

The Efficient Queue and the Case Against Dynamic Pricing

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ABSTRACT: From surge pricing by Uber to last-minute fare increases by airlines, the use of price hikes to determine who should gain access to scarce resources has swept the business world in recent years, enabled by the easy access to information on what consumers are willing to pay, and the power of algorithms to act on that information, that characterize the information age. This practice, often euphemistically called dynamic pricing, has been defended on the ground that higher prices are required to equilibrate supply and demand. Lower prices, the argument goes, would lead to wasteful queuing. In fact, the same technological advances that have enabled dynamic pricing have also driven the cost of queuing nearly to zero, by allowing consumers to place orders online, which amounts to standing on instantaneously-self-clearing queues. Today, firms engage in dynamic pricing not because the practice is better at rationing access to scarce resources, but because charging higher prices is more profitable. Antitrust enforcers do not normally prosecute the charging of high prices, but they have an opportunity to do so here, because the harmfulness of dynamic pricing to consumers is clear and the remedy—prohibiting dynamic pricing—would be relatively easy to administer.

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I. INTRODUCTION

Generations of introductory economics students have been taught that prices clear markets, ensuring that the number of units of a good or service demanded by consumers precisely equals the number of units supplied.¹ And yet the real world has always been rather obviously messier, as anyone who has ever waited on line for a table at a restaurant, or found a child's favorite toy sold out at Christmas, can attest. Firms sometimes accidentally set their prices considerably below the level required to equilibrate supply and demand, resulting in too many buyers given available supply, because firms have always lacked sufficient information to identify that magic market-clearing price with certainty.² The archetypical example of undershooting is the old Communist state-run enterprise, which charged prices so low that anyone could buy, leading to interminable lines.³ But underpricing has always been pervasive in all capitalist countries as well, though to a far lesser degree, with waiting lists, preordering, reservations systems, sold out notices, and indeed lines a familiar experience for shoppers everywhere.⁴

Waiting lists, preordering and the like are species of the same basic solution to the problem of how to ration a resource for which price has been set too low to equilibrate supply with demand. That solution is queuing, the granting of access based on the principle of first-come-first-served.⁵

1. See, e.g., HAL R. VARIAN, *INTERMEDIATE MICROECONOMICS: A MODERN APPROACH* 289–90 (7th ed. 2006) (“The equilibrium price of a good is that price where the supply of the good equals the demand. Geometrically, this is the price where the demand and the supply curves cross.”).

2. See STEVEN ORLA KIMBROUGH, *AGENTS, GAMES, AND EVOLUTION: STRATEGIES AT WORK AND PLAY* 193–98 (2011).

3. See JÁNOS KORNAI, *THE SOCIALIST SYSTEM: THE POLITICAL ECONOMY OF COMMUNISM* 287 (1992).

4. See Andrew Ross Sorkin, *Hurricane Price Gouging Is Despicable, Right? Not to Some Economists*, N.Y. TIMES (Sept. 11, 2017), <https://www.nytimes.com/2017/09/11/business/hurricane-price-gouging.html> [https://perma.cc/62NX-VK2C].

5. See Yoram Barzel, *A Theory of Rationing by Waiting*, 17 J.L. & ECON. 73, 73, 75 (1974).

Economists have long lamented the waste associated with queuing, from time spent on lines that could have been spent on labor, to the resources wasted by firms in managing reservations systems.⁶ The arrival of the information age has therefore seemed a godsend, giving firms the power to put an end to shortages and queuing by allowing firms at last to identify the market-clearing price. Vast amounts of data on consumers, generated by firms themselves based on records of their own interactions with consumers, and purchased from third-party data aggregators, allow firms to determine how many consumers are able to pay each possible price for a product, and therefore to identify the price that just clears the market.⁷

Charging that price empties all lines, sending a magical signal to consumers that encourages hopefuls who cannot afford the price to disperse, and beckons those who can afford the price to come forth to buy.⁸ In this spirit, economists have celebrated the spread in recent years of dynamic pricing throughout the economy, from Disney World, which now uses higher prices to reduce lines during periods of peak demand, to commuter highways, which are dynamically pricing their fast lanes, to cities considering charging a “congestion price” for access to downtown, to Uber, which uses surge pricing to handle the rush after concerts and games, and to Amazon, which varies prices on thousands of products hundreds of times per day.⁹

The irony of the information age is that at the same time that information makes the finding of market-clearing prices easier, information also reduces the waste associated with queuing, eliminating the problem that the charging of market-clearing prices was intended to solve. The information age has greatly reduced the cost of selling based on the principle of first-come-first-served, by allowing consumers to determine instantaneously, via online retail platforms, whether an item is available for purchase or sold out. As an increasing amount of commerce moves online from brick-and-mortar

6. See *id.* at 73; VARIAN, *supra* note 1, at 308.

7. See Akiva A. Miller, *What Do We Worry About When We Worry About Price Discrimination? The Law and Ethics of Using Personal Information for Pricing*, 19 J. TECH. L. & POL'Y 41, 44–54 (2014).

8. See VARIAN, *supra* note 1, at 7–8, 306–07 (“At this price, each consumer who is willing to pay at least p^* is able to find an apartment to rent, and each landlord will be able to rent apartments at the going market price. Neither the consumers nor the landlords have any reason to change their behavior.”).

9. Sorkin, *supra* note 4; see Winnie Hu, *Congestion Pricing Falters in New York, Again*, N.Y. TIMES (Mar. 31, 2018), <https://www.nytimes.com/2018/03/31/nyregion/congestion-pricing-new-york.html> [<https://perma.cc/Z7KQ-6454>]; S.K., *Disney Discovers Peak Pricing*, ECONOMIST (Feb. 29, 2016), <https://www.economist.com/free-exchange/2016/02/29/disney-discovers-peak-pricing> [<https://perma.cc/UP8A-3XWM>]; Ben Popper, *Uber Surge Pricing: Sound Economic Theory, Bad Business Practice*, VERGE (Dec. 18, 2013, 11:34 AM), <https://www.theverge.com/2013/12/18/5221428/uber-surge-pricing-vs-price-gouging-law> [<https://perma.cc/CH6D-J6DM>]; Harry Wallop, *How Online Giants Like Amazon Can Rip You off by Changing Prices up to 300 Times a Year (And if You're Rich, Some Websites Could Soon Charge You Even More!)*, DAILY MAIL, <http://www.dailymail.co.uk/~/-/article-4935422/index.html> [<https://perma.cc/X2RT-8NZZ>] (last updated Oct. 2, 2017, 7:56 AM).

locations, and service providers, from hair dressers to restaurants, increasingly allow consumers to reserve services online, the cost of first-come-first-served is falling across the economy.¹⁰ Consumers who might have wasted time on a futile trip to a brick-and-mortar store, or trying to hail a taxi on a downtown street, now use a phone or computer to learn immediately whether a good or service is available. This “virtual queuing” rations supply on the principle of first-come-first-served, just as cheaply as dynamic pricing rations supply using market-clearing prices. Indeed, virtual queueing is cheaper because it does not require that firms acquire any data on the prices that consumers are willing to pay in order to be implemented effectively.

