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SCREENS FOR CONSPIRACIES AND THEIR MULTIPLE APPLICATIONS

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ABSTRACT

A screen is a statistical test designed to detect conspiracies aimed at illegally manipulating a market. Competition authorities, academics, and consultants have designed a variety of screens to detect competition problems, and the use of such screens has been increasing. In this paper, we first describe screens designed to detect bid- rigging, price-fixing, market- allocation schemes, and commodity-market manipulation. Next, we discuss the ways in which screens can be used by plaintiffs and defendants in antitrust cases. These include: (i) class certification, (ii) motions to dismiss after Twombly; (iii) estimating the effects and damages of collusion; (iv) assisting companies in deciding when and whether to file a leniency application; (v) assisting in disproving the existence of a conspiracy and manipulation or establishing its immateriality; and (vi) assisting managers in large companies to monitor for data manipulation (e.g. falsified reimbursement or accounting statements) and price-fixing in purchasing.

I. INTRODUCTION

Competition authorities pursue price-fixing conspiracies in three stages: detection, prosecution, and penalization. In the United States and Europe, antitrust authorities historically have relied on leniency applications for the detection stage. Leniency programs have identified cartels in numerous industries including vitamins, dynamic random access memory ("DRAM") chips, graphite electrodes, and fine art auctions. As a result, over $2.5 billion dollars in fines have been assessed in the United States alone from 1997 to 2004.[1]

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[1] See Scott D. Hammond, *Cornerstones of an Effective Leniency Program,* ICN Workshop on Leniency Programs (2004), *available at* http://www.justice.gov/atr/public/speeches/206611.htm.

While leniency programs have been a success for antitrust agencies, some collusion remains undetected. Indeed, the very fact that leniency applications continue to be filed at high rates is evidence that collusion still occurs. Moreover, leniency programs likely reflect a bias towards uncovering conspiracies close to the breaking point, meaning that the most successful and durable cartels likely remain undetected. Recognizing the limitations of leniency programs, many antitrust agencies have started to search for alternative approaches to detecting conspiracies. One such approach is screening.

Recognizing the limitations of leniency programs, many antitrust agencies have started to search for alternative approaches to detecting conspiracies. One such approach is screening

A screen is a statistical test designed to identify industries where competition problems exist and, in such industries, which firms are involved in a conspiracy. Screens use commonly available data such as prices, costs, estimated market shares, or bids, and then use statistical tools to identify patterns in the data that are anomalous or highly improbable. Broadly speaking, collusion screens used in the literature employ two strategies.

The first is to search for improbable events. This type of screen is similar to looking for a cheat in a casino. For example, the probability that a gambler at a Las Vegas casino will place a winning bet in roulette is roughly 0.5 percent. During her shift, a roulette dealer may see a handful of players win five, six, or even seven times in a row. However, the probability of winning twenty times in a row is around one in one million. If a pit boss sees this occur, he may not be able to prove that cheating has occurred, but he would be well advised to watch closely or risk losing a lot of money. One set of collusive screens generalizes this idea by looking for events that are improbable unless firms in the industry have coordinated their actions.

The second type of screen uses the concept of a control group. In the 1980s, organized crime in New York City operated a concrete club that rigged bids on contracts over $2 million. During this period, the price of concrete was 70 percent higher in New York City than other U.S. cities. While it is true that the price of many goods and services is higher in New York City, few prices are 70 percent higher than in other large cities. Prices that are anomalous compared to other markets suggest a competition problem. In this simple example, a control group consisting of prices in other cities is used as a basis for comparing prices in New York.

Below, we describe how economists have implemented screens to search for competition problems. The examples we discuss are bid-rigging, price-fixing, market-allocation schemes, and manipulating commodities markets.

Screens are not only useful to antitrust agencies; they can also be powerful tools for plaintiffs and defendants in antitrust cases. We will describe the multiple uses screens have (i) during class certification, (ii) for motions to dismiss after *Twombly*; (iii) estimating the effects and damages of collusion; (iv) assisting companies in deciding when and whether to file a leniency application; (v) assisting in disproving the existence of a conspiracy and manipulation or establishing its immateriality; and (vi) assisting managers in large companies to monitor for data manipulation (e.g. falsified reimbursement or accounting statements) and price-fixing in purchasing.

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It is important to emphasize that screens do not *prove* collusion. Screens isolate outcomes that are improbable or anomalous. Screens will exhibit both false positives and false negatives. However, this does not mean that screens lack value. Doctors regularly screen their patients for diseases even though their methods exhibit both false positives and negatives. Even so, patients are screened because the expense of testing all patients for a rare disease is prohibitive. The process of screening identifies a subset of patients that are at a higher risk than others, which then allows the doctor to engage in the more extensive testing for just a selective few. Analogously, a good antitrust screen will narrow the set of possible conspiracies to a manageable few that merit further review.

