

**COMMODITY FUTURES
TRADING COMMISSION**

Notice of Proposed Rulemaking)	Rin Number 3038-AD27
Prohibition of Market Manipulation)	
17 CFR Part 180)	

**Comments of
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I. INTRODUCTION

The tremendous growth in size, importance and complexity of commodity markets make it essential that new regulations and oversight procedures be developed to assure the efficiency and integrity of commodity trading while not unnecessarily weakening its vitality. The authors¹ applaud the efforts of the Commodity Futures Trading Commission (“CFTC” or the “Commission”) and other agencies to fashion a balanced regulatory regime for commodity-related markets, and welcome the opportunity to comment upon the Commission’s Notice of Proposed Rulemaking on the Prohibition of Market Manipulation (hereafter the “NOPR”).²

In responding to the mandates of the Dodd-Frank Act, the Commission has proposed a two-pronged approach. The first relies heavily upon the fraud-oriented regime developed for the

¹ The authors are Principals of *The Brattle Group* who have been involved in several recent regulatory and court proceedings dealing with commodity price manipulation in the natural gas, propane and electric power markets. The opinions expressed herein are solely those of the authors. We would like to thank Dr. Shaun Ledgerwood for his invaluable assistance and our partners Paul Carpenter, Frank Graves and Jim Reitzes for the helpful comments and support.

² See 17 CFR Part 180, *Prohibition of Market Manipulation*, Commodities Futures Trading Commission, November 3, 2010, Vol. 75, at 67,657-67,662.

securities industry (Section 6(c)(1)).³ The second is a prohibition of manipulation broadly targeted at any conduct intended to illegitimately influence commodity or swap prices (Section 6(c)(3)). For this second prong, the Commission proposes continued reliance upon the traditional four-part framework developed in the context of manipulations involving market power and since applied more generally.⁴ As interpreted to date, neither of these approaches is well suited to detect or deter the types of behavior that are likely to be the most problematic in commodity-related markets. Commodity manipulations are typically effected through transactions without overt misrepresentations, and thus they lack the traditional elements of fraud.⁵ Similarly, there may be both the incentive and ability to engage in transactions intended to influence the price that may be effective even without the traditional trappings of market power.

The lack of a properly laid foundation for assessing manipulation in commodity markets will complicate the fashioning of an effective enforcement structure as well as limit deterrence, which is the primary purpose of anti-manipulation efforts. Vagueness will permit errors of both over and under inclusion, allow enforcement policy to vary widely and both confound enforcement efforts and reduce market efficiency.⁶ Delay in determining enforcement structure, and thus the boundaries between legitimate and illegitimate behavior on a case-by-case basis will undercut the primary objective of the proposed regulation. Market participants will frequently find themselves in a large gray area between the poles of fraud and market power, and certain manipulative actions will likely be undeterred.

This need not be the case. As discussed in more detail below, a definition of transaction-based manipulation that has elements of both fraud and market power could provide a useful framework for assessing potential violations. This definition, which focuses upon anomalous price-making behavior intended to benefit the manipulator's related price-taking positions,

³ *Id.* at 67,658.

⁴ *Id.* at 67,660. The latter standard requires the proof of an artificial price, whereas the former does not.

⁵ Commodity markets differ in significant ways from securities markets, and as various commentators have noted, they are more vulnerable to manipulative activities reflecting elements of market power. See *Infra* notes 8 and 9.

⁶ Tension between the fraud and market power foundations of manipulation has sparked considerable academic discourse, but more importantly it has created ambiguity in the definition of manipulation and impeded effective enforcement. *Id.*, at 12-13

involves generalization of fraud concepts of the sort already reflected in the NOPR and the approaches of other agencies with oversight of commodity markets, and it is sufficiently flexible to cover the exercise of market power.⁷ The proposed definition also provides a model for quantifying an accused manipulator's incentives and identifies data that should be of interest for monitoring purposes. It also would provide a basis for gauging market impacts in some circumstances, an element lacking in the proposed regulatory scheme.

A workable definition of manipulation, while useful in establishing the necessary elements of manipulation, still leaves many questions unanswered both with regard to individual enforcement actions and overarching policy matters with which the Commission must grapple. At the policy level, how much manipulation is too much? After all, efficient trading also affects prices, especially in thinly traded products. In antitrust, the concept of workable competition recognizes that few markets are perfect and some degree of deviation from perfection must, as a practical matter, be tolerated given limited regulatory resources and the potential to chill legitimate market activity. In enforcement actions, even where activities fit our proposed definition of manipulation, the Commission would still be faced with finding the behavior intentional. Even if intended, might it have been undertaken for a legitimate business purpose? In volatile, dynamic markets, where participants may have many trading locations with differing market presence, objectives, and risk management strategies, these are challenging issues. Defining manipulation explicitly would create clearer standards that allow the Commission and other interested parties to properly identify *actual* manipulated transactions and gauge their impacts. This would provide much needed regulatory certainty to market participants with respect to assessing the legitimacy of specific trading activities and allow the Commission to better focus its limited resources.

⁷ Because manipulations are likely to involve both physical and financial positions across markets and a manipulation is likely to be implemented in a physical market in order to benefit financial positions dependent upon the physical price, working to ensure well functioning physical markets that are transparent and competitive should be a primary objective of all anti-manipulation efforts.

II. TOWARD A WORKABLE DEFINITION OF MANIPULATION

The lack of a clear definition of price manipulation has left enforcement efforts with a checkered history.⁸ This has led some to argue that in commodity markets in particular, the law must be revised to distinguish market-power-based manipulation from that based upon fraud and to provide more guidance on what constitutes manipulation in the market power context.⁹ It is true that certain aspects of commodity markets differ substantially from securities markets in ways that make them less prone to fraud¹⁰ and more vulnerable to the exercise of market power.¹¹ It is also true that fraud and market power have very different legal roots. Nevertheless, it seems less fruitful to distinguish two separate strains of manipulation than to recognize that in the commodities industry, manipulation will frequently have elements of both fraud and market power.

Indeed, the Commission has followed the fraud and market power routes to nearly the same spot. The fraud oriented regulation proposed by the Commission to effect CEA Section 6(c)(1) makes it unlawful for market participants *inter alia* to intentionally or recklessly employ a manipulative device, scheme or artifice, to engage in any act or course of business, or to make untrue or inaccurate statements to deceive or defraud.¹² The Commission proposes that the statute be given a broad reading to embrace “the use...of any manipulative or deceptive contrivance for the purpose of impairing, obstructing or defeating the integrity of the markets...”¹³ Proof of the common law elements of reliance, loss causation and damages is not required. To implement the prohibition relating to “other” manipulative activity in CEA Section 6(c)(3), the Commission offers a regulation making it unlawful to directly or indirectly manipulate or attempt to

⁸ For a comprehensive overview through 1990, see, *Manipulation of Commodity Futures Prices – The Unprosecutable Crime*, Jerry W. Markam, Yale Journal on Regulation, Vol. 8, No. 2, p. 281-389 (1991).

⁹ See, Pirrong, Craig, *Energy Market Manipulation: Definition, Diagnosis, and Deterrence*, Energy Law Journal, Vol. 31, No. 1, (2010) at 1-2.

¹⁰ In its recent NOPR on Prohibitions on Manipulation in crude oil and petroleum products markets the FTC noted that market participants were generally large, sophisticated entities, more capable of self-protection than small investors in securities. It also noted the broader disclosure requirements in the securities industry upon which investors rely. See 16 CFR Part 317, *Prohibition of Market Manipulation Final Rule*, Federal Trade Commission, Federal Register, Vol. 74, No. 154, pp. 40686, 40690 (August 12, 2009). (Hereafter, “FTC Final Rule.”)

¹¹ Pirrong, *supra* note 9.

¹² NOPR at 67,658 – 67,659.

¹³ *Id.* at 67,659.

manipulate the price in covered transactions. Again, the Commission intends a broad interpretation to include “every effort to influence the price of a swap, commodity, or commodity futures contract that is intended to interfere with the legitimate forces of supply and demand in the marketplace.”¹⁴

This apparent move toward common ground merely reflects the frequent overlap of fraud and market power elements in commodity price manipulation. To be sure there are cases that fall relatively cleanly into one paradigm or the other. Overt misrepresentation of transaction data to publishers of commodity price indices, or creating rumors of scarcity, are examples of fraud in the traditional paradigm. On the other hand, a “corner,” whereby a trader acquires a large portion of the commodity underlying futures contracts, or a “squeeze,” in which a trader acquires a large number of futures contracts and demands delivery of the underlying commodity to create a shortage, are examples of traditional market power-based manipulations. However, these examples are exceptions.

As a rule, commodity manipulations are not accurately described as the exclusive product of either traditional fraud or market-power, but instead reflect elements of both concepts. In these cases, the manipulator has some ability to move a price, but without traditional indicia of market power such as control over a large portion of the supply of a physical commodity or a large portion of the total amount of long or short futures contracts.¹⁵ Furthermore, unlike the typical exercise of market power, manipulative price movements may run counter to the perpetrator’s stand-alone self interest in one market, resulting in losses, in order to reap a greater gain from a position in another, related market. They may even occur to increase volatility, without generally moving the price in either direction. Similarly, although such manipulative commodity transactions “misinform” other market participants through the price and/or volume information observed in the marketplace, there is no overt misrepresentation of information to the public such as is found in the traditional fraud paradigm.

¹⁴ *Id.* at 67,660.

¹⁵ The ability to move the price in the absence of traditional indicia of market power may be particularly prevalent in commodity markets that rely on voluntary reporting of fixed-price transactions to trade publications for market index price information. Such reporting may be very illiquid in certain markets and thus susceptible to price manipulation. See copy of 2009 Analysis of Physical Gas Market Transactions, Federal Energy Regulatory Commission, December 16, 2010 (attached).

The Commission has the opportunity through this rulemaking to further refine and modify its prohibition of “Other Manipulation in Section 180.2 in a manner that reflects these realities of commodity markets by incorporating both fraud and market power elements.¹⁶ A proposed definition is as follows: *Manipulation is engaging in anomalous price-making behavior¹⁷ intended to alter a price in order to profit in affected price-taking transactions.*¹⁸ Manipulation thus defined can be interpreted as a form of fraud whereby anomalous behavior (non-economic, stand-alone transactions for the actor) injects false or misleading information into a market thus impairing its integrity.¹⁹ Although sounding in fraud and requiring only the ability to influence price, the definition is sufficiently flexible to include the traditional monopoly withholding where an entity foregoes economic sales (anomalous price-making behavior) by withholding supply.²⁰ Foregone sales on the margin elevate the price received in infra-marginal (price-taking) transactions. Consistent with unilateral market power (monopoly) analysis, when considering the benefit to an entity engaging in manipulative behavior, the losses in price-making transactions are weighed against gains in price-taking transactions to examine the overall gain for the accused manipulator.²¹

¹⁶ Note that the definition would not apply to manipulation based solely upon overt, fraudulent misrepresentation under Section 180.1.

¹⁷ Anomalous price-making behavior could be either engaging in transactions that themselves are not economic for the actor or foregoing transactions that would be economic.

¹⁸ See, Ledgerwood, Shaun D., Screens for the Detection of Manipulative Intent (December 19, 2010). Available at SSRN: <http://ssrn.com/abstract=1728473> (hereafter, “Ledgerwood”, copy attached). As far as the authors are aware, Dr. Ledgerwood’s model that describes the use of price-making transactions to benefit price-taking positions is the first to formally characterize the use of uneconomic behavior to effect a manipulation. See also *Prepared Testimony of Dr. Paul Carpenter*, Exhibit No. S-3, FERC Docket No. IN06-3-003, September 26, 2008.

¹⁹ Because fraudulent or deceptive conduct within wholesale petroleum markets injects false information into the market process, it distorts market data and thus undermines the ability of consumers and businesses to make purchase and sales decisions congruent with their economic objectives. See FTC Final Rule, at 40,688. The Supreme Court has defined “the term [manipulation to refer] generally to practices, such as wash sales, matched orders...that are intended to mislead investors by artificially affecting market activity.” See, FTC Final Rule at 40,688, n. 35, quoting *Santa Fe Indus., Inc. v. Green*, 430 U.S. 462, 476 (1977).

²⁰ While consistent with monopoly concepts, the proposed definition of manipulation need not be limited to traditional market power manipulations such as corners and squeezes.

²¹ As in monopoly analysis, the manipulator’s profit is maximized when marginal gains are offset by marginal losses and marginal benefits fall to zero. See, Ledgerwood, at 32-42 for a detailed description of

The benefits of this more specific definition of manipulation are numerous and significant. It provides an analytic framework for quantitatively assessing the ability and motivation of an alleged manipulator. The ability to manipulate a market and the target market's vulnerability to manipulation, could be assessed by examining such factors as the liquidity of the market, the alleged manipulator's market presence, the spreads between bid and ask prices, the elasticity of demand and supply for the product, logistical or temporal constraints affecting supply of the product, or other factors relevant to the underlying commodity market that could be systematically identified.²²

Under this definition, the motivation for an alleged manipulation can be assessed by examining the accused manipulator's positions in related markets that benefit from the price movement achieved or attempted. Here the marginal profit functions of the alleged manipulator's positions in related markets dependent upon the manipulated price, and the magnitude of those positions, would be combined with the marginal profit function in the targeted market. A combined marginal profit function indicating that the alleged manipulator stood to benefit would provide evidence of motive.²³

The factors relevant to assessing the means and motive for manipulation suggest the data that might be collected and monitored on an ongoing basis, as well as screens that could be developed as indicators of market vulnerability and the incentives of market participants to engage in manipulation. While the fact that anomalous price-making behavior aligned in a particular instance with market vulnerability and the incentive to manipulate would provide some evidence of the alleged manipulator's intent, a correlation of these elements over time would strongly support an inference of the necessary scienter.²⁴

profit maximization in the context of manipulation relating to Firm Transmission Rights (FTRs), a form of swap in electricity markets.

²² See Ledgerwood at 14-18.

²³ Clearly, this depends upon the Commission's ability to collect and to process the large volumes of data associated therewith. In the absence of (or in advance of) such reporting, preliminary screens focusing upon the price-making trades are needed. See the discussion below in Section III.

²⁴ For example, see tests proposed in Ledgerwood Section 4 at 41-53.

The proposed definition of transaction-based manipulation also offers a potential framework for assessing market impact in some instances.²⁵ An evaluation of the directional impact which price-making transactions would have upon price-taking positions would provide evidence of the intent to manipulate.²⁶ Further, removal or repricing of anomalous price-making transactions that alter the market price may in some circumstances permit a “but-for” determination of the price that would have resulted in the target market absent the accused’s manipulative behavior.²⁷ The required analysis would depend upon comprehensive bid and offer data that are available in some markets, such as RTO operated electricity markets, but may be lacking in others. The ability to demonstrate causation and to quantify the impact of manipulation in this way might provide meaningful information regarding the scale of the crime relative to other manipulations or the appropriateness of candidate remedial options.²⁸

By establishing a necessary but not sufficient standard for manipulation, the proposed definition should focus Commission resources where they will most count by limiting the time spent on activities that fail to involve the necessary elements. Where price-making transactions are economic or are undertaken with an insufficient price-taking position to offset losses, for example, there is no case for manipulation.²⁹ As set out below, even with a workable definition of manipulation, the Commission will have much to do to establish reliable boundaries between acceptable activities (such as legitimate hedging) and those that merit the resources required to detect and remedy them through Commission enforcement actions or changes in regulations.

²⁵ The framework would not apply to manipulations based purely upon fraudulent representations under Section 180.1.

²⁶ Ledgerwood at 51-52.

²⁷ This is not always the case. For example, a manipulator can frame the open such that future trades occur around the opening price, thus resulting in no evidence of a “but for” price. See Ledgerwood at 52-53.

²⁸ The Commission’s quandary over the need to measure impacts is evident in the NOPR. With regard to violations under CEA Section 6(c)(1) it states: “...the common law elements of fraud, reliance, loss causation and damages are not needed to establish a violation...”, but then immediately recognizes that these “...may be relevant in any Commission determination of the appropriate penalty of remedy for a violation.” NOPR at 67,660. When addressing violations under Section 6(c)(3), after a discussion of the use of a conclusive presumption of price artificiality in *DiPlacido*, the Commission observes: “... the Commission recognizes that economic analysis may in some cases be appropriate to determine whether the conduct in question actually caused an artificial price. The Commission stresses, however, that an illegal effect (sic) on price can often be conclusively presumed from the nature of the conduct in question and other factual circumstances not requiring expert economic analysis.” NOPR at 67,661.

²⁹ There may, however, be a case for attempt. Assessment of price-taking incentives requires information on all positions affected by the price, raising concerns about the comprehensiveness of the data available to the Commission.

III. ENFORCEMENT CHALLENGES

Striking a reasonable balance between regulation and market forces remains a challenge even with a sound definition of manipulation, particularly in an illiquid market. The Commission must still grapple with difficult issues at the “actor” level, largely involving questions of identifying nefarious intent, and with policy-level questions regarding the manipulative activities that deserve to be targeted vs. ignored for enforcement actions. In contexts exclusively involving fraud or market power, these sorts of questions have been addressed, if not resolved, though they are still difficult and case-specific. However, in the context of manipulation of complex and dynamic commodity markets, these issues will likely need to be revisited, and will be more difficult. Additional challenges arise from the volume and complexity of the data and analyses needed for effective enforcement.

