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**Should We Fear The Things That Go Beep In the Night?
Some Initial Thoughts on the Intersection
of Antitrust Law and Algorithmic Pricing**

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Thank you all for having me. This evening I am going to talk about a topic that has been generating a lot of interest in both the press and the academy recently: the use of computer algorithms to automate decision-making by market participants.

For the uninitiated, a computer algorithm is simply a set of specific rules or instructions. To use a familiar example, a buy limit order is an algorithm. If the stock price reaches \$50 or below, then purchase 100 shares. Like recipes, some algorithms are simple, and some can be very complex. An algorithm can include a virtually unlimited number of rules, conditions and variables. This means that many extremely complex and nuanced behaviors can be modeled in a set of detailed computer instructions.

There are at least two key advantages to using computer algorithms to make certain kinds of decisions: speed and complexity. Computers can examine hundreds or even thousands of different variables in a fraction of a second, and react almost instantaneously to changes in any

¹ The views expressed in these remarks are my own and do not necessarily reflect the views of the Federal Trade Commission or any other Commissioner.

one of those variables. Certain algorithms can gain accuracy over time, by identifying patterns in data and adjusting to the patterns they identify.

Perhaps unsurprisingly, once people realized computers could be programmed to make decisions more quickly and accurately than humans in some narrow, clearly defined areas, they tried to gain a trading advantage using these new tools. Algorithmic trading is a ubiquitous phenomenon across the financial markets today.

Eventually, people figured out that the useful applications for this kind of high-speed, rules-based approach to financial decision-making were not limited to trading stocks or bonds. As algorithms spread out from the financial markets and started to be used in the on-line pricing of consumer goods, voices have been raised in alarm.² The inner workings of these tools are poorly understood by virtually everyone outside the narrow circle of technical experts that directly work in the field. But they raise a number of questions. Are there opportunities for mischief in the black box nature of all this? Will the use of pricing algorithms allow firms to collude or increase prices in ways that will ultimately go undetected by the enforcement agencies? Does antitrust doctrine need to change in important ways to reflect the greater use of automated decision-making across markets?

I'd like to suggest tonight that although antitrust enforcers should always remain vigilant for new forms of anticompetitive behavior, some of the concerns about algorithms are a bit alarmist. From an antitrust perspective, the expanding use of algorithms raises familiar issues that are well within the existing canon. An algorithm is a tool, and like any other tool, it can be

² See, ARIEL EZRACHI AND MAURICE E. STUCKE, VIRTUAL COMPETITION, THE PROMISE AND PERILS OF THE ALGORITHM-DRIVEN ECONOMY, (Harvard Univ. Press 2016) (containing an extended and detailed analysis of the potential pitfalls of algorithmic pricing).

put to either useful purposes or nefarious ends. There is nothing inherently wrong with using mathematics and computers to engage more effectively in commercial activity, regardless of whether that activity is participation in the financial markets or the selling of goods and services.

That said, the widespread use of these tools may necessitate changes in how the enforcement agencies investigate some forms of problematic conduct, just as the movement from paper to email and text messaging necessarily required corresponding changes in discovery techniques.

Background – The Difference Between Interdependence and Collusion

With your indulgence, I'd like to set the stage for the discussion of this topic with a distinctly old school, analog example.

I want you to imagine a small, rural town somewhere in the desert southwest. This little town is modest and utterly unremarkable in every way. But in the center of town, clustered around the only stoplight, are three gas stations. These three stations have the only gas for sale within 150 miles in every direction.

The date is 1970, so this is a time with no internet, no personal computers, no cell phones, and certainly no algorithmic pricing.

All three gas stations currently charge exactly the same price for a gallon of gas. Prices may go up and down as the wholesale price of gasoline moves, but all three stations generally charge identical prices, and have been charging essentially identical prices for years.

All of that is about to change. At 6:00AM one bright clear Monday morning, the owner of the first gas station gets out his ladder and leans it against the big price sign out front. He then climbs up the ladder and changes the price, making it five cents a gallon more expensive.

Then he takes his ladder down, walks over to a lawn chair in the shade and sits down to have a cup of coffee. At 10:00AM, he gets the ladder back out and lowers his price back down five cents so his price is now the same as everybody else's price. He repeats that same pattern of behavior every Monday morning.

He never directly talks to his competitors about the prices he is charging or why he is doing what he did. Has he violated the antitrust laws just by changing his price for four hours? If that is all he has done, the answer is no. Generally, firms are free to set whatever prices they choose, as long as they act independently.

Nor would it be unlawful for one of the other gas stations to decide, on his own, to follow the lead of our analog-era friend with the ladder and start raising his own prices on Monday mornings. Even if all the stations in the town ultimately decide to follow the lead of the first station and raise prices five cents, then keep those high prices in place, the antitrust laws do not condemn this behavior.