A good screen should possess the following properties: (i) it should minimize the number of false positives and negatives; (ii) it should be easy to implement; (iii) it should be costly for firms to disguise collusive behavior; and (iv) it should have empirical support.

II. EXAMPLES OF SCREENS

In this section, we describe several screens and their empirical applications. We start with the example of competitive bidding because the strict rules of competitive bidding help to identify colluders. Next, we discuss screens when only price data are available. These include variance screens, which search for pockets of high or low variances in prices as a flag for competition problems. Finally, we discuss screens based on Benford's Law, which describes the rates at which certain digits occur in many data sets.

A. Bid-Rigging

Bid-rigging in competitive tenders is a productive setting to apply screens for three reasons. First, competitive tenders account for a large volume of economic output. Public sector procurement, which often uses some form of competitive bidding, accounts for about 15 percent of

There is a large body of empirical literature on collusion in auctions that implements various types of screens.

world output. In addition, competitive bidding is widely used in financial markets, privatization of public assets, real estate, and many other transactions. Second, bid-rigging is a common antitrust offense. For example, during the 1980s, bid-rigging accounted for more than half of the criminal cases filed by the Department of Justice's Antitrust Division ("DOJ"). Third, markets that use competitive bidding are frequently rich in data. In many countries, statutes require the public disclosure of bids.

There is a large body of empirical literature on collusion in auctions that implements various types of screens.[2] While these papers span a wide variety of industries, researchers have identified common patterns when collusion is known or suspected. We describe these patterns below.

B. Bid-Rigging Screens Based on Improbable Events

The first set of screens looks for improbable events in sealed bid auctions. In these settings, firms submit their bids simultaneously. These bids are then read at a fixed date. In the public sector, the contract is typically awarded to the lowest bidder. If firms do not collude, they cannot condition their bids on the bids of other firms. As a result, we should expect that the bids would be independent after we control for information that is observed by all bidders, such as variables that influence cost or market power.

On the other hand, if firms collude, they need to coordinate their actions. Frequently, this coordination destroys the independence of the bids and can be detected through the use of statistical hypothesis testing. Collusion is suspected when bids are "too correlated" with each other to be the result of independent actions by bidders. Searching for identical bids is a limiting case

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[2] *See* Robert H. Porter & J. Douglas Zona, *Detection of Bid Rigging in Procurement Auctions*, 101 J. Pol. Econ. 518 (1993) (examining auctions for highway construction projects in Long Island); Laura H. Baldwin et al., *Bidder Collusion at Forest Service Timber Sales*, 105(4) J. Pol. Econ. 657 (1997) (examining timber auctions in the Pacific Northwest); Robert H. Porter & J. Douglas Zona, *Ohio School Milk Markets: An Analysis of Bidding*, 30 RAND J. Econ. 263 (1999) (examining the procurement of school milk in Ohio); Martin Pesendorfer, *A Study of Collusion in First-Price Auctions*, 67 Rev. Econ. Stud. 1 (2000); Peter Crampton & Jesse Schwartz, *Collusive Bidding: Lessons from the FCC Spectrum Auctions*, 17 J. Reg. Econ. 229 (2000); Patrick Bajari & Jungwon Yeo, *Auction Design and Tacit Collusion in FCC Spectrum Auctions*, forthcoming in Information Economics And Policy. Econ. & Pol'y; Patrick Bajari & Lixin Ye, *Deciding Between Competition and Collusion*, 85(4) Rev. Econ. Stat. 971 (2003); John List, Daniel Millimet, & Michael Price, *Inferring Treatment Status when Treating Assignment is Unknown: with an Application to Collusive Bidding Behavior in Canadian Softwood Timber Auctions*, mimeo University of Chicago (2004); John Asker, *A Study of the Internal Organisation of a Bidding Cartel*, 100(3) Am. Econ. Rev. 724 (2010); Robert Marshall & Leslie Marx, *The Vulnerability of Auctions to Bidder Collusion*, forthcoming in Q. J. Econ. (2007).

of this sort of screen. A famous example is bids received by the Tennessee Valley Authority to install conductor cables in the 1950s. Seven firms submitted identical bids of $198,438.24. This is analogous to a gambler making twenty winning bets in a row at the roulette wheel. The chances of seven bidders, acting independently, arriving at bids that agree to eight significant digits is almost zero and a very strong signal that firms have explicitly or implicitly arrived at a mechanism for coordinating bids.

We illustrate this screen with an example involving bids to supply school milk in Ohio between 1980 and 1990.[3] In Ohio, firms submitted sealed bids for contracts to supply schools with pint-size portions of milk. The bidders were typically processors or distributors of milk, and school milk typically represented less than 10 percent of their annual revenues. Based on court evidence, Robert Porter and Douglas Zona argued that a bidder's costs are easily explained by a small number of variables, which are readily observed and include the price of raw milk and transportation costs, which represent 7 percent of total costs. Competition in the school milk market is localized due to transportation costs. Firms that are close to a particular school have a cost advantage because of shorter delivery routes.