Why, then, has dynamic pricing spread across American industry, when it has never been less wasteful to charge low prices and ration based on place in line?¹¹ The answer, of course, is profit. Firms charge prices they think will allow them to sell what they can produce, which means that when demand turns out to be unexpectedly large, firms will lack the capacity to satisfy demand.¹² The firm cannot immediately adjust supply to correct, but must wait for component orders to be filled, workers to be hired, and equipment to be readied.¹³ While the firm is waiting, the firm’s supply is fixed, and the firm must therefore decide how to ration out a supply that is too small to meet demand.¹⁴ If the firm raises prices to limit demand, the firm will end up charging a price in excess of the cost of production, because the firm would not have planned to supply the market at all if the firm had not expected to

10. See Kate Kaye, *Walmart’s Everyday Low Prices Face Amazon’s Dynamic Price Push*, ADAGE (Dec. 10, 2015), <http://adage.com/article/datadriven-marketing/walmart-s-everyday-low-prices-face-amazon-s-dynamic-push/301613> [<https://perma.cc/M72D-EP6A>] (discussing shift of brick-and-mortar retail to online retail).

11. See AP, *‘Dynamic Pricing’ Becoming More Popular in Many Industries*, ST. AUGUSTINE REC. (May 11, 2016, 2:18 PM), <http://staugustine.com/news/national-news/2016-05-11/dynamic-pricing-becoming-more-popular-many-industries> [<https://perma.cc/EGA7-99SC>]; Neil Irwin, *Why Surge Prices Make Us So Mad: What Springsteen, Home Depot and a Nobel Winner Know*, N.Y. TIMES (Oct. 14, 2017), <https://www.nytimes.com/2017/10/14/upshot/why-surge-prices-make-us-so-mad-what-springsteen-home-depot-and-a-nobel-winner-know.html> [<https://perma.cc/NW8V-G9C8>]; Adam Tanner, *Different Customers, Different Prices, Thanks to Big Data*, FORBES (Mar. 26, 2014, 6:00 AM), <https://www.forbes.com/sites/adamtanner/2014/03/26/different-customers-different-prices-thanks-to-big-data/#39cf8e657305> [<https://perma.cc/NS9A-JDGH>]. See generally Dax Cross, *A History of Revenue Management and the Advent of Next-Generation RM*, 15 J. REVENUE & PRICING MGMT. 293 (2016) (discussing the development of dynamic pricing practices in travel, hospitality, automotive, retail, cruise line, and entertainment industries); Robert G. Cross et al., *Milestones in the Application of Analytical Pricing and Revenue Management*, 10 J. REVENUE & PRICING MGMT. 8 (2011) (explaining the development of pricing and revenue management as a science); Sheryl E. Kimes, *The Evolution of Hotel Revenue Management*, 15 J. REVENUE & PRICING MGMT. 247 (2016) (discussing the history of revenue management practices in the hotel industry, including the “best available rate” pricing structure); Stefan Poelt, *History of Revenue Management—From Leg to O&D*, 15 J. REVENUE & PRICING MGMT. 236 (2016) (analyzing the transformation of pricing and revenue management in the airline industry).

12. See VARIAN, *supra* note 1, at 409–10.

13. See *id.* at 402–04.

14. See Barzel, *supra* note 5, at 75.

cover costs at prevailing prices.¹⁵ The higher prices that the firm charges to clear the market will therefore exceed cost, generating profit for the firm in the economic sense of surpluses unnecessary to create an incentive for the firm to produce.¹⁶ Unlike queues, which ration based on first-come-first-served, here price allocates goods or services only to that subgroup of consumers, out of the group that is willing to pay the lower price that the firm was initially planning on charging, who are willing to pay the most for the product. As a result, the firm extracts the maximum possible profit from consumers.¹⁷

Introductory economics teaches that competition turns firms into “price takers” that should be unable to raise their prices to ration supply during periods when supply cannot be expanded to meet demand. But in the real world, firms actually always have at least some power over the prices they charge and the amounts they produce, even in fiercely competitive markets.¹⁸ Every firm sells a product that differs, at least in brand name, from all others. Because at least some consumers care about these differences, and only one firm is able to produce any particular differentiated product, each firm can use price to ration access to its own product to the product’s greatest fans at the highest possible prices.¹⁹ Consumer loyalty to the differentiated product ensures that no other firm will be able to lure those fans away by selling the exact same product at a lower price, as would happen in a world of perfect competition, rather than the world of monopolistic competition in which people actually live.²⁰

The wealth-extractive character of ration pricing must be understood to violate the antitrust laws, because, almost without realizing it, antitrust has morphed in recent decades into a general defender of consumer welfare against all attempts to redistribute wealth from consumers to producers in the

15. See VARIAN, *supra* note 1, at 410–12.

16. See *id.*

17. See *id.* at 8.

18. Edward Chamberlin explains:

Under pure competition, the individual seller’s market being completely merged with the general one, he can sell as much as he pleases at the going price. Under monopolistic competition, however, his market being separate to a degree from those of his rivals, his sales are limited and defined by three new factors: (1) his price The divergence of the demand curve for his product from the horizontal imposes upon the seller a price problem, absent under pure competition, which is the same as that ordinarily associated with the monopolist. Depending upon the elasticity of the curve and upon its position relative to the cost curve for his product, profits may be increased, perhaps by raising the price and selling less, perhaps by lowering it and selling more. That figure will be sought which will render the total profit a maximum.

EDWARD HASTINGS CHAMBERLIN, *THE THEORY OF MONOPOLISTIC COMPETITION: A RE-ORIENTATION OF THE THEORY OF VALUE* 71 (7th ed. 1958).

19. See *id.* at 71–74.

20. See *id.*

form of greater profits.²¹ Since the 1970s, antitrust has recognized the protection of consumer welfare in the economic sense, understood to mean the margin between the value the consumer derives from a product and the price the consumer pays for the product, as the ultimate goal of antitrust enforcement.²² This has resulted in an antitrust regime that today measures legality in terms of the magnitude of harm inflicted by a firm on consumers.²³ For an antitrust obsessed with using consumer harm in the economic sense as a rule of decision in antitrust cases, condemning dynamic pricing should not be hard, as the point of dynamic pricing, at least when deployed in response to unexpected surges in demand, is to increase the profits firms extract from consumers, which is equivalent to harming consumers.