So why don't we enforcers take action in this situation to prevent conscious parallelism? The simple reason is that there is no sensible remedy here.³ In a free market, individual actors are free to set their prices on the basis of all the information legally available to them. It is

³ See, *Brooke Group Ltd. v. Brown & Williamson Tobacco Corp.*, 509 U.S. 209, 227 (1993) (describing conscious parallelism as "not in itself unlawful"); see also *Reserve Supply Corp. v. Owens Corning Fiberglas Corp.*, 971 F.2d 37, 50 (7th Cir. 1992) (discussing why interdependent pricing is not unlawful: "This is not because such pricing is desirable (it is not), but because it is close to impossible to devise a judicially enforceable remedy for 'interdependent' pricing. How does one order a firm to set its prices *without regard* to the likely reactions of its competitors?").

axiomatic that we cannot tell firms to ignore the public behavior of their rivals when they set prices without deleting the “free” in free market. Enjoining this kind of behavior would inevitably lead to price regulation, which is completely inimical to the underlying purposes of the antitrust laws.

Because we cannot police this sort of behavior directly, instead we try to make sure, primarily through our merger enforcement program, that the conditions that allow this kind of behavior to take place generally don't arise in the first place. We also prohibit explicit agreements to set prices collusively and exchanges of competitively sensitive, non-public information between competitors.

Fortunately for all of us, there are many, many reasons why this kind of informal pricing interdependency frequently fails or breaks down in the real world. For example, when the products are highly differentiated, or the market participants have different cost structures, or transactions are relatively infrequent, it is very difficult to maintain stable, interdependent pricing just by watching the behavior of your rivals.

So the specific facts of my gas station example are very important. Everybody is selling the exact same commodity product. Transactions happen frequently, with each individual transaction relatively small and unimportant, so there is little risk of major losses associated with price leadership. Also, there are few participants in the market, making it easier to get to a point of tacit consensus. Finally, and most critically, there is complete price transparency because everybody can see the prices everyone else charges just by looking at those big signs. If we take away any one of those facts, the whole thing will generally fall apart on its own. For example, if

firms could somehow secretly discount and steal market share from their rivals, they have a significant incentive to do that and so on.

What antitrust law does address in these situations is the glue that can hold together a group of competitors who might otherwise be unable to tacitly coordinate prices by simply watching each other's behavior. That glue is an express agreement among competitors, and it can overcome problems with insufficient price transparency, product differentiation, too many competitors and the like. A cartel is nothing more than an agreement among a group of competitors to fix prices or output so that prices can be maintained above competitive levels.

So while our friend with the ladder may eventually, informally lead everyone's prices higher, things look a lot different from a legal perspective if he walks over to one of his competitors and starts talking to him about prices. Suddenly we now have conduct that has nothing to do with independently setting prices and reacting to market conditions. The policy considerations that tolerate unilateral but interdependent pricing no longer apply. Once competitors reach an agreement setting price or output, they are engaged in behavior with no social utility and an enforcement response by the government is warranted.

So there is a critical legal difference between concerted behavior among competitors aimed at influencing prices and unilateral decision-making in light of observed market conditions. Setting prices together is illegal, while observing the market and making independent decisions is not.

This is the basic framework that antitrust has used for many years to evaluate questions of collusion and tacit, interdependent price setting. Indeed, those of you who took antitrust law

in law school might even remember some variant of the gas station hypothetical, as it has been used for many years to explain the mechanics of interdependent pricing.

What I'd like to suggest to you this evening is that this same analytical framework is sufficiently flexible and robust that it can already accommodate several of the current concerns applicable to the widespread use of algorithms.

Single Firm Use of Algorithms

I will start with the easiest question, the use of a complex algorithm by a single firm to observe and respond to various market conditions and set prices nearly instantaneously in response to changes in the market.

Go back to my gas station example. If the market participants cannot see their competitors' posted prices easily with their naked eyes, they might decide to buy a pair of binoculars to read their competitors' signs better from the comfort of their offices. The binoculars make it easier for the market participants to understand market conditions more quickly and respond accordingly. It is certainly true that the binoculars increase transparency in the market and thereby make it easier for informal, tacit coordination to take place. But we don't use the antitrust laws to police firms' abilities to understand the markets they operate in or to optimize prices.

We may recognize that the binoculars make it easier to understand the behavior of competitors and that fact, in turn, becomes part of the calculus in evaluating future mergers in this space. But we don't ban the use of binoculars just because they can be used to assist in conscious parallelism. Unilateral efforts to understand market conditions better and respond to

them are a critical part of a well-functioning economy. This is just not a place where antitrust needs to impose new rules in response to new tools.