Porter and Zona constructed econometric models of submitting a bid and bid levels. Economic theory suggests that both decisions should depend on two factors. The first is costs, which the authors measured using data on the distance between a public school, the bidder's location, and the number of deliveries made by the bidder. The second is local market power, which the authors controlled for by variables measuring the locations of competing firms.

The first screen proposed by Porter and Zona examined the correlation in bidders' entry decisions. After controlling for information that was publicly observed at the time of bidding, the authors found that the bidding decisions of some firms in the sample was too high to be explained by pure randomness, which supported the hypothesis that many accused colluders coordinated their decisions to submit bids.

Next, Porter and Zona constructed econometric models that express bids as a function of costs (controlled for by the distance between a public school, the bidder's location, and the number of deliveries made by the bidder) and local market power (controlled for by variables measuring the locations of competing firms). Porter and Zona found that bids for the non-colluding firms were explained using these regression models while, in comparison, the bids of cartel members were too highly and persistently correlated to be explained by

[3] Robert H. Porter & J. Douglas Zona, *Ohio School Milk Markets: An Analysis of Bidding* (NBER Working Paper No. 6037 (1997)).

Therefore, a second screen proposed in the literature is to determine how well bids reflect costs

the data. Porter and Zona concluded that it was difficult to reconcile this high and persistent correlation in bids with the hypothesis that firms were bidding independently. This high degree of correlation is similar to a gambler in a casino who has "correctly guessed" which bet to place in roulette twenty times in a row. These events appear to be too improbable to have occurred at random.[4]

C. Bid-Rigging Screens Based on Control Groups

A second prediction of economic theory is that bids should reflect costs in reasonably competitive markets. The act of collusion, on the other hand, attenuates the relationship between bids and costs so that conspirators can earn profits above a normal competitive rate. Therefore, a second screen proposed in the literature is to determine how well bids reflect costs. In our motivating example, one of the pieces of evidence we used to help make our case about the concrete club in New York City was that the cost of concrete there was 70 percent higher than in other U.S. cities. In this example, costs in other cities are a control group for the costs in New York.

Patrick Bajari (a co-author of this article) and Lixin Ye[5] examined bids by highway contractors in the upper Midwest during the 1990s. Three of the firms in their sample had been convicted of collusion in the last decade. However, market observers believed that the industry was free of a market-wide conspiracy to rig bids. The authors used bids for a type of road repair known as seal coating. The standard job in their data was fairly small—the winning bids are approximately $175,000. State highway departments prepare cost estimates before bidding occurs. These cost estimates are largely based on bids made in other geographic markets. Companies like McGraw Hill sell "blue books," which are essentially price indexes for particular construction tasks with market-specific adjustments. Note that the ratio of the winning bid to the cost estimate is almost equal to one with a fairly small standard deviation. This suggests that bids

[4] Other studies have performed similar tests with similar results in markets where collusion is strongly suspected. This includes Porter & Zona's (1993) analysis of paving contacts on Long Island in the 1980s, List et. al.'s (2004) examination of bids for Canadian timber, and Marshall & Marx's (2008) study of bidding decisions for Russian Oil and Gas leases. Taken together, these papers demonstrate the usefulness of a screen that tests for the independence of bid submissions and bid levels. In the introduction, we argued that a good screen should have few false positives. Bajari & Ye, *infra*, demonstrate that this screen appears to have this property in their study of bidding by contractors in Minnesota, North Dakota, and South Dakota during the late 1990s.

[5] Patrick Bajari & Lixin Ye, *Deciding Between Competition and Collusion*, 85(4) Rev. Econ. Stat., 971-989 (2003).

TABLE 1 Summary Statistics from Bajari and Ye

Variable	# of Observations	Mean	Std Deviation
Total Bid	441	175,000	210,000
Winning Bid/Cost Estimate	139	1.0031	0.1573
Distance of Winning Firm	139	188.67	141.51
Distance of Second Lowest Bidder	139	213.75	152.01
Backlog of Winning Bidder	131	0.3376	0.3160
Backlog of Second Lowest Bidder	131	0.4326	0.3435

are comparable to properly deflated bids from other markets. The authors took this as positive evidence that most bids in the market are competitive.

Distance is an important determinant of costs in seal coating. Bajari and Ye used mapping software to measure the travel time in minutes from a bidder's location to the project site. The table above shows that the winning bidder is closer than the second lowest bidder, which is consistent with bids increasing in transportation costs, and supporting evidence of a competitive market.

