# ALGORITHMIC PRICE ADMINISTRATION: HOW AMAZON HIJACKS THE PRICE SYSTEM

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## I. INTRODUCTION

A specter is haunting the antitrust laws—the specter of Amazon.com. Despite increased scrutiny of its growing dominance in recent years, Amazon has proven largely untouchable.[1] Amazon facilitates approximately half of e-commerce in the United States,[2] which now makes up at least 15% of all retail sales nationally.[3] With over 350 million products for sale and nearly 200 million site visitors each month,[4] it is estimated that Amazon wields over one billion gigabytes of data regarding its catalog and users.[5] It is this data that should concern competition regulators and enforcers as much as Amazon's increasing dominance in retail markets. That data is funneled into algorithms that analyze and organize it, compiling it with other external data—available inventory, fulfillment capabilities, profit margins, competitor's prices, and more—all to be funneled into yet another algorithm that determines the optimal price. All told, product prices on Amazon change 2.5 million times a day, "meaning that an average product listed on Amazon changes prices every 10 minutes."[6] Amazon's ability to meet or beat the lowest price offered by competitors, while offering perhaps the widest product catalog of any retailer with rapid delivery

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1. *See* Spencer Soper, *Amazon Antitrust Lawsuit in D.C. Dismissed by Judge*, BLOOMBERG (Mar. 18, 2022), https://www.bloomberg.com/news/articles/2022-03-18/amazon-antitrust-lawsuit-in-d-c-dismissed-by-judge.

2. *E-Commerce as Percentage of Total Retail Sales in United States from 2013 to 2024*, STATISTA, https://www.statista.com/statistics/379112/e-commerce-share-of-retail-sales-in-us/ (last visited May 13, 2023).

3. *Projected Retail e-Commerce GMV Share of Amazon in the United States from 2016 to 2021*, STATISTA, https://www.statista.com/statistics/788109/amazon-retail-market-share-usa/ (last visited May 13, 2023).

4. Emily Dayton, *Amazon Statistics You Should Know*, BIGCOMMERCE BLOG, https://www.bigcommerce.com/blog/amazon-statistics/#10-fascinating-amazon-statistics-sellers-need-to-know-in-2020 (last visited May 13, 2023).

5. Neel Mehta, Parth Detroja & Aditya Agashe, *Amazon Changes Prices on Its Products About Every 10 Minutes—Here's How and Why They Do It*, BUS. INSIDER, (Aug. 10, 2018), https://www.businessinsider.com/amazon-price-changes-2018-8.

6. *Id.*

times, continues to fundamentally reshape the retail market in the United States.[7]

Amazon's interlocked data and pricing practices threaten not only to disrupt retail markets, but the market price system itself, and specifically its role as an impersonal medium of information exchange between market actors. Indeed, it this role, which enables the price system's service as a decentralized coordinator of economic activity, that the antitrust laws purport to protect. As incumbent industries transform in an era of ongoing digitalization,[8] the antitrust laws too must transform if the incumbent system of market regulation is to survive. To preserve competition, private information exchange outside of the price system must be regulated—not only between firms, but within firms.

The conceptualization of the market price system as a medium of information exchange evolved largely out of Adam Smith's pre-industrial theory of prices as products of haggling in the market, "regulated by the proportion between the quantity of which is actually brought to market, and the demand of those who are willing to pay."[9] If one asks why the price of bread has increased, there is a simple answer: either the demand for bread has increased or its supply has diminished. With this clean and coherent theory of prices in mind, Friedrich Hayek developed his influential vision of the market price system as critical infrastructure in a world of limited knowledge.[10]

Hayek recognized that economic theory was constructed on a series of assumptions: "[*if*] we possess all the relevant information, *if* we can start out from a given system of preferences, and *if* we command complete knowledge of available means," then an "economic calculus" could determine "the best use of the available means."[11] The problem is that, in a world divided by great spans of time and space, to say nothing of cultures and politics, no one person or entity simply "possess[es] all the relevant information." Thus, the problem facing both individuals and societies in planning their economic activities is

7. Suman Bhattacharyya, *Pressured by Amazon, Retailers are Experimenting with Dynamic Pricing*, DIGIDAY (Feb. 21, 2019), https://digiday.com/retail/amazon-retailers-experimenting-dynamic-pricing/.

8. "Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business." *Digitalization*, GARTNER, https://www.gartner.com/en/information-technology/glossary/digitalization (last visited Mar. 25, 2022).

9. ADAM SMITH, AN INQUIRY INTO THE NATURE AND CAUSES OF THE WEALTH OF NATIONS 68–69 (Edwin Cannan, ed., Methuen 1904) (1776).

10. *See* FRIEDRICH A. HAYEK, *The Use of Knowledge in Society*, *in* INDIVIDUALISM AND ECONOMIC ORDER 77 (1948).

11. *Id.* at 77.

the impracticality of gathering all this dispersed information as to the supply of and demand for resources. Information as to how much bread is needed and how much bread can be supplied is dispersed among the multitude of producers and consumers not only of bread, but of all the factors of bread production. It was inconceivable to Hayek that such dispersed information could be collected, analyzed, and distributed to those individuals to enable the rational planning of their activities and to enable the organization of an efficient economy.[12] Instead, his solution to the problem rested in the decentralization achieved through impersonal markets.[13]

As equations of supply and demand, prices are conveyors of that same information. The market price system communicates the prices of, say, bread and labor such that individuals can plan their activities so that they will sell enough labor to buy enough bread. In so doing, they unwittingly input their own unique information into the system—their unique demand for and supply of goods—which is aggregated with all the other inputs to produce a broadly intelligible numerical price.[14] What Hayek regarded as remarkable about this system was "how little the individual participants need to know in order to be able to take the right action."[15] Conveying "by a kind of symbol. . . only the most essential information" and "only to those concerned," the price system offers an efficient means of economic coordination without any central authority.[16] Individuals can develop and execute their own economic plans, while society can leave it to the price system to effect the "division of labor and coordinated utilization of resources."[17] At the very least, as Hayek said himself, the market price system may be the best of many imperfect solutions to the economic problem of imperfect information.[18]

However, as Hayek also noted, the efficacy of the market price system as a conveyor of information is diminished "as prices grow more rigid."[19] Economists at the time of Hayek's writing increasingly recognized price rigidity as evidence that markets rarely if ever conformed to the theoretical ideal of perfect competition.[20] While best known as the co-author of *The*

12. *Id.* at 84.
13. *See id.* at 85.
14. *See id.*
15. *Id.* at 86.
16. *Id.* at 86.
17. *Id.* at 88.
18. *Id.* at 87 ("Of course, these adjustments are probably never 'perfect' in the sense in which the economist conceives of them in his equilibrium analysis.").
19. *See id.* at 86.
20. "Perfect competition" exists where "no buyer or seller has the power to influence prices, which result solely from an equilibrium of supply and demand," and assumes an

*Modern Corporation and Private Property*,[21] a foundational text in corporate law and governance,[22] Gardiner Means devoted most of his scholarly life to developing and defending an argument he posed most succinctly just a few years after that famous publication: that rigid, "administrative" prices are ubiquitous across the economy, threaten to disrupt its functioning, and "[we]re largely responsible for the failure of a policy of laissez faire."[23]

Means' study, titled *Industrial Prices and Their Relative Inflexibility*, found in the Bureau of Labor Statistics' wholesale price indices evidence of "two essentially different types of market in operation."[24] Conforming to "traditional" economic theory, there existed one type of market "in which supply and demand [we]re equated by a flexible price" and "adjustments" by market actors primarily comprised "fluctuations in price."[25] Prices for agricultural commodities like wheat and cotton, for example, dropped by 63% between 1929 and 1933 likely due to the Depression-era drop in demand.[26] Then there existed another type of market, in which "*production* and demand [we]re equated at an *inflexible* administered price" and adjustments by market actors primarily comprised "changes in volume of production."[27] While these administered prices were attached to a wide range of retail, wholesale, and capital goods, the market for agricultural implements offered the most striking example: prices dropped only 6% from 1929 to 1933, while production dropped 80%.[28] According to Means, inflexible administered prices not only explained the observed disparities in price behavior, but so disrupted the capacity of markets to adequately adjust with the business cycle that they undermined "the effective functioning of the American economy."[29]

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absence of product differentiation, "a multiplicity of small buyers and sellers, no barriers to entry, and a state of perfect information." JONATHAN LAW & JOHN SMULLEN, OXFORD DICTIONARY OF FINANCE AND BANKING (6th ed., 2018).

21. *See* ADOLF A. BERLE & GARDINER C. MEANS, THE MODERN CORPORATION AND PRIVATE PROPERTY (1932).

22. *See generally* William W. Bratton, *Berle and Means Reconsidered at the Century's Turn*, 26 J. CORP. L. 737 (2001) (describing *The Modern Corporation*'s particular and persistent significance in corporate law scholarship).

23. GARDINER C. MEANS, INDUSTRIAL PRICES AND THEIR RELATIVE INFLEXIBILITY, S. DOC. NO. 74-13, at 1 (1st Sess. 1935).

24. *Id.*

25. *Id.*

26. *Id.* at 8.

27. *Id.* at 1 (emphasis added).

28. *Id.* at 8.

29. *Id.*

Administered prices today are assigned a variety of other names,[30] but remain ubiquitous. Despite contradicting orthodox price theory, it is a "mainstream view that sticky prices are the rule, not the exception, in American industry."[31] Price markups have steadily risen since 1980 "from 21% above cost to 61% above cost in 2016" in correlation with an increased incidence of market power across industries.[32] While the price system remains a critical medium of information exchange,[33] firms with the ability to administer prices undermine the accuracy of said information by injecting into their prices "noise"—a term Fischer Black deployed in contrast to information to refer to "what makes our observations imperfect."[34] While prices remain in part an impersonal aggregate of supply and demand, they are affected to an indeterminate degree by the mark-ups and mark-downs of price "administrators." Thus when a market actor relies on the price system to inform their making and taking of prices, it is equally indeterminate whether they are trading on accurate information or noise.

Nevertheless, this noisy exchange remained the primary, if imperfect, coordinator of economic activity until the onset of digitalization. Unprecedented developments in the capacity of firms to collect, organize, and utilize data—capacities encapsulated in the concept of Big Data[35]—have upended this coordinative function of the price system. With the assistance of machine learning algorithms,[36] firms are now capable of processing vast

30. This Note treats studies of, *inter alia*, "administered" prices, "rigid" prices, and "sticky" prices as describing phenomena that are sufficiently analogous to allow use of such terminology interchangeably.