A. ACTOR ISSUES

Like the regulations proposed by the Commission under Sections 6(c)(1) and 6(c)(3), the definition of manipulation offered above includes the element of intent.³⁰ As the Commission has recognized, intent may be lacking where the offending activity was undertaken by mistake.³¹ In the context of market power, even intentional actions may be permitted where they are undertaken for a legitimate business purpose.³² In the context of manipulation, the accused must not only intend to act, but must further intend to act manipulatively.³³

Trading in commodities and related futures and swaps is dauntingly complex. Although perhaps separate in the sense of formal product definition, physical commodity markets are often linked as are the physical and related financial derivatives markets. Natural gas prices may drive electric power prices and crude oil and gasoline prices affect one another, and spark and crack spreads are swaps that formally span such markets. Within a single corporate entity there may be numerous affiliates; each with many traders in diverse locations trading in a wide array of

³⁰ See, NOPR at 67,659 for Section 6(c)(1) and at 67,660 for Section 6(c)(3).

³¹ See, *e.g.*, NOPR at 67,662; CEA Section 6(c)(a)(A) [as amended by the Dodd-Frank Act, Section 753].

³² *Aspen Skiing Co. v. Aspen Highland Skiing Corp.*, 472 U.S. 585, 597 (1985) (upheld jury instruction stating “In other words, if there were legitimate business reasons for the refusal, then the defendant, even if he is found to possess monopoly power in a relevant market, has not violated the law”).

³³ The Commission has softened this requirement to include acting with reckless disregard. NOPR at 67,659.

markets with differing short and long-term objectives. Prices vary widely in the normal course of business. In this environment, it is obviously possible that traders might buy or sell without knowledge of how their activity would impact positions implemented by others, perhaps even others within their own corporate organization. A trader, for example, might liquidate a long gas position in a declining market to limit losses not realizing that another trader in the same or a related firm holds spark spreads dependent upon the gas price.

Current hedging and risk management practices will also complicate the picture. Hedging necessarily involves investments designed to gain precisely when losses would be expected in other positions exposed to a particular risk.³⁴ Under enterprise wide portfolio risk management, transactions may be executed not to hedge any specific position, but rather to balance exposure to certain kinds of losses seen in the overall portfolio of holdings. Such transactions might often occur as commodity contracts approach expiration and may even be implemented through computerized trading programs executed without human intervention. Transactions involving losses in specific markets may also be driven by such factors as credit or the desire to prevent further losses. Given the uncertainty in commodity markets, such activities reflect legitimate business purposes, yet *ex post* analysis could frequently snare them in screens seeking trading patterns consistent with manipulation. Screens thus must be carefully designed and applied. We further discuss potential screens in Section III.C. below.

B. POLICY ISSUES

Even where evidence of manipulation is clear, there may be good reasons to forgo enforcement activity. Perfect competition is an economic paradigm rarely realized. The concept of workable competition reflects this fact by declaring that some degree of deviation from perfection should, as a matter of policy, be accepted by regulatory authorities as below the level meriting their attention. Antitrust law permits the exercise of fairly acquired market power as long as competition is not otherwise impaired because market forces should respond to correct the situation without regulatory intervention.³⁵ Finite resources, the complexity of the problem, and

³⁴ In the perfectly implemented hedge, gains and losses match exactly. In the real world, however, hedges may over or undershoot resulting in gains or losses.

³⁵ *Aspen Skiing Co. v. Aspen Highland Skiing Corp.*, 472 U.S. 585, 597 (1985). In fact monopoly rents provide the incentive for other actors to compete away the monopolist's advantage.

the simple imperative of regulatory efficiency will require the Commission to limit and focus its activities to maximize the impact of its enforcement.

In determining where to focus its resources, the Commission can rely upon principles of market integrity³⁶ and market efficiency³⁷ already stated in the NOPR. When parties interested in trading shun markets for lack of confidence in the reliability of information or pricing, markets cannot but fail to deliver on their potential. Where market prices do not reflect accurately the forces of supply and demand, society's resources are misallocated. Ideally the Commission would concentrate its efforts where market integrity and efficiency are most impacted by manipulation. This is likely when a party willingly behaves uneconomically to wrest value not through superior business acumen, but rather through the willingness to employ an artifice to the detriment of other market participants.³⁸ Here again, the definition we have proposed could be beneficial because it provides a framework for measuring the impacts of manipulative activity. Without such measures it will be difficult, if not impossible to address such questions as "How much manipulation-related market distortion is tolerable?" or "Which potential market manipulation should be of greatest concern to the Commission?"

C. DATA COLLECTION AND MONITORING ISSUES

While the definition of manipulation proposed herein is quite simple in concept, application in the commodities industry requires careful and thoughtful implementation. Although preliminary analysis of the uneconomic, price-making trades that trigger manipulative transactions is relatively simple,³⁹ the ultimate application of the conceptual definition, or manipulation "model," requires assessment of the trader's net aggregate exposure across all related markets to price movements caused by an alleged manipulation. As indicated above, the relationships among markets (such as physical and futures markets) and market participants could be extremely complicated. They are also dynamic: companies appear and disappear; affiliates are bought and sold or merged; trading practices evolve, new instruments are developed, and moribund instruments lapse; positions change rapidly; and trading frequency and volumes are

³⁶ See, NOPR at 67,659.

³⁷ See, NOPR at 67,660, n. 36 and associated text.

³⁸ Ledgerwood at 16.

³⁹ Ledgerwood at 44.

high and spread across numerous geographic venues and time zones.⁴⁰ The data may be natively jurisdictional to different regulatory authorities that have inconsistent reporting requirements and incongruous monitoring and enforcement programs. Real-time documentation of commodity transactions involves tremendous volumes of data that often contain errors and inconsistencies that take considerable time and effort to correct, process, accumulate and analyze.

The model we propose, given our market manipulation definition, requires careful implementation as to the collection and analysis of data. Determination of the first element of the model, anomalous behavior, is also not straightforward. In most commodity markets and for many suppliers, whether or not a transaction is economic depends upon opportunity costs rather than marginal production costs, and these may not be readily available.⁴¹ With regard to the second element of the manipulation model concerning trader aggregate exposure in price-taking positions, the assembly, maintenance and monitoring of a comprehensive real-time database on trader positions over time, even if feasible, may not be a sensible use of resources. Historically, the assessment of individual traders' relevant positions has proven to be a complex exercise better left until there is sufficient suspicion of manipulation to merit further investigation. This, of course, still requires that the Commission mandate⁴² and enforce⁴³ preservation and reporting of relevant position information in a format that would allow for meaningful transactional analysis to commence.⁴⁴ We recognize that the Commission has proposed to obtain necessary

⁴⁰ Some of a trader's long position may physically be in a storage tank or on a ship invisible in any exchange data.

⁴¹ Ledgerwood at 47-49.

⁴² In mandating position reporting the Commission must weigh the need for information against the practical burdens of producing and collecting it. Since companies generally develop daily position reports for their own internal purposes, these, placed in a standard format, might be an appropriate requirement for market participants. Real-time transaction data from exchanges could, of course, be preserved for detailed analysis where potential manipulation is detected through screening.

⁴³ The experience of the FERC is instructive in this regard. When California energy markets whirled out of control the FERC instructed its staff to analyze the situation. Only then was it discovered that transaction data reported under Commission mandate was wholly inadequate to the task due to lax reporting. See, Letter from Donald J. Gelinas, Director, FERC Office of Markets, Tariffs and Rates to All Jurisdictional Sellers and Non-Jurisdictional Sellers in the West, Docket No. PA02-2 (March 5, 2002).

⁴⁴ Since manipulations relevant to swaps subject to CFTC oversight will often occur in physical commodity markets, the Commission must coordinate data collection with agencies with jurisdiction over these markets.

information to perform its enforcement obligation.⁴⁵ The Commission should encourage other agencies with jurisdiction over the underlying commodities to screen for systemic uneconomic behavior in instruments that set the prices that can be used to trigger manipulations and to report these findings to the Commission.⁴⁶

The difficulties associated with exhaustively testing for manipulation dictate the use of screening mechanisms to identify transactions and market participants meriting further investigation to make the most efficient use of the Commission's scant resources.⁴⁷ If screens applied to price-making trades point to potential manipulation, the Commission would assess the second element of the model by assembling information regarding how price-taking positions held by the potential manipulator would or did benefit from anomalous transactions in the target market.⁴⁸

Where potentially manipulative patterns are found in price-making transactions to the benefit of leveraged price-taking positions, a question will arise as to whether or not the behavior served a legitimate business purpose for the accused. Did the transactions undertaken,⁴⁹ standing alone, benefit their instigator? If so, it will be very difficult for a manipulation claim to prevail. If not, the Commission may prove manipulative intent by using the same screens used to identify the manipulative behavior, thus demonstrating that the actor willingly engaged in uneconomic price-making transactions to benefit its aggregate price-taking position.

As noted earlier, calculating economic gain may depend upon the determination of opportunity costs. In many cases, these could be reasonably approximated for screening purposes without complex economic modeling. Profitability measures may not prove informative, as they can be

⁴⁵ The Commission has issued various Notice of Proposed Rulemakings on reporting requirements (*e.g.*, 17 CFR Parts 15, 20, and 43) and on Core Principles and Other Requirements for Designated Contract Markets, 17 CFR Parts 1, 16, and 38.

⁴⁶ Examples of other agencies include the Federal Trade Commission for the petroleum physical market and the Federal Energy Regulatory Commission (FERC) for the electricity and natural gas spot markets. In October 2005, the Commission and the FERC issued a memorandum of understanding (MOU) regarding the sharing of information and the confidential treatment of proprietary energy trading data. Later this month, additional MOUs between the Commission and the FERC are expected.

⁴⁷ Ledgerwood at 41 *et. seq.*

⁴⁸ Obviously, some or all of the screening process might be avoided where another market participant complains that certain behavior is manipulative.

⁴⁹ In the case of withholding one question whether transactions not undertaken would have benefitted the supplier.

large and abrupt due to luck and leverage, and will be complicated where trades made over multiple periods are not independent,⁵⁰ or where manipulative trading behavior has severely biased the market. In most cases, the identification of anomalous price-making transactions facilitates the ability to examine the directional impact of those trades on price-taking positions, and may ultimately allow for the calculation of a “but for” price for comparison to the observed price if data on supply and demand, (or offer and bid data) are available. Since the ownership of leveraged price-taking positions is the *sine qua non* of manipulative activity,⁵¹ and because such transaction data should be available to the Commission, this is where the Commission must ultimately look to confirm manipulative signatures.

Before looking for manipulative trading patterns, it may be worthwhile to identify markets or time periods particularly amenable to manipulation. This would entail assessment of factors discussed earlier including:

- Liquidity (*e.g.*, Open Interests, Trading Volumes);
- Bid-ask spreads;
- Supply and demand elasticity (supply and demand bid curves);⁵²
- Market structure;⁵³ and
- Temporal or logistic constraints such as contract expiration or transmission congestion.
- Price differentials (convergence) between spot and futures contracts of the underlying commodity as proposed by the Commission.⁵⁴

Within susceptible markets, screens would search price-making activity for indicative patterns.

These might include:

⁵⁰ A coal plant operator, for example, may find it economically rational to bid at very low levels and incur losses in off-peak periods to assure the unit remains running thus avoiding shutdown and restart costs.

⁵¹ Ledgerwood at 37-38.

⁵² Ledgerwood at 16-18.

⁵³ While traditional thresholds for market power in terms of Herfindahl-Hirschman Index (HHIs) or market shares may not be very helpful in assessing commodity markets, other approaches such as pivotality or residual supply indices (“RSI”) may provide useful information. Various RTOs in the electricity markets, such as California Independent System Operators, Pennsylvania-Jersey-Maryland, and Midwest Independent System Operator, utilize one form or another of RSI to monitor competitive conditions in their wholesale electricity markets.

⁵⁴ See CFTC, 17 CFR Parts 1, 16, and 38, *Core Principles and Other Requirements for Designated Contract Markets; Proposed Rule*, December 22, 2010 at 80,583.

- Large or frequent price movements driven by a single market participant;⁵⁵
- Price-making transactions of a market participant frequently and significantly above or below average prices or a price index formed using the transactions;⁵⁶
- Bids that consistently raise or lower prices;⁵⁷
- Correlation of bids or price-making transactions with market susceptibility or other market conditions; and
- Repeated behaviors such as these by a market participant over time.

In complex markets, where manipulative activity is limited only by man’s ingenuity, many other such screens might prove constructive. Likewise, no single screen will prove sufficient or reliable, with any test having significant risks of “false positives” or “false negatives.” We encourage the Commission to favor screens that will provide a straightforward, transparent evaluation of manipulative intent. Should the screening indicate behavior consistent with the definition of manipulation, the Commission would have to decide whether or not to investigate further. Information from the screening analysis on the actors implicated, the markets affected, the size of the price movements in target markets, the magnitude of apparent manipulator gains and the frequency and temporal patterns of manipulative activity⁵⁸ would obviously be useful in the Commission’s deliberations on how best to proceed.

IV. CONCLUSION

The Commission faces an unenviable task in developing an approach for limiting manipulation in commodity-related markets that strikes a reasonable balance between meritorious regulatory objectives and legitimate market interests. It is handicapped in this effort by the lack of a workable definition of manipulation based upon transactions reflecting elements commonly found in commodity price manipulations. We urge the Commission to adopt such a definition

⁵⁵ Our discussion treats only manipulation by individual market participants. Obviously, markets may be affected by multiple manipulators acting in concert or individually in parallel.

⁵⁶ In markets with normal distributions and numerous transactions the probability that any particular trader’s transactions will frequently fall significantly above or below the average is quite small. See, Ledgerwood at 44 et. seq.

⁵⁷ Because attempted manipulation is also actionable, even unsuccessful bids may prove of interest if the bidder held price-taking positions that stood to gain from such bids.

⁵⁸ Frequent repetition of manipulative patterns should obviously be of greater interest for enforcement activities.

for transaction-base manipulation that encompasses both misinformation intentionally injected into the market and an alteration in price effected by the manipulator, elements sounding respectively in fraud and market power.

The proposed definition is general in nature. It does not proscribe specific activities, but it does provide behavioral guidance to market participants and would sharpen the boundary between legitimate and illegitimate activities. It also provides a conceptual framework currently lacking for quantitative assessment of manipulator incentives and gains and for measurement of potential market impacts of manipulative activity. The additional clarity regarding manipulative activity and its effects provided by the definition would enhance the deterrence value of the Commission's regulatory efforts.

A sharper definition of manipulation would also help the Commission focus its limited resources where they will be most beneficial.⁵⁹ Analytic screens derived from the definition would identify potential manipulative activity so the Commission might better target enforcement actions. By establishing a necessary minimum hurdle for manipulative behavior, the Commission could move on and spend its time addressing the next level of actor and policy issues that must be resolved effectively to balance regulatory and market interests.

⁵⁹ In addition, coordinating efforts across entities with jurisdiction over physical markets and derivative financial markets to provide for transparency and workable competition in the physical market will render many forms of manipulation difficult.



FEDERAL ENERGY REGULATORY COMMISSION

2009 Analysis of Physical Gas Market Transactions

Using FERC Form 552 Submissions

Item No: A-3
December 16, 2010

Mr. Chairman, Commissioners. Today I am pleased to present the Office of Enforcement's analysis of physical gas market transactions for 2009, using FERC Form 552 submissions.

FERC Form 552

- Collects data on physical gas purchases and sales volumes
- Collects data on market participants that bought or sold more than 2.2 Trillion Btu of physical gas a year

Order No. 704 had its genesis in the Energy Policy Act of 2005, where section 23 of the Natural Gas Act authorized the Commission "to facilitate price transparency in markets for the sale or transportation of physical natural gas in interstate commerce." On December 26, 2007, the Commission issued Order No. 704, which imposed an annual reporting requirement on certain natural gas market participants.

Last year, the Commission began collecting information in its "Annual Report of Natural Gas Transactions" (Form 552) to shed light on the use of published price indexes by the gas industry and to better understand the fixed-price transactions that contribute or could contribute to published monthly and daily gas price indexes.

Form 552 collects information from market participants that sold and purchased 2.2 million MMBtu or more of physical gas in the reporting year, roughly the amount of gas used by a 90-MW peaker power plant running everyday for 9 hours.

FERC Form 552

[cont.]