Antitrust has traditionally shied away from prohibiting the charging of high prices, however, because courts are ill-equipped to respond by determining and supervising the charging of lower prices.²⁴ In the case of dynamic pricing, this concern is absent because courts would not need to set prices to provide a remedy for dynamic pricing. Instead, courts could simply ban the practice. Courts need not know the costs of firms to know that prices are too high under dynamic pricing, because the entire point of dynamic pricing in response to surges in demand is to use ration pricing to increase profits. Prohibiting dynamic pricing must therefore benefit consumers without posing a danger of driving prices below costs.

A ban on dynamic pricing would be almost identical to the ban on price fixing that is probably the most well-established rule in antitrust.²⁵ Like a ban

21. See John B. Kirkwood & Robert H. Lande, *The Fundamental Goal of Antitrust: Protecting Consumers, Not Increasing Efficiency*, 84 NOTRE DAME L. REV. 191, 192–97, 242 (2008) (“Congress made clear that the fundamental goal [of the antitrust laws] is protecting consumers from exploitation. Congress’ principal objective, in other words, was to prevent firms from acquiring or maintaining market power without justification and then using that power to raise prices to consumers.”); Steven C. Salop, *Question: What is the Real and Proper Antitrust Welfare Standard? Answer: The True Consumer Welfare Standard*, 22 LOY. CONSUMER L. REV. 336, 337–39 (2010) (“The true consumer welfare standard is indifferent to conduct that harms competitors—unless the conduct also likely harms consumers. In contrast, the aggregate welfare standard is equally concerned with the harm to competitors as it is to the benefits or harms to consumers and the defendant firm. . . . Many courts and the federal enforcement agencies appear to have opted for the true consumer welfare standard.”); Ramsi A. Woodcock, *The Antitrust Duty to Charge Low Prices*, 39 CARDOZO L. REV. 1741, 1755–60 (2018) [hereinafter Woodcock, *The Antitrust Duty to Charge Low Prices*].

22. See *Brooke Grp. Ltd. v. Brown & Williamson Tobacco Corp.*, 509 U.S. 209, 219–27 (1993); Salop, *supra* note 21, at 338–47; Sandeep Vaheesan, *The Evolving Populisms of Antitrust*, 93 NEB. L. REV. 370, 395–403 (2014).

23. See Woodcock, *The Antitrust Duty to Charge Low Prices*, *supra* note 21, at 1755–60.

24. See *Verizon Commc’ns Inc. v. Law Offices of Curtis V. Trinko, LLP*, 540 U.S. 398, 407–08 (2004); Ramsi A. Woodcock, *The Antitrust Duty to Charge Low Prices*, *supra* note 21, at 1747–48, 1763–64.

25. See *United States v. Socony-Vacuum Oil Co.*, 310 U.S. 150, 218 (1940); HERBERT HOVENKAMP, *FEDERAL ANTITRUST POLICY: THE LAW OF COMPETITION AND ITS PRACTICE* 254–55 (5th ed. 2016).

on dynamic pricing, the ban on price fixing prevents firms from using a particular method—joint price setting in the case of price fixing—to set prices.²⁶ Like a ban on dynamic pricing, the ban on price fixing can be enforced without judicial central planning, but rather by prohibition. As would a ban on dynamic pricing, the ban on price fixing applies even without proof of monopoly power, because firms that engage in price fixing always have monopoly power.²⁷ Firms do not bother to fix prices if they cannot make a profit from fixing higher prices, and the ability to profitably raise price is all that the monopoly power requirement demands, making it superfluous in the case of price fixing.²⁸ Similarly, firms do not seek to raise price to ration levels during moments of fixed supply unless doing so is profitable. If they were interested only in covering costs, firms could achieve that without raising prices, simply by rationing access to their supply based on first-come-first-served and continuing to charge the original prices that they chose when they misjudged their output levels. So proof of monopoly power is superfluous in the case of dynamic pricing as well.

To be sure, antitrust bans price fixing under a different provision of the Sherman Act from that which would serve as the basis for condemning dynamic pricing, but that is only because price fixing incidentally requires cooperation with competitors, and the provision generally used to prohibit price fixing has been held to prohibit collusive behavior in particular.²⁹ Antitrust's consumer welfare standard applies to both provisions, however, and antitrust has come in recent years to apply the same test to identify violations of both provisions as well.³⁰ If antitrust continues to ban price fixing, it must also ban dynamic pricing in response to unexpected surges in demand.³¹

Part II defines dynamic pricing and shows how, when deployed in response to unexpected increases in demand, dynamic pricing always harms consumers and can be banned under the antitrust laws for that reason. Part III refutes the objection that, by enabling the use of price to ration access to scarce resources, dynamic pricing is efficient and should not therefore be subject to antitrust condemnation. Part IV considers the implications of this analysis for the broader practice of using price as a rationing mechanism.

26. See *Socony-Vacuum Oil Co.*, 310 U.S. at 221. The old ban on resale price maintenance was another example of a ban on a method of setting prices. See *Leegin Creative Leather Prods., Inc. v. PSKS, Inc.*, 551 U.S. 877, 886–87, 907 (2007).

27. See *Socony-Vacuum Oil Co.*, 310 U.S. at 221; ANDREW I. GAVIL ET AL., *ANTITRUST LAW IN PERSPECTIVE: CASES, CONCEPTS, AND PROBLEMS IN COMPETITION POLICY* 121 (3d ed. 2017); HOVENKAMP, *supra* note 25, at 211.

28. See GAVIL ET AL., *supra* note 27, at 489–90; HOVENKAMP, *supra* note 25, at 88–89.

29. 15 U.S.C. § 1 (2012); HOVENKAMP, *supra* note 25, at 171.

30. See *United States v. Microsoft Corp.*, 253 F.3d 34, 58–60 (D.C. Cir. 2001) (per curiam); Salop, *supra* note 21, at 340, 345; see also Timothy J. Muris, *The New Rule of Reason*, 57 ANTITRUST L.J. 859, 859–61 (1988).