31. ALAN S. BLINDER, ELIE R. D. CANNETTI, DAVID E. LEBOW & JEREMY B. RUDD, ASKING ABOUT PRICES: A NEW APPROACH TO UNDERSTANDING PRICE STICKINESS, 298 (1998).

32. Jan De Loecker, Jan Eeckhout & Gabriel Unger, *The Rise of Market Power and the Macroeconomic Implications*, 145 QUARTERLY J. ECON. 561, 562 (2020). Moreover, "labor share is inversely proportional" to a firm's markups, and thus, as economic activity has become concentrated in high-markup firms, the overall labor share has decreased, providing a potential explanation for widening wealth inequality. *See id.* at 607–608.

33. *See* KAI-UWE KÜHN & XAVIER VIVES, INFORMATION EXCHANGES AMONG FIRMS AND THEIR IMPACT ON COMPETITION, 2 (1995).

34. *See* Fischer Black, *Noise*, 41 J. FIN. 529, 529 (1986). ("[P]eople sometimes trade on noise as if it were information. If they expect to make profits from noise trading, they are incorrect. However, noise trading is essential to the existence of liquid markets.")

35. Big Data is capitalized herein to emphasize its status as a neologism.

36. A Machine Learning (ML) algorithm uses "statistical learning and optimization methods" to "analyze datasets and identify patterns" while autonomously "improv[ing] with each run as it teaches itself from the data it analyzes." *See* Michael Tamir, *What is Machine Learning (ML)?*, U.C. BERKELEY SCH. INFO. BLOG (Jun. 26, 2020), https://ischoolonline.berkeley.edu/blog/what-is-machine-learning/.

quantities of raw data into useful information.[37] Firms thereby minimize their own demand for information conveyed by the price system and convey through their own administered prices ever more indeterminate quantities of noise.[38] Big Data incentivizes itself by undermining both the demand for and the utility of information exchanged through the price system, thereby fostering a positive feedback loop in which the integration of information acquisition within the firm increases the demand for such acquisition. Today, Amazon exemplifies this complex dynamic: as a firm becomes more informed, its prices become noisier.

Decisions from the Supreme Court holding certain forms of information exchange between competitors unlawful under section 1 of the Sherman Act demonstrate that antitrust liability related to the use of data depends largely on the means of acquisition.[39] While horizontal competitors have been held liable for exchanging data either directly or through third-party intermediaries,[40] Amazon has avoided liability by developing a vertically integrated informational infrastructure. These different means impute different liability risks, but both tactics seek the same end: a way to acquire information beyond the price system that better enables firms to administer prices according to their broader business strategies. Ongoing digitalization is likely to both accelerate market concentration and promote price administration using algorithms optimized toward those strategies. In turn, both consequences are likely to propel the displacement of the market price system as a decentralized coordinator of economic activity, as firms find it increasingly necessary to integrate information acquisition either within the firm or through horizontal exchange. While only horizontal exchange will subject a firm to antitrust liability under contemporary doctrine, both means of information acquisition demand attention if the current paradigm of decentralized market regulation is to persist.

Part II of this paper develops the concept of price as a medium of information exchange, explains the reality of administered prices, and demonstrates how Big Data practices can enable algorithmic price

37. This Note distinguishes between data and information, as discussed *infra* Section II.B.1.

38. Digital data increasingly conveys, for example, insights into the behaviors and preferences of consumers. If a firm chose to adjust its prices based on such data, the firm would be injecting "noise" into its prices, as this Note uses the term. This is so because the source of such information and its weight in said price adjustment is indeterminate to other actors.

39. *See infra* Section IV.A.

40. For a recent example, see *In re Broiler Chicken Antitrust Litigation*, 290 F. Supp. 3d 772, 793–94 (N.D. Ill. 2017).

administration. Part III argues that Amazon's growth has been directly tied to the development of a vertically integrated informational infrastructure, which not only enables such price administration, but threatens to displace the market price system as a decentralized informational and coordinative mechanism. Part IV critiques contemporary antitrust doctrine and argues for remedying Amazon's anticompetitive impact on retail markets and the broader price system by recognizing Amazon's informational infrastructure as an essential facility. Finally, a brief conclusion synthesizes the argument that Amazon's algorithmic price administration effectively hijacks the market price system itself, displacing and delegitimizing its coordinative function, and that the recreation and preservation of a truly decentralized market demands new forms of equitable information exchange reflecting our digitalized reality.

## II. ADMINISTERED PRICES, OLD AND NEW

### A. MEANS' ADMINISTERED PRICE THESIS

Well before Hayek's famous exposition of prices as conveyors of market information, Means argued that the disparate behaviors of agricultural and industrial prices in the Great Depression undermined this theorized communicative function and thus posed a fundamental risk to economic stability.[41] While an idealized vision of communication through prices assumes that a market actor is compelled to respond to other prices by maintaining, raising, or lowering their own price to equate supply and demand, certain industries had the capacity to lower production to reduce supply while maintaining their price.[42] Producers of perishable agricultural commodities facing a drop in demand largely maintained supply, accepted lower prices "made in the market," and failed in significant numbers due to those lower prices.[43] Meanwhile, corporations that "administered" prices left buyers to "purchase or not as they wish," and responded to drops in demand by cutting production.[44] This in turn prompted reduced employment, cutting workers' income share, and thus contributing to a further decline in demand.[45] "Such maladjustments" resulting from administered prices produced what Means

41. *See* MEANS, *supra* note 23, at iv.
42. *Id.*
43. *Id.* at 1.
44. *See id.*; *id.* at 8 for figures showing "the relation of price drop and production drop for 10 major industries from 1929 to the spring of 1933 . . . ."
45. *Id.* at 9.

referred to as an "unbalancing factor" that contributed to economic instability.[46]

Indeed, the prevalence of administered prices signaled a shift in "the control of price-and-production policy from the market to the hands of business administrators," whose actions were determined by their own business strategies to the detriment of workers and consumers facing lost jobs and greater scarcity but the same old prices.[47] Production cuts in industries administering prices reduced income share, thereby reducing purchasing power. This in turn imposed "the burden of further price adjustment on the flexibly priced commodities," which had already reduced prices in response to an initial drop in demand.[48] Administered prices thus impaired the "adjustability of the economy"—increasing the risk of a downturn spiraling into a depression—and inequitably gave priority to the particular policies of "business administrators" in place of an "industrial policy" determined autonomously by the market, all to the detriment of workers, consumers, and society at large.[49]

In theory, Means agreed with Hayek that "individual self-interest" could cause supply and demand to adjust in relation to each other and converge, such that "the right amount of each thing would tend to be produced at the right price," thus optimally allocating "human and material resources."[50] In this manner, "[t]he business policy of individuals" would interact to produce industrial policy, "but no one individual or enterprise" would significantly control industrial policy at large—that is, a decentralized market price system would ideally produce a decentralized industrial policy.[51] However, the validity of this "traditional picture of automatic balance" only lasted so long as individuals had no ability to affect or control price.[52] If market actors could control prices, the consequence would be "industrial policy making by individuals"—a disruption of the Hayekian ideal of a decentralized industrial policy determined by atomized adjustments to market prices.[53]

According to Means, the development of administered prices could be attributed to increasing economic concentration and technological

46. *Id.*

47. Gardiner C. Means, *The Consumer and the New Deal*, 173 ANNALS AMER. ACAD. POL. & SOC. SCI. 7, 10 (1934).

48. *Id.*

49. *Id.* at 10.

50. MEANS, *supra* note 23, at 20.

51. *Id.* at 20.

52. Gardiner C. Means, *Notes on Inflexible Prices*, 26 AMER. ECON. REV. 23, 33 (1936).

53. MEANS, *supra* note 23, at 22.

innovation.[54] While the market price system may have effectively coordinated the economic activities of many individual farmers and craftspeople, the half-century or so prior to Means' writing saw many of those individuals "drawn into large factories or business organizations" wherein "tens and even hundreds of thousands of individuals have their economic activity coordinated by administrative direction."[55] This concentration of business activity in large corporations not only wrested economic coordination from the market mechanism to corporate administration, but also "made possible tremendous increases in the efficiency of industrial production,"[56] due to "the aggregation of capital" in the large corporation, the Taylorist division of labor, and the use of increasingly advanced machinery.[57] Increased demand for machinery "made for rapid and extensive development of technology and the improving technology in turn has increased the advantages of administrative coordination."[58] All the while, where the activities of "individuals or small enterprises operating independently" were replaced by those of a single large corporation, "the market. . . to the corresponding extent [was] replaced by administration."[59]

Thus, Means presented something of a Hobson's choice: industrial development—and with it the "possibility of a high standard of living for all"—appeared to be "the joint product of technology and administration,"[60] but such administration "reduced the flexibility of the market place and perhaps entirely destroyed its effectiveness as an over-all economic coordinator."[61] The failure of the market price system as coordinator meant also that the administrators—the large corporations—would "have a direct power over industrial policy which they exercise in making business policy for their own enterprise."[62] For Means, the intervention of individual business policies[63] in collective industrial policy explained why administered prices

54. *Id.* at 33.

55. MEANS, *supra* note 23, at 9.

56. *Id.* at 10.

57. Mean, *supra* note 47, at 8.

58. *Id.* What Means described was a process of industrial development defined by two phenomena associated today with developments in the digital economy: economies of scale and feedback loops.

59. *Id.* at 7–8.

60. *See* MEANS, *supra* note 23, at 10.

61. Means, *supra* note 46, at 9.

62. MEANS, *supra* note 23, at 11.

63. Borrowing from Means, the term "business policy" is used throughout this paper, but it is at times used interchangeably with "strategic policy," "business strategy," and like terms. All such uses are intended to convey essentially the same meaning.

contributed to economic instability: "when the business man has the power to affect industrial policy, he almost necessarily makes wrong industrial decisions."[64] Because the "business man is expected to make business policy in a way to maximize the profits of his own enterprise," when faced with declining demand, "good business policy" may require curtailing production.[65] While the rewards of cutting prices are uncertain and often negligible—particularly in a time of economic crisis—cutting production by laying off workers is quick and easily reversed, and its costs and benefits are more easily quantifiable.