Backlog is another important determinant of costs. Most firms in the data are small, with annual revenues under $20 million. As a result, they have limited capacity and could not win all of the projects awarded in a particular year. As firms near their capacity constraints, their bids should increase as a result. The authors measured an individual firm's capacity by tracking the number of projects it previously won and the completion dates for those projects. Capacities are normalized to always lie between zero and one. The table shows that bids increase with backlog, which is consistent with economic intuition.

Next, the authors model bids using regression analysis. They use control variables, such as the engineer's cost estimate, distance from the project, and backlog. The regression also controls for competitive factors, such as the distance of the closest rival to the project. They estimated the regression separately for the eleven largest firms in the market. This allows them to study how and if bids are determined differently across the firms.

The authors screen for collusion by comparing the regressions described above for pairs of firms. The intuition behind the screen is simple. If A and B are not colluding, their bids will only depend on cost and competitive factors. On the other hand, if A and B collude, these factors alone cannot explain their bids. As a result, we should expect A and B's bid regressions to differ, which can be detected using hypothesis testing. Bajari and Ye apply this test to the eleven largest firms in their data set. They find that they cannot reject the hypothesis of no collusion, with the exception of two firms recently sanctioned for bid rigging.

D. Screens Based on Price and Cost Information

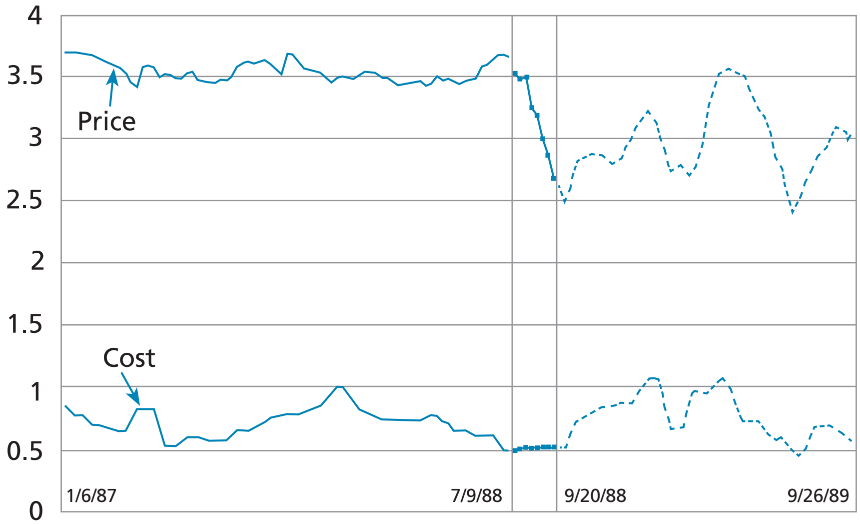
Economists also can screen for collusion by searching for prices that appear to be the result of direct coordination or that fail to reflect costs. For example, the DOJ suggests that the following patterns might be indicative of collusive behavior. Identical prices may indicate a price-fixing conspiracy, especially when: (i) prices remain identical for long periods of time; (ii) prices previously were different among firms before they were identical; (iii) price increases do not appear to be explainable by increased costs; (iv) discounts are eliminated, particularly in a market where discounts historically were given, or (v) vendors are charging higher prices to local customers than to distant customers.[6]

In a recent paper by Rosa Abrantes-Metz (a co-author of this article), Luke Froeb, John Geweke, and Christopher Taylor, the authors build on the intuition suggested in the first pattern noted above.[7] The authors propose a screen based on a search for pockets of high and low price variances among gasoline stations within a single metropolitan area. The idea for the screen came from the observation of price and cost behavior during, and after, the fall of a bid-rigging conspiracy in the market for frozen perch fillets purchased by the Defense Personal Support Center between 1987 and 1989. This conspiracy showed that collusive prices are less volatile and less responsive to cost shocks than are competitive prices. This empirical finding is also a prediction of many theoretical models. A cartel can be thought of as a "filter" that attenuates cost shocks before passing them to price, thereby reducing price

[6] *See* Price Fixing, Bid Rigging, and Market Allocation Schemes: What They Are and What to Look For, *available at* http://www.usdoj.gov/atr/public/guidelines/primer-ncu.htm.

[7] Rosa Abrantes-Metz, Luke Froeb, John Geweke, & Christopher Taylor, *A Variance Screen for Collusion*, 24 Int'l J. of I.O. 467-486 (2006).

FIGURE 1 Frozen Perch Prices and Costs: 1/6/87 - 9/26/89



variance. The figure above, extracted from their paper, plots prices, in dollars per pound, for frozen perch filets paid by the Philadelphia Defense Personal Service Center from 1987 through September 1989. The cost data is the average monthly price of fresh perch, also in dollars per pound.