31. See *Arizona v. Maricopa Cty. Med. Soc'y*, 457 U.S. 332, 347–48 (1982).

II. WELFARE EFFECTS AND ANTITRUST CONSEQUENCES

A. DYNAMIC PRICING AND ITS SPREAD

Dynamic pricing is the use of information age tools, such as big data and algorithms, to adjust prices based on new information over periods during which output is fixed.³² The practice operates as a kind of salve, allowing firms to use prices to minimize the losses they experience when they misjudge consumer demand and accordingly have failed to produce the amount of output that would maximize their profits. Ideally, a firm would respond to such a mistake by adjusting both price and quantity supplied to the new profit-maximizing price and output levels.³³ But historically the firm often could do neither in the short run. Output, once produced, could not be unproduced, and output not produced could not immediately be produced. Orders had to be placed, workers hired, and machines run. And prices, once printed, distributed, and posted, could not easily be raised or lowered.³⁴ Once the supermarket had put a sticker on a box of Cheerios, that box's price did not change, unless supermarket employees went through the time-consuming process of finding and covering over every price sticker.³⁵ Once circulars containing prices for electronics were printed, those prices did not change, at least until another print run rolled around.³⁶

The information age has solved half of this problem by allowing firms to adjust prices almost instantaneously in response to changes in demand. It now takes but a few electrons to change the online prices displayed to buyers.³⁷ Data and algorithms allow firms to identify changes in demand, recalculate prices accordingly, and transmit the new prices to consumers, with greater speed than before.³⁸ Online selling, and barcode scanning at brick-and-

32. This is an original definition. More commonly, dynamic pricing is taken to mean only the varying of prices over short time periods. See Tanner, *supra* note 11; Tim Walker, *How Much . . . ? The Rise of Dynamic and Personalised Pricing*, GUARDIAN (Nov. 20, 2017, 1:00 AM), <http://www.theguardian.com/global/2017/nov/20/dynamic-personalised-pricing> [<https://perma.cc/6NB6-7V3J>]; see also Cross, *supra* note 11, at 293–94.

33. See VARIAN, *supra* note 1, at 424–25 (“When there is only one firm in a market, that firm is very unlikely to take the market price as given. Instead, a monopoly would recognize its influence over the market price and choose that level of price and output that maximized its overall profits.”).

34. See ALAN S. BLINDER ET AL., ASKING ABOUT PRICES: A NEW APPROACH TO UNDERSTANDING PRICE STICKINESS 226–53 (1998).

35. See *id.*

36. See *id.*

37. See Wonseok Oh & Henry C. Lucas, Jr., *Information Technology and Pricing Decisions: Price Adjustments in Online Computer Markets*, 30 MIS Q. 755, 757–58 (2006).

38. Alessandro Acquisti & Hal R. Varian, *Conditioning Prices on Purchase History*, 24 MARKETING SCI. 367, 367 (2005); see ARIEL EZRACHI & MAURICE STUCKE, VIRTUAL COMPETITION: THE PROMISE AND PERILS OF THE ALGORITHM-DRIVEN ECONOMY 89–100 (2016); Hal R. Varian, *Online Ad Auctions*, 99 AM. ECON. REV. 430, 430–32 (2009) [hereinafter Varian, *Online Ad Auctions*].

mortar stores, give firms data on the time, place, and amount of every transaction consumers make.³⁹ Credit or debit card purchasing, and loyalty programs, allow firms to identify every buyer.⁴⁰ Vast amounts of data on browsing habits, collected by retailers themselves through their own websites, and purchased from third-party web tracking firms, provide huge numbers of additional data-points on buyers.⁴¹ Surveillance cameras with facial recognition technology provide brick-and-mortar retailers with information about in-store buyers.⁴² And vast amounts of data on economic trends, gleaned from everything from the frequency of internet searches for certain items, the prices and products listed by competitors online, satellite data on the number of lights showing at night, and traditional macroeconomic time series like the GDP jobs reports, now in easy-to-access digital form, provide firms with additional information about consumer willingness to pay.⁴³ Algorithms allow firms to parse their data quickly and use the results automatically to adjust prices.⁴⁴

Not surprisingly, given the power of this technology, dynamic pricing has appeared to explode across the business world over the past decade, although aggregate data on adoption does not yet exist. Uber is perhaps the most infamous practitioner. The ride sharing service engages in “surge pricing,” increasing ride prices when demand surges.⁴⁵ Uber has argued that the higher prices go in part toward offering drivers more money for driving during peak periods, thereby increasing supply, but when sufficient drivers fail to materialize, even after Uber offers more money to drivers, Uber continues to charge the higher prices.⁴⁶ That amounts to dynamic pricing, because it

39. See Miller, *supra* note 7, at 44–54.

40. See *id.* at 52.

41. See *id.* at 50; Benjamin Reed Shiller, *First-Degree Price Discrimination Using Big Data* 6–7 (Brandeis Univ. Dep’t. of Econ., Working Paper No. 58, 2014).

42. See Miller, *supra* note 7, at 45; Nick Wingfield et al., *Retailers Race Against Amazon to Automate Stores*, N.Y. TIMES (Apr. 1, 2018), <https://www.nytimes.com/2018/04/01/technology/retailer-stores-automation-amazon.html> [<https://perma.cc/3EXR-E5CH>].

43. See EZRACHI & STUCKE, *supra* note 38, at 89–100.

44. See *id.* Firms may not even need to use data to tease out changes in demand, because the information age has also turned the marketplace into a laboratory, in which firms can poke and test consumers to determine changes in their willingness to pay without needing to consult repositories of data about them. See Miller, *supra* note 7, at 47; Varian, *Online Ad Auctions*, *supra* note 38, at 430–32. Firms can vary prices on their websites based on the time visitors spend on a high-price page, relative to the time they spend on a low-price page, to try to infer willingness to pay, for example. See Miller, *supra* note 7, at 53–54. When not testing consumers, firms can simply manipulate them, using data to tailor advertising to individual consumers to lift their willingness to pay. See EZRACHI & STUCKE, *supra* note 38, at 89–100; Ramsi A. Woodcock, *The Obsolescence of Advertising in the Information Age*, 127 YALE L.J. 2270, 2278–81 (2018) [hereinafter Woodcock, *The Obsolescence of Advertising in the Information Age*]. I am grateful to Glenn Harrison for first suggesting the connection between online auction techniques and data-driven pricing to me.

45. See Popper, *supra* note 9; see also Jonathan Hall et al., *The Effects of Uber’s Surge Pricing: A Case Study*, U. CHI. BOOTH SCH. BUS. 1–4 (2015).

46. See Hall et al., *supra* note 45, at 4; Mike Murphy, *Uber Got Two Economics PhDs to Explain*

means that Uber is raising prices faster than supply can adjust, allowing the firm to extract additional profits from consumers due to the surge in demand. But consumers are far more likely to have paid dynamically chosen prices to Amazon than to Uber. Amazon has pioneered dynamic pricing in online retail, and now varies the prices it charges for hundreds of thousands of goods hundreds of times per day, a frequency that far exceeds the weeks required for Amazon to refresh inventories.⁴⁷ And the company is seeking to bring dynamic pricing to brick-and-mortar retail, operating new physical stores that have easy-to-change digital price tags.⁴⁸ Airlines, which pioneered the use of computers to generate prices back in the 1970s, have long engaged in a crude form of dynamic pricing: charging higher prices for seats as planes fill up.⁴⁹ The number of seats an airline can fly between two points is often constrained by the availability of planes and airport gates. When airlines raise prices as seats fill, they are engaging in dynamic pricing in the face of an anticipated excess of demand over available supply.⁵⁰ Much of the event industry, which is in the same business of filling fixed numbers of seats, has followed suit in

How Supply and Demand Works, QUARTZ (Sept. 17, 2015), <https://qz.com/505031/uber-got-two-economics-phds-to-explain-how-supply-and-demand-works> [<https://perma.cc/32FJ-78UB>].