Means presented two possible responses to the problem of administered prices. First, the large corporations could be broken up such that administered prices would disappear and a laissez faire market could convey more accurate information and thus become again an effective coordinator.[66] But, following this route, "productive efficiency would have to be greatly impaired and a lower standard of living accepted than is made possible by modern industrial organization and modern technology."[67] Second, the market could be supplemented "with institutional arrangements . . . sufficient to allow the economy to function effectively in the presence of and in spite of inflexible prices."[68] Arguing that this second response did not necessarily imply government ownership or "economic dictatorship," Means cited the recently instituted Agricultural Adjustment Administration and National Recovery Administration as examples of "institutional framework[s] through which certain key industrial decisions are made and within which private or corporate enterprise and initiative can function effectively."[69] Such institutions would have to "devise techniques of control for establishing the necessary elements of industrial policy," with the aim of effecting "what the market is supposed to accomplish, namely, a balance of the interests of the various interest groups which constitute industry so as to produce the most effective use of human and material resources."[70]

Since Means, economists have lent further support to the thesis, offering a coherent yet multifaceted understanding of rigid prices and the motivations driving them. Some have found that firms face significant uncertainty as to both their marginal revenue and marginal demand curves—that is, it is difficult

64. MEANS, *supra* note 23, at 11.
65. *Id.*
66. *Id.* at 12.
67. *Id.*
68. *Id.*
69. *Id.*
70. *Id.* at 14.

if not impossible for firms to predict the reactions of consumers and competitors to a price change.[71] Price changes are costly both to enact and to bear the risk inherent in uncertainty.[72] Perhaps due to this risk aversion, firms may not pursue profit maximization, but instead may seek to maximize other ends complementary to a broader strategic policy.[73] For example, firms may choose to maximize revenue[74] or security[75] in order to promote long-term growth or the maintenance of their position within the industry.[76]

Critically, these interrelated rationales are all rooted in the problem of dispersed information that Hayek described. The onset of price rigidity fundamentally undermined the efficacy of the market price system as conveyor of information and coordinator of a decentralized industrial policy. Whatever the reason for its failure, the inadequacy of the market price system drove firms to acquire information through other means and to adjust their business strategies accordingly. Indeed, the tendency of firms to pursue concentration should be understood as a natural response to the inadequate information attained through prices. Concentration offers a means of informed coordination that market prices cannot offer so long as price rigidity persists. That concentration and the attendant power to administer prices enable firms to tailor prices towards their strategic ends is a mere surplus. Yet such administration furthers the displacement of a decentralized industrial policy coordinated through the market in favor of private business policies. Such displacement harms workers and consumers who lack the firm's capacity to coordinate and lose out on the theoretically equitable information exchange that the Hayekian market price system is supposed to facilitate.

## B. THE NEW ADMINISTERED PRICES

### *1. Big Data, Algorithms, and Digitalized Information*

The market price system is a medium of information exchange whether it is subject to a perfectly competitive market or to administration.[77] However, digitalization has fundamentally transformed the information problems that

71. *See* R. L. Hall & C. J. Hitch, *Price Theory and Business Behavior*, OXFORD ECON. PAPERS 12, 22 (1939).

72. *See id.*

73. *See* Nina Shapiro & Malcolm Sawyer, *Post Keynesian Price Theory*, 25 J. POST KEYNESIAN ECON. 355, 356 (2003) ("The ends of the enterprise decide the markup on products.").

74. *See* WILLIAM BAUMOL, BUSINESS BEHAVIOR, VALUE, AND GROWTH 45–48 (1959).

75. *See* K. W. Rothschild, *Price Theory and Oligopoly*, 57 ECON. J. 299, 308 (1947).

76. *See id.* at 309–11.

77. *See* KÜHN & VIVES, *supra* note 33, at 2.

Hayek confronted along with the rest of the economy. Engagement with Big Data practices has undermined both the demand for and the utility of information conveyed through the price system. These practices mitigate the need for information exchange between market actors and incentivize the integration of information acquisition within the firm.

If, as Marc Porat defined it, "[i]nformation is data that have been organized and communicated," then data is the raw material—facts and figures, bits and bytes.[78] The organization of data into information requires the application of a "system of logic"—statistical methods, for example.[79] But where such organization was once performed largely by "information workers,"[80] today, algorithms encoded in software execute the organization and analysis of data. Put simply, an algorithm is "a sequence of computational steps that transform the input into the output."[81] If a firm wants to communicate to a customer the monetary value it ascribes to a good, an algorithm could be programmed to calculate that value as its output based on relevant data as its input, and then to communicate that value by establishing a numerical price.[82] Today's algorithms can more efficiently organize data before communicating it as useful information.

The use of algorithms as organizers and communicators of information has proliferated in tandem with the development of Big Data. Big Data is often defined by way of the "3 Vs": data that is so large in volume, so diverse in variety, or moving with such velocity, that older modes of capturing and analyzing the data are inadequate.[83] The declining costs of collection, storage, and processing of data have produced an unprecedented volume of data collected, especially due to new sources of data like "sensors, cameras, geospatial and other observational technologies."[84] Increasing quantities of audiovisual data captured by phones and physical activity data captured by wearable devices further bring forth data in a broader variety of formats.[85] Collection and organization of said data is being "conducted at a velocity that

78. MARC URI PORAT, DEP'T COM., THE INFORMATION ECONOMY: DEFINITION AND MEASUREMENT 2 (1977).

79. *See id.*

80. *See* PORAT, *supra* note 78, at 104–35.

81. THOMAS H. CORMEN, CHARLES E. LEISERSON, RONALD L. RIVEST & CLIFFORD STEIN, INTRODUCTION TO ALGORITHMS 5 (3d ed. 2009).

82. This is a simple description of algorithmic pricing, discussed *infra* Section II.B.2.

83. *Big Data: Seizing Opportunities, Preserving Values*, EXEC. OFF. PRESIDENT 3 (May 2014), https://obamawhitehouse.archives.gov/sites/default/files/docs/big_data_privacy_report_may_1_2014.pdf.

84. *Id.* at 4.

85. *See Big Data: Seizing Opportunities, Preserving Values*, *supra* note 83.

is increasingly approaching real time," which means there is a growing potential for "big data analytics" to immediately affect an entity's decision-making.[86] Each of these three Vs—the volume, variety, and velocity of data—is developing rapidly as technological advances permit new methods of collection and new uses, including the equally rapidly developing predictive power of organized data.[87]

The "life cycle" of Big Data can be divided into four phases: (1) collection, (2) compilation and consolidation, (3) data mining and analytics, and (4) use.[88] As noted, firms and other entities collect the bits of data that make up Big Data in a variety of ways. When consumers browse the internet or shop online, companies can track and link their activities, either because consumers log into services or otherwise identify themselves or because sites deploy techniques like cookies, "browser or device fingerprinting," and "history sniffing."[89] Today, consumers are tracked across multiple devices and products—from their computers, phones, and tablets, to the increasing number of products that fall within the "Internet of Things."[90] Of course, data collection happens offline as well, whether through credit card transactions or the increasing ubiquity of cameras on buildings, cars, and persons. After collection, that data is compiled into a usable form, before it is analyzed or "mined" in order "to uncover and summarize patterns," or deployed for use by algorithms "to generate new data" that itself will be mined—metadata on a demographic group, for example.[91] Ultimately, firms and other entities can discover a wide variety of applications for such Big Data practices. But Big Data's most significant impact may be how it enables certain firms to use increasingly vast quantities and varieties of data to acquire and analyze market information, and thereby causes the price system's role as a medium of information exchange to become increasingly superfluous.

86. *Id.*

87. *Big Data: A Tool for Inclusion or Exclusion?*, FED. TRADE COMM'N 1–2 (Jan. 2016), https://www.ftc.gov/system/files/documents/reports/big-data-tool-inclusion-or-exclusion-understanding-issues/160106big-data-rpt.pdf.

88. *See id.* at 3.

89. *See Big Data: A Tool for Inclusion or Exclusion?*, *supra* note 87, at 3–4.

90. *Id.* at 4.

91. *Id.*

*2. Algorithmic Price Administration*

Consider two gas stations positioned three miles apart on the same road.[92] When one station raised its price by three-and-a-half cents, the station down the road followed suit soon after.[93] Did the operator of the second station take a drive daily to assess competitors' prices? No. Instead, both stations used machine learning software to determine the "optimal price" based on predictions of "what competitors are charging and what consumers are willing to pay."[94] Both gas stations used the same software—based on "mountains of historical and real-time data" and optimized to maximize revenue—to gain "almost superhuman insight into market dynamics," including the capacity to predict reactions from consumers and competitors to any price change.[95] According to the software's developer, the goal is to make "margin on people who don't care" about small price differences, and give away that margin "to people who do care."[96] How did this work in practice? Most likely, the developer's data analysis showed that rates of gasoline sales increase later in the day—perhaps as buyers are on their way home from work—and thus the price was raised as the day went along. If a buyer "care[d]," they could have made sure to get to the gas station earlier in the day.[97]

Indeed, pricing algorithms can seem rather simple. One third-party developer offers a rule for its algorithm labeled "Beat Competitor by 10%," which instructs the algorithm: "If the competitor's price is greater than the cost of making the item, and the competitor isn't running a onetime promotion, then undercut the competitor by 10 percent."[98] But most algorithms are not so simple, and instead interlay rules on top of each other, often including "guardrails"—rules designed to avert calamities like price wars.[99]

92. *See* Sam Schechner, *Why Do Gas Station Prices Constantly Change? Blame the Algorithm*, WALL ST. J. (May 8, 2017, 6:41 PM ET), https://www.wsj.com/articles/why-do-gas-station-prices-constantly-change-blame-the-algorithm-1494262674.

93. *See id.*

94. *Id.*

95. *Id.*

96. *Id.*

97. Of course, such a response depends on the buyer having the means to get to the gas station early in the day, to say nothing of the buyer's ability to notice the pricing pattern.

98. Jerry Useem, *How Online Shopping Makes Suckers of Us All*, ATLANTIC (May 2017), https://www.theatlantic.com/magazine/archive/2017/05/how-online-shopping-makes-suckers-of-us-all/521448/.

