on the subject. Incorporation of rigorous scholarship into manipulation regulation, legislation, and jurisprudence analogous to the way such scholarship has influenced anti-trust practice would make deterrence of manipulation cheaper and more effective, and thereby enhance the efficiency of commodity markets.

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Figure 1
July Soybean Futures Cumulative Residuals

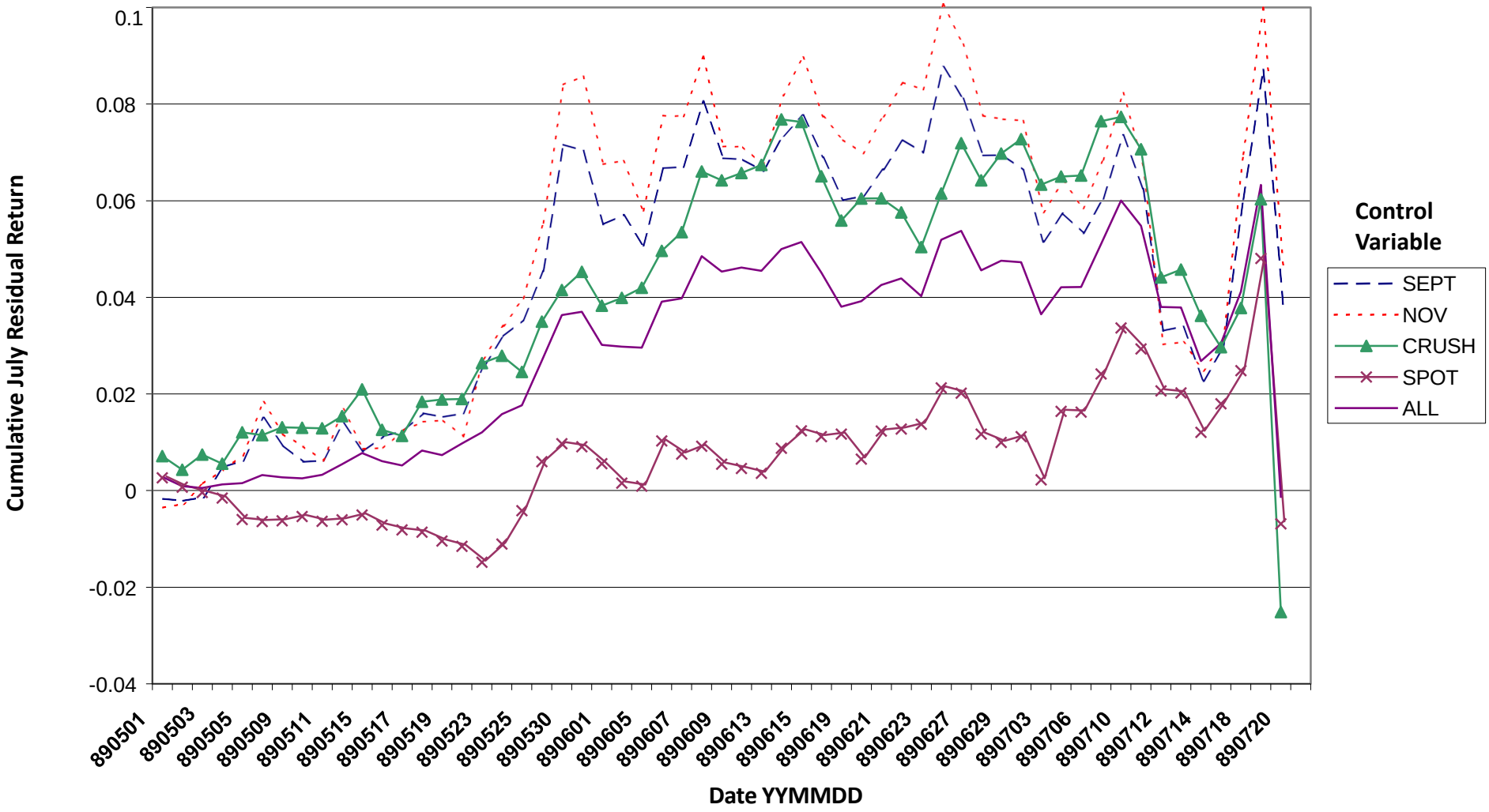

Figure 2
Change in May 2008 Gasoline Futures Price on Manipulation Dates