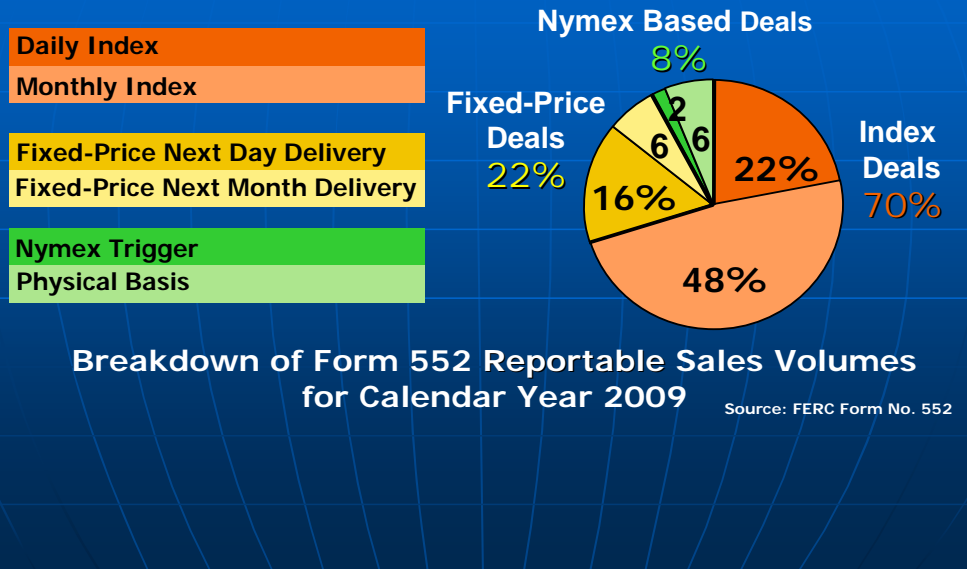
- **Reports total volumes for the following transactions:**
 - **Published daily or monthly indexes**
 - **Fixed-priced next-day delivery**
 - **Fixed-priced next-month delivery**
 - **Nymex trigger agreements**
 - **Physical basis**

Form respondents report aggregate transactions that use published daily and monthly indexes, aggregate transactions for fixed-price next-day or next month delivery that could be used in an index and certain monthly transactions that are based on Nymex trigger agreements and physical basis.

This information helps Market Oversight and the public understand the market's level of reliance on published price indexes. It also helps clarify the types of participants that contribute to and rely on those indexes for pricing information. Additionally it allows us to understand the size of the wholesale market for physical gas. The data collected for 2009 shows that the respondents who reported fixed price transactions to index publishers accounted for just 11% to 13% of the total gas volumes reported on by Form 552 respondents. Thus, the data indicates that index publishers are deriving their index prices from a relatively small amount of gas volumes. That a relatively small amount of gas volumes are being used to determine index prices may be a matter of some concern as a number of indexes are used to set the price of physical and financial gas contracts.

Form 552 does not attempt to catalog all possible kinds of physical market transactions, although we do think we are capturing a large portion of the market. Because the data are aggregated by company or company subsidiary, it is not a tool to uncover confidential commercial information.

Index Volumes Dominate Transactions



For calendar year 2009, we received Form 552 submissions from 700 respondents, which included corporate subsidiaries and which accounted for 2,057 companies. Respondents reflected the entire spectrum of the gas industry, including producers, marketers, LDCs, generators and industrial customers.

Total reported physical gas market transactions amounted to almost 56 Tcf, about 2.5 times domestic marketed production in 2009 of 22 Tcf. Reported transactions are a multiple of the physical gas market because the same gas can be resold several times between producers and consumers. For example, if a producer sells to a marketer who sells to an end user, the same gas supply has been involved in two transactions.

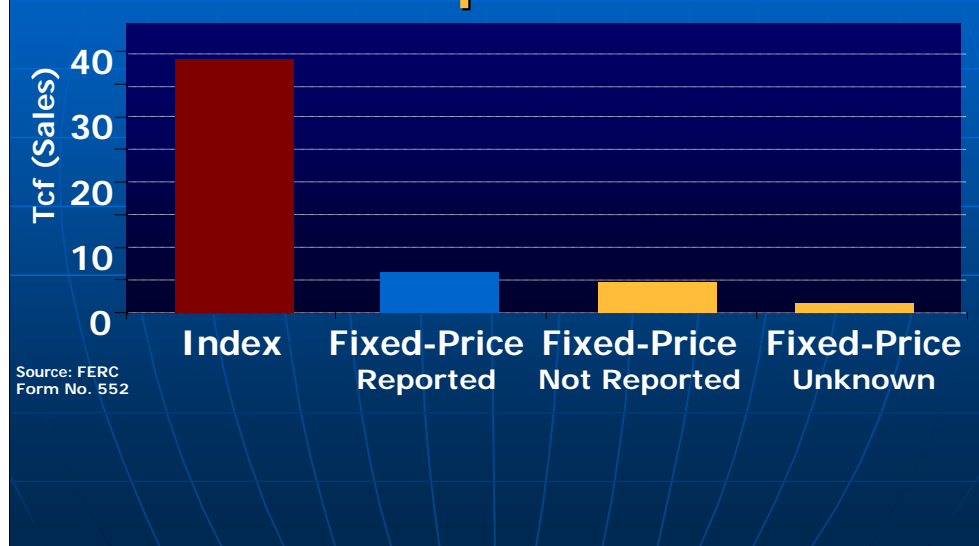
Our analysis of the 2009 data shows that:

Transactions at a published index price accounted for 70% of reported volumes, and more than two-thirds of those transactions were based on next-month indexes.

Taken together, fixed-priced transactions from bilateral deals for next-day and next-month gas accounted for 22% of total volumes. And of those, daily fixed-price deals are the majority.

Transactions based on Nymex, such as Nymex trigger and physical basis agreements, represented about 8% of reported volumes.

Index Prices Derived from Low Amount of Fixed-price Volumes



As noted earlier, Form 552 requires market participants that sold and purchased 2.2 million MMBtu or more of physical gas during the reporting year to report total volumes for: (1) transactions that used published daily and monthly index prices, (2) transactions for fixed-priced next-day or next month delivery that are reported to index publishers and used by publishers in an index, (3) transactions for fixed-priced next-day or next month delivery that are not reported to index publishers, and (4) certain monthly transactions based on Nymex trigger agreements and physical basis.

The Form 552 data for 2009 indicates that about one-fifth of respondents reported the prices for their fixed-price transactions to index publishers in 2009. These respondents accounted for about 6 Tcf of the volumes reported through Form 552. Nearly 5 Tcf of the volumes reported through Form 552 were fixed-priced transactions that were not reported to index publishers. According to the Form 552 data, approximately 39 Tcf of the volumes reported through Form 552 were transacted at index prices. The reporting status of a statistically insignificant portion of fixed-price volumes was unclear.

By recasting the earlier pie chart in terms of index-based and fixed-price transaction volumes, we can see that index publishers are deriving their index prices from a relatively small amount of gas volumes. With at least 6 Tcf of the market setting the price for 39 Tcf of the market, this means that for every MMBtu reported to an index publisher, more than 6 MMBtu rely on that price. This estimate is aggregated on a national basis, and the leverage of index volumes on fixed-price volumes will vary from point to point. In addition, as the largest market participants generally report to index publishers, the top 10 sellers represent 55% of the 6 Tcf reported to index publishers.

Conclusions

- Gas market sales and purchase volumes in 2009 were at least 2.5 times marketed production.
- Form 552 provides information on who the largest participants are and details common transactions by buyers and sellers.
- Most physical transactions are based on index prices.
- Index prices are formed from a relatively small volume of fixed-price transactions.

In conclusion, Form 552 shows the approximate size of the U.S gas market. Almost 56 Tcf of physical gas market transactions occurred in 2009, 2.5 times the volume of gas produced.

Form 552 provides information on which the largest participants are and details common transactions by buyers and sellers. For example, the top 10 gas sellers accounts for 33% of total reported volumes. Also, monthly and daily index sales accounted for the majority of total reported volumes.

Finally, the data indicate that index publishers are deriving their index prices from a relatively small amount of gas volumes. This is added information to the market, advances the goal of price transparency and provides a better understanding of the formation of price indexes. However, since the data are aggregated nationally, the actual leverage of index volumes on fixed price volumes by trading hub is not captured by the data.



FEDERAL ENERGY REGULATORY COMMISSION

2009
Analysis of Physical
Gas Market Transactions
Using FERC Form 552 Submissions

We would be happy to answer any questions.

Screens for the Detection of Manipulative Intent

SHAUN D. LEDGERWOOD*

ABSTRACT

Surrounding the passage of Dodd-Frank, a noted author argues that existing market manipulation statutes cannot effectively prosecute manipulation cases because the statutes prohibit fraud, not market power. This is incorrect. While traditional economic theory can explain the incentives underlying manipulation, it is not readily adaptable to untangling the counterintuitive logic of manipulative intent. Consequently, no unifying economic paradigm exists for evaluating manipulative behavior across applications, agencies, or statutes. This void necessitates the use of opaque techniques to detect and prove (or disprove) manipulation. Compliance suffers because lack of uniformity across cases inhibits the establishment of precedent and complicates the analysis required in subsequent proceedings. To overcome this problem, I propose five tests designed to transparently identify the uneconomic behavior associated with manipulation, as supported by a paradigm developed across three progressively rigorous economic constructs. These tests could be useful in litigation contexts beyond the scope of traditional anti-manipulation enforcement actions.

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Screens for the Detection of Manipulative Intent*

Passage of the *Dodd-Frank Wall Street Reform and Consumer Protection Act* (P.L. No: 111-203 [July 21, 2010]) (Dodd-Frank) altered several statutory provisions relevant to the proof of intent in market manipulation cases, including the addition of a fraud provision to the anti-manipulation language of the Commodities Exchange Act (7 U.S.C. §§ 1 et seq. [2006]) (CEA). Advocates for this change included Bart Chilton, Commissioner of the Commodities Futures Trading Commission (CFTC), who stated that “...in 35 years, there has been only one successful prosecution for manipulation” by the CFTC.¹ In contrast, Pirrong (2010) argued that a fraud-based standard for proof of manipulative intent will complicate future cases under the CEA because the triggering mechanism for many manipulations is market power, not fraud. This perspective has an intuitive appeal, for economic theory instructs that the ability to move prices is dependent upon market power, the use of which is an act of flexing economic muscles, not an act of deception or deceit. This viewpoint is also profoundly incorrect. A would-be manipulator needs no market power to move a price in a direction in opposition to its stand-alone self-interest in one market to benefit the value of other positions that tie to that price. Indeed, reliance on traditional economic tools to explain this counterintuitive logic may underlie why so few

* I wish to thank the staff of the Divisions of Energy Market Oversight and Investigations of the Federal Energy Regulatory Commission, most notably Mr. Matthew L. Hunter. Special thanks also to Dr. Paul Carpenter and Dr. Hannes Pfeifenberger of the Brattle Group, Dr. Kathleen King of Bates White, and Dr. Donald Murry of C.H. Guernsey and Company for their comments.

¹ Commissioner Chilton’s remarks were made on March 23, 2010 to the Metals Market Investors group in Washington, D.C. The “one successful prosecution” referred to is *DiPlacido v. CFTC* (2009 U.S. App. LEXIS 22692 [2d Cir. Oct. 16, 2009]), an energy trading case brought under the CFTC Anti-Manipulation Rule (7 U.S.C. § 13b [2006]).

manipulation cases succeeded under existing anti-manipulation statutes. This suggests that a significant revision of the methods used to detect manipulative behavior is in order to effectively support future anti-manipulation enforcement actions post Dodd-Frank.

Entrenchment in the literature of the perception that the execution of a “market-based manipulation” requires traditional market power is due in part to a bias in the contributions made by Dr. Pirrong concerning this subject over the years. In the early 1990s, authors such as Fischel and Ross (1991) asserted that the vague intent standard of the (pre Dodd-Frank) CEA created inefficiency by over-deterring legitimate trading behavior to prevent what was viewed by many at the time as a victimless crime. Pirrong (1993, 1994) broke with this convention, positing that manipulations such as market corners are statistically measurable phenomena revealed through patterns of behavior that are distinguishable from competitive benchmarks. His later articles and testimony continued to advocate for the use of regression analyses and other statistical tests to prove or disprove intent and measure the price effect of manipulative behavior, including analyses of manipulations of cash-settled futures (2001), soybeans futures (2004), petroleum futures and derivatives (2008), and index-driven physical and financial natural gas contracts (2009). However, consistent with his early writings and without exception, these works examined manipulative behavior through the lens of a market corner, a type of manipulation that by definition requires market power to execute. If the analysis of other forms of “market-based manipulation” must be functionally equivalent to that of corners, the deterministic conclusion that a manipulation cannot occur in the absence of market power results.

The desire to group all types of “market-based manipulation” under a common construct is understandable given the breadth of circumstances in which manipulative behavior can occur and the uneven abilities of different government agencies to enforce their anti-manipulation rules. Because the first successful CFTC enforcement action did not occur until 2009, almost all of the (not Pirrong authored) literature on point focuses on manipulations occurring under the jurisdiction of the Securities Exchange Commission (SEC), not the CFTC. For example, Gerard and Nanda (1993) discussed the manipulation of seasoned equity offerings using secondary markets; Jarrow (1994) studied the manipulation opportunities created by the emerging availability of financial derivatives; Aggarwal and Wu (2003) empirically tested SEC data to discern qualitative elements of stock price manipulations; Attari, Mello and Ruckes (2005) observed that strategic trading can profit from liquidations by “large” arbitrageurs to manipulate markets; Drudi and Massa (2005) examined the manipulation of positions held in secondary treasury markets using transparent strategic trading in treasury auctions; and Goldstein and Guembel (2008) concluded that strategic trading causes financial market prices to misrepresent equity values, incenting selling and enabling manipulations.

It is noteworthy that the analytical focus of much of this literature centers upon relatively narrow and often unrelated types of manipulative behavior. This typifies and perpetuates a lack of analytic portability across case studies, frustrating the accumulation of a knowledge base for consistently evaluating manipulations across different cases under the same statute and across different statutes. Some authors have shown promise for bridging these gaps. For example, Kyle

and Viswanathan (2008) used the earlier works of Allen and Gale (1992) and Kumar and Seppi (1992) to provide a vague reconciliation of SEC and CFTC “trade-based” manipulation cases, and Pirrong (2010) raised the issue of comparability between the anti-manipulation statute of the CFTC with the fraud-based statutes of the SEC, the Federal Energy Regulatory Commission (FERC) and the Federal Trade Commission (FTC). Unfortunately, these works again lead to the false premise that all manipulations are the product of either fraud in the factum or the exercise of market power, providing no transparent guidance for a Trier-of-fact to rely upon in evaluating manipulative behavior and intent.

In this paper, I advance the literature by providing a base for analyzing manipulative behavior and intent in a manner that is consistent across applications and across statutes. I accomplish this by examining three progressively rigorous economic constructs that share the attribute of a manipulator that purposely incurs a loss in one market to alter a price that benefits its overall portfolio. Because the manipulator willingly introduces a negative externality and injects false price information into the market, these “market-based manipulations” demonstrate that the fraud-based provisions of the SEC, FERC, FTC, and now CFTC anti-manipulation rules are appropriate for curbing such incentives. The paradigms use consistent assumptions to unify the presentation and to maximize ties to the literature and to the analysis of a wide variety of behavior. Because the lessons learned are analytically consistent, I use them to create five tests to transparently identify the uneconomic behavior associated with manipulation. These tests

could support the proof (or disproof) of intent in cases brought under the anti-manipulation laws, and could be extended to other litigation contexts.

The remainder of this paper consists of five sections. Section 1 offers an example of an index-based manipulation that requires insignificant market power to execute, demonstrating that such behavior is appropriately considered fraudulent under existing statutes and recent case law. Section 2 extends this logic to cleared markets and discusses the negative externalities presented by market manipulation. Section 3 builds on the discussion of cleared markets to introduce a microeconomic model that examines a trader's incentives to manipulate physical energy prices to benefit a related financial position. Section 4 uses the lessons learned from the prior examples to propose five relatively simple tests to identify behavior consistent with manipulative intent. Section 5 concludes the discussion, stressing that evidence of manipulative intent could be used in a broad range of litigation types beyond the scope of anti-manipulation enforcement actions.

1. Fraud, Market Power, and the Manipulation of Indexed Products

Consider the following hypothetical: two bedroom condominiums roughly identical to my own are currently selling in my neighborhood for around \$500,000, as measured by a Web site index that tracks comparable sales. The index tracks transactions over a rolling 30 day period, with a 15 day lag for new sales to be recorded and added into the calculation. There are many units available for purchase, all offering at prices around \$500,000. Were I wishing to list my condominium for sale, I would (presumably, as a rational seller) seek to obtain the highest price possible to maximize my gain from the sale on a stand-alone basis. However, my ability to

raise price significantly above \$500,000 is constrained by the other sellers in the market, a hallmark of effective competition and a check on market power.²

Compare this to a scenario where I sought to sell my condominium for a price *significantly below* the existing market price (say, for \$100,000). Such an offer would be immediately snapped up, the buyer walking away with a windfall while I incur a loss (relative to my opportunity cost) of around \$400,000. While one could imagine multiple scenarios wherein a sub-competitive price might be justifiable from my perspective on a stand-alone basis, the magnitude of the loss in this example is designed to demonstrate an obvious but salient point: the further a seller is willing to drop their offer below the competitive market price, the greater the likelihood that they will face *absolutely no competition whatsoever*.³ The same principle will hold for buyers that bid at prices above the competitive equilibrium, underscoring the point that market participants do not need market power to successfully execute trades (and therefore post prices) in a manner that injures their stand-alone self-interest.

The willingness of a market participant to make uneconomic trades can be a precursor for its ability to execute a manipulation. Returning to the prior example, assume that the \$100,000 sale of my condominium is purposely designed to lower the index price 15 days hence, and that

² To raise my price significantly above the competitive benchmark would require that I develop some form of market power outside the parameters of the example, such as product differentiation that demonstrates product superiority or through exploitation of an informational asymmetry (such as finding a buyer who is uninformed as to the market price).