47. See Kaye, *supra* note 10 (discussing Walmart's response to Amazon's changes in pricing); Bill Snyder, *Report Analyzes Amazon's Dynamic Pricing Strategy*, CIO (Jan. 16, 2015, 6:15 AM), <https://www.cio.com/article/2870961/report-analyzes-amazons-dynamic-pricing-strategy.html> [<https://perma.cc/Q2YJ-E2P4>]; see also Kathy Kristof, *How Amazon Uses "Surge Pricing," Just Like Uber*, CBS NEWS, <https://www.cbsnews.com/news/amazon-surge-pricing-are-you-getting-ripped-off-small-business> [<https://perma.cc/R8Y6-T2DX>] (last updated July 24, 2017, 10:08 AM); Ankitha Nagaraj, *Shipping From China to Amazon FBA—Everything You Need to Know*, SELLERAPP, <https://www.sellerapp.com/blog/how-to-get-your-shipments-from-china-to-amazon-fba> [<https://perma.cc/3N39-3NTA>]; Wallop, *supra* note 9.

48. Aly Weisman & Jeremy Dreyfuss, *I Visited Amazon's First Retail Store, and One Thing Was Especially Annoying*, BUS. INSIDER (Dec. 3, 2015, 10:13 AM), <http://www.businessinsider.com/amazon-bookstore-doesnt-have-prices-2015-12> [<https://perma.cc/TTU5-JXHL>].

49. See Cross et al., *supra* note 11, at 9–11; see also Cross, *supra* note 11, at 293–95.

50. See Cross et al., *supra* note 11, at 9–11; see also Peter P. Belobaba & John L. Wilson, *Impacts of Yield Management in Competitive Airline Markets*, 3 J. AIR TRANSPORT MGMT. 3, 4–6 (1997). High airline ticket prices for last-minute travelers may not reflect dynamic pricing if the prices are the product of a pre-determined bucket price schedule in which the last available seats on a plane are placed in a high-price bucket. See Lars A. Stole, *Price Discrimination and Imperfect Competition*, in 3 HANDBOOK OF INDUSTRIAL ORGANIZATION 2223, 2224–25 (Mark Armstrong & Robert H. Porter eds., 2007).

recent years, from Broadway shows to pop concerts.⁵¹ Ditto hotels, which now dynamically price their limited inventories of rooms.⁵² Ditto sports.⁵³

The list goes on. Services like YieldStar and LRO help apartment communities vary apartment rental rates on a daily basis.⁵⁴ Disney World now raises ticket prices on days of high demand.⁵⁵ A San Francisco startup tried to dynamically price municipal parking spaces by occupying them and then reselling them at a premium during period of excess demand.⁵⁶ The city put an end to those plans.⁵⁷ But governments have not been immune to the dynamic pricing frenzy. Dynamically-priced highway tolls, which increase when demand spikes for the fixed-supply service that is highway access, have proliferated over the past two decades.⁵⁸ And New York City recently adopted

51. See Steve Knopper, *Taylor Swift's Ticket Strategy: Brilliant Business or Slowing Demand?*, ROLLING STONE (Apr. 9, 2018, 2:59 PM), <https://www.rollingstone.com/music/music-news/taylor-swifts-ticket-strategy-brilliant-business-or-slowing-demand-630218> [https://perma.cc/4EP9-EBV5] ("Superstars like Swift are increasingly using 'dynamic pricing' that shifts ticket prices constantly like airline seats."); see also Patrick Healy, *Broadway Hits Make Most of Premium Pricing*, N.Y. TIMES (Nov. 24, 2011), <http://www.nytimes.com/2011/11/25/arts/new-pricing-strategy-makes-the-most-of-hot-broadway-tickets.html> [https://perma.cc/X7AM-46YT]; *How Are Ticket Prices and Fees Determined?*, TICKETMASTER, <https://help.ticketmaster.com/s/article/How-are-ticket-prices-and-fees-determined> ("In some instances, events on our platform may have tickets that are 'market-priced,' so ticket and fee prices may adjust over time based on demand. This is similar to how airline tickets and hotel rooms are sold and is commonly referred to as 'Dynamic Pricing.'"); Michael Paulson, *High Ticket Prices Are Fueling a Broadway Boom*, N.Y. TIMES (May 23, 2017), <https://www.nytimes.com/2017/05/23/theater/high-ticket-prices-are-fueling-a-broadway-boom.html> [https://perma.cc/2JLV-EJTP]. Broadway was pushed into dynamic pricing in part by the rise of automated ticket scalpers, which bet on demand for shows by buying up tickets and then raising prices if demand turns out to exceed supply. See James B. Stewart, *Broadway Tickets, for the Price of an Economics Lesson*, N.Y. TIMES (June 8, 2017), <https://www.nytimes.com/2017/06/08/business/broadway-theater-ticket-prices.html> [https://perma.cc/WA6C-B3SA]; see also Robert J. McFadden, Note, *The BOTS Act: A Small Step for Fankind When a Giant Leap Is Needed*, 55 WASHBURN L.J. 427, 427–29 (2016). Whether the show or the scalper does it, consumers suffer. Congress has responded to scalping with legislation, but it is not clear why scalpers should be sanctioned but original sellers should not when they engage in the same practice. See McFadden, *supra* at 428–29.

52. See Cross et al., *supra* note 11, at 11–16; see also SUNGJIN CHO ET AL., OPTIMAL DYNAMIC HOTEL PRICING 5–6 (2018).

53. See Stephen L. Shapiro & Joris Drayer, *A New Age of Demand-Based Pricing: An Examination of Dynamic Ticket Pricing and Secondary Market Prices in Major League Baseball*, 26 J. SPORT MGMT. 532, 533–35 (2012).

54. See NOWSHABA AHMED ET AL., APPLICATIONS OF REVENUE MANAGEMENT IN APARTMENT RENTAL INDUSTRY 17–22, 30, available at <https://personal.utdallas.edu/~metin/Or6377/Reports/RMforApartments.pdf> [https://perma.cc/25A9-RVML].