Use of Algorithms By Multiple Firms

(1) Algorithms as a Collusion Vehicle

At least facially, things get a bit more interesting when multiple firms competing with each other employ algorithms to determine prices. In theory, these systems can allow competitors to communicate with each other in ways that may be difficult for enforcers to detect.

In this scenario, the algorithms are programmed to produce some sort of signal to the market, a signal that only the other market participants, similarly armed with algorithms of their own, will be able to detect. Through those signals, competitors reach an agreement on prices or output levels. The executives are still communicating with each other, but now they are using algorithms essentially to fly under the radar, so their unlawful agreements can escape detection by the enforcement agencies.

Although this might sound pretty exotic and scary at first, it is actually pretty familiar ground for antitrust law. Way back in 1993, a group of airlines got in a lot of trouble with the U.S. Department of Justice for using the common, on-line reservation system to signal each other on airline fares.⁴ Both the enforcers and the court had little trouble understanding the legal implications of the airlines' conduct. This is because the type of technology used to communicate with competitors is wholly irrelevant to the legal analysis. Whether it is phone

⁴ *United States v. Airline Tariff Publishing Co.*, 836 F. Supp. 9 (D.D.C. 1993); see <http://www.usdoj.gov/atr/cases/dir23.htm>.

calls, text messages, algorithms or Morse code, the underlying legal rule is the same – agreements to set prices among competitors are always unlawful.

But wait a minute, won't it be extremely hard to detect the use of algorithms to fix prices? Won't the technology make it impossible for enforcers to easily detect unlawful price-fixing agreements?

Unfortunately, this is really not a new problem either. It is often difficult to detect a determined group of people who are both aware of the illegality of their conduct and actively trying to conceal it. This is one of the many reasons why cartel behavior is punished criminally in this country. Communicating through algorithms is just one of a myriad of different ways that conspirators could conceal their illegal behavior.

Recognizing the difficulty in detecting cartels, the leniency program at the Department of Justice explicitly doesn't depend on external detection of any kind. Instead, it works to turn the members of a cartel on each other, by incentivizing early cooperation with the agency, coupled with stiff penalties for the conspirators who don't come forward early. Since 1997, the Department of Justice has imposed fines for criminal price fixing of approximately \$11 billion, and the average criminal sentence for an executive accused of price fixing in recent years is 22 months.⁵ I'd say that suggests a program that is already working pretty well and likely to continue to function well when faced with any nefarious use of algorithms.

⁵ U.S. DEP'T OF JUSTICE ANTITRUST DIVISION, CONGRESSIONAL SUBMISSION FY 2017 PERFORMANCE BUDGET 12 (2016), available at www.justice.gov/jmd/file/821001/download.

(2) Algorithms As Hub of Conspiracy

What if algorithms are not used in such a clearly illegal way, but instead effectively become a clearing house for confidential pricing information? Imagine a group of competitors sub-contracting their pricing decisions to a common, outside agent that provides algorithmic pricing services. Each firm communicates its pricing strategy to the vendor, and the vendor then programs its algorithm to reflect the firm's pricing strategy. But because the same outside vendor now has confidential price strategy information from multiple competitors, it can program its algorithm to maximize industry-wide pricing. In effect, the firms themselves don't directly share their pricing strategies, but that information still ends up in common hands, and that shared information is then used to maximize market-wide prices.

Again, this is fairly familiar territory for antitrust lawyers, and we even have an old-fashioned term for it, the hub-and-spoke conspiracy. Just as the antitrust laws do not allow competitors to exchange competitively sensitive information directly in an effort to stabilize or control industry pricing, they also prohibit using an intermediary to facilitate the exchange of confidential business information.

Let's just change the terms of the hypothetical slightly to understand why. Everywhere the word "algorithm" appears, please just insert the words "a guy named Bob".

Is it ok for a guy named Bob to collect confidential price strategy information from all the participants in a market, and then tell everybody how they should price? If it isn't ok for a guy named Bob to do it, then it probably isn't ok for an algorithm to do it either.

Conclusions

It is certainly true that as markets move on-line, they can become much more transparent. As I have explained here tonight, transparency can be either a good thing or a bad thing for consumers, depending on the broader market dynamics. But there is nothing inherently suspect about using computer algorithms to look carefully at the world around you before participating in markets.

So, from my perspective, if conduct was unlawful before, using an algorithm to effectuate it will not magically transform it into lawful behavior. Likewise, using algorithms in ways that do not offend traditional antitrust norms is unlikely to create novel liability scenarios.

The enforcement agencies should remain vigilant here, in the same way they need to remain vigilant about all new market dynamics. But I'm not yet afraid of the things that go beep in the night. Nor do I think that the Federal Trade Commission is planning to take away your ability to use mathematics and computers to fully engage with markets as effectively as you can.

Thanks very much for having me.