³ Of course, the further away from the competitive price such a trade is executed, the greater the likelihood that it will be ignored by other market participants as anomalous and detected by regulators as suspicious (as the saying goes, “pigs get fat, hogs get slaughtered”).

my plan is to then buy 20 condominiums at the lower price in the following few days. This plan will be profitable only if a number of conditions exist, most importantly (i) that the index is trusted and used by other sellers as a measure of the competitive price, and (ii) that the impact my sale will have on the index will be more than sufficient to recoup my \$400,000 opportunity cost (that is, causing a greater than \$20,000 average price reduction across the 20 condominiums that I intend to buy). The ability to impact the index in this manner is not consistent with the traditional perception of market power; simple arithmetic reveals that my one sale at \$100,000 would move the index sufficiently if 18 (or fewer) other trades at the average price of \$500,000 were used in the index. As one of 19 sellers forming the index, my trade corresponds to a market share of *only 5.27% of the trades that make the index*, insufficient to be characterized as the basis for a “market power manipulation” on either a stand-alone or market concentration basis.⁴ The contrarian may assert that this manipulation is dependent upon my ultimate willingness to buy more condominiums than presently reside on the index and thus is indicative of the use of “market power.” This is incorrect, however, because the 20 condominiums that I purchase are as a *price-taker* to the index and thus irrelevant to setting the index price.

⁴ Specifically, the profitability criterion given one manipulative sale at \$100,000 and “n” sales at \$500,000 is given by:

$$\frac{\$500,000n + \$100,000}{n + 1} < \$480,000 \Rightarrow \$20,000n < \$380,000 \Rightarrow n < 19.$$

Assuming all sales were from unrelated sellers, the Herfindahl-Hirschman Index (HHI) for the 19 sales on the index would be 526, well under the 1,500 threshold of the latest *U.S. Department of Justice and Federal Trade Commission Horizontal Merger Guidelines* (<http://www.ftc.gov/os/2010/08/100819hmg.pdf> [revised August 19, 2010]) that indicates concerns of market concentration (such as “thinness” of volume on the index) and associated concerns of traditional market power. Note that this example is easily adaptable to reduce the manipulator’s market share below 5%, the threshold used by SEC Form SC 13D for reporting beneficial ownership of equity interests and considered by some to be the benchmark for identifying “large” market participants.

Irrespective of the value of the “market power manipulation” argument, there is a more salient issue that must be addressed: can a trade between a willing buyer and seller at a mutually agreed upon price be considered fraudulent purely on the basis of comparison to the buyer’s or seller’s opportunity cost?⁵ From a legal perspective, the answer is yes if there is sufficient evidence of *scienter* (intent) to manipulate. Legal precedent as to the application of the SEC’s anti-manipulation Rule 10b-5 established that proof of scienter requires a showing that “but for the manipulative intent, the defendant would not have conducted the transaction.”⁶ A FERC administrative law judge similarly found that Amaranth trader Brian Hunter executed trades “specifically designed to lower the NYMEX price in order to benefit his swap positions on other exchanges” in violation of that Commission’s Rule 1c (18 C.F.R. § 1c [2010]), while the CFTC found that a buyer had the requisite scienter under its statute because he “intentionally paid more than he would have had to pay for the purpose of causing the closing quotation to increase.”⁷

Each of these cases exemplify that the manipulator purposely lost money relative to their opportunity cost on a set of transactions designed to set prices which then enhanced the value of a physical or financial position tied to that price. Thus, the willingness of a buyer to consistently

⁵ While the actual cost of the item sold at a loss (or actual value for something purchased at a premium) is relevant, the value of the loss incurred by the would-be manipulator from the perspective of a competitive market is the value of their next-best market alternative.

⁶ The SEC’s anti-manipulation rule is codified in 17 C.F.R. § 240.10b-5, arising under the authority granted in 15 U.S.C. § 78j(b) (2010). See *SEC v. Masri* 523 F. Supp 2d at 372-373. See also *Markowski v. SEC* (274 F.3d 525, 529 [D.C.Cir.2001]) (“‘manipulation’ can be illegal solely because of the actor's purpose”).

⁷ See *Brian Hunter* (130 FERC ¶ 63,004 [2010]) (action brought under the FERC’s anti-manipulation rule); and *DiPlacido* (2009 U.S. App. LEXIS 22692) (finding was made under the anti-manipulation provisions of the CEA prior to its amendment by the Dodd-Frank Act).

bid at prices in excess of their true willingness to pay or the willingness of a seller to repeatedly place offers below its true willingness to sell is indicative of affirmative acts designed to inject misleading price signals into the marketplace – acts appropriately classified by the Trier-of-fact in each of these three cases as *fraud*.⁸ Assertions that the fraud-based anti-manipulation statutes of the SEC, FERC, FTC, and CFTC cannot apply to cases involving the intentional movement of market prices are therefore ill-considered, as use of market power is unnecessary to the execution of a successful market manipulation.

A better case for questioning the appropriateness of fraud-based statutes to prevent “market power manipulations” might be argued for the subset of manipulations potentiated by a true exercise of market power as the cause of the price movement (such as a profitable act of economic withholding that simultaneously benefits a long financial position). In such cases, where the market price is arguably a legitimate result of a profit maximizing decision made on a stand-alone basis, it may be a stretch to classify the behavior that triggers the manipulation as “fraud.” However, a manipulation fuels its perpetrator’s ability to behave anti-competitively by giving it the ability to leverage against the trigger to extract profit from the targeted positions and enhance the overall profitability of its scheme.⁹ If the counterparties to the contracts targeted by

⁸ As will be discussed later herein, opportunity cost may not be readily ascertainable in all situations because the manipulator’s behavior may have poisoned the market to the extent that an observable competitive price is incalculable. In such event, an accounting cost may be used in place of the competitive price in the opportunity cost calculation if the result provides a conservative screen for manipulative behavior. See Section 4.

⁹ This was recognized by Dr. Pirrong in recent testimony: “Although some market power manipulations exploit the delivery mechanism of derivative contracts, large traders can exercise market power in physical markets by buying or selling excessive quantities of the commodity in order to distort prices that are used to determine the settlement values of cash settled derivatives contracts. These strategies can affect the value of these derivative

the manipulation enter into those contracts unaware of the ability of the manipulator to move the price of the underlying asset, the essence of fraud remains.

Because proof of a market manipulation requires evaluation of the exploitation of an economic nexus between price-making and price-taking instruments, analysis of the economic logic of the decision to manipulate must not be viewed as a limited application relegated to the domain of government agencies performing a regulatory or prosecutorial function. To the contrary, this analysis should be thought of as a method for examining *any* portfolio wherein the actor places price-making trades to directly benefit one or more related price-taking positions. In addition to private actions available under the SEC, FTC, and CFTC anti-manipulation statutes,¹⁰ this has direct application to support actions brought under Section 2 of the Sherman Antitrust Act (15 U.S.C. § 1 et seq. [1890]) (such as the mechanism for recoupment in price predation claims), as well as claims made under state consumer protection or below-cost sales statutes.¹¹ The discussion of the remainder of this paper will provide a foundation for such analyses.

contracts, thereby profiting a party that exercises market power while holding a position in these contracts.” Pirrong (2008), at 5. See also Pirrong (2001), at 221.

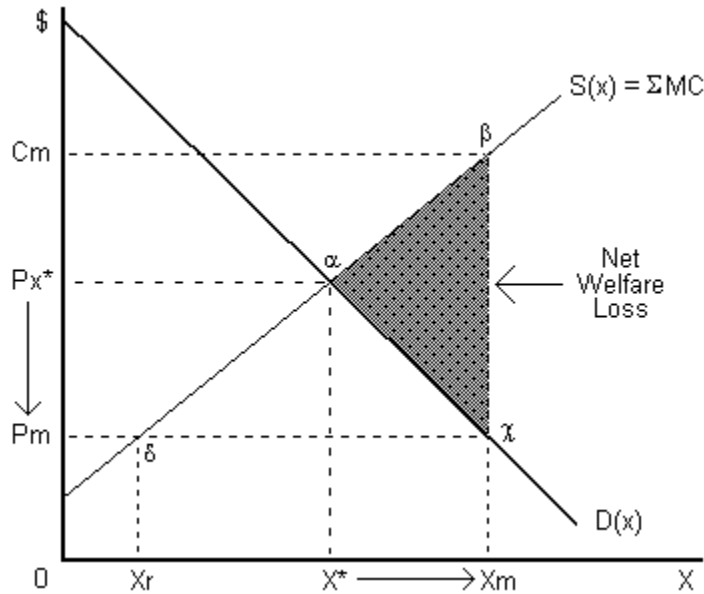
¹⁰ Only the FERC’s market manipulation rule specifically precludes private causes of action under the Act (see 18 C.F.R. § 1c.1(b) and § 1c.2(b)). By comparison the FTC determined that “it is not unreasonable to assume that the Final Rule may provide a cause of action under some state consumer protection laws.” See *Prohibitions on Market Manipulation; Final Rule*, fn. 10 (16 C.F.R. Part 317 [2009]).

¹¹ The United States Supreme Court has ruled that the success of a predation claim requires a plaintiff to prove that the firms pricing below cost would be able to recover their losses through the ability to raise prices in the long run. See *Brooke Group LTD. V. Brown & Williamson Tobacco Corp.* (509 U.S. 209 [1993]). The existence of a financial position that would benefit from the predation would allow the actor to *immediately recoup* their losses, thus bypassing the otherwise impossible task of proving recoupment through the erection of entry barriers. For an example of a state below-cost sales statute, see the *Oklahoma Unfair Sales Act* (Okla.Stat. tit. 15, §§ 598.1-598.11 [1951]).

2. Evidence of Market Harm: Manipulation of a Cleared Market

Upon presentation of the example of the index-based manipulation of the condominium market that I describe above, several of my colleagues railed against the notion that any harm resulted to that marketplace. After all, it is intuitive that the loss I incur on the initial \$100,000 sale that lowers the index is offset by an equivalent gain made by the lucky buyer, and that my ability to profit from the lower index results in nothing more than a zero sum wealth transfer enabled by exploiting a defect in the way the index conveys information (transactions costs aside, of course). These observations miss: (i) that the initial sale may cause a loss of social welfare because the offer made is substantially below the market price, possibly causing the asset to transfer from a party who values it more to one who values it less; (ii) that the ensuing transfer of wealth rewards the creation of moral hazard enabled by my injection of false pricing into the market; and (iii) that the index used in the example is competitive either *ex post* or *ex ante* the manipulation if judged by traditional measures of market concentration and market power. To demonstrate these points in a broader context, it may be helpful to change the paradigm of the market pricing mechanism from an index to a cleared competitive model. To this end, Figure 1 below illustrates the mechanics of a loss-based market manipulation within the familiar context of a typical Marshallian market.

Figure 1
Net Social Welfare Loss from Below-Market Sales



Absent manipulation, this market would clear at a competitive equilibrium corresponding to the point “ α ” at the price P_{x^*} and quantity traded X^* . The manipulator in this example offers a quantity $(X_m - X_r)$ at a price sufficiently low so as to act as a price-taker in the market.¹² The resulting manipulated market equilibrium (point “ χ ”) causes a lower price P_m and higher quantity traded X_m , with the manipulator supplying the quantity $(X_m - X_r)$ to the market and competitors left to sell the remaining units X_r . Note that buyers are thrilled by this activity, as the consumer surplus increases by an amount equal to an area geometrically bounded by P_{x^*} , α , χ , P_m . However, all of this gain is offset by a loss of profits of the manipulator (triangle α , χ , δ)

¹² This is the concept of “artificial price” that is endemic to the literature concerning the proof of market manipulations under the CEA. For discussion, see Pirrong (1994) at 994.

and of the other would-be competitive sellers (area Px^* , α , δ , Pm). This results in a net societal loss of welfare shown by the shaded triangle α , β , γ .¹³ The per-unit cost to the manipulator “ Cm ” of the quantity it offers to trigger the manipulation initially is assumed to equal the competitive price that corresponds to the total market output Xm .

$$(Px^* - Pm) \cdot R > (Xm - Xr) \cdot (Cm - Pm). \quad (1)$$

From the manipulator’s viewpoint, Equation (1) above is the profitability criterion for a successful manipulation. Left of the inequality, the revenue from the manipulation increases as the leverage of the related positions “ R ” held by the manipulator increases or as the divergence from the competitive price caused by the manipulation ($Px^* - Pm$) increases. To the right of the inequality, the loss incurred by the manipulator grows as the size of the offer that triggers the manipulation ($Xm - Xr$) grows or as the per-unit loss to the manipulator ($Cm - Pm \geq 0$) worsens. Given these variables, three factors underlie the incentive to manipulate (and associated moral hazard problem): the per-unit cost of the manipulation trigger (Cm), the leverage built in the related position (R), and the price elasticity of demand and supply. The remainder of this section discusses these factors to support the more rigorous manipulation model presented in Section 3 and the five screens for manipulative behavior presented in Section 4.

¹³ The addition of positive transaction, enforcement and litigation costs would add to the net societal welfare loss caused by this manipulation. Indeed, the presence of such costs mandates that an *attempt* to manipulate a market incurs a societal welfare loss, with the harm caused by a successful manipulation adding to the externality. The FERC considers such costs a primary factor in weighing the need for civil penalties in manipulation cases as discussed in its *Policy Statement on Enforcement* (113 FERC ¶ 61,068 [October 20, 2005]).

2.1. The Cost of the Output Used to Trigger the Manipulation

To cover the offer it uses to trigger the manipulation, the manipulator must pay a per-unit cost of C_m for all units ($X_m - X_r$), measurable as the higher of the accounting or opportunity cost it incurs for those units. If the manipulator has no ability to self-supply, it must buy off-market through transactions with other sellers, paying (at minimum) the marginal cost of producing the market output X_m (shown in Figure 1).¹⁴ Conversely, if the manipulator can self-produce the units or secure access to an alternative supply source such as storage, C_m equals the higher of the manipulator's accounting and opportunity costs as presented at the time the market clears. This creates the possibility that $C_m < P_m$, meaning the triggering offer is profitable and fulfills a legitimate business purpose on a stand-alone basis. A savvy manipulator can use this to its advantage by placing triggers at prices that are profitable on an accounting basis but below its opportunity cost; parties opposing the manipulation then face the difficult burden of proving that a better price (such as P_x^*) was available and the manipulator intentionally and uneconomically undercut that price. The model presented in Section 3 directly addresses this issue.

2.2. The Leverage of Related Positions

The manipulator gains leverage by acquiring positions that are price-taking to the market, including financial derivatives and physical contracts that reference the market price as an index.

¹⁴ Other suppliers could extract significant monopoly rents under these circumstances, raising C_m significantly above marginal cost. This would reduce the profitability of the manipulation and could alter the quantity offered as a trigger (see Section 3). Absent a change in the trigger, an increase in C_m reflects a zero-sum transaction and thus has no effect on market efficiency.

The only constraints that limit the size of the financial positions the manipulator can accrue are its funds available for the scheme, the willingness of counterparties to execute contracts that benefit its targeted position, and regulatory controls such as exchange-based position limits. By comparison, delivery constraints can limit the assemblage of a price-taking physical position and may limit the number of counterparties able to trade. Note that the accumulation of a physical index position provides the manipulator with a valuable option; it can keep the position as part of its portfolio of related positions (R), or trade units out of that position at a fixed price, thus using a price-taking position to generate price-making trades. Holding physical index in addition to a complimentary financial position therefore enhances the potential for a successful manipulation, for a manipulator can use uneconomic fixed-price trades to simultaneously flatten its physical obligations and benefit its remaining financial and physical positions.¹⁵

The manipulator will cite the risk associated with its leveraged positions to characterize them as legitimate speculative investments, capable of generating losses or gains. It is true that these positions place the manipulator (and its counterparties) at risk of unfavorable market price movements, as evidenced by the demise of Amaranth subsequent to its manipulation. However, this risk is not borne equally because the ability and willingness of the manipulator to use its leveraged position to influence the market price biases the likely outcome in a manner that counterparties could not predict. It is for this reason that the attempt to execute a market

¹⁵ Interestingly, as the manipulator's share of the total index volume traded approaches 100%, the average price of its uneconomic fixed-price trades equals the price used to value its physical index position, such that the per-unit cost of the manipulation (Cm) approaches zero (plus or minus any discounts or premiums relating to those transactions). This compounds the difficulty of proving the manipulation because an actual or opportunity cost separate from the manipulated index may not exist. This is discussed in Section 4.

manipulation is appropriately forbidden on the basis of fraud; if the manipulator introduces a cleared price-setting transaction to the market that is below its true willingness to sell (or above its true willingness to buy), the resulting trade potentiates a loss to the manipulator's counterparties in the targeted markets that they could not reasonably foresee upon transacting. The resulting (zero sum) transfer of wealth arises not due to superior foresight or business acumen, but because the actor on one side of the position is willing to execute an artifice to the detriment of the other.