55. See S.K., *supra* note 9.

56. See Eliana Dockterman, *App for Selling Public Parking Spots Suspends Service in San Francisco*, TIME (July 11, 2014), <http://time.com/2974647/monkeyparking-parking-space-app-suspended> [https://perma.cc/J7LM-4LDU].

57. See *id.*

58. See Yingyan Lou et al., *Optimal Dynamic Pricing Strategies for High-Occupancy/Toll Lanes*, 19 TRANSP. RES. PART C 64, 64–65 (2011); Bart Jansen, *'Dynamic Tolls': How Highways Can Charge \$40 for Driving Just 10 Miles*, USA TODAY, <https://www.usatoday.com/story/news/2017/12/>

a congestion plan for downtown Manhattan that allows for dynamic pricing of vehicular access to city streets.⁵⁹

But what all this new technology cannot do is to help a firm adjust the other factor that a firm must change in order to maximize profits in the face of an unexpected shock to demand: the quantity of output that the firm supplies. The information age has not enabled firms to make excess production disappear, or missing production appear much more quickly than it could be made to appear before. A pair of sneakers or an ironing board cannot be conjured into existence much more quickly than it could be in 2000 or 2010. Dynamic pricing therefore does not fully solve the economic problem of imperfection in firms' information about demand. But it does allow firms to mitigate the problem by adjusting prices to maximize profits conditional on fixed, and indeed suboptimal, output levels in the short run. This mismatch between the flexibility of price and the inflexibility of supply in the short run, has important consequences for the antitrust treatment of dynamic pricing.

B. EXPLOITING AN ANTITRUST LOOPHOLE TO HARM CONSUMERS

Dynamic pricing can be good for consumers when firms use it to react to demand that is lower than expected at the original price that the firm planned to charge. The firm might find it profitable to lower prices, for example, to bring more buyers into the market, and lower prices are good for consumers.⁶⁰ Even if the firm uses dynamic pricing to raise prices, the increases may be necessary to help the firm cover fixed costs that can no longer be covered at the original price given reduced demand, an outcome that may keep the product on the market in the long term.⁶¹

But dynamic pricing does not have these benefits when firms use it to react to unexpected increases in demand, the context that is the subject of this Article. Unexpected surges in demand cannot lead to lower prices because if demand exceeds supply at the original price, then demand will surely exceed supply at lower prices, as more consumers enter the market seeking to take advantage of the discount. Thus, all that dynamic pricing can do in response to surges in demand is raise prices.⁶² But unlike in the context of demand that falls below expectations, price increases here are never

07/states-governments-increasingly-turn-tolls-manage-highway-traffic-jams/930900001 [https://perma.cc/7EMN-X9QA] (last updated Dec. 8, 2017, 11:52 AM) ("Forty jurisdictions nationwide have adopted tolls that fluctuate depending on traffic congestion since Southern California adopted the first one in 1995.").

59. See Vincent Barone, *Congestion Pricing Passes, but Without Key Details*, AMNY (Apr. 1, 2019), <https://www.amny.com/transit/mta-congestion-pricing-cuomo-1-29209432> [https://perma.cc/2CMZ-DE5P]. For more on congestion pricing, see Winston Harrington et al., *Overcoming Public Aversion to Congestion Pricing*, 35 TRANSP. RES. PART A 87, 87–89 (2001).

60. See VARIAN, *supra* note 1, at 249–50.

61. See *id.* at 435–37.

62. See *id.* at 412–15.

necessary to cover fixed costs, because the firm will have already chosen the original price to cover costs, including fixed costs, and since demand exceeds supply, the firm could still sell its entire inventory at the original price and cover its costs.⁶³ Any price increase must therefore be in furtherance of above-cost pricing, meaning the extraction of profits, in the economic sense, from consumers.⁶⁴ Thus dynamic pricing, when used to respond to unexpected surges in demand, is always harmful to consumers. As a result of dynamic pricing, some consumers pay higher prices that the firm does not need to charge in order to remain in the market, because the prices are above costs, with costs understood in the economic sense to mean all payments, including dividends to shareholders, necessary to make the firm ready, willing, and able to serve the market.⁶⁵ And other consumers may be priced out of the market, if the firm raises prices high enough.⁶⁶

The fact that the firm is able to alter its prices at all may seem strange to those who continue to treat the perfectly competitive market as a touchstone in thinking about economics. But power over price is common to virtually all firms, because all firms sell products that are differentiated relative to other

63. It is sometimes argued that above-cost prices are required to allow firms to make up for unfortunate periods during which they have failed to cover their costs due to low demand. *See* JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY 77, 88–90 (1994) (“Practically any investment entails, as a necessary complement of entrepreneurial action, certain safeguarding activities such as insuring or hedging. . . . In analyzing such business strategy *ex visu* of a given point of time, the investigating economist or government agent sees price policies that seem to him predatory and restrictions of output that seem to him synonymous with loss of opportunities to produce. He does not see that restrictions of this type are, in the conditions of the perennial gale, incidents, often unavoidable incidents, of a long-run process of expansion which they protect rather than impede.”). But this argument reflects a misunderstanding of the definition of economic cost. *See* WILLIAM J. BAUMOL, ECONOMIC THEORY AND OPERATIONS ANALYSIS 593 (4th ed. 1977) [hereinafter BAUMOL, ECONOMIC THEORY]. That cost includes a risk adjustment, which means that unit cost charged when demand is healthy is bulked up to provide a cushion for times when demand is not healthy. *See id.* To argue that above-cost pricing is always required to provide for lean periods is to argue that it is impossible for a firm to earn profits in the economic sense of revenues in excess of all expenditures required to guarantee production, including the cost of insuring against lean periods. *See id.*; Ramsi A. Woodcock, *The Antitrust Case for Consumer Primacy in Corporate Governance*, 10 U.C. IRVINE L. REV. (forthcoming 2020) (manuscript at 22–30) [hereinafter Woodcock, *Antitrust as Corporate Governance*], available at <https://ssrn.com/abstract=3123985>. And yet it seems obvious that some firms do earn profits—revenues that are simply not necessary to sustain production—even after accounting for risk. *See* RICHARD A. BREALEY ET AL., CORPORATE FINANCE 280–90 (8th ed. 2006). Apple’s \$268 billion cash hoard appears, for example, far more than Apple might ever have needed to sustain a lean period. *See* Apple Inc., Annual Report (Form 10-K) 49 (Sept. 30, 2017), available at <https://www.sec.gov/Archives/edgar/data/320193/000032019317000070/a10-k20179302017.htm> [<https://perma.cc/TP77-NDS3>].

64. *See* VARIAN, *supra* note 1, at 412–15 (“Economic rent is defined as those payments to a factor of production that are in excess of the minimum payment necessary to have that factor supplied.”).

65. *See* BAUMOL, ECONOMIC THEORY, *supra* note 63, at 593.