99. *Id.* Retailers have long feared the prospect of online price wars. *See, e.g.,* Michael D. Smith, *The Impact of Shopbots on Electronic Markets*, 30 J. ACAD. MKTG. SCI. 446, 446 (2002).

Critically, pricing algorithms are "built to manage consumers' perception of price."[100] Developers now input enormous volumes of data from a wide variety of sources that enable them to predict consumer perceptions and behaviors. This process often begins with the "segmentation" of users.[101] Segmentation splits users into groups based on information including demographics and behavioral patterns extracted from interaction data, such as how many times a user has visited a website and what the user has clicked on, liked, purchased, or left in their shopping cart.[102] Once users have been segmented into groups predictive of their interests and perceptions, that information becomes an input for the pricing algorithm. Contextual data can be added like the weather, the time of day or year, the user's zip code, or even the device used to browse the given website.[103] For example, a user's interaction data may signal their thriftiness from the length of their shopping sessions or any tendency they may have to shop more during sales seasons. Demographic information like race and gender or a zip code might support such a prediction or contradict it. All these inputs help an algorithm to better predict the price at which a user will buy.

Big Data practices have vastly expanded the capacity of market actors to acquire information outside the price system. Algorithmic pricing deploys that information in pursuit of the firm's strategic policies. Meanwhile, comparably effective means of information acquisition are unavailable to consumers and many competitors, who instead acquire little more than the information—and noise—conveyed by prices. Moreover, prices are likely to become *noisier* due to the strategic injection of information unrelated to market conditions. Such developments are likely to upend the status quo of economic coordination through the price system and displace decentralized industrial "policymaking" in favor of the business policies of powerful firms.

## III. AMAZON'S ALGORITHMIC PRICE ADMINISTRATION

While algorithmic pricing may be increasingly adopted by businesses across industries, Amazon is arguably its most significant adopter. Amazon's share of gross merchandise volume in the U.S. e-commerce market has grown

100. Useem, *supra* note 98.

101. Dan Foley, Debarshi Raha, Ge Liu, Haizhou Fu & Yifei Ma, *Improve the Return on Your Marketing Investments with Intelligent User Segmentation in Amazon Personalize*, AWS MACH. LEARNING BLOG (Nov. 29, 2021), https://aws.amazon.com/blogs/machine-learning/improve-the-return-on-your-marketing-investments-with-intelligent-user-segmentation-in-amazon-personalize/.

102. *Id.*

103. *Amazon Personalize*, AWS, https://aws.amazon.com/personalize/.

from 34% in 2016 to a projected 50% in 2021,[104] while total e-commerce industry revenue has grown from nearly $286 billion in 2017 to nearly $470 billion in 2021,[105] all while the percentage of total retail sales through e-commerce in the U.S. has grown from 8% in 2016 to 9% in 2017 to 15% in 2021.[106] These figures demonstrate not only the remarkable growth of both Amazon and e-commerce broadly, but also that Amazon is eating up an ever greater share of this growth as the transition from in-person to online retail continues. Two factors explain how Amazon has managed to achieve this enormous growth: a strategic policy oriented towards this growth instead of short-term profit maximization, and the development of a marketplace and complementary products that function effectively as massive data farms. The critical link between these two factors is Amazon's developing use of algorithmic pricing.

Amazon wields pricing algorithms and other pricing policies to effect both supply- and demand-side economies of scale. Supply-side economies of scale refer to positive feedback loops in production: as the rate of production grows, the relative cost of production diminishes.[107] As sales increase with growing retail market share, the relative costs of manufacturing[108] and logistics are likely to decrease. However, it is demand-side economies of scale that are of particular importance to Amazon—that is, positive feedback loops in adoption of the platform itself by both vendors and customers.[109] As more customers become regular Amazon users, vendors are more incentivized to sell on Amazon, which in turn causes even more customers to turn to Amazon as their retail platform of choice. Thus, the platform's popularity and value compound in tandem.[110]

104. *Projected Retail e-Commerce GMV Share of Amazon in the United States from 2016 to 2021*, STATISTA, https://www.statista.com/statistics/788109/amazon-retail-market-share-usa/ (last visited May 14, 2023).

105. *Retail e-Commerce Revenue in the United States from 2017 to 2025*, STATISTA, https://www.statista.com/statistics/272391/us-retail-e-commerce-sales-forecast/ (last visited May 14, 2023).

106. *E-Commerce as Percentage of Total Retail Sales in United States from 2013 to 2024*, STATISTA, https://www.statista.com/statistics/379112/e-commerce-share-of-retail-sales-in-us/ (last visited May 14, 2023).

107. *See* CARL SHAPIRO & HAL R. VARIAN, INFORMATION RULES 179 (1999).

108. Amazon maintains dozens of private label brands including AmazonBasics, which accounted for $7.5 billion in sales in 2018. *See* Joshua Fruhlinger, *AmazonBasics Products Are Now Best-Sellers in 22 of Amazon's 51 Categories*, BUS. BUS. (Jun. 14, 2019), https://www.businessofbusiness.com/articles/how-amazon-is-gobbling-up-profits-with-its-amazon-basics-house-brand/.

109. *See* SHAPIRO & VARIAN, *supra* note 107, at 180.

110. *See id.*

The result of supply- and demand-side economies of scale coming together for one company is a "double whammy," as Shapiro and Varian put it, "in which growth on the demand side both reduces cost on the supply side and makes the product more attractive to other users—accelerating the growth in demand even more."[111] Amazon is likely to continue growing at an increasing rate, increasing its rate of data collection in tandem. This ever-increasing rate of data collection and application facilitates Amazon's pricing algorithms and policies, which in turn facilitate the economies of scale that produce ever more data.

Algorithmic pricing facilitates this positive feedback loop as one component of a broader strategy of predatory pricing.[112] Arguably, algorithmic pricing is *the* critical component in its predation because it enables Amazon to act as price leader in the retail market and easily absorb vendors on its platform into its scheme. While it is up to the judiciary to determine whether Amazon has had the requisite intention to be held liable for such predation,[113] there should be little doubt that Amazon's rapid growth in market share has come from undercutting competitors' prices and selling products below cost—and pricing algorithms enable Amazon to do both.[114]

### A. "GREY MARKETS" ON AMAZON

Amazon has propelled their price-leading power through policies enacted to simultaneously absorb vendors into its pricing strategy while monitoring compliance and disciplining any lack thereof. These policies further the efficacy of Amazon's predation and broader strategic policy. Amazon has worked to compel ever greater numbers of brands and their distributors to join Amazon as vendors, both to promote its position as the first stop for online shoppers by expanding access to desirable brands and to better control prices across the retail market.

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111. *Id*, at 182. Shapiro and Varian go on: "The result is especially strong positive feedback, causing entire industries to be created or destroyed far more rapidly than during the industrial age." *Id.*

112. *See* Lina M. Khan, *Amazon's Antitrust Paradox*, 126 YALE L.J. 710, 747–53, 756–68 (2017) ("[F]or the vast majority of its twenty years in business, losses—not profits—were the norm.").

113. According to Areeda and Turner, predatory pricing is "the deliberate sacrifice of present revenues for the purpose of driving rivals out of the market and then recouping the losses through higher profits earned in the absence of competition." Phillip Areeda & Donald F. Turner, *Predatory Pricing and Related Practices Under Section 2 of the Sherman Act*, 88 HARV. L. REV. 697, 698 (1975).

114. *See generally* Christopher R. Leslie, *Predatory Pricing Algorithms*, 98 N.Y.U. L. REV. 49 (2023) (explaining how pricing algorithms facilitate predatory pricing).

While Amazon's demand-side economies of scale partially account for the increasing prevalence of well-known brands selling directly through Amazon, another cause is the problem of unauthorized third-party sellers on Amazon Marketplace—a phenomenon referred to as a "grey market."[115] For example, Nike began direct sales on the platform in 2017 partially to gain protection from Amazon's "Brand Registry" that eases the process for brands to remove counterfeits offered by virtually anonymous third-party sellers.[116] Resigned to decreased revenue from its own e-commerce site and in-person retail, Nike compromised with the expectation that it could rely on Amazon to remove unauthorized vendors.

Yet, as soon as one third-party vendor offering Nike-branded goods was removed, another would pop up offering the same products, "akin to [a] game of whack-a-mole."[117] Indeed, there is evidence that Amazon has "deliberately turned to and empowered the 'grey market'" in order to capture desirable brands to further its broader strategy.[118] Former employees have reported that Amazon "actively sought out and recruited unauthorized sellers."[119] Unauthorized third-party vendors may deal in diverted or counterfeit products, or may merely resell products from brands or their distributors, which often violates those brands' Minimum Advertised Price (MAP) policies.[120] According to one account, Amazon vendor managers have helped such unauthorized vendors become "official Amazon partners by providing them with Vendor Central Accounts, which transformed them into suppliers who sell to Amazon in bulk."[121] That is, Amazon may have deliberately created the very problem of unauthorized sales in order to eventually compel large brands like Nike to negotiate, if only to capture some of their lost revenue. And, as Nike found, once the brands arrive as first-party sellers, the problem of unauthorized sales does not necessarily abate. Amazon has at times refused

115. *See* Shaoul Sussman, *How Amazon's Pricing Policies Squeeze Sellers and Result in Higher Prices for Consumers*, PROMARKET (Aug. 23, 2019), https://promarket.org/2019/08/23/how-amazons-pricing-policies-squeeze-sellers-and-result-in-higher-prices-for-consumers/.

116. *Why Nike and Birkenstock Are Cautionary Tales for Brands on Amazon*, BUY BOX EXPERTS (July 10, 2018), https://www.buyboxexperts.com/blog/why-nike-and-birkenstock-are-cautionary-tales-for-brands-on-amazon/.

117. *Id.*

118. *See* Sussman, *supra* note 115.

119. *See id.*

120. *See id.* "MAP policies impose restrictions on the price at which a product or service may be advertised without restricting the actual sales price." Benjamin H. Diessel & Timothy Cowan, *Why Correctly Understanding Antitrust Risk is Crucial to Properly Addressing Brand Dilution in the E-Commerce Age*, NAT'L L. REV. (June 11, 2019), https://www.natlawreview.com/article/why-correctly-understanding-antitrust-risk-crucial-to-properly-addressing-brand.