The authors compare prices and costs in the collusive regime (to the left of the vertical lines) to prices in the competitive regime (to the right of the vertical lines). The period between the two lines represents a transition from collusion to competition. This figure illustrates five features of the collusive and competitive regimes: (i) there was a structural break when the cartel collapsed, marked by a sudden drop in prices; (ii) the average price was higher during collusion than during competition; (iii) prices were more stable under collusion than under competition; (iv) prices followed costs movements more closely under competition than under collusion; and (v) gross margins were higher under collusion.

These five features are consistent with theoretical models of cartels. Also, the features of the data are consistent with the screens we discussed earlier and could be used by antitrust authorities to spot collusion. For example, the higher variance of prices in the competitive regime would be flagged by a well-designed variance screen.

As we will discuss in the next section, this variance screen has started to be used by a number of competition agencies in the United States and Europe.[8]

E. Screens Based on Quantities

Another potential screen uses data on quantity. The literature and evidence from prior cartels demonstrate that cartels may attempt to collude by fixing market shares.[9] Two screens are suggested by the literature: (i) markets shares that appear to be too stable over time and (ii) market shares for all firms in a particular market are negatively correlated over time. The first screen will detect an agreement by the cartel members to divide the market. Examples of cartels with stable market share agreements include cartels in copper plumbing tubes, organic peroxides, and several vitamins (A, E, and folic acid, in particular). In these industries, the cartel set shares at pre-cartel levels. Cartels in citric acid, sorbates, and zinc phosphate used the average of previous years. The second screen is suggested by dynamic models of collusion.[10] In these models, if a cartel member deviates from the collusive agreement, it will need to compensate other cartel members in subsequent time periods. As a result, abnormally high shares for a particular firm in one period should be followed by a reduction in shares the following period.

F. Screens Based on Mathematical Laws

In many data sets, the distribution of digits has a naturally, regularly occurring pattern. Benford's Law is a mathematical formula that describes this regularly occurring distribution of digits. Studies have shown that the law applies to a surprisingly large number of data sets, including populations of cities, street addresses of the first 348 persons named in *American Men of Science* (1934), electricity usage, word frequency, the daily returns to the Dow Jones, and even the

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8 At the Italian Competition Authority, two economists "tested" the price variance screen on actual cartels in two different industries: the motor fuel market (gasoline and diesel); and the market for personal care and baby food products sold in pharmacies. The authors found that had the variance screen been applied to the data, it would successfully have detected these cartels. *See* Fabio Esposito & Massimo Ferrero, *Variance Screens for Detecting Collusions: An Application to Two Cartel Cases in Italy*, Italian Competition Authority, Working Paper (2006).

9 *See* Harrington, *Behavioral Screening and the Detection of Cartels*, Eur. Competition Law Annual 2006: Enforcement of Prohibition of Cartels (Claus-Dieter Ehlermann & Isabela Atanasiu, eds.) (2007).

10 *See* Susan Athey & Kyle Bagwell, *Optimal Collusion with Private Information*, 32(3) RAND J. Econ, 428-465 (2001) and Susan Athey, Kyle Bagwell & Chris Sanchirico, *Collusion and Price Rigidity*, 71 Rev. Econ. Studies, 317-349 (2004).

distribution of digits for the opening prices of 780 stocks on the Toronto Stock Exchange over a period of 300 days starting on June 30, 1998. Since Benford's Law is a naturally occurring pattern in many data sets, violations of the Law can be used to detect irregularities. In the past, violations of Benford's Law have been used to detect data tampering, manipulation of financial ratios, and tax evasion.[11]

Rosa Abrantes-Metz, Sofia Villas-Boas & George Judge use Benford's Law to test for conspiracies in several applied settings. The authors also use Benford's Law to test for manipulation of the Libor rate.[12] Similar to the findings in Abrantes-Metz, Kraten, Metz & Seow, their results indicate possible collusion for a specific period.[13,14]

III. THE USE OF SCREENS BY ANTITRUST AGENCIES

In this section we discuss efforts by antitrust agencies in the United States and Europe to detect conspiracies through the use of screens.[15] Screening efforts in the United States date back the 1970s when the DOJ formed an "identical bids" unit to investigate government procurement auctions in which identical bids were submitted. During the six years of its existence, no conspiracies were uncovered.

In October 2006, the DOJ created the National Procurement Fraud Task Force to promote prevention, early detection, and prosecution of fraud in federal procurement contracts.