66. *See* VARIAN, *supra* note 1, at 431–33.

products in the market, if only based upon time and place of sale.⁶⁷ It follows that because some consumers will prefer a particular product's unique characteristics over the characteristics of other products, and be willing to pay more for them, every firm has the power to profitably raise prices, at least by very small amounts.⁶⁸ In this monopolistically-competitive world, competition from similar, but still different, products limits the power of firms to raise prices, but can never eliminate that power entirely.⁶⁹ It follows that all firms charge monopoly prices in the sense of prices they choose to maximize their profits in light of existing demand.⁷⁰ Moreover, unless firms' fixed costs are very high, all firms generate profits, in the sense of revenues in excess of their costs in the economic sense, precisely because they have the power to choose the prices they charge.⁷¹ The firm that underestimates demand would not therefore have sold its products at a perfectly competitive price, a price equal to marginal cost, if the firm had properly predicted demand.⁷² The price and quantity the firm chooses are meant by the firm to be the monopoly price and quantity, not the competitive price and quantity.⁷³ It follows that a firm's use of dynamic pricing to increase prices and profits when the firm's initial price and quantity choices prove mistaken, cannot in itself constitute a problem for the antitrust laws, any more than the quotidian charging of monopoly prices by sellers of differentiated products constitutes a violation of the antitrust laws.⁷⁴

Section 2 of the Sherman Act prohibits monopolization, defined as conduct by a single firm having monopoly power that tends to create or

67. See CHAMBERLIN, *supra* note 18, at 56–57 (“Differentiation may be based upon certain characteristics of the product itself, such as exclusive patented features; trade-marks; trade names; peculiarities of the package or container, if any; or singularity in quality, design, color, or style. It may also exist with respect to the conditions surrounding its sale. In retail trade, to take only one instance, these conditions include such factors as the convenience of the seller's location, the general tone or character of his establishment, his way of doing business, his reputation for fair dealing, courtesy, efficiency, and all the personal links which attach his customers either to himself or to those employed by him.”).

68. See *id.* at 71.

69. See *id.* at 68–70.

70. See *id.* at 71.

71. See *id.*

72. See VARIAN, *supra* note 1, at 386–87.

73. See *id.* at 424–25.

74. See *United States v. E.I. du Pont de Nemours & Co.*, 351 U.S. 377, 392–93 (1956) (“A retail seller may have in one sense a monopoly on certain trade because of location, as an isolated country store or filling station, or because no one else makes a product of just the quality or attractiveness of his product, as for example in cigarettes. Thus one can theorize that we have monopolistic competition in every nonstandardized commodity with each manufacturer having power over the price and production of his own product. However, this power that, let us say, automobile or soft-drink manufacturers have over their trademarked products is not the power that makes an illegal monopoly. Illegal power must be appraised in terms of the competitive market for the product.”). For the antitrust laws, see, *inter alia*, 15 U.S.C. §§ 1–7 (2012).

maintain a monopoly.⁷⁵ But the antitrust laws do not prohibit the monopoly power created by differentiation, and in fact encourage it, so long as firms differentiate their products by improving them, rather than by degrading the products of competitors.⁷⁶ That is because product improvements are innovations, and innovation is widely accepted as the principal driver of economic growth and gains for consumers in the long run.⁷⁷ Antitrust normally addresses monopoly power by ordering an end to the practices that create the power, but antitrust cannot do that in the case of product differentiation without putting an end to innovation, something that would harm consumers.⁷⁸ But that does not mean that the power created by product differentiation, as distinct from the benefits of product improvements, is not harmful to consumers. It is. For while the power created by product differentiation may allow innovators to charge prices that cover fixed costs associated with research and development, there is no reason to suppose that the power always naturally stops there.⁷⁹ Firms often acquire, from innovation, the power to charge prices far in excess of what they need to cover their costs.⁸⁰ Every penny they earn in excess of cost represents a pure

75. 15 U.S.C. § 2; *United States v. Grinnell Corp.*, 384 U.S. 563, 570–71 (1966); *United States v. Aluminum Co. of Am.*, 148 F.2d 416, 429–30 (2d Cir. 1945).

76. See *Aluminum Co. of Am.*, 148 F.2d at 430 (“A single producer may be the survivor out of a group of active competitors, merely by virtue of his superior skill, foresight and industry. In such cases a strong argument can be made that, although, the result may expose the public to the evils of monopoly, the Act does not mean to condemn the resultant of those very forces which it is its prime object to foster: *finis opus coronat*. The successful competitor, having been urged to compete, must not be turned upon when he wins.”); Gregory J. Werden, *Identifying Exclusionary Conduct Under Section 2: The “No Economic Sense” Test*, 73 ANTITRUST L.J. 413, 419 (2006) (“[C]ourts have refused to entertain the notion that merely introducing a new product . . . could violate Section 2.”); see also DANIEL J. GIFFORD & ROBERT T. KUDRLE, *THE ATLANTIC DIVIDE IN ANTITRUST: AN EXAMINATION OF US AND EU COMPETITION POLICY* 28 (2015); HOVENKAMP, *supra* note 25, at 417–18; Richard Schmalensee, *Thoughts on the Chicago Legacy in U.S. Antitrust*, in *HOW THE CHICAGO SCHOOL OVERSHOT THE MARK: THE EFFECT OF CONSERVATIVE ECONOMIC ANALYSIS ON U.S. ANTITRUST* 11, 12–14 (Robert Pitofsky ed., 2008); Woodcock, *The Obsolescence of Advertising in the Information Age*, *supra* note 44, at 2311.

77. See Kenneth J. Arrow, *Workshop on the Economy as an Evolving Complex System: Summary*, in *THE ECONOMY AS AN EVOLVING COMPLEX SYSTEM: THE PROCEEDINGS OF THE EVOLUTIONARY PATHS OF THE GLOBAL ECONOMY WORKSHOP* 275, 281 (Philip W. Anderson et al. eds., 1988) (discussing that innovations “have contributed more to per capita economic growth than any other factor”).

78. See GAVIL ET AL., *supra* note 27, at 1379 (“The most common remedy in civil prosecutions is termination of the unlawful conduct.”).

79. See Ramsi A. Woodcock, *Inconsistency in Antitrust*, 68 U. MIAMI L. REV. 105, 126–36 (2013) [hereinafter Woodcock, *Inconsistency in Antitrust*] (showing that even after taking fixed costs associated with innovation into account it remains possible for a monopolist to charge an above-cost price); cf. David J. Teece & Mary Coleman, *The Meaning of Monopoly: Antitrust Analysis in High-Technology Industries*, 43 ANTITRUST BULL. 801, 820–22 (1998) (distinguishing the profits generated as a result of innovation from monopoly profits).