121. *See* Sussman, *supra* note 115.

to "comply with brands' suspension demands on various grounds, or simply ignores them."[122] Essentially, Amazon has developed another predatory tool beyond below-cost prices to promote its unequal bargaining power in relation to desirable brands. Meanwhile, these brands draw in more consumers, which in turn draw in more brands, contributing to Amazon's positive feedback-driven growth.

### B. "PRICE ALERTS" AND THE "BUY BOX"

Once those brands, their distributors, and other vendors join the platform, Amazon exerts further control in order to ensure compliance with its predatory pricing scheme. Due to the costs of shipping, particularly the high costs of fulfillment for Prime members, many vendors could sell their products for lower prices through other platforms—including their own e-commerce sites, in-person retail, and competing platforms like Walmart and Target.[123] Amazon, however, has enacted policies to compel vendors to offer the lowest price on their products on Amazon's platforms, while also requiring those vendors to "bundle the costs of Prime fulfillment" into that price.[124] Algorithms track competitors' prices and upon discovering that a product—say, a Nike shoe—is offered at a lower price on another platform, Amazon sends "pricing alerts" to its vendor that show "the product, the price on Amazon and the price found elsewhere on the web."[125] Amazon then warns the vendor that their product "is currently ineligible for being a featured offer on the product detail page because those items are priced higher on Amazon than at other retailers."[126] Rather than merely beating prices with direct sales, Amazon's algorithms enforce compliance with its predatory pricing upon virtually all vendors big and small.

In fact, such tactics may lead to higher prices for consumers. Because vendors are required to meet Amazon's fulfillment requirements and bundle that cost into their advertised price on Amazon, vendors may not be able to cut their prices to ensure uniformity across platforms. Instead, vendors' MAP policies work to Amazon's advantage, as the vendors instead raise their prices elsewhere to match the break-even price they charge on Amazon.[127] The price

122. *Id.*

123. *See id.*

124. *Id.*

125. Spencer Soper, *Amazon is Squeezing Sellers That Offer Better Prices on Walmart*, BLOOMBERG, (Aug. 5, 2019), https://www.bloomberg.com/news/articles/2019-08-05/amazon-is-squeezing-sellers-that-offer-better-prices-on-walmart.

126. *Id.*

127. Sussman, *supra* note 115.

of a product on Walmart's platform may include the costs associated with Prime fulfillment on Amazon. Indeed, "Walmart routinely fields requests from merchants to raise prices on its marketplace because they worry a lower price on Walmart will jeopardize their sales on Amazon."[128]

The threat that products may be ineligible to be "featured offers" communicated by "price alerts" acts as an automated enforcement mechanism. In the past, when a customer searched for a general product on Amazon, there were often numerous vendors offering it. Based on a number of factors, including the vendors' "past performance, price, delivery speed, and other factors," an algorithm would select one particular vendor's offer of the product to be featured in its "Buy Box."[129] That is, when a customer chooses to "buy now" or "add to cart" upon their initial search, the vendor with the "featured offer" would get the order.[130] "Over 80% of Amazon sales" are executed through the Buy Box, which emphasizes the significance of Amazon's threat to vendors via its "price alerts."[131] If vendors want to sell effectively on Amazon, they need access to the Buy Box, which requires them to ensure uniformity of prices across retail platforms. But to recoup the higher costs of Amazon fulfillment, this uniformity may require vendors to raise their prices elsewhere, not lower them on Amazon.

Amazon's Buy Box is not just a tool to promote its own bargaining power. The underlying Buy Box algorithm works together with the algorithms that track competitors' prices and send out "price alerts" to constitute a critical component of Amazon's algorithmic price administration. As noted, the algorithm that determines the Buy Box winner does not simply give customers the lowest price, but instead factors in other strategic considerations like fulfillment time and previous customer reviews. Amazon is no longer simply a predatory price leader—always offering the lowest price to undercut competition—rather, it is a price *maker*. Amazon may be offering up the lowest prices around, but those prices, compelled upon other platforms and retailers, now incorporate unknown quantities and varieties of data compiled by Amazon and channeled through its algorithms. When a customer buys a pair of Nikes, potentially from any retailer at all, the price they pay likely includes a

128. Soper, *supra* note 125.

129. Adrianne Jeffries & Leon Yin, *When Amazon Takes the Buy Box, It Doesn't Give It Up*, MARKUP (Oct. 14, 2021), https://themarkup.org/amazons-advantage/2021/10/14/when-amazon-takes-the-buy-box-it-doesnt-give-it-up.

130. *Id.*

131. Matt Juul, *The 2021 Amazon Buy Box Playbook for Sellers and Resellers*, FEEDVISOR (July 20, 2021), https://feedvisor.com/resources/e-commerce-strategies/the-amazon-buy-box-playbook-for-sellers-and-retailers/.

hidden premium that effectively subsidizes Amazon and its broader growth strategy: its speedy fulfillment times, its ostensibly generous benefits to Prime members, and, of course, its ability to undercut competitors' prices where it cannot compel a vendor to do the work for them.

### C. FROM PREDATORY PRICING TO PRICE ADMINISTRATION

Patterns in Amazon's pricing policies signal that its long-term growth strategy is aimed at attaining and maintaining monopsony power in the retail market.[132] While the monopolist seeks to be the single seller in a market, the monopsonist seeks to be the single buyer.[133] The strategy of undercutting competitors' prices by tracking and automatically matching or beating said prices was only the beginning. Customer growth consequent to this strategy propelled the positive feedback loop that has transformed Amazon into *the* essential platform for sellers of retail products—making Amazon the essential buyer. Amazon has wielded its increasingly monopsonistic bargaining power to ensure its continued price leadership with incentives for price uniformity among third-party vendors and with punishment for those who failed to comply.

The immediate consequences of Amazon's monopsonistic price leadership have been *higher* prices for consumers "in order to accommodate the need of third-party sellers to pay the ever-increasing fees involved in selling through Amazon."[134] One third-party bookseller showed that the minimum advertised price for one of their products, "at any and all outlets, ha[d] increased more than 30 percent" in the previous four years.[135] And "[d]espite this fact, this seller's margins" were "tighter than ever due to Amazon's fee increases."[136] Amazon's predatory prices enabled its attainment of a position tending toward monopsony power in the retail market such that it could attain sufficient dominance over pricing to recoup on its strategy.

Indeed, Amazon has likely been recouping for some time. A recent report reveals that Amazon now "pockets an average of 34 percent of each sale" from

132. *See* Khan, *supra* note 112, at 765–68.

133. Antitrust enforcers are increasingly attending to the growing trend of monopsony power, particularly in labor markets. *See, e.g.*, Jonathan Kanter, Assistant Attorney General, Dep't of Justice, Antitrust Div., *Remarks to the New York State Bar Association Antitrust Section* (Jan. 24, 2022), https://www.justice.gov/opa/speech/assistant-attorney-general-jonathan-kanter-antitrust-division-delivers-remarks-new-york.

134. Sussman, *supra* note 115.

135. *Id.*

136. *Id.*

third-party vendors, "up from 30 percent in 2018, and 19 percent in 2014."[137] This increased take has caused revenue from vendor fees to increase "from $60 billion in 2019, to $90 billion in 2020, to a projected $121 billion in 2021"—a revenue stream growing faster than even Amazon Web Services (AWS), which was long thought to be propping up Amazon's predatory pricing.[138] Due to both its pricing dominance and its increasingly monopsonistic position in retail, Amazon is capable of recouping any costs of its previous predation. But Amazon is doubling down and reinvesting in its own growth to cement its dominance. Vendor fees add to Amazon's war chest that funds its below-cost prices for everything from Prime memberships and rapid fulfillment to its private label brands, its acquisitions that target competitors[139] and new markets[140] alike, and its 70 percent expansion of its logistics network over the last two years.[141]

Amazon's overarching strategic policy has been to capture retail market share in pursuit of monopsony power, and Amazon's developing capacity to administer prices is the foundation of this strategy. This capacity is a product of Amazon's informational infrastructure that collects an unprecedented volume and variety of data and feeds off network effects to grow in tandem with the firm itself. Amazon's algorithms organize this data into useful information and deploy it through administered prices that Amazon enforces. These machine learning algorithms benefit from network effects of their own because feedback from every algorithmic action provides further data from which the algorithm can learn.[142]

What Amazon has accomplished is far more radical than the price administration of large corporations described by Means a century ago. The capacity to administer prices has always been tied to market concentration, the aggregation of capital in the firm, and investment in technology—the former two enabling discretion as to pricing, and the latter often requiring it. Although

137. Stacy Mitchell, *Amazon's Toll Road: How the Tech Giant Funds Its Monopoly Empire by Exploiting Small Businesses*, INST. FOR LOCAL SELF-RELIANCE, 4 (Dec. 2021), https://ilsr.org/wp-content/uploads/2021/11/ILSR-AmazonTollRoad-Final.pdf.

138. *Id.*

139. *See, e.g.*, Brad Stone, *Amazon's Expanding with Deal for Zappos*, N.Y. TIMES (July 22, 2009), https://www.nytimes.com/2009/07/23/technology/companies/23amazon.html.

140. *See, e.g.*, Darrell Etherington, *Amazon to Acquire Autonomous Driving Startup Zoox*, TECHCRUNCH (June 26, 2020), https://techcrunch.com/2020/06/26/amazon-to-acquire-autonomous-driving-startup-zoox/.

141. Mitchell, *supra* note 137, at 4.

142. *See* Tejas Narechania, *Machine Learning as Natural Monopoly*, 107 IOWA L. REV. 1543, 1577–81 (2022).

this discretionary "area of choice"[143] as to prices may have undermined the coordinative function of the price system, it did not threaten to render it entirely superfluous. But that is exactly what Amazon's algorithmic price administration threatens. Through the development of its data infrastructure, its use of machine learning algorithms, and its exploitation of network effects to compound the value of both, Amazon has effectively hijacked the price system's informational mechanism. Amazon is likely to have little need for the information aggregated and exchanged through prices, and is likely to have free rein to displace a decentralized industrial policy in favor of its own business policies.