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11 Others who have used Benford's law to check the validity of purported scientific data in the social sciences include Hal Varian, *Benford's Law*, 26 Amer. Statistician, 65-66 (1972); Charles Carslaw, *Anomalies in Income Numbers: Evidence of Goal Oriented Behavior*, 63(2) Acct. Rev. 321-327 (1988); Mark Nigrini, *A Taxpayer Compliance Application of Benford's Law*, 18(1) J. Amer. Taxation Assn. 72- 91 (1996); Cindy Durtschi, William Hillson & Carl Pacini, *The Effective Use of Benford's Law to Assist in Detecting Fraud in Accounting Data*, 5 J. Forensic Acct., 17-34 (2004); C. Geyer & P. Williamson, *Detecting Fraud in Data Sets Using Benford's Law,* 33 Comm. In. Stat., 229-246 (2004); D. Giles, *Benford's Law and Naturally Occurring Prices in Certain Ebay Auctions*, 14(3) Applied Econ. Letters 157-161 (2007); John Nye & Charles Moul, *The Political Economy of Numbers: On the Application of Benford's Law to International Macroeconomic Statistics*, 7(1) The B.E. Journal of Macroeconomics (2007); George Judge & Laura Schechter, *Detecting problems in Survey Data using Benford's Law*, J. Human Resources, forthcoming (2009).

12 Rosa Abrantes-Metz, Sofia Villas-Boas, & George Judge, *Tracking the Libor Rate*, Applied Econ. Letters, forthcoming (2010).

13 Abrantes-Metz, Villas-Boas, and Judge are also testing the power of Benford's Law to detect manipulations in commodities markets and in price-fixing cartels.

14 Rosa Abrantes-Metz, Michael Kraten, Albert Metz & Gim Seow, *LIBOR Manipulation?* Working Paper (2008), *available at* http://papers.ssrn.com/sol3/cf_dev/AbsByAuth.cfm?per_id=339863.

15 A more detailed discussion can be found in Rosa Abrantes-Metz & Luke Froeb, *Competition Authorities are Screening for Conspiracies: What are they Likely to Find?* The American Bar Association Section of Antitrust Law Economics Committee Newsletter (2008).

This variance screen was referred to in the FTC's post-hurricane Katrina and Rita investigations to refute allegations of gasoline price manipulation

The Task Force focuses on defective pricing, false claims, grant fraud, labor mischarging, and bid-rigging.[16] And more recently, the DOJ announced proactive efforts in partnership with state and local agencies to protect stimulus funds provided for by the American Recovery and Reinvestment Act of 2009 from fraud, waste, and abuse. These efforts include spotting behavior consistent with red flags for collusion.[17]

In the late 1990s, Federal Trade Commission ("FTC") Chief Economist Jonathan Baker proposed a screen based on the behavior of prices over the business cycle. He hypothesized that the exercise of market power would cause prices to increase coming out of a business cycle trough. FTC economists searched for industries that experienced price increases during periods where output was not rising (to rule out demand increases). This screen flagged 600 industries for potential collusion, 25 of which were chosen for investigation. Of the 25, no benign reason for the price increases could be found for 3. One industry was already under extensive investigation by the DOJ. What happened as a result of these investigations is not a matter of public record.

More recently at the FTC, Abrantes-Metz, Froeb, Geweke and Taylor developed the price variance screen for collusion described in the previous section while Froeb was the Chief Economist at the Federal Trade Commission.[18] The authors used it to screen for conspiracies in gasoline retail stations in a localized area by searching for pockets of low variance and high means. Figure 2 below, which is extracted from their paper, represents the 279 gasoline stations studied in Louisville, Kentucky. Each gasoline station is represented by the average value of prices over the period studied and by the standard deviation of those prices. The authors look for a group of stations in the lower right-hand-side corner of the figure, characterized by high mean and low price variance, which is consistent with possible collusive behavior. No such group was found.

This variance screen was referred to in the FTC's post-hurricane Katrina and Rita investigations to refute allegations of gasoline price manipulation.[19]

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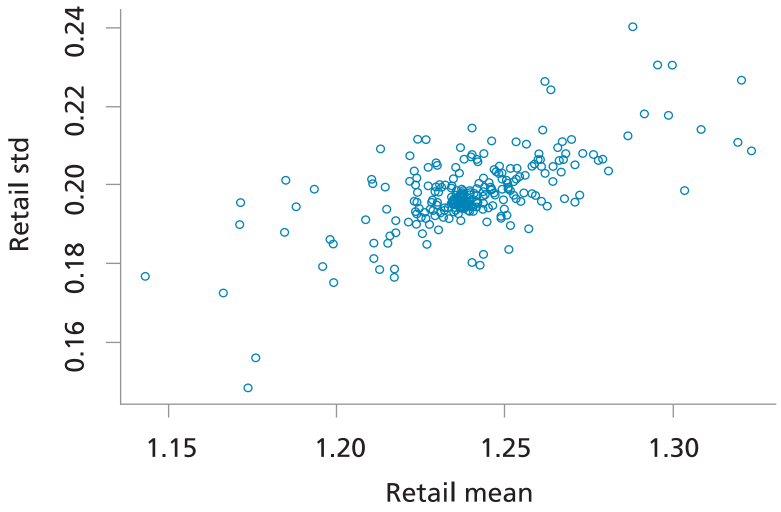
[16] The National Procurement Fraud Task Force Web page is located at http://www.usdoj.gov/criminal/npftf/.