2.3. The Price Elasticity of Demand and Supply

As supply or demand becomes more price inelastic, the manipulator's ability to cause a price deviation that favors its related positions becomes more favorable from two perspectives. If the manipulator plans to offer some fixed uneconomic volume ($X_m - X_r$) into the market, a larger price effect ($P_{x^*} - P_m$) will result.¹⁶ Conversely, if the manipulator seeks some minimum price change to make the related positions profitable, inelastic curves make a smaller volumetric trade sufficient to execute the manipulation. The loss incurred by the trader on the transactions that trigger the manipulation may or may not increase as the curves become more inelastic; because greater inelasticity simultaneously increases the loss on each unit traded while reducing

¹⁶ At this point, a distinction between legitimate and uneconomic behavior is necessary. That a buyer bids or a seller offers a quantity of product sufficient to move the market price does not in and of itself substantiate a finding of market manipulation. To the contrary, as it is natural that bids and offers tend (respectively) to raise and lower prices, the placement of bids above or offers below the competitive price usually serves a legitimate business purpose on a stand-alone basis, thus providing a defense against manipulation claims. By comparison, placement of large or persistent bids or offers in a manner that is uneconomic on a stand-alone basis is symptomatic of an attempt to move price to benefit a related position and is subject to further scrutiny.

the size of the trade needed to profitably execute the manipulation, the aggregate effect of a change in elasticity on the manipulator's loss is indeterminate.

Recent enforcement actions by the SEC, CFTC, and the FERC validate the correlation of price elasticity and manipulation. In *SEC v. Masri*, (523 F. Supp 2d 361 [S.D. N.Y. 2007]), the SEC alleged that an equity trader placed a large number of bids for a security at the end of the trading day to “mark the close” and raise the closing price; this strategy necessarily played upon the inability of the offer stack to replenish itself in time to react to the higher price, reflecting temporal inelasticity of supply. In *DiPlacido v. CFTC* (2009 U.S. App. LEXIS 22692), an energy broker was successfully prosecuted for “offering through” bids, taking advantage of demand inelasticity to post high prices during the settlement of the NYMEX prompt month natural gas contract and raise the profitability of its related options position. Two administrative actions by the FERC also involved natural gas: in *Energy Transfer Partners, L.P., et al., Order to Show Cause and Notice of Penalties* (120 FERC ¶ 61,086 [July 26, 2007]) (ETP), ETP was alleged to place price-setting trades intended to lower the price of natural gas at the Houston Ship Channel, in benefit to short financial and long index positions held by the company; by comparison, the defendants accused in *Amaranth Advisors L.L.C., Order to Show Cause and Notice of Penalties* (120 FERC ¶ 61,085 [July 26, 2007]) were alleged to have traded strategically to lower prices during the settlement of the NYMEX prompt month natural gas contract to benefit Amaranth's short prompt month physical and financial positions. ETP ended in

settlement, as did Amaranth for nine named defendants; Amaranth defendant Brian Hunter was found guilty of manipulation by an administrative law judge in early 2010.¹⁷

2.4 Toward a More Rigorous Model of Market Manipulation

That three of the four recent manipulation cases cited above involve the energy sector is not incidental. Energy markets are especially susceptible to manipulation due to heavy reliance upon indices for price formation and frequent or episodic issues of price inelasticity of demand and supply. This is especially true of electricity markets, wherein lack of storage mandates that supply must be prepared in advance to meet an expected (but highly variable) demand and the quantity of the good produced must be constantly balanced with load given a litany of economic and physical constraints. When combined with the layered myriad of physical and financial instruments that can set or be set by multiple interrelated settlement pricing mechanisms, the electric industry is flush with opportunities for manipulation, whether derived from traditional sources of “market power” or not.¹⁸ As it is also my area of expertise, this industry presents a logical conduit for a more rigorous presentation of the principles discussed in Sections 1 and 2.

¹⁷ See *Order Approving Uncontested Settlement* (128 FERC ¶ 61,269 [September 21, 2009]); *Order Approving Uncontested Settlement* (128 FERC ¶ 63,014 [August 12, 2009]); and *Initial Decision* (130 FERC ¶ 63,004 [January 22, 2010]).

¹⁸ FERC maintains oversight of the wholesale market for electricity pursuant to the Federal Power Act (16 U.S.C. 791-828c [1920]). In 1996, the FERC issued *Order 888* (75 FERC ¶ 61,080 [April 24, 1996]), opening the wholesale market to competition. A wholesale market participant may transact at market based rates pursuant to tariff upon a showing to the FERC that it does not have market power or, alternatively, upon providing a satisfactory mitigation plan in situations where market power would become a concern. See *Order 697* (119 FERC ¶ 61,295 [June 21, 2007]). However, it is unclear if the exercise of market power to move prices to the benefit of related positions in the wholesale electricity markets would be punished as a tariff violation rather than a market manipulation under the FERC’s Rule 1c.

For this analysis, I will use a “Day 2” Regional Transmission Organization (RTO) wholesale power market as a backdrop for the manipulation. Using a bifurcated market design, physical power is competitively traded in an hourly “day-ahead” market designed to optimize supply to meet forecasted load, and a “real-time” market trading electricity to balance the system for variances from the planned day-ahead dispatch. The RTO offers products designed specifically to hedge and arbitrage price differentials within and between these markets. While some of these products are price-taking instruments, others can directly influence physical electricity prices in the day-ahead and real-time markets and thus be used for manipulative purposes.

Section 3 presents a simple economic model descriptive of a specific type of electricity market manipulation within Day 2 RTOs: the use of virtual bids to affect the value of financial transmission rights (FTRs). This model will show that the incentives driving an electric market manipulation are consistent with those that motivate manipulations of other markets as described in Sections 1 and 2. However, by providing greater rigor to the analysis of how a manipulator optimizes a joint portfolio, the model of Section 3 provides a flexible paradigm for porting the analysis of manipulative behavior to contexts beyond the scope of traditional anti-manipulation statutes, conceivably including actions based in antitrust, consumer protection or below-cost sales contexts, or other fraud-based litigation. Section 4 will rely on this analysis to create benchmarks to detect and measure the cause and effect of manipulative behavior.

3. A Model of the Incentive to Manipulate a Day 2 Electricity Market

This section adapts the manipulation logic discussed above to Day 2 wholesale electricity markets, wherein a market trader possesses congestion rights over a transmission path and uses virtual bids or offers (collectively, “virtuals”) to accentuate the value of those rights. I begin with a discussion of the incentives that underlie a trader’s decision to place virtuals; this will assist readers in understanding the incentives of virtual trading and the modality of their use as a trigger for manipulation. Next, I explain the function that financial transmission rights play in Day 2 wholesale electricity markets on a stand-alone basis and as a target for manipulation. Last, I examine the collective incentives that emerge from the trader’s ability to use virtuals to the benefit of its overall portfolio using the construct of a simple microeconomic model.

3.1. Virtual Bids and Offers

Traders participating in some Day 2 wholesale electricity markets use virtual bids (also known as “decremental bids,” “DECs,” or “virtual load”) and virtual offers (also known as “incremental bids,” “INCs,” or “virtual supply”) to exploit expected differences between day-ahead and real-time prices.¹⁹ Virtuals simultaneously clear with bilateral and other physical trades and therefore may impact day-ahead and real-time locational marginal prices (LMPs).

The distinguishing characteristic of a virtual trade is that the quantity of megawatts (MW)

¹⁹ At the time of this writing, virtuals are allowed in five RTOs with a sixth phasing in virtuals in 2011. Market participants can also place “synthetic” virtuals using other types of transactions, such as scheduling to sell power into a region in the day-ahead market then cutting that schedule in the real-time. These “no-flow” transactions are functionally identical to virtual bids and are executable in markets that do not yet allow virtual trading to occur, such as sales of power into and outside of a RTO.

purchased or sold by the trader in the day-ahead market is exactly offset by a sale or purchase of an identical quantity of MW in the real-time, such that the net effect on the market quantity traded is zero. For example, if in a given hour a trader expects the day-ahead LMP at a point to exceed the real-time LMP at that point, it would place a virtual offer at that point for that hour. If the offer clears, the trader would receive the day-ahead price on all MW “sold” and pay the real-time price for the same number of MW “purchased,” netting a profit (or loss) equal to the difference of the day-ahead and real-time prices multiplied by the quantity of MW cleared. In essence, the trader uses the day-ahead market to sell to itself in the future real-time market such that the net effect is that of a purely “financial” transaction.

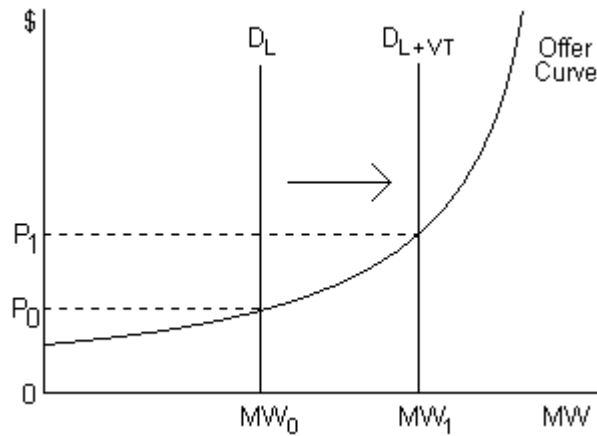
The Physicality of Virtual Trading

Despite the trader’s perspective, characterization of the effect of virtuals on the day-ahead and real-time markets as purely “financial” is erroneous because virtuals can physically set LMPs. For example, in each hour for each pricing point, the RTO could choose to use the higher of the summed demand forecasted by the load serving entities (LSEs) in the market, the LSE forecasted loads plus the net virtual demand in the market (equal to cleared DEC’s less cleared INC’s), or the load forecasted by the RTO.²⁰ Adding virtuals to the day-ahead load may therefore affect the day-ahead LMP and could affect the real-time market once the reversing virtual transaction clears. To demonstrate this phenomenon, consider the representation of the day-

²⁰ Note that use of the maximum of these three calculations mandates that net short virtual positions (when the number of INC’s cleared exceeds the number of cleared DEC’s) will not be considered in the day-ahead market. This is consistent with procuring a sufficient supply needed to preserve reliability in the market.

ahead market shown below in Figure 2. For each hour, net virtual trades (VT) add to the demand forecast for native load (D_L) if the quantity of DECs exceeds the quantity of INCs. This raises the price in the day-ahead market from P_0 to P_1 and increases the amount of generation resources procured by the RTO from MW_0 to MW_1 . Since these resources will be available to the real-time market, the failure of the virtual load to materialize may decrease the real-time demand below forecast and place downward pressure on real-time prices.²¹ Because the placement of virtuals affects the dispatch of physical capacity, it is therefore inaccurate to characterize their impact as solely financial in nature.

Figure 2
The Effect of Positive Net Virtual Load on the Day-Ahead Market



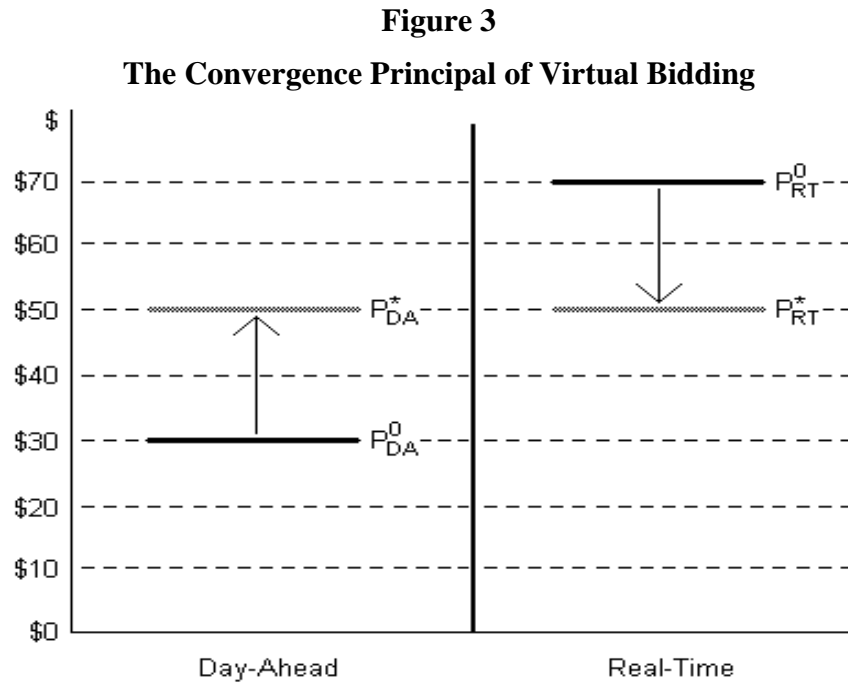
²¹ One could argue that because real-time dispatch is independent of all load forecasts, virtual bids should not affect real-time prices. However, because the RTO prepares physical generation for dispatch to meet virtual load, the failure of that load to materialize could logically serve only to decrease the real-time price unless the market is operating in a perfectly elastic region of the of the real-time offer curve. Whether this real-time price effect manifests through the real-time LMP or through a different pricing mechanism (such as “uplift” charges) is irrelevant to this presentation, assuming such charges transparently tie back to their associated virtual trades.

Notwithstanding this observation, there is a clear price effect which virtuals exert on the day-ahead and real-time markets. As Figure 2 demonstrates, DEC's tend to raise prices in the day-ahead market while INC's tend to lower day-ahead prices. The converse is true in the real-time as the physicality of the virtual transaction reverses. The concave-up nature of the offer curve accentuates these pricing effects in power markets due to diminishing returns. Thus, as load increases, successive clearing decremental bids will have an increasingly powerful effect on price. The reverse is true for successive incremental bids, as the first INC negates the last (most powerful) DEC and subsequent INCs will negate demand with less and less price impact.

The Role of Virtual Trading in Price Convergence

The main benefit cited in support of the use of virtual transactions derives from their tendency to equilibrate the prices in the day-ahead and real-time markets. To demonstrate this, consider a numeric scenario wherein a virtual trader expects the day-ahead and real-time LMPs at a node to be \$30/MW and \$70/MW, respectively. This is represented in Figure 3. The trader would place a virtual bid at that point for that hour, paying the day-ahead price on all MW purchased and receiving the real-time price for an identical number of MW sold. However, the act of buying MW in the day-ahead tends to push the LMP in that market up from \$30, while the act of selling MW in the real-time tends to push the price down below \$70. As long as a differential exists, some trader in the market will have the incentive to continue to place virtuals until the day-ahead and real-time LMPs are equal. This is shown to occur at a price of \$50. For

this reason, virtual trading is also known as “convergence bidding,” as a competitive virtual market should tend to cause the day-ahead and real-time prices to converge in each hour.²²



Because convergence of day-ahead and real-time prices mitigates market power and improves the efficiency of serving load, virtual traders have a physical impact on the operations of the RTO and upon market participants that physically transact at the LMPs set in the day-

²² See Order [G]ranting [sic] Motion for Extension of Time And Addressing Convergence Bidding Design Policy Filing (130 FERC ¶ 61,122 [February 18, 2010]). Figure 3 shows that real-time prices fall as a result of the cleared DEC, which may or may not be the case given the RTOs' method for dispatching its system. However, it is ultimately irrelevant to the analysis herein as to whether virtuals actually affect real-time prices because the placement of DEC will continue as long as a spread between the day-ahead and real-time prices exists; if real-time prices are unaffected by the virtuals placed in the example, the \$40 spread will be reduced to zero at a price of \$70 instead of \$50.

ahead and real-time markets.²³ The act of creating convergence paradoxically acts against the self-interest of virtual traders, as the revenue from all virtual trades will be zero if the day-ahead and real-time prices are equal. In the presence of transactions costs, traders should therefore be averse to placing excessive virtuals for fear of incurring losses. The resulting corollary is that if a trader places virtuals beyond the point of convergence, they will lose money on the entire lot. This signifies that the trader is *diverging* the day-ahead and real-time LMPs and thereby creating inefficiency in the market. The choice by a trader to continually place virtual bids or offers in a manner that consistently loses money on a stand-alone basis therefore raises concerns that the trader may be attempting to trigger a manipulation by moving the day-ahead or real-time LMPs to accentuate the value of financial positions tied to those LMPs.²⁴

Profit Maximization for One Trader of Virtuals

The following presentation generalizes the principle shown in Figure 3 to capture the trader's incentive to place a virtual bid in any given hour. For simplicity, this discussion will initially assume that a single trader bids virtual demand into the day-ahead market at a single pricing location, paying the day-ahead price " P_{DA} " and receiving the real-time price " P_{RT} " for every MW of DEC bids that clear at that point. This is rational only if $P_{RT}^0 > P_{DA}^0$, a condition

²³ For further discussion of the merits of convergence bidding, see the California ISO's filing *Convergence Bidding Design Policy* (FERC Docket No. ER10-300-000 [November 20, 2009]).

²⁴ A trader may have a legitimate purpose in its willingness to persistently take losses on a virtual trade. For example, the owner of generation might be willing to consistently lose money on a DEC bid at a generation source to hedge the possibility of outages during peak periods. However, if the virtual market is truly competitive, other traders should see the profit opportunity afforded by the divergence and bid INCs to restore convergence to the market.