## IV. INFORMATION EXCHANGE AS ANTITRUST PROBLEM AND REMEDY

Amazon's build-out of its data infrastructure has achieved the vertical integration of an informational network that effectively replaces the informational mechanism of the price system. There is good reason to believe that this method of information acquisition is more effective than that offered by the price system; the information available to Amazon is likely more accurate and less noisy. Just as algorithms enable this information acquisition, algorithms execute Amazon's pricing policy. Predatory pricing algorithms implement Amazon's strategic policy of positive feedback-driven growth and enforcement algorithms ensure compliance with its policies both on Amazon's platforms and across markets. Because algorithmic price administration negates Amazon's need for the price system as a medium of information exchange, it threatens to negate that function for all market actors as well. Amazon's power over both prices and markets threatens the coordinative capacity of said information exchange, displacing the decentralized industrial policy that is its product in favor of Amazon's own business policies. Amazon threatens to effectively integrate the price system within itself, which will enable unprecedented intrafirm coordination, minimize any need to coordinate with competitors, and undermine the capacity of competitors to coordinate beyond the noise of Amazon's administration.

The price system enables coordination among competitors, and the antitrust laws regulate such coordination outside the price system. Section 1 of the Sherman Antitrust Act prohibits "[e]very contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States."[144] Section 1 does not explicitly prohibit the

143. *See* Means, *supra* note 52, at 34.

144. 15 U.S.C. § 1.

exchange of information between horizontal competitors, nor does it describe such as evidence of a "contract," "combination," or "conspiracy." But in 1921's *American Column & Lumber Co. v. United States*, a majority of the Supreme Court concluded that certain forms of information exchange between competitors—outside that facilitated by the idealized price system—could qualify as an illegal restraint of trade under Sherman Act § 1.[145]

### A. INFORMATION EXCHANGE AS PRICE-FIXING

In 1918, 365 members of the American Hardwood Manufacturers' Association, whose total membership produced approximately one third of the hardwood in the United States, joined in what was referred to as an "Open Competition Plan."[146] The Plan's purpose was to "disseminate among members accurate knowledge of production and market conditions" so as "to enable each member to intelligently make prices and . . . govern his production."[147] The Plan required regular reporting from the members on sales, shipping, production, stock, price-lists, and inspection reports that would police members by "promptly expos[ing]" any deviation "from the tacit understanding that all were to act together."[148] The participants claimed they had no other means beyond this information exchange to gain clarity as to true "market conditions,"[149] the Plan was to be "a central clearing house," and coordination would "only replace *undesirable competition*": competition blinded by noise and information asymmetries between horizontal or vertical competitors, buyers, and sellers.[150]

After the government alleged this exchange violated the Sherman Act, Justice Clarke found that the organization behind the Plan "[o]bviously" constituted "a combination," but that the question for the Court was whether this combination resulted in an "undue restraint of interstate commerce."[151] Clarke answered affirmatively, finding evidence of such "undue restraint" in the repeated calls from the Plan's organizers to *avoid increases in production*, "thereby keeping the supply low and the prices high . . . ."[152] This was the Plan's "fully realized" purpose: "a concerted effort to raise prices regardless of

145. *See* Am. Column & Lumber Co. v. United States, 257 U.S. 377, 412 (1921).

146. *Id.* at 391. For a contemporaneous survey of debates in the 1920s over trade associations and the legality of their activities under the Sherman Act, see generally Herman Oliphant, *Trade Associations and the Law*, 26 COLUM. L. REV. 381 (1926).

147. *Am. Column*, 257 U.S. at 392–93.

148. *Id.* at 394–95, 411.

149. *Id.* at 393.

150. *Id.*

151. *Id.* at 399–400.

152. *Id.* at 403–04.

cost or merit."[153] At work in the decision was a particular conception of the sort of competition the Sherman Act sought to preserve unrestrained. Clarke's vision of competition foreclosed any notion of "harmony" in a market made up of "naturally competing dealers."[154] Section 1 of the Sherman Act, the Court's majority insisted, demands survival-of-the-fittest.

While Clarke defended a Darwinian vision of "natural" competition, Justices Holmes and Brandeis raised separate defenses of *reasonable* information exchange among horizontal competitors in dissent. Justice Holmes countered Clarke's notion of "natural" competition with an "ideal of commerce" in which both buyer and seller engaged in "an intelligent interchange made with full knowledge of the facts . . . ."[155] While Clarke's treatment of information exchange as effective price-fixing implied that the trade association's activities were unlawful *per se*, Holmes implicitly argued for application of the rule of reason,[156] and asserted that a combination to "distribute such knowledge . . . is very far from a combination in *unreasonable* restraint of trade."[157] Holmes rightly noted that information asymmetries undermine efficiency, and thus argued that there is nothing unreasonable *per se* about a combination seeking to overcome such asymmetries.

Justice Brandeis followed, agreeing with Holmes that there was no evidence of a "restraint of trade."[158] In an illuminating passage, Brandeis revealed the basic principle grounding his reading of the antitrust laws—that "the essence of restraint is power; and power may arise merely out of position."[159] Thus, "[w]herever a dominant position has been attained, restraint necessarily arises."[160] Here, according to Brandeis, were individually small manufacturers who together made up less than a third of the market, and clearly had no such dominant position and thus little *power* to coerce other market actors.[161] Noting that the Sherman Act does not demand blind competition, nor does it prohibit regulation of competition,[162] Brandeis argued

153. *Id.* at 409.
154. *Id.* at 411.
155. *Id.* at 412 (Holmes, J., dissenting).
156. Under the "rule of reason," plaintiffs must "plead and prove that defendants with market power have engaged in anticompetitive conduct," while under the "*per se*" rule, "power generally need not be proven and anticompetitive effects are largely inferred from the conduct itself." Herbert J. Hovenkamp, *The Rule of Reason*, 70 FLA. L. REV. 81, 83 (2018).
157. *Am. Column*, 257 U.S. at 412 (Holmes, J., dissenting) (emphasis added).
158. *Id.* at 414 (Brandeis, J., dissenting).
159. *Id.*
160. *Id.*
161. *Id.*
162. *Id.* at 415 (citing Bd. of Trade v. United States, 246 U.S. 231 (1918)).

that the Plan's members had no intention to regulate competition, but only "to make rational competition possible, by supplying data not otherwise available."[163] Therefore, the Plan promoted competition by enabling a collection of small manufacturers to survive to compete at all.[164] Indeed, manufacturers may see their only opportunity to engage in "rational competition" to require concentration if such an exchange were prohibited.[165] Enforcers of the Sherman Act, Brandeis insisted, must be flexible enough to foresee such possibilities and to mitigate them.

After reaffirming *American Column* at its first opportunity,[166] the Court's treatment of information exchange shifted in 1925's *Maple Flooring Manufacturers' Association v. United States*, where Justice Stone reframed the analysis by asking whether an exchange without an explicit agreement to fix prices produced a "necessary tendency" to unreasonably restrain competition.[167] Addressing a similar exchange of costs and sales data as in *American Column*, the trial court had found that the association's "controlling influence" risked "impeding the economic laws of supply and demand."[168] But Stone disagreed, finding that the particular exchange of information at issue offered no basis to infer that "concerted action" to "curtail production or raise prices" would "necessarily result."[169]

Like Brandeis and Holmes, Stone explained the utility of information gathering and dissemination in markets, while recognizing that information exchange "tends to produce uniformity of prices" and "to prevent overproduction." Therefore, information exchange can stabilize both of these elements of the market for better or worse.[170] Stone pointed to a "consensus of opinion of economists and . . . the most important agencies of government that the public interest is served by the gathering and dissemination" of such information, precisely because this exchange "tends to stabilize trade and industry, to produce fairer price levels and to avoid the waste which inevitably attends the unintelligent conduct of economic enterprise."[171] Just as Holmes'

163. *Id.* at 415–16 (Brandeis, J., dissenting).

164. *Id.*

165. *Id.* at 418–19.

166. *See* United States v. Am. Linseed Oil Co., 262 U.S. 371 (1923).

167. Maple Flooring Mfrs. Ass'n. v. United States, 268 U.S. 563, 578 (1925) (quoting *Linseed Oil Co.*, 262 U.S. at 390).

168. *Id.* at 576.

169. *Id.* at 584–86.

170. *Id.* at 582.

171. *Id.* at 582–83. In an opinion handed down the same day regarding a similar case, Stone noted that price uniformity may naturally result from "active, free and unrestrained competition" due to the particular flow of information within the market through the "reports

*American Column* dissent envisioned commerce as an "intelligent interchange," Stone argued that the "free distribution of knowledge" of the market's "essential factors" did not make competition "less free," but left *all* market actors "more intelligent."[172] For an exchange of information to qualify as an unlawful restraint under the Sherman Act, the *Maple Flooring* Court ruled that the exchange at issue must support an inference of an inevitable and arbitrary impact on the market, thus extending Brandeis' notion in *American Column* of restraint as an abuse of power.[173]

While additional cases involving information exchange by trade associations arose in the interim,[174] it was not until 1969 that the Supreme Court significantly amended its guidance on the issue in *United States v. Container Corporation of America*.[175] According to Justice Douglas, an information exchange between competing producers of shipping containers was distinct from and simpler than the earlier trade association cases: the defendants merely requested from competitors their most recent prices and those competitors generally complied, with the expectation of reciprocity.[176] According to Douglas, "[t]he result of this reciprocal exchange of prices was to stabilize prices though at a downward level," since the knowledge generally caused defendants to either match or beat their competitor's price.[177] That some price-reducing competition was apparent, however, did not undermine the greater problem of stabilization, according to Douglas. Indeed, when Douglas cited *American Column*, he and the majority largely ignored Justice Stone's nuanced analysis in *Maple Flooring* and held the defendants liable, because "interference with the setting of price by free market forces is unlawful per se."[178]

Unlike the Justices of the 1920s, Justice Douglas treated an agreement to exchange information as equivalent to an "agreement" as contemplated by section 1.[179] Any apparent change in prices under such an exchange constituted

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of salesmen, agents, and dealers," and "the prompt meeting of changes in price by competing sellers." Cement Mfrs. Protective Ass'n v. United States, 268 U.S. 588, 605 (1925).

172. *Maple Flooring*, 268 U.S. at 583.

173. *See id.* at 585; Am. Column & Lumber Co. v. United States, 257 U.S. 377, 414 (1921) (Brandeis, J., dissenting).

174. *See, e.g.*, Sugar Inst. v. United States, 297 U.S. 553, 600 (1936) (affirming *Cement Manufacturers'* in holding that exchange must be "part of a plan to impose unwarrantable restrictions").