[17] Scott D. Hammond, Director of Criminal Enforcement, Antitrust Division, U.S. Dep't of Justice: *Follow the Money: An Update on Stimulus Spending, Transparency and Fraud Prevention*, Testimony Before the Committee on Homeland Security and Governmental Affairs of the United States Senate (Sept. 10, 2009), *available at* http://www.usdoj.gov/atr/public/testimony/250274.htm.

[18] *Supra* note 10.

[19] Federal Trade Commission, *Gasoline Price Changes: The Dynamic of Supply, Demand, and Competition* (2005), http://www.ftc.gov/reports/gasprices05/050705gaspricesrpt.pdf.

FIGURE 2 All Brands, 279 Stations



(Extracted from Abrantes-Metz, Froeb, Geweke and Taylor (2006))

The FTC uses screens in gasoline markets in its official monitoring program.[20] The FTC uses gasoline prices at major supply points like New Orleans as a competitive benchmark to screen retail prices in 360 cities and wholesale prices in 20 major urban areas. When the screen identifies persistent and significantly high prices, further investigation is conducted. To date, all of these anomalous prices have come down in a short period of time or have been found to be caused by non-collusive events like pipeline breaks or refinery outages.

In Great Britain, Grout and Sonderegger of the Office of Fair Trading identified industry-level variables that predict cartel activity.[21] The authors built an econometric model to predict collusion at the industry level using data from prior price-fixing cases obtained from the DOJ and the European Commission. The study concludes that industry turnover, cost measures, concentration measures, entry barriers, and employee costs, among other factors, help explain the prevalence of

[20] Federal Trade Commission, *Gasoline and Diesel Price Monitoring, available at* http://www.ftc.gov/ftc/oilgas/gas_price.htm.

[21] Paul A. Grout & Silvia Sonderegger, *Predicting Cartels, Office of Fair Trading*, Economic discussion paper (March 2005).

collusion in an industry. Competition authorities in the Netherlands use a similar approach to screen for cartels employing data on leniency applications and industry characteristics.

Other European antitrust agencies are actively using screens to detect conspiracies, namely in gasoline and diesel markets. For example, the European Commission's market monitoring program is a two-step, industry-level approach.[22] First, the program identifies industries at risk of collusion, using characteristics such as a small number of firms, more homogeneous products, and more stable demand. Having identified these at-risk industries, the second stage establishes a "reasonable theory of harm" and a "focused in-depth analysis" to test the theory of harm. Screens play roles in both stages of this EC approach.

IV. MULTIPLE USES OF SCREENS

Screens are more than just detection tools for antitrust agencies. They can also be used during litigation in the prosecution and penalization stages by plaintiffs, defendants, and antitrust agencies. Additionally, screens can be quite useful to companies in a pre-litigation setting.

During the prosecution and penalization stages, screens can be used in class action suits, to assist in establishing or rejecting certification, and during motions to dismiss, particularly after *Twombly*. At a later stage in litigation, plaintiffs and defendants can apply screens to determine if an alleged cartel caused harm. Finally, experts can apply screens when estimating but-for prices and in providing support in damages estimation.

A. Use of Screens in the Class Action Certification Stage

Screening methodologies might prove very useful in the class certification stage, in which factual claims are alleged to be common across class members. The use of screens could help illustrate different price patterns among the alleged participants in the alleged cartel, as well as in showing that the prices charged to each type of consumer were different enough after controlling for relevant market conditions.

B. Use of Screens During Motions to Dismiss After *Twombly*

Suppose plaintiffs file a complaint in which they infer the existence of a conspiracy, based on a screen, and for which there are no sufficient facts plausibly supporting the existence of explicitly

22 Hans Friederiszuck & Frank Maier-Rigaud, *Triggering Inspections Ex Officio: Moving Beyond a Passive EU Cartel Policy*, 4 J. Comp. L. & Econ. 89 (2008).

coordinated behavior rather than independent strategic behavior. This is particularly important after the Supreme Court decision in *Bell Atlantic Corp. v. Twombly*[23] in which it is stated that "an allegation of parallel conduct and a bare assertion of conspiracy" does not by itself justify a claim for relief under Section 1 of the Sherman Act since the complaint does not provide sufficient facts to plausibly support the inference of a conspiracy as opposed to independent action.[24] This decision marks a clear turn in the standards required in these types of cases by requiring enough factual matter and plausibility that a collusive agreement existed. Previously, and for the last fifty years, the Court allowed cases to proceed unless it appeared likely beyond doubt that plaintiffs would not be able to prove the facts in support of their claims.[25]

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With the higher standards imposed by *Twombly*, screens can be of particular importance as it is now required that the economic expert opines on plausibility, i.e., on "how likely is it that such evidence was in fact produced under an agreement among alleged conspirators?"