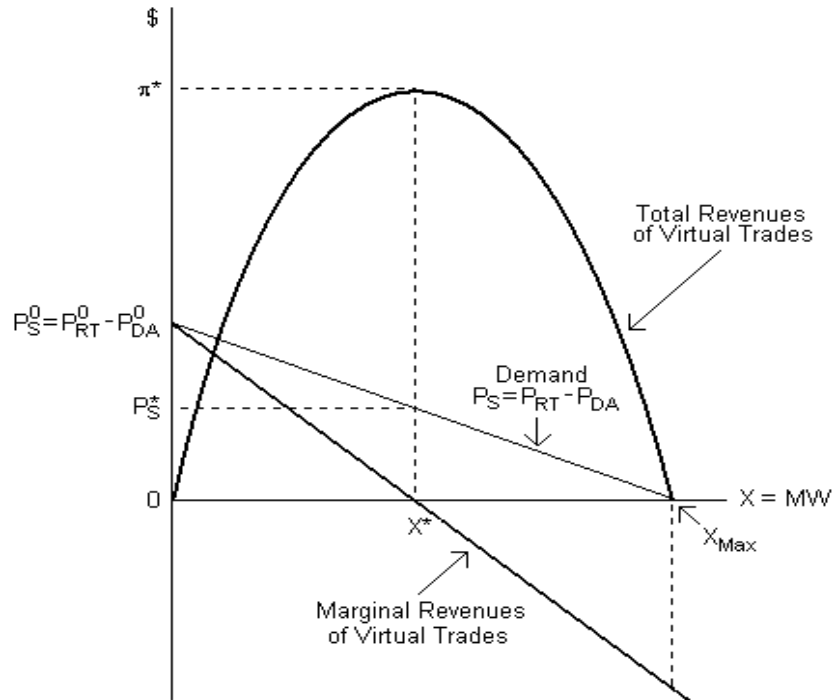
that becomes less likely with each additional MW of DEC cleared because the day-ahead and real-time prices then tend to converge. Using Figure 3 as an example, if the initial day-ahead price is \$30/MW and the initial real-time price is \$70/MW, a one MW DEC would garner about $P_{RT}^0 - P_{DA}^0 = \$70 - \$30 = \$40$. Continual placement of DECs that successfully clear ultimately causes the prices to converge at $P_{DA}^* = P_{RT}^* = \$50/\text{MW}$, yielding no profit to the participant. This produces the efficiency gains associated with virtual bidding, as the coordination of day-ahead and real-time pricing through arbitrage simultaneously minimizes a source of uplift and neutralizes pricing variances caused by the use of market power.

Continuing with the assumption of a single trader bidding DECs in a single hour at a single node, the trader has the ability to develop a derived demand curve for virtual bids given the expected price spread (P_S) between the real-time and day-ahead prices assuming different quantities of DEC clear ($P_S = P_{RT} - P_{DA}$). Given the inverse relationship between the spread paid to DECs and the total quantity of DECs that clear, the demand for virtuals is downward sloping, with a vertical intercept at a price equal to $P_S^0 = P_{RT}^0 - P_{DA}^0$ and a horizontal intercept at the quantity of DECs “ X_{max} ” that creates price convergence ($P_{DA} = P_{RT}$, thus $P_S = 0$). For simplicity, this demand function is represented as linear and is shown in Figure 4.²⁵

²⁵ More realistically, the derived demand has a non-positive slope with horizontal segments occurring intermittently due to portions of the day-ahead and real-time offer curves where blocks of generation are offered at a constant price. Subsequent analysis in this section will consider the negative region of this demand curve beyond the point of convergence, wherein the trader’s decision to place DECs is based on a joint portfolio of virtual bids and a FTR. The analysis also will be generalized mathematically to extend the model’s flexibility beyond the linear case.

Figure 4

The Derived Demand for Decremental Bids and Associated Revenues



The clearing of successive DECs (and resulting movement down the demand curve) has two countervailing effects on the trader's revenues. By successfully bidding each additional MW of DEC into the market, the marginal sale brings added revenue to the trader; however, the additional DEC sold simultaneously causes greater convergence between the day-ahead and real-time prices, thus reducing the revenues obtained across the entire lot of DECs bid by the trader. The "Marginal Revenues of Virtual Trades" curve in Figure 4 illustrates this combined effect. Marginal revenues are positive up to X^* , the point where the gain from the last MW bid exactly offsets the loss caused by price convergence across the lot of all DECs bid previously. Beyond X^* , the losses from convergence exceed the incremental value of each one MW sale, such that marginal revenues are negative. Assuming transactions are costless, the total profit made by the

trader is the sum of the marginal revenues across all MW of DEC's that clear, shown in Figure 4 by the "Total Revenues of Virtual Trades" curve. As the trader bids successive DEC's up to X^* , each additional MW that clears adds positive revenues to the trader's book. Beyond X^* , Total Revenues will decline at an increasing rate due to increasing losses caused by convergence. Assuming the trader is solely interested in maximizing the profit (π) derived by their virtual trades, they will therefore bid DEC's in the amount X^* and earn π^* .

Table 1
Profit Maximization of Virtual Bids Placed on a Stand-Alone Basis

Location on Horizontal Axis	Real-Time vs. Day-Ahead Price Spread ($P_s = 40 - X$)	Quantity of DEC MW Cleared (X)	Total Revenues from Virtuals (TR = $P_s * X$)
Origin (0)	40	0	0
	35	5	175
	30	10	300
	25	15	375
Maximized Revenues (X^*)	20	20	400
	15	25	375
	10	30	300
	5	35	175
Convergence (X_{max})	0	40	0

Table 1 combines the concepts presented in Figures 3 and 4 in an algebraic construct. The trader is assumed to expect the pre-DEC spread between the real-time and day-ahead prices to be \$40 and expects that convergence will occur if 40 MW of DEC clear. If the derived demand is linear, the trader's demand for DEC's is $P_s = 40 - X$, where " P_s " is the difference in

the day-ahead and real-time prices given the quantity of DECs that clear, “ X ” is the quantity of DEC MW bid by the trader that clear, and 40 is the pre-DEC spread corresponding to the vertical intercept $P_{RT}^0 - P_{DA}^0$.²⁶ Assuming the trader then bids DECs (which, by assumption, clear) in five MW increments, the calculations shown in Table 1 result. The trader maximizes its total revenues by bidding 20 MW of DECs and driving the day-ahead/real-time spread to \$20 per MW, corresponding precisely with the profit maximizing quantity of bids X^* and resulting price spread P_S^* the presentations of Figures 3 and 4 anticipate.

A generalized method for determining the optimal stand-alone quantity of DECs that the virtual trader should place to maximize revenue derives from Equation 2:

$$P_S = P_{RT} - P_{DA}. \quad (2)$$

Specifically, because DECs (X) tend to raise day-ahead and (possibly) lower real-time prices,

$$\frac{\partial P_{DA}}{\partial X} \geq 0, \quad \frac{\partial P_{RT}}{\partial X} \leq 0, \quad (3a)$$

so convergence occurs such that $\frac{\partial P_S}{\partial X} = \frac{\partial P_{RT}}{\partial X} - \frac{\partial P_{DA}}{\partial X} \leq 0$. (3b)

The trader’s total revenues from its virtual trading then equal cleared DECs times the spread, and these revenues are maximized where the marginal revenues from trading equal zero:

$$TR = P_S \cdot X = (P_{RT} - P_{DA}) \cdot X = P_{RT} \cdot X - P_{DA} \cdot X \Rightarrow \quad (4a)$$

²⁶ Since Demand is given by $P_S = 40 - X$, Total Revenues (TR) = $P_S \cdot X = (40 - X) \cdot X = 40X - X^2$ and Marginal Revenues (MR) = $\frac{\partial TR}{\partial X} = 40 - 2X$.

$$MR = \frac{\partial TR}{\partial X} = P_{RT} + \frac{\partial P_{RT}}{\partial X} \cdot X - P_{DA} - \frac{\partial P_{DA}}{\partial X} \cdot X = 0 \Rightarrow \quad (4b)$$

$$\left(\frac{\partial P_{RT}}{\partial X} - \frac{\partial P_{DA}}{\partial X} \right) \cdot X = P_{DA} - P_{RT} \Rightarrow \quad (4c)$$

Substituting Equations (2) and (3b): $\left(\frac{\partial P_S}{\partial X} \right) \cdot X = -P_S \Rightarrow \quad (4d)$

$$X^* = -P_S \cdot \frac{\partial X}{\partial P_S} > 0 \quad \left| \quad \frac{\partial X}{\partial P_S} < 0 \right. \quad (4e)$$

Thus, for the linear demand curve used in the previous example where the spread is \$20/MW and the inverse of the slope of the demand curve is negative one, $X^* = - (20) \cdot (-1) = 20$ MW of DEC.

Convergence in the Presence of Multiple Traders of Virtuals

The previous discussion assumes that only one trader bids DECs into the market, yielding a bid of X^* DECs that will not fully converge the prices of the day-ahead and real-time markets upon clearing ($P_S^* > 0$). However, assuming sequential bidding,²⁸ there is an incentive for

²⁷ While a change in the quantity of DECs traded could result in no change in price (indicating transactions occurring within a horizontal region of the demand curve), any change in price must necessarily be caused by a change in the quantity of DECs traded.

²⁸ For simplicity, this presentation assumes that traders place bids sequentially. This is clearly not the case since the day-ahead and real-time markets follow an auction format. If competitive conditions exist, auction theory would nevertheless predict an equivalent result, either through a Bertrand equilibrium (wherein two traders would compete fiercely until convergence is met) or a Cournot equilibrium, where the number of traders “ N ” will grow continuously until all traders collectively bid a number of DECs “ X^* ” at a price “ P_S^* ” such that:

$$X^* = \left(\frac{N}{N+1} \right) \cdot X_{Max} \quad \text{and} \quad P_S^* = \left(\frac{1}{N+1} \right) \cdot (P_{RT}^0 - P_{DA}^0).$$

Thus, as the number of traders becomes large, the number of DECs placed approaches X_{max} and the price associated with the difference of the day-ahead/real-time spread approaches zero.

another trader to subsequently enter the virtual market and bid DECs to take advantage of the remaining price spread associated with P_s^* . In the context of Table 1, the second trader will observe that there remains a \$20 spread in the market after the first trader's bids clear. The second trader's residual demand for DECs is then $P_s = 20 - X$, prompting it to maximize revenues by bidding 10 MW of DECs. If these clear, the total number of DECs in the market will then be 30 and the resulting spread will fall to \$10. Continuing in this sequential bidding paradigm, subsequent traders would then opportunistically bid for the remaining surplus, moving the market toward a total quantity of DEC trades equal to X_{max} and bringing convergence of the day-ahead and real-time prices. This process typifies arguments of why virtual bids contribute to market efficiency; because physical capital is not required to participate in the virtual market, a multitude of traders can participate and use virtuals to eliminate the market power that would exist if only physical entities were able to trade.

3.2. Financial Transmission Rights and the Incentive to Manipulate Day-Ahead Prices

FTRs allow customers to protect against the risk of congestion-driven price increases in the day-ahead market for transmission service in the RTOs. Congestion costs occur as the demand for scheduled power over a transmission path exceeds that path's flow capabilities. For example, if the transmission capacity going from Point A (the "source") to Point B (the "sink") is 500 MW, but the RTO seeks to send 600 MW of power from Point A to Point B when calling on the least-cost generators to serve load, congestion occurs on the path. This will cause the price at the source to decline and the price at sink to increase, raising the congestion cost of serving point

B from Point A. By obtaining a FTR over the path from Point A to Point B, the FTR holder receives the difference of the congestion prices at the sink and source, allowing it to hedge against the congestion costs incurred in the day-ahead market. FTRs were originally developed to give native LSEs in the nascent organized markets price certainty similar to that available to traditional vertically integrated utilities operating in non-RTO markets. This practice continues, as FTRs (or auction revenue rights that are convertible into FTRs) are allocated to LSEs and to entities which fund the construction of specific new transmission facilities in the Day 2 RTOs.

Although FTRs are used by transmission providers and LSEs as a hedge, they can also be purchased by any creditworthy entity seeking their financial attributes as a hedge or a speculative investment. In this regard, FTRs are virtually indistinguishable from financial swaps that are executed as a contract for differences between day-ahead LMPs at two locations. However, FTRs can be differentiated from swaps because (i) FTRs do not consider transmission losses in their pricing, and (ii) the physical constraints of the transmission grid limit the available quantity of FTRs. On this second point, the RTO limits the quantity of FTRs made available for auction through a simultaneous feasibility test across all potential flowgates. The RTO performs this test cognizant of existing FTR positions and system constraints.²⁹ The resulting portfolio of FTRs that is available for allocation or auction constrains the size of the net positions that can be held by market participants. By comparison, because financial swaps have no physical dimension,

²⁹ Note that participants in FTR auctions can procure “counter flow” capacity which directly offsets “prevailing flow” FTRs, thereby allowing the value at risk on a given path to exceed the physical limits of the line. However, such bids are ultimately physically constrained, as the net position held on the path should always conform to the simultaneous feasibility test.

traders can accumulate positions in quantities bounded only by the willingness of counterparties to take an opposing financial position.

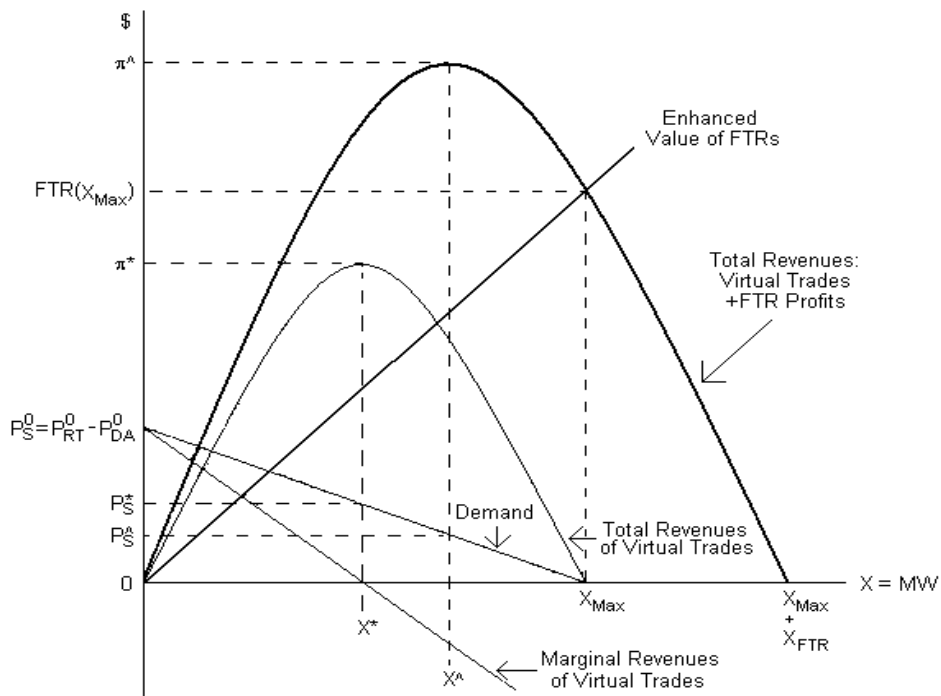
Whether used as a hedge or held as a speculative investment, it is in the interest of the RTO to allow all qualified market participants to bid in the auctions and procure FTRs because robust participation funds the auction revenue rights paid to LSEs. However, holders of large FTR positions (or equivalent positions in swaps) have the incentive to purposely enhance those positions' value using transactions that affect physical day-ahead LMPs, such as virtual bids and offers. This is consistent with the moral hazard problem discussed previously in the examples of Sections 1 and 2. If there is evidence that a trader is consistently engaging in uneconomic price-setting trades at specific locations, the behavior may be an attempt to alter the prices that set the value of that trader's related positions to trigger a manipulation. To understand the incentives that drive such behavior, I will add a FTR to the virtual trader's portfolio to extend the analyses of Figure 4 and Table 1 to examine the trader's joint decision making process.

3.3. The Effect of Placing DEC's at the Sink of a Prevailing Flow FTR

A prevailing flow FTR pays its holder the difference of the day-ahead congestion charges at the FTR's sink and source, thus hedging the holder against the cost of increased congestion at the sink (or, less likely but conceivably, a glut of supply at the source). The effect of repeated DEC bids at a sink tends to worsen congestion in the day-ahead market at that point, causing the day-ahead price to increase and the resulting value of the FTR sinking at that point to increase. For simplicity, the relationship between the quantity of DEC's cleared and the resulting effect on

the day-ahead price is assumed to be linear, shown below in Figure 5 by the line “Enhanced Value of FTRs.”³⁰ The combination of the revenues from the FTR with those of the virtuals yields “Total Revenues: Virtual Trades + FTR Profits.” This curve achieves a maximum at a level of DECs (X^\wedge) and a level of profits (π^\wedge) above those associated with a trader capable of bidding only virtuals without the benefit of a related day-ahead financial position. This presents the (now familiar) moral hazard problem that incents the trader to manipulate the market price to benefit its overall portfolio.

Figure 5
The Total Revenues from Placing DECs at the Sink of a FTR



³⁰ Because the day-ahead offer curve is generally concave-up, every added DEC cleared will tend to increase the price at the sink, thus making this curve concave-up. Although a linear curve is used in this example for simplicity, this presentation confirms that a concave-up curve would increase the leverage of the FTR holder’s as more DECs are placed, thus increasing its incentive to manipulate the market.