175. United States v. Container Corp. Am., 393 U.S. 333 (1969).

176. *Id.* at 335.

177. *Id.* at 336–37.

178. *Id.* at 337 (citing United States v. Socony-Vacuum Oil Co., 310 U.S. 150, 224 n.59 (1940)).

179. *See id.* at 337.

price-fixing and was unlawful *per se*.[180] Douglas doubted the efficacy of intervention in markets to render them more "intelligent," especially by private groups like trade associations. Like the idealized price system, antitrust offered a decentralized form of market regulation, wherein competition would ensure social welfare rather than coordination within a given industry. Thus, any effect of this coordination on prices constituted a restraint. As Douglas put it, "[p]rice is too critical, too sensitive a control to allow it to be used even in an informal manner to restrain competition."[181] An institutional choice favoring the antitrust laws carried with it a commitment to Hayek's solution to the dispersed knowledge problem: a market system in which prices *must* be set by "free market forces" with strict rules of competition crafted to ensure the efficacy of that process.[182]

### B. ANTITRUST DOCTRINE'S PRICE-FIXING PARADOX

Every case of price-fixing involves some exchange of information that facilitates the conspiracy. That exchange enables the conspirators to effectively integrate the price system within their group, dominate and manipulate the exchange of information within the given market, and therefore harm out-group competitors, workers, and consumers reliant on that noisy information. Applying Douglas's reasoning, where out-groups rely on the market price system to coordinate their economic activities this in-group information exchange is inherently anticompetitive, no matter how reasonable the desire of said in-group to avoid "unintelligent conduct of economic enterprise," to borrow Stone's language.[183]

Yet a platform like Amazon can achieve the same capacity to dominate and manipulate the exchange of information within a given market through vertical integration while avoiding charges of price-fixing. This distinction drawn in the antitrust laws between the horizontal coordination of ostensible competitors and the vertical coordination of a single firm is rendered illogical by recognition of the identical goal of both tactics: the administration of prices. While Amazon's administered prices may not look like those of hardwood or container manufacturers—who often fix artificially low rather than high prices—price administration in either form should be understood as price-fixing. Despite this reality, the Court's premise that price-fixing is unlawful *per se* due to the risk of "interference with the setting of price by free market

180. *See Socony-Vacuum Oil Co.*, 310 U.S. at 223.
181. *Container Corp.*, 393 U.S. at 338.
182. *Id.* at 337.
183. *Maple Flooring*, 268 U.S. at 582–83.

forces"[184] paradoxically applies only to price-fixing by horizontal competitors under current antitrust doctrine, while price-fixing that is the product of single firm conduct is subject to the entirely different standards set out under § 2 of the Sherman Act.[185]

Under § 2, a single firm will only be held liable for "charging monopoly prices" where the firm willfully acquired or maintained "monopoly power."[186] Moreover, monopoly prices are expected to be artificially high, while artificially low prices are presumed to benefit consumers and pose no threat to competition "so long as they are above predatory levels."[187] Proving a price to be predatory requires demonstrating that the firm not only injured competition, but was capable of recouping its costs by raising "prices above a competitive level . . . sufficient to compensate for the amounts expended on the predation, including the time value of the money invested in it."[188] To avoid setting "standards of predatory pricing liability . . . so low that antitrust suits themselves became a tool for keeping prices high"[189]—an example of what Robert Bork famously referred to as the "Antitrust Paradox"[190]—federal courts have imposed upon antitrust enforcers a second paradox: price-fixing is presumed to unduly restrain trade when achieved through horizontal coordination, but not when achieved through single firm conduct.

This is not to say that the reasoning behind this doctrinal second paradox is entirely nonsensical. Louis Kaplow has noted "coordinated oligopolistic price elevation is qualitatively different" than that of a single firm because the oligopoly rewards horizontal colluders "not for outperforming their rivals but rather to the extent that they refrain from such competition."[191] Horizontal coordination suppresses the need to innovate to gain comparative advantage, whereas a single firm—like Amazon—is more likely to innovate to win a struggle for a vertical position that would enable unilateral price-fixing.[192] While a predatory pricing strategy undermines this latter argument since the

184. *Container Corp.*, 393 U.S. at 337.

185. *See* 15 U.S.C. § 2 ("Every person who shall monopolize, or attempt to monopolize . . . any part of the trade or commerce among the several States . . . shall be deemed guilty of a felony . . . .").

186. *See* Pac. Bell Tel. Co. v. linkLine Commc'ns, Inc., 555 U.S. 438, 448 (2009) (citing United States v. Grinnell Corp., 384 U.S. 563, 570–71 (1966)).

187. Atl. Richfield Co. v. USA Petroleum Co., 495 U.S. 328, 340 (1990).

188. Brooke Group Ltd. v. Brown & Williamson Tobacco Corp., 509 U.S. 209, 225 (1993).

189. *Id.* at 226–27.

190. *See* ROBERT H. BORK, THE ANTITRUST PARADOX (2d ed., 1993).

191. Louis Kaplow, *Price-Fixing Policy*, 61 INT'L J. INDUS. ORG. 749, 758 (2018).

192. *Id.*

single firm wins the struggle for position through superior pricing rather than superior products, the concern of courts to avoid chilling good faith price-cuts is a reasonable one.[193] Highlighting these complex considerations, Amazon likely has achieved its dominance through a predatory pricing policy founded on an innovative informational infrastructure.

Whether or not Amazon's predatory pricing can be proven to the satisfaction of the federal courts, its position of dominance—unlawfully acquired or the product of "business acumen"—poses a fundamental challenge to the logic of antitrust doctrine.[194] As Brandeis warned in *American Column*, "[w]herever a dominant position has been attained, restraint necessarily arises."[195] Contemporary antitrust doctrine's paradoxical approach to price-fixing fails to comprehend how Amazon's dominance extends not only over retail markets, but also over the information exchanged through those markets that other market actors must rely on.

### C. MANDATING EQUITABLE INFORMATION EXCHANGE

While Amazon's liability under the antitrust laws under contemporary doctrine is open for debate, the profound impact of Amazon's algorithmic price administration on the informational quality of market prices and the overall efficacy of the price system as a decentralized coordinative mechanism is not. Means warned nearly a century ago that administered prices in any context threaten to displace the collective industrial policy of decentralized coordination in favor of the business policies of price administrators. This displacement occurs when the administrator injects noise, as opposed to information, into their marked-up prices. While prices aggregate dispersed information, the noise a price administrator injects through markups represents an aggregate of centralized, *private* information irrelevant to the efficient allocation of resources but crucial to the business policies of the administrator. Concentration of both capital and information within the administering firm enable its capacity to administer prices, which extends to the firm an area of price choice beyond the equations of supply and demand that the price system communicates. While a trade association's facilitation of horizontal information exchange was a prerequisite to price administration in the past, Amazon's vertically integrated informational infrastructure enables unilateral price administration precisely tailored to its business policies. In turn,

193. *See Brooke Group*, 509 U.S. at 226.

194. *See Grinnell Corp.*, 384 U.S. at 572 (distinguishing the "willful acquisition or maintenance" of monopoly power from "growth or development as a consequence of a superior product, business acumen, or historic accident").

195. *Am. Column*, 257 U.S. at 414 (Brandeis, J., dissenting).

Amazon's price administration supports its positive feedback-driven growth and therefore extends the concentration of capital and information that had enabled the price administration in the first instance. In this manner, Amazon's algorithmic price administration has captured a positive feedback loop of its own that only creates more noise in the market.

However, none of these considerations deny the potential benefits of algorithmic pricing and even price administration. Means argued that industrial development may depend on the concentration of capital in large firms and the technological progress that this concentration arguably enables. Administered prices may be a necessary and worthwhile consequence of these benefits. Particularly where prices are administered so they undermine the coordinative efficacy of the price system, algorithmic pricing and other Big Data practices may encourage improvements upon, if not revolutionize, the allocation of both information and resources. Indeed, Stone argued the "free distribution of knowledge" is likely to leave all market actors "more intelligent."[196] Market actors therefore might be more capable of achieving Holmes' "ideal of commerce" as an "intelligent interchange."[197] And, as Brandeis noted, "rational competition" is only possible where information asymmetries are minimized.[198] The problem is that, absent intervention, such conceivable benefits are likely to accrue disproportionately to corporate administrators and investors, while harms like Amazon's predatory pricing are likely to accrue disproportionately to those lacking the means to acquire information outside the price system.

However, this inequity can be remedied. Means presented two potential responses to the problem of administered prices that are still relevant today. First, the antitrust laws could be deployed to break up highly concentrated firms and therefore disable their capacities to administer prices and build out informational infrastructures that threaten the coordinative role of the price system. Second, "institutional arrangements" could be developed to supplement the market price system. Means pointed to the Agricultural Adjustment Administration and National Recovery Administration as examples of "institutional frameworks" in which public and private interests could be mediated and economic activity coordinated without unfairly advantaging any particular party.[199]

196. *Maple Flooring*, 268 U.S. at 583.

197. *Am. Column*, 257 U.S. at 412 (Holmes, J., dissenting).

198. *Id.* at 415–16 (Brandeis, J., dissenting).

199. *See* GARDINER C. MEANS, INDUSTRIAL PRICES AND THEIR RELATIVE INFLEXIBILITY, S. DOC. NO. 74-13, at 12–13 (1st Sess. 1935).

Amazon's informational infrastructure is a *private* attempt at such a framework because it supplements the inadequate information conveyed through market prices, promotes its own intrafirm coordination, and compels the participation of other market actors pursuant to its business policies. It is comparable to the idealized price system that directs the economic activities of market actors in line with its decentralized industrial policy. In fact, Amazon has provided a third way between the paths Means illuminated since it has displaced the public institution that is the price system in favor of a private substitute. Pursuant to the essential facilities doctrine, the antitrust laws could compel Amazon to put its private infrastructure to work in service of the public interest.