Screens have been used on stock options backdating cases and survived some motions to dismiss. Plaintiffs have used screening methodologies based on abnormally high returns on particular days to assist in their argument for evidence of stock options backdating and spring-loading, and defendants have argued for the low power of some of these screens to correctly identify such situations for the current case and putting forward their own screens.

C. Use of Screens in Damages and Effects Calculations

Screens can also provide useful information for the estimation of overcharges and damages, for two reasons. First, screens can be used to uncover the time periods during which a cartel operated effectively. As discussed above, studies of previous cartels indicate that they may fail to change prices and quantities from a competitive level during many time periods. Second, many screens require the economist to study the relationship between prices and costs in normally functioning markets. This can assist the expert in estimating the but-for price in a damage estimate. Froeb and Shor use data from the cartel in Figure 1 to estimate but-for competitive prices during collusion, based on the observed relationship between prices and costs after the break of the cartel.[26]

[23] Twombly, 127 S. Ct. 1955, 1965 (2007).
[24] *Id.*, 1961, 1965-66.
[25] Conley v. Gibson, 355 U.S. 41 (1957).
[26] Luke Froeb & Mikahel Shor, *Auctions, Evidence and Antitrust*, in Econometrics: Legal, Practical and Technical Issues (John Harkrider ed.) (2005).

In addition, screens allow the economic expert to predict which effects and damages a competition authority may estimate when a cartel is alleged. Above, we surveyed the screens used by various competition authorities. The alleged effects of a cartel are likely to be closely related to the screen used to detect the cartel in the first place. Many alleged cartels are international. Even if an alleged colluder's business is primarily in the United States, collusion may be detected by screens used by European authorities. If collusion is suspected in Europe, the screen is likely to be used by U.S. antitrust authorities and may become an issue in U.S. courtrooms as a result.

D. Uses of Screens in Pre-Litigation

Screens can help firms decide whether it would be beneficial to apply for leniency. Applicants need to compare the benefits obtained from applying versus the risk of prosecution and penalties. Leniency programs differ substantially between the United States and Europe. The U.S. leniency program applies only to the first reporting firm and only applies before an investigation has begun. In Europe, however, there are also benefits to the second and third reporting parties.

E. Use of Screens by Defendants in Manipulation Cases

An additional use of screens is by defendants who are accused of market manipulation. Abrantes-Metz and Addanki developed a screen for manipulation in commodities markets.[27] The idea behind the test is to see whether short-run futures market prices are an unbiased predictor of spot market prices. This is a key prediction of economic models of competitive financial and commodities markets. If markets are manipulated, there may be a divergence between spot and futures prices.

This screen was applied on behalf of the defendants in a case and was used as supporting empirical evidence of the absence (or non-materiality) of anticompetitive behavior. As a benchmark to test the method, the authors applied it to the famous Hunt Brothers silver manipulation episode of 1979-1980. The authors demonstrated that this screen was able to detect this well-known instance of market manipulation but that the same manipulation features found in the silver episode were not verified in the case at hand, representing evidence inconsistent with the alleged manipulation for the case at hand.

[27] Rosa Abrantes-Metz & Sumanth Addanki, *Is the Market being Fooled? An Error-Based Test for Manipulation*, Working Paper (2007), *available at* http://papers.ssrn.com/sol3/cf_dev/ AbsByAuth.cfm?per_id= 339863.

F. Use of Screens for Internal Monitoring

Finally, screens described above could also be used by managers to monitor for fraud in accounting and reimbursement statements, collusion on employee compensation surveys, or other forms of data manipulation. Furthermore, screens could be used to detect for price-fixing in purchasing or procurement and enhance robustness of compliance programs as explained in Abrantes-Metz, Bajari, & Murphy.[28] However, note that the methods we have discussed are powerful and can be used to detect a much wider range of attempts by employees or suppliers to manipulate data.

V. CONCLUSION

A screen is a statistical test designed to detect conspiracies aimed at illegally manipulating a market. Competition authorities, academics, and consultants have designed a variety of screens to detect competition problems. In this paper, we first describe screens designed to detect bid-rigging, price-fixing, market allocation schemes, and commodity market manipulation. Next, we discuss the ways in which screens can be used by plaintiffs and defendants in antitrust cases. We also describe the use of screens for internal company use and in enhancing compliance programs. The use of empirical screens has been increasing over time. Given the increased data availability and computer power, we expect such a trend to continue into the future.

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[28] Rosa Abrantes-Metz, Patrick Bajari & Joseph Murphy, *Enhancing Compliance Programs Through Antitrust Screening*, The Antitrust Counselor, forthcoming (2010).