The ability of a trader to enhance the value of its FTR gives it the incentive to bid more virtuals at the sink than it would absent the FTR. Specifically, assuming “ F ” megawatts of FTR:

$$TR = P_S \cdot X + P_{DA} \cdot F = (P_{RT} - P_{DA}) \cdot X + P_{DA} \cdot F = P_{RT} \cdot X - P_{DA} \cdot X + P_{DA} \cdot F, \quad (5a)$$

which is identical to the profitability criterion for the successful manipulation of a cleared market discussed in Section 2 and shown in Equation (1) above.³¹ Maximizing Equation (5a) obtains:

$$MR = \frac{\partial TR}{\partial X} = P_{RT} + \frac{\partial P_{RT}}{\partial X} \cdot X - P_{DA} - \frac{\partial P_{DA}}{\partial X} \cdot X + \frac{\partial P_{DA}}{\partial X} \cdot F = 0 \Rightarrow \quad (5b)$$

$$\left(\frac{\partial P_{RT}}{\partial X} - \frac{\partial P_{DA}}{\partial X} \right) \cdot X = (P_{DA} - P_{RT}) - \frac{\partial P_{DA}}{\partial X} \cdot F \Rightarrow \quad (5c)$$

Substituting Equations (2) and (3b): $\frac{\partial P_S}{\partial X} \cdot X = -P_S - \frac{\partial P_{DA}}{\partial X} \cdot F \Rightarrow \quad (5d)$

$$X^\wedge = -P_S \frac{\partial X}{\partial P_S} - \frac{\partial P_{DA}}{\partial P_S} \cdot F \Rightarrow \quad (5e)$$

Substituting Equation (4e) yields $X^\wedge = X^* - \frac{\partial P_{DA}}{\partial P_S} \cdot F. \quad (5f)$

Hence, given $\frac{\partial P_{DA}}{\partial P_S} < 0$ and $F > 0$, $-\frac{\partial P_{DA}}{\partial P_S} \cdot F > 0$ and therefore $X^\wedge > X^*$.

³¹ For profitability, $TR = P_{RT} \cdot X - P_{DA} \cdot X + P_{DA} \cdot F > 0 \Rightarrow P_{DA} \cdot F > (P_{DA} - P_{RT}) \cdot X$, where “ X ” is the manipulation trigger (“ $Xm - Xr$ ” in Equation (1)), $(P_{DA} - P_{RT})$ is the unit cost of the trigger (“ $Cm - Pm$ ” in Equation (1)), “ F ” is the related position (“ R ” in Equation (1)), and “ P_{DA} ” is the benefit to the manipulation (“ $Px^* - Pm$ ” in Equation (1)). Note the sign of $P_{DA} = P_{RT} - P_S$ is opposite that of $(Px^* - Pm)$ in Equation (1) because this example assumes a demand-based manipulation, whereas the example in Section 2 assumed a manipulation of supply.

As Figure 5 demonstrates, the trader's behavior yields a desirable result for the market; while X^\wedge lies to the right of X^* , it is below X_{max} , the level of DEC's needed to converge the day-ahead and real-time prices. As the goal of convergence bidding is for the market to supply an amount of DEC's equal to X_{max} , the trader could reasonably argue that any quantity of DEC's it places such that $X^\wedge \leq X_{max}$ benefits the market, thus serving a laudable purpose that should be immune to scrutiny for market manipulation. As Section 1 discussed, a savvy trader can use this to its advantage by placing DEC's that are profitable on an accounting basis but that fail to cover its opportunity cost (thus, $X^* < X^\wedge < X_{max}$). Counterparties to the targeted position are injured by this behavior, but must demonstrate that an act benefiting the efficiency of the system and profiting the trader on a stand-alone basis nevertheless was executed to intentionally undercut the trader's opportunity cost (the unobservable π^*) and thus facilitate a manipulation.

Faith in the virtual bidding process can amplify this logic to an undesirable extreme. If the market collective by assumption provides the net quantity of virtual trades associated with convergence at X_{max} , the expected value of the trader's FTR shown in Figure 5 *must* tend to $FTR(X_{max})$ irrespective of that trader's actions. From this logic, it follows that any attempt to manipulate day-ahead and real-time prices is futile since virtuals mitigate attempts to exercise market power and disequilibrate those markets. Thus, a showing that a trader placed virtuals in stand-alone uneconomic quantities and in a manner designed to enhance the value of its targeted financial position is irrelevant, because the divergence caused by the manipulative strategy will incite opposing virtuals that will restore convergence to the market and thwart the manipulation.

Ignoring that this perspective assumes the competitive conditions needed for convergence are ubiquitous, a useful corollary emerges: in a competitive market, *the expected value of a virtual trade is zero*. Thus, while a fixed-size DEC placed at one location in any single hour may earn a significant profit or loss, placement of that DEC over time should result in offsetting gains and losses such that the trader's cumulative profit should net to zero. If the trader is shown to consistently lose money on the virtuals it places over time, it is possible that it is intentionally placing virtuals in excess of X_{max} to benefit its related positions. While the discussion of possible benchmarks to evaluate what is a "consistent" loss is deferred to Section 4, the remainder of this section will describe how the trader could leverage losses in its triggering virtuals to manipulate the value of its targeted FTR.

As the quantity of FTR megawatts increases relative to the size of the DECs bid at the FTR sink, the trader can better leverage FTR gains against virtual losses such that it will place more DECs than necessary to create convergence. If the quantity of FTR megawatts (F) exceeds the quantity of DEC megawatts associated with X_{max} , the trader will set $X^\wedge > X_{max}$ such that gains on its FTR will more than offset losses incurred on its virtuals. From Equation (5c):

$$\left(\frac{\partial P_{RT}}{\partial X} - \frac{\partial P_{DA}}{\partial X} \right) \cdot X = (P_{DA} - P_{RT}) - \frac{\partial P_{DA}}{\partial X} \cdot F \Rightarrow \quad (5c)$$

Substituting Equation (3b): $\frac{\partial P_S}{\partial X} \cdot X + \frac{\partial P_{DA}}{\partial X} \cdot F = (P_{DA} - P_{RT}) \Rightarrow \quad (6a)$

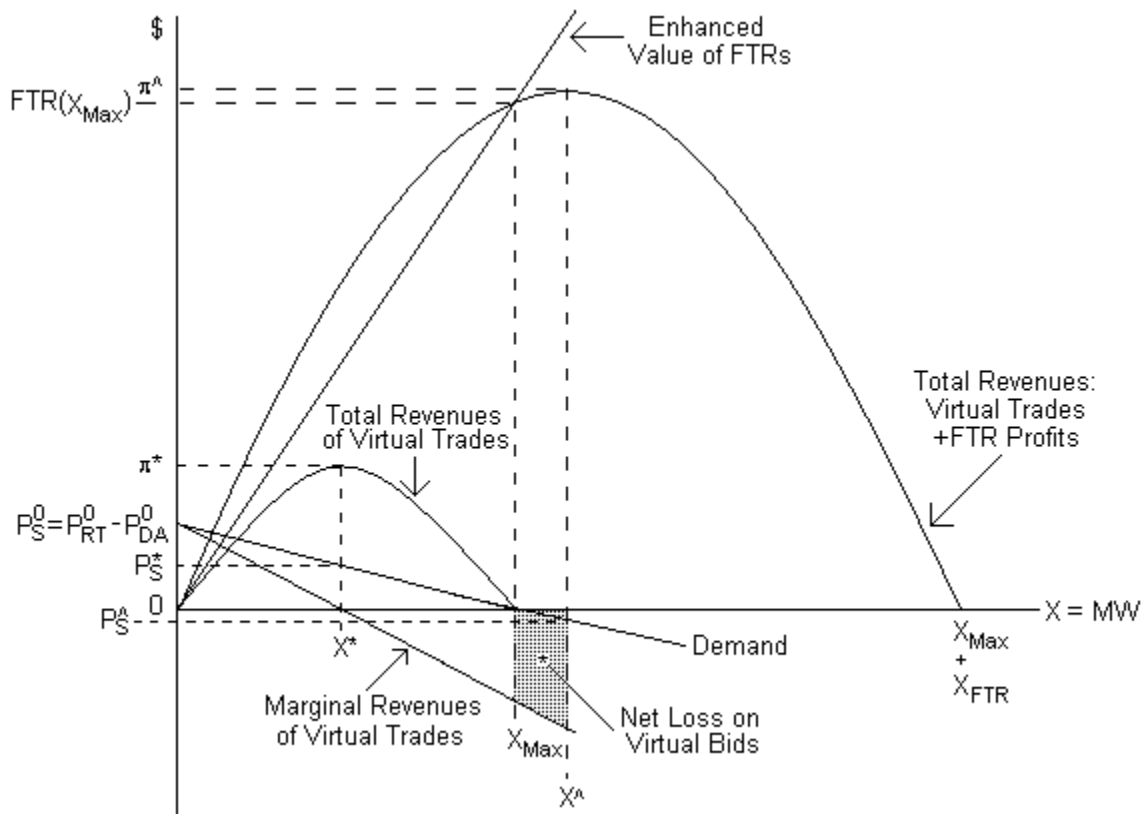
If $X^\wedge > X_{max}$, then $(P_{DA} - P_{RT}) > 0 \Rightarrow \frac{\partial P_S}{\partial X} \cdot X + \frac{\partial P_{DA}}{\partial X} \cdot F > 0 \Rightarrow \quad (6b)$

$$-\frac{\partial P_S}{\partial P_{DA}} < \frac{F}{X} \Rightarrow \tag{6c}$$

Therefore, because $-\frac{\partial P_S}{\partial P_{DA}} \geq 1 \Rightarrow \frac{F}{X} > 1 \Rightarrow F > X$.

The exploitation of a leveraged FTR position is shown below in Figure 6:

Figure 6
The Incentive to Place DEC in Quantities Greater Than X_{max}



If more than X_{max} megawatts of DEC clear, the trader sells virtuals at a negative price (P^{\wedge}) such that the loss on the last virtual traded (X^{\wedge}) equals the gain on the enhanced value of the FTR, thus

maximizing the total profits garnered from the combined position (π^{\wedge}). The shaded region shows the losses the trader willingly incurs on its DEC's to enhance the value of its FTR above $FTR(X_{max})$. By definition, the negative price and losses on the virtuals result from divergence of the day-ahead and real-time prices, such that the resulting day-ahead congestion is worse than that in the real-time. This should incent other traders to offer INCs into the market to profit from the high real-time price, and the inability or unwillingness of other market participants to restore the market to X_{max} suggests an anomaly that might be indicative of manipulative behavior.³²

Table 2
Profit Maximization Using Uneconomic Virtual Bids to Enhance FTR Values

Location on Horizontal Axis	Real-Time vs. Day-Ahead Price Spread ($P_S = 40 - X$)	Quantity of DEC's Cleared (X)	Total Revenues of Virtuals (TR= $P_S * X$)	Enhancement of FTR Value from Cleared DEC MWs FTR = $60*(40 - P_S)$	Total Profit from Scheme (TR+FTR)
Origin (0)	40	0	0	0	0
	30	10	300	600	900
Max Profit Virtuals (X^*)	20	20	400	1,200	1,600
	10	30	300	1,800	2,100
Convergence (X_{max})	0	40	0	2,400	2,400
Maximum Revenues (X^{\wedge})	-10	50	-500	3,000	2,500
	-20	60	-1,200	3,600	2,400
	-30	70	-2,100	4,200	2,100
	-40	80	-3,200	4,800	1,600
	-50	90	-4,500	5,400	900
TR Intercept ($X_{max} + X_{FTR}$)	-60	100	-6,000	6,000	0

³² A competitive market would see a response from many other traders, such that there would theoretically be no long-term benefit in attempting to DEC beyond X_{max} . However, the trader's ability to leverage its gains from the financial position could allow it to bid more DEC's than can rationally be countered by other market participants, especially given the likely low return on the INCs used to negate the manipulator's virtual position and potentially high risk of losses should the manipulator unexpectedly withdraw its bids from the market.

Table 2 also demonstrates the manipulation. In addition to the assumptions made for the example shown in Table 1, assume that the trader holds a 60 MW FTR position that sinks at the point where the decremental bids clear and that the clearing of virtuals does not affect real-time prices.³³ Beyond X^* , every dollar the day-ahead price increases will increase the profits of the FTR position but simultaneously reduce profitability from the virtuals. If the trader's DEC's clear in ten MW increments, the calculations shown in Table 2 result. The trader now maximizes its revenues by bidding 50 MW of DEC into the market, causing the spread to move beyond convergence such that the day-ahead price will exceed the real-time price by \$10/MW. This incents the over-commitment of generation resources in the day-ahead market at the location. Compared to the 20 megawatts of DEC's the trader would bid were it seeking to maximize the revenues from its virtuals on a stand-alone basis, the trader gives up \$900 (a loss measured relative to its opportunity cost) to gain \$1,800 on its FTR. Relative to the 40 MW of DEC's needed for convergence, the trader purposely loses \$500 on its virtuals (a loss measured by its accounting cost) to create a \$600 gain on its FTR.

The trader's behavior in the example provided in this section encompasses all attributes of the market manipulations discussed in Sections 1 and 2. The trader incurs a loss on a price-setting transaction to enhance the value of its price-taking financial position in exploitation of a moral hazard. This introduces an externality by injecting false price information into the market,

³³ If the real-time price is not affected by the placement of DEC's, the closure of the spread is due entirely to increases in the day-ahead price. This simplifies calculation of the enhancement to the FTR's value shown in Table 2, for the change in the day-ahead price must then equal the pre-DEC spread (\$40) less the spread that results after the trader's DEC's clear (P_S).

to the detriment of efficient market operations and of all buyers exposed to the day-ahead price. The externality creates harm due to the higher costs to the RTO (such as inefficient dispatch) that result from divergence. Finally, the trader's willingness to use an uneconomic virtual trade as a trigger to benefit the value of its targeted price-taking FTR is consistent with manipulation. However, this is only one data point; that the trader lost money on one bid placed at one point in one hour provides very little meaningful evidence of manipulation, irrespective of how that trade affected the trader's FTR. Indeed, if the virtuals market is competitive, the trader *should* lose money on about half of its virtual transactions because the mean value of virtuals should tend to zero given convergence. To prove manipulative intent, it is necessary to demonstrate the trader purposefully took *consistent* losses on the transactions triggering the manipulation. To this end, the next section proposes and discusses the merits of several benchmarks that could be used to evaluate the consistency of a trader's losses in support of (or in defense against) governmental or private actions designed to detect and punish such behavior.

4. Five Proposed Screens for Detecting Manipulative Behavior and Intent

Proof of manipulative intent is difficult because an asymmetric presumption of innocence is attributable to the trader's decision making. The party alleging a manipulation must prove that (i) the trader willingly lost money on the triggering transactions, (ii) those losses benefited the trader's targeted related positions, and (iii) the trader willingly created and sought to exploit the nexus between the trigger and target. As to the first point, a trader that earns a stand-alone profit on the transactions alleged to trigger the manipulation can claim a legitimate business purpose

for those trades, thus negating an assertion of intent to manipulate. Proof of the second point is also complicated, as the trader (or its affiliates) could have many physical and financial positions that relate to the trigger and target, the sum (or partial sum) of which could negate an assertion of manipulative intent; these positions may not be apparent to the party alleging the manipulation absent the investment of sizable discovery costs, injecting substantial uncertainty in the calculus of bringing actions based on manipulation claims.³⁴ Proof of the third element largely depends on successful proof of the first two points in some magnitude or over a protracted period of time, such that the evidence demonstrates that the trader purposely sought to exploit the nexus between trigger and target. Note that proof of these three elements is sufficient to demonstrate an *attempt* to manipulate, but does not prove the price effect needed to support claims of damages to injured parties or disgorgement of profits made from a successful manipulation. Under statutes where the level of civil penalties or punitive awards depends upon the proof of actual damages, this additional requirement can also tend to thwart the commencement of manipulation-based actions.

As discussed previously, Pirrong (1993, 1994, 2004, 2008, 2009, 2010) advocates using statistical techniques, including regression analysis, to prove or disprove intent and measure the price effect of manipulative behavior. He used these techniques in recent testimony before the FERC (2009), demonstrating therein that the variety, complexity, and lack of transparency such analyses entail can be used strategically to counter allegations of manipulation. This places the

³⁴ Presumptively, the combination of these high costs and the uncertainty of obtaining a positive outcome will deter many would-be plaintiffs from pursuing manipulation based actions. This explains why the enforcement of anti-manipulation statutes has historically been the domain of government and why punitive damages (modeled as civil penalties or fines) are appropriate for establishing a socially efficient level of deterrence. For further discussion see Justice Posner's opinion in *Kemezy v. Peters* (79 F.3d 33 [7th Cir. 1996]).

Trier-of-fact in the uncomfortable position of refereeing the “battle of the experts,” wherein the positive assertions made by a claimant can be offset by a relatively limitless number of negative counterarguments.³⁵ More transparent tests for supporting or defending manipulation claims are desirable and could provide better standards of proof upon which a Trier-of-fact could rely. The detection of suspected manipulation is also complicated by (i) the inability to acquire data concerning the manipulator’s portfolio of targeted positions and (ii) difficulty in obtaining (accounting or opportunity) cost data against which to evaluate the profitability of the triggering transactions on a stand-alone basis. The development of screens that can use limited data to transparently detect manipulative behavior could assist enforcement agencies and potential claimants in forming preliminary assessments as to whether to proceed in filing an action based upon suspected manipulative behavior.