The essential facilities doctrine recognizes that access to and use of certain facilities may be essential to compete in a given market, and that these facilities may be subject to monopolization.[200] As the Seventh Circuit formulated it, establishing liability under the essential facilities doctrine requires showing "(1) control of the essential facility by a monopolist; (2) a competitor's inability practically or reasonably to duplicate the essential facility; (3) the denial of the use of the facility to a competitor; and (4) the feasibility of providing the facility."[201] Admittedly, the essential facilities doctrine is disfavored, if not definitively rejected, under contemporary antitrust law. While some scholars have found that the doctrine "has a long and respected history as part of U.S. antitrust law,"[202] Phillip Areeda critically noted that "most Supreme Court cases invoked in support" of the doctrine "do not speak of it and can be explained without reference to it."[203] In *Trinko*, Justice Scalia cited Areeda's critique favorably, and added "[w]e have never recognized such a doctrine . . . and we find no need either to recognize it or to repudiate it here."[204] Despite *Trinko*'s pronouncement, many have highlighted the doctrine's relevance to the digital economy in recent years.[205] Though the

200. *See* Brett Frischmann & Spencer Weber Waller, *Revitalizing Essential Facilities*, 75 ANTITRUST L.J. 1, 2–3 (2008).

201. *MCI Commc'ns Corp. v. Am. Tel. and Tel. Co.*, 708 F.2d 1081, 1133 (7th Cir. 1983).

202. Robert Pitofsky, Donna Patterson & Jonathan Hooks, *The Essential Facilities Doctrine Under U.S. Antitrust Law*, 70 ANTITRUST L.J. 443, 445 (2002).

203. Phillip Areeda, *Essential Facilities: An Epithet in Need of Limiting Principles*, 58 ANTITRUST L.J. 841, 841 (1989).

204. *Verizon Commc'ns Inc. v. Law Offices of Curtis V. Trinko, LLP*, 540 U.S. 398, 411 (2004).

205. *See, e.g.*, Frischmann & Waller, *supra* note 200; Marina Lao, *Search, Essential Facilities, and the Antitrust Duty to Deal*, 11 NW. J. TECH. & INTELL. PROP. 275 (2013); Zachary Abrahamson, *Essential Data*, 124 YALE L.J. 867 (2014); Maxwell Meadows, *The Essential Facilities Doctrine in Information Economies: Illustrating Why the Antitrust Duty to Deal is Still Necessary*

doctrine has generally been applied to cases involving restriction of access to physical infrastructure for railroads[206] or telecommunications,[207] the doctrine is equally relevant to developing digital infrastructures.

The doctrine is particularly applicable to Amazon's informational infrastructure—its tools of data acquisition, its algorithms that transform that data into useful information through machine learning, and the data itself. First, unlike a railroad bridge,[208] data and algorithmic learning are nonrivalrous—that is, capable of being "used by any number of firms or people simultaneously, without being diminished."[209] Second, while developing its informational infrastructure has certainly involved significant and ongoing investment, sharing access and use would be relatively costless.[210] Therefore, provision of the essential facility likely is feasible, with minimal need for the sort of "day-to-day" administration that concerned the *Trinko* court.[211] Third, machine learning algorithms promote demand-side network effects, since each use of the algorithm "increases the application's value for future uses by improving the application's predictive functions."[212] Even leaving aside the additional network effects that compound Amazon's acquisition of data through positive feedback-driven growth, the relative informational value of Amazon's infrastructure is likely to compound at a rate that competitors will not to be able to match, and thus will not be replicable. By enabling algorithmic price administration and therefore undermining the coordinative function of the market price system, Amazon's informational infrastructure now constitutes an essential facility in retail markets—one entirely under Amazon's control.

A recent study from the European Commission has addressed the possibility of applying the essential facilities doctrine to data infrastructures, where it proposed mandatory data exchange as one potential remedy.[213] For example, this remedy could require Amazon to share some or all of its raw

*in the New Economy*, 25 FORD. INTELL. PROP. MEDIA & ENT. L.J. 795 (2015); Nikolas Guggenberger, *Essential Platforms*, 24 STAN. TECH. L. REV. 247 (2021).

206. *See, e.g.*, U.S. v. Terminal R.R. Ass'n of St. Louis, 224 U.S. 383 (1912).

207. *See, e.g.*, *Trinko*, 540 U.S. 398.

208. *See Terminal R.R.*, 224 U.S. at 391–92.

209. Charles I. Jones & Christopher Tonetti, *Nonrivalry and the Economics of Data*, 110 AM. ECON. REV. 2819, 2819 (2020).

210. *See* Abrahamson, *supra* note 205, at 877–78.

211. *See Trinko*, 540 U.S. at 415.

212. Narechania, *supra* note 142, at 1577–81.

213. *See* Jacques Crémer, Yves-Alexandre de Montjoye & Heike Schweitzer, *Competition Policy for the Digital Era*, EUR. COMM'N 73 (2019), https://op.europa.eu/en/publication-detail/-/publication/21dc175c-7b76-11e9-9f05-01aa75ed71a1/language-en.

data inputs in an open-access pool.[214] If a court found that Amazon were owed compensation for costs associated with maintaining its infrastructure or otherwise, access to the pool could be granted through non-exclusive licenses with fair, reasonable, and non-discriminatory (FRAND) terms.[215]

However, Michal Gal and Nicolas Petit have recently proposed a "radical" remedy that "has some similarities with data sharing remedies, but goes one step further": it mandates an exchange of algorithmic learning.[216] The algorithms themselves, parts of their code, and other "essential" components of Amazon's informational infrastructure would be subject to mandatory exchange rather than the data inputs.[217]

As noted, algorithmic learning and raw data both are nonrivalrous and likely cost little to exchange, but Gal's and Petit's radical remedy would be superior to the exchange of raw data in at least three further respects. First, an exchange of data alone would still leave competitors at a potentially insuperable disadvantage due to the network effects of machine learning, whereas an exchange of said learning would capture and share that positive feedback loop.[218] Sharing algorithms could quickly level the coordinative capacities of all competitors, thus restoring some degree of competition with greater immediacy.[219] Second, sharing algorithms could potentially be a "one-time remedy," whereas data exchange may require ongoing supervision of FRAND licensing, data provision from Amazon, and more.[220] Finally, the sharing of algorithms and their outputs could minimize concerns for consumer privacy that may attach to the widespread sharing of data inputs.[221] Recognizing Amazon's informational infrastructure as an essential facility and mandating the exchange of algorithms that constitute said infrastructure offers a compelling third way between disablement of Amazon through structural antitrust remedies and direct control of Amazon through public regulation.

Unlike either of those equally radical remedies, this third way conveys an additional prize: a decentralized mechanism for resource allocation aligned with the purposes and values of Hayek's idealized market price system. Hayek highlighted the epistemic *needs* of a society in allocating resources and planning

214. *See id.* at 97.

215. *Id.*

216. Michal S. Gal & Nicolas Petit, *Radical Restorative Remedies for Digital Markets*, 36 BERKELEY TECH. L.J. 617, 622 (2021).

217. *See id.* at 637.

218. *See id.* at 625–629; *see also* Narechania, *supra* note 142, at 1577–81.

219. *See* Gal & Petit, *supra* note 216, at 635.

220. *Id.*

221. *See id.* at 622.

its economic activities and the epistemic *power* of market prices in rendering efficient that allocation and planning.[222] In theory, the price system's decentralization drives its communicative—and thus coordinative—efficiency, which in turn enables broader economic efficiency.[223] Because decentralization channels widely dispersed information through an impersonal and omnipresent numerical price, the spatial and temporal limits of communication are extended and the interjection of noise is minimized.

While direct regulation may undermine such decentralization, break-ups of inordinately large firms like Amazon would theoretically effect decentralization. As written, "the antitrust laws represent a fundamental national economic policy"[224] that prefers decentralized markets in which competition will compel self-regulation.[225] The Hayekian vision of decentralization arguably legitimates capitalism itself. Unlike the socialist central planning that Hayek polemicized, the "social force, hierarchies, cruelties, and damages" of ostensibly decentralized markets are not perceived as "imposed from above."[226] Decentralization leads to depoliticization of the market, which lends airs of legitimacy and accountability to economic institutions like the price system.[227]

Yet the ubiquity of administered prices undermines both this vision of decentralized economic coordination through the price system and the antitrust laws founded upon that vision. Though Amazon's informational infrastructure mimics such decentralization by channeling massive volumes of data through pricing algorithms, it could never mimic the market's legitimacy while subject to Amazon's unilateral control. Recognition that this infrastructure is an essential facility in light of its disruption of the price system, then mandated access to and exchange of Amazon's algorithms and algorithmic learning, could lend to algorithmically administered prices the impersonal and mutualistic character of decentralized market prices. Such a mandate would acknowledge that the informational function of the price system has been superseded in an era of digitalization by the epistemic power of Big Data and machine learning, but that the full and equitable use of that power demands its democratization.

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222. *See* Elizabeth Anderson, *The Epistemology of Democracy*, 3 J. SOC. EPISTEMOLOGY 8, 8–9 (2006) (categorizing Hayek as "a pioneer theorist of institutional epistemology").

223. *See* HAYEK, *supra* note 10, at 86–88.

224. Carnation Co. v. Pac. Westbound Conference, 383 U.S. 213, 218 (1966).

225. *See* Ohio v. Am. Express Co., 138 S. Ct. 2274, 2290 (2018) (Breyer, J., dissenting).

226. Wendy Brown, *Why Is Democracy So Hard? University of California, Berkeley Memorial Lecture for Erik Olin Wright, January 2020*, 48 POL. & SOC. 539, 545 (2020).

227. *See id.*

## V. CONCLUSION

In theory, the market price system is a medium of information exchange. As equations of supply and demand, prices convey exactly that information to market actors, and thereby coordinate those actors' economic activities. Contemporary antitrust doctrine rests upon this theory, and seeks to preserve competition in order to facilitate this decentralized coordination. Thus, information exchange between competitors outside the price system may be proscribed where it poses an unreasonable threat to that coordinative function.

However, due to a paradoxical approach to price-fixing where the collection and use of information within a single firm is distinguished from that exchanged between competitors, Amazon has escaped liability despite effectively hijacking the price system's coordinative function. Under a guise of procompetitive low prices, Amazon has in fact deployed an unprecedented informational infrastructure—made possible by rapid developments in Big Data practices—to dominate price-making in the e-commerce market.

A response is needed if the current paradigm of market regulation through decentralized enforcement of competition is to persist. The essential facilities doctrine offers one avenue for potential remediation. Amazon could be compelled to share its algorithmic learning with competitors, contributing to a democratized and effectively decentralized mechanism of information exchange, moving beyond the price system while retaining some aspect of its legitimacy.