To this end, I propose five types of screens to detect and prove (or disprove) manipulative intent: binomial probabilities tests, tests of the profitability of the triggering instruments, market presence tests, frequency tests, and tests for disgorgement. Each test screens for only one indicia of intent and is insufficient to prove the existence of an actual or attempted manipulation on a stand-alone basis. For example, a binomial probabilities test measures the trader’s impact on the directionality of prices, but provides no measure of the stand-alone profitability or volume-

³⁵ An analogy would be the detection of cancer cells within a biopsied sample; although the malignancy could be detectable when the magnification focuses at a particular strength and at one part of the sample, observations of other parts of the sample or at other magnifications could obscure detection. This analogy is not meant to criticize valid defenses to a manipulation claim such as legitimate business purpose for the triggering transactions or lack of nexus between the triggering transactions and targeted position. To the contrary, the point is that evaluation of a reasonable defense to alleged manipulative conduct cannot and should not allow for limitless hypothetical counterfactuals that do not address the cause and effect of the behavior in question.

weighted impact of its trades. Also, because subjectivity in setting the benchmark for a screen could bias the results to produce more false positives or false negatives, vetting of the benchmarks used for specific applications is necessary to demonstrate their validity for detecting intent in manipulation-based litigation. Given the simple nature of the tests I propose, this vetting process should be a relatively straightforward and transparent exercise for the Trier-of-fact, especially if compared to evaluating an expert witness's econometric techniques.

A key benefit of the screens proposed herein is their use in preliminary investigations for detecting or disproving manipulative behavior *based on the analysis of triggering transactions alone*. If such analysis confirms the presence of suspicious behavior, a claimant or enforcement agency would have a better foundation for deciding whether to invest in the legal and analytic resources necessary to obtain and examine the full extent of the trader's triggering transactions and targeted positions. For example, once a determination of the trader's aggregate net long or net short exposure to prices set by the triggers is complete, the interested person would apply the screens to determine if a case should proceed. If so, the results would support future discovery requests, inform future analyses, and provide the Trier-of-fact with objective quantitative evidence as to the propensity of the trader's intent.

4.1. Binomial Probabilities Tests

One method for evaluating a trader's intent is to compare the marginal prices at which its price-setting transactions occur to the average market price (such as an index) ultimately formed using those transactions. Assuming a competitive market, the distribution of prices that form the

index should approximate a normal distribution around the index price over time, meaning that any one of the trader’s transactions should have a roughly 50% chance of being above or below the index. Examining the totality of its trades made over time, the percentage of a trader’s price-setting transactions that would tend to raise or lower the index should therefore be roughly equal assuming the trader is attempting to “beat” the index on a stand-alone basis.³⁶ On first blush, this assertion might offend conservative sensibilities; countless market events that are unpredictable by and unknown to the trader could cause the index to move drastically such that all of its trades appear purposely designed to bias the settlement of the index in a particular direction. This is a valid concern if the analysis considers only a few transactions, but the likelihood that the totality of a trader’s transactions could deviate significantly above or below the 50% threshold declines significantly as the number of trades and the number of settlement periods evaluated increases.

Table 3
Binomial Probabilities of 60% or More Trades Falling on
One Side of a Competitive Index

Total Number of Transactions	Minimum Directional Trades (60% of Total)	Binomial Probability of 60% or More Directional Trades (%)
5	3	50.00
10	6	37.70
20	12	25.17
40	24	13.41
80	48	4.65
160	96	0.70

³⁶ Following the logic discussed in Section 1, market participants facing a competitive index should have no more success in trying to beat the index than in simply acting as a price-taker and accepting the index price.

To demonstrate this point, consider the binomial probability that 60% or more of a trader's price-setting transactions would fall on one side of a competitive index. Table 3 above shows that as the number of transactions considered grows large, the likelihood of a trader beating (or losing to) a fair index as a matter of chance grows highly unlikely. This is a property of the law of large numbers, for the addition of volume to the average (index) value makes it increasingly difficult to move that average significantly from the mean. Reversing this logic potentiates a binomial probabilities test for detecting manipulation. If the trader is forensically shown to have placed transactions on one side of a competitive index a majority of (M) times out of some total number of transactions (N), the binomial probability (P^B) that the totality of the trading was the product of random chance is given by Equation (7):

$$P^B = \sum_{C=M}^{C=N} \left(\frac{N!}{C!(N-C)!} \right) (.5)^N \quad (7)$$

For example, assume an alleged manipulator is shown to have sold below index on 150 of 235 trades (about 64%) that set the index values across multiple trading periods, to the benefit of its targeted positions that were short to the index. The manipulator could assert the intuitive argument that because 36% of its price-setting trades raised the index price (thus reducing the value of the targeted short positions), analysis of its trades in total negates proof of manipulative intent. However, use of the binomial probability test estimates the likelihood that the totality of the behavior would occur with random chance to be 0.2%, about one in five hundred.

Skeptics of this methodology may rightfully assert the need for further analysis to verify the statistical properties of the distribution of the index and the alleged manipulator's fixed-price trades before the result holds evidentiary weight. Further, the value of a fully vetted suspicious outcome of the binomial probabilities test is not dispositive of manipulative intent because the test is only designed to measure the directionality of price-setting trades. The result is simply one flag needing corroboration with other indicia of manipulation, such as the willingness of the trader to sustain consistent losses over time. This requires measurement of the volume-weighted price effect of the triggering transactions on the trader's profitability, discussed next.

4.2. Tests for the Profitability of Triggering Instruments

If the transactions used to enable the alleged manipulation are profitable on a stand-alone basis, the trader can claim the trades served a legitimate economic purpose and are thus immune from scrutiny. This can lead a defense to engage in selective relativism as to the values against which costs are measured and the group of transactions within which the triggering trades are considered a "strategy." Concerning the measurement of cost, economic theory suggests that the benchmark be set as the best price available to the trader to profit from its triggering transactions, equal to the trader's opportunity cost. This typically is the price obtainable from a competitive market absent the manipulation, such as the \$500,000 initial index price discussed in Section 1, the pre-manipulation market price Px^* from Section 2, or the \$20 spread gained by the virtual trader in Section 3. This valuation can be problematic, as observation of the competitive price may be impossible given the impact of the triggering transactions on price formation; for

example, P_m is the only observable price in the example of Section 2 after the market clears, while the \$20 spread in the example of Section 3 is completely unobservable.

If a sufficiently untainted substitute price (such as that of an identical product sold elsewhere and adjusted for costing variances such as transportation) is unavailable, accounting cost is appropriate for calculating profitability.³⁷ The example of Section 3 presents such a case, because expected profitability of virtual trading is zero given convergence. If the trades comprising the trigger are sufficiently discrete and the size of the losses is significant, the choice of a cost benchmark is less important; for example, the price-making sale in Section 1 was so out of the money at \$100,000 that the choice of the *ex ante* (\$500,000) or *ex post* (\$480,000) index value is irrelevant. By comparison, the choice of an opportunity cost measure (P_x^*) versus an actual cost measure (C_m) under the clearing scenario of Section 2 could be significant.

Evaluation of triggers in the broader context of a trading strategy is more problematic because a trader is in a superior position to selectively group triggering transactions as arrays of trades inside and outside of the scope of the manipulation until a profitable “strategy” emerges. For example, in the context of a trading strategy for virtual bids and offers placed across multiple hours at multiple nodes, the manipulator only needs to find one combination of trades that encompasses the triggers across a set of nodes (N) and in specific hours (H) such that:

³⁷ Dr. Pirrong developed a substantial body of literature recommending the use of econometric and other statistical techniques to isolate the price effect of a manipulation from the competitive market price. Pirrong (2004), p. 28. Such techniques may not be needed if sufficiently untainted substitutable products are available, such as location-adjusted prices at nearby trading points.

$$\sum_{i=0}^N \sum_{j=0}^H (P_S^{i,j}) \cdot X^{i,j} > 0 . \quad (8)$$

This is not to assert that one must always view a trader's explanation of the profitability (or lack of profitability) of its strategy with suspicion. Quite the opposite, incurring persistent losses may be completely reasonable if the trader is legitimately hedging risk, and behavior that may appear to be manipulative in a narrow context may reasonably represent part of a broader rational profit-seeking strategy. However, the trader cannot be afforded the opportunity to make continual alternative pleas such that a claimant must expend vast resources to disprove what could be a relatively limitless number of counterfactuals. The Trier-of-fact must balance the trader's and claimant's interests in considering alternative presentations of a trigger profitability test, with concomitant use of other behavioral screens to identify or disprove indicia of intent.

4.3. *Market Presence Tests*

As discussed in Section 1, the detection of manipulative behavior requires a different set of metrics than traditional economic analyses provide because the mechanisms used to facilitate a manipulation may be economically counterintuitive on a stand-alone basis. This is not to say that traditional economic theory is irrelevant to the analysis, but rather that the benchmarks for analyzing traditional concepts such as market power need adaptation across applications for use in the context of evaluating manipulative intent. The use of leverage exemplifies this point. As discussed in the example of Section 3, the success of a manipulation of virtual bids depends on the ability of the trader to assemble its net targeted physical and financial positions in quantities

sufficient to more than offset losses it incurs on the triggering transactions. One check as to the viability of a manipulation is therefore to determine whether the size of the targeted net long or net short position is at least as large as that of the of the price-setting instruments used to assist the scheme. This may not be possible in the initial phases of evaluating the behavior in question because the extent of the trader's financial positions is likely to be unobservable prior to legal discovery. However, proof of a successful manipulation will require the claimant to prove that the trader ultimately held not only the requisite intent but the means to execute the manipulation.

Many other traditional economic tools that measure market power require adaptation to varying degrees before they can add value in the manipulation context. Price-based comparisons to cost (such as the Lerner Index) are instructive and underlie the trigger profitability and disgorgement tests herein. Lerner (1934). Volumetric measures of market power such as HHIs or concentration ratios need downward adjustments to their threshold values to account for the relatively small market presence needed to effectuate a manipulation, evidenced by the examples provided in Sections 1 through 3. The timing and volume of trades are also of great importance to assessing the trader's ability and intent to manipulate, for opportunistically concentrated or well-timed trading can take advantage of inelasticities of demand and supply to the benefit of related portfolio positions.³⁸ Other traditional elements for the analysis of market power may

³⁸ Examples of such behavior include the placing of high bids or low offers in volume at the beginning of the trading day to inject the trader's desired price information into the market (framing the open), buying or selling in volume at the end of the trading day to affect the price marked for overnight valuation (marking the close), or other price-taking trades placed in volume and designed to take advantage of temporal inelasticities to post prices above the market (lifting offers) or below the market (hitting bids).

also be of relevance. For example, acts to create and exploit moral hazard through the placement of uneconomic trades could represent the erection of a barrier to entry by the manipulator.³⁹

4.4. Frequency Tests

As a logical and legal truism, proof of an *attempted* manipulation does not necessitate the showing of an actual price movement brought about by the trader. This does not relieve a party seeking to prove a manipulation from showing that the alleged manipulator intentionally sought to enhance the value of targeted positions by executing specific triggering transactions, nor does it negate the trader's ability to disprove the alleged nexus or show that the trades executed were made for a stand-alone legitimate business purpose. To prove attempt thus raises one question: if the trader's alleged target positions would benefit from a directional price movement, did the trader execute triggering trades that would tend to move the price in that same direction? For example, if the value of a trader's net short position ties to a specific market price, did the trader consistently place transactions (such as adding supply) that would tend to lower prices in that market? One would expect an affirmative answer to this question for the majority of the time the manipulation was occurring, leading to an examination of additional screens to corroborate the behavior. While the usefulness of frequency tests extends beyond the proof of an attempted

³⁹ Legal precedent in antitrust held that the willingness to perform illegal acts such as theft can raise entry barriers and create a restraint of trade. See *Harolds Stores, Inc.; Cmt Enterprises, Inc., Plaintiffs-Appellees, v. Dillard Department Stores, Inc., Defendant-Appellant. Harolds Stores, Inc., Plaintiff-Cross-Appellant, v. Dillard Department Stores, Inc., Defendant-Cross-Appellee* (82 F.3d 1533 [10th Cir. 1996]). A price-based manipulation similarly erects a barrier because the manipulator willingly injects false pricing information into the market, thereby foreclosing the market to some participants. See the example associated with Figure 1 in Section 2, wherein the manipulation decreases the output of other suppliers from X^* to X_r .

manipulation, they are of greater importance therein due to the absence of evidence that shows actual price movements. A Trier-of-fact's benchmark for the frequency of "yes" answers should therefore be sufficiently high in such cases to confirm the trader's motives.

4.5. Tests for Disgorgement

Unlike the previously discussed screens that focus upon the cause of a manipulation, the calculation of disgorgement measures the effect of the manipulation relative to the profits made by the trader. While evidence of disgorgement is not needed to prove intent to manipulate under a fraud-based statute, claimants in private actions or on behalf of harmed parties in governmental enforcement actions must prove disgorgement to recover damages and obtain meaningful civil penalties.⁴⁰ Further, a claimant's case for proving manipulative intent benefits if it can show that the alleged manipulator profited from its scheme. Disgorgement calculations can be deceptively complicated, requiring two steps: determining the price effect caused by the triggering trades, then multiplying this effect by the net quantity of the positions benefiting from the manipulation. Proof of the size of the targeted positions is often impossible until full disclosure occurs pursuant to discovery, but should then be a relatively straightforward exercise in transactional analysis. By comparison, a variety of factors complicate the determination of the price effect, most

⁴⁰ For example, treble damages in antitrust are expressly tied with proof of actual damages. See Section 4 of the Clayton Antitrust Act (15 U.S.C. § 12–27, 29 U.S.C. § 52–53 [1914]). Similarly, the civil penalties the government can seek in actions brought under the FERC's anti-manipulation statute are also potentially tied to disgorgement. See *Policy Statement on Penalty Guidelines* (130 FERC ¶ 61,220 [March 18, 2010]), subsequently suspended (131 FERC ¶ 61,040 [April 15, 2010]), revised and reissued (132 FERC ¶ 61,216 [September 17, 2010]).

notably the inability to observe the competitive price given the impact of the manipulation on price formation (discussed previously with respect to the trigger profitability test).

The examples provided in Sections 1 through 3 provide insight as to the relative ease of making disgorgement calculations under different scenarios. In the condominium example of Section 1, disgorgement equals the \$20,000 price effect on the index due to the trigger multiplied by the 20 units purchased at the lower price, for \$1 million total. The reality of index formation may complicate such computations, however, for the triggers may influence other trades and bias the index to reflect a smaller price change than is accurate given the manipulation. Because less transparency is available in cleared markets (exemplified in Section 2), the competitive price (P_m^*) is unobservable in the wake of the manipulation. The calculation of disgorgement then requires that (i) the market be “rerun” without the inclusion of the triggering transactions, or (ii) the claimant develops an acceptable surrogate for the competitive price. The use of accounting cost can greatly simplify disgorgement calculations; in the example of Section 3, disgorgement is the divergent price spread multiplied by the size of the FTR, with the addition across hours and nodes as applicable. This nexus between virtuals and FTRs is so obvious that some RTOs require automatic forfeitures of a FTR’s profits if virtuals are placed in a proximity that could influence their value. See *PJM Open Access Transmission Tariff, Attachment M – Appendix, Part VI* at 453Q (September 8, 2010).

5. Conclusion

Market manipulation remains an understudied and misconstrued phenomenon. This is because traditional microeconomic assumptions concerning the maximization of profits do not readily explain the counterintuitive intent of manipulators to use uneconomic behavior for moving prices to benefit related positions. Financial derivatives markets create linkages across products and across industries, many of which are undetectable absent the commencement of litigation or enforcement actions. Although the Dodd-Frank Act may bring some measure of transparency to these instruments, it is likely that financial innovation and the ability of swaps traders to move operations offshore will continue to create an endless array of semi-transparent instruments. Unscrupulous opportunists will use these to the detriment of participants in the triggering market and counterparties in the targeted market. Given the difficulties in detection and enforcement, it will undoubtedly be true that like other forms of market failure, there is some “efficient” level of manipulative behavior that will remain endemic to the market.⁴¹ Extension of the manipulation paradigm to other litigation contexts, including actions in antitrust, consumer protection, below-cost sales, and other anti-fraud statutes that allow private causes of action could minimize this externality and create better anti-manipulation compliance over time.

The adaptation of economic models to assess the efficacy of real-world behavior is often fraught with a certain amount of pragmatic skepticism. Indeed, efficient market proponents may

⁴¹ Note that the example provided in Section 3 suggests that this is the case, for there is a range of trading activity shown (between X^* and X_{max}) wherein the behavior could be classified as manipulative but where detection and proof thereof is essentially impossible.

be convinced that the five tests proposed herein will serve no purpose but to quash savvy trading strategies and injure competition by driving liquidity from the market. There is some wisdom in this nihilistic viewpoint; the idea that traders should be held to a standard of clairvoyance such that they fear losing money on “triggering” transactions under a crucible of millions of potential plaintiffs is indeed an undesirable result. However, the screens suggested herein do not focus on isolated incidents of unlucky or risk-averse trading, but on uneconomic behavior that persists with such repetition or magnitude that a rational trader would avoid the loss but for the existence of some benefiting physical or financial target. Where benchmarks should be set for the five tests proposed in the movement across applications may be the subject of substantial debate. However, movement of the discussion out of cloistered conclaves within federal agencies into a more public forum will ultimately serve to reduce the externality present and associated harm.

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