80. See Teece & Coleman, *supra* note 79, at 820–22 (“There are a number of factors that prevent competitors from appropriating the rents from innovation instantaneously An obvious one is that much of the knowledge at issue may be highly tacit, rendering the

redistribution of wealth from firms to consumers, a payment not necessary to keep the firm in the market.⁸¹

Ideally, antitrust would solve the problem of differentiation's power by enjoining innovators from charging above-cost prices. But the antitrust laws are not meant to be rate regulation by courts, and judges shy away from the debates over how to define costs, and the ongoing supervision, associated with enjoining firms to charge lower prices.⁸² So the antitrust laws have, for lack of an alternative, treated monopoly power derived from product differentiation as exempt, an approach I have called "innovation primacy."⁸³

C. THE CASE FOR PER SE ILLEGALITY UNDER THE ANTITRUST LAWS

While the power that makes dynamic pricing possible comes from product differentiation, making it indistinguishable from the power all firms normally exercise without violating the antitrust laws, there is a remedy uniquely available for dynamic pricing that does not involve putting an end to product differentiation, and all of differentiation's associated benefits: prohibition. Prohibiting dynamic pricing would allow firms to continue to improve and differentiate their products, while preventing firms from raising their prices above costs in response to surges in demand. And, unlike a general prohibition on above-cost pricing, a prohibition on dynamic pricing would not require firms to dabble in the difficult business of ascertaining the costs of firms or setting the prices firms charge. That is because dynamic pricing in response to demand surges is always above-cost pricing.⁸⁴ Banning the practice simply forces firms to continue to charge at-cost prices in response to surges in demand, effectively forcing firms, as will become clear in Part III, to sell out of their inventories instead of exploiting temporary scarcity to extract more profits from consumers. By focusing on and banning the practice of adjusting prices over time periods that are shorter than those required to alter a firm's output, antitrust enforcers can stop a practice that always leads to above-cost pricing without needing to know what a firm's costs actually are and without needing to dictate the prices that the firm must

product/process difficult to imitate. Secondly, the knowledge at issue may not be observable in use, and so reverse engineering is not feasible as an imitation pathway. Furthermore, the process/product in question may enjoy a certain amount of intellectual property protection, rendering imitation more costly, and possibly impossible (in the case of a broad-scope patent), at least for a period of time.").

81. See BAUMOL, *ECONOMIC THEORY*, *supra* note 63, at 593.

82. See HOVENKAMP, *supra* note 25, at 393-94.

83. See Woodcock, *The Obsolescence of Advertising in the Information Age*, *supra* note 44, at 2311. For the argument that courts should respond to this problem by symbolically condemning the charging of above-cost prices and awarding plaintiffs only nominal damages, see Woodcock, *Antitrust as Corporate Governance*, *supra* note 63, at 44-54; and Woodcock, *The Antitrust Duty to Charge Low Prices*, *supra* note 21, at 1744-49.

84. See *supra* Section II.B.

charge.⁸⁵ By contrast, a general prohibition on above-cost pricing by firms selling differentiated products would require courts to do both of those things, which is why the courts generally refuse to regulate prices under the antitrust laws.⁸⁶ Because prohibiting dynamic pricing does not actually involve direct price regulation, the courts' rationale for not intervening in the pricing decisions of firms simply does not exist in the dynamic pricing context.

The administrability of a ban on dynamic pricing gives the courts an opportunity to protect consumers from the harmful side effects of the power created by product differentiation. And antitrust's consumer welfare standard requires that the courts act.⁸⁷ That standard, current since the 1970s, holds that the mission of the antitrust laws is to protect consumer welfare in the economic sense against harms arising from anticompetitive conduct.⁸⁸ Product differentiation is anticompetitive, in the sense that it gives a firm's products characteristics that competing products lack, putting those competing products at a competitive disadvantage.⁸⁹ But product differentiation is only harmful to consumers when the firm uses the power that product differentiation's anticompetitive aspect confers on the firm to raise prices above costs.⁹⁰ Otherwise, differentiation benefits consumers, by giving them improved products that they prefer.⁹¹ It follows that antitrust's consumer welfare standard requires that antitrust laws intervene, whenever possible, to prevent firms from exploiting the power differentiation gives them to raise prices, without preventing firms from engaging in the act of differentiation itself.⁹² Prohibiting dynamic pricing gives the courts an opportunity to use the antitrust laws to do just that.

Antitrust's developing doctrine of less restrictive alternatives, which the courts apply today in reviewing virtually all conduct challenged under the

85. See W. KIP VISCUSI ET AL., *ECONOMICS OF REGULATION AND ANTITRUST* 539–46 (5th ed. 2018) (discussing challenges associated with regulating rates); see also HOVENKAMP, *supra* note 25, at 392–93.

86. See *Verizon Commc'ns Inc. v. Law Offices of Curtis V. Trinko, LLP*, 540 U.S. 398, 406–07 (2004) (expressing disapproval of rules that force “antitrust courts to act as central planners, identifying the proper price, quantity, and other terms of dealing—a role for which they are ill-suited”).

87. See Salop, *supra* note 21, at 336–38; Woodcock, *The Antitrust Duty to Charge Low Prices*, *supra* note 21, at 1755–60.

88. See Salop, *supra* note 21, at 336–38.

89. See Woodcock, *The Obsolescence of Advertising in the Information Age*, *supra* note 44, at 2309.

90. See Woodcock, *Inconsistency in Antitrust*, *supra* note 79, at 126–36.

91. See Neil W. Averitt & Robert H. Lande, *Consumer Choice: The Practical Reason for Both Antitrust and Consumer Protection Law*, 10 LOY. CONSUMER L. REV. 44, 46 (1997) (“The essence of consumer sovereignty is the exercise of choice. By choosing some goods or some options over others, consumers satisfy their own wants and send signals to the economy. It is, therefore, critical that the exercise of consumer choice be protected. . . . [E]ffective consumer choice requires two things: options in the marketplace and the ability to select freely among them.” (emphasis omitted)).

92. Cf. Woodcock, *The Antitrust Duty to Charge Low Prices*, *supra* note 21, at 1755–60.

antitrust laws, shows why the consumer welfare standard demands a prohibition on dynamic pricing.⁹³ According to that doctrine, the courts decide whether to condemn anticompetitive conduct that, like product differentiation, benefits consumers, by asking whether the defendant has chosen to pursue the conduct in a way that minimizes harm to consumers.⁹⁴ If the firm has pursued the conduct in that way, meaning that the firm has pursued the conduct in a way that is less restrictive with respect to the welfare of consumers, then the court will stand aside and impose no liability.⁹⁵ But if instead there is a less restrictive alternative to the conduct actually pursued by the firm, then the court will impose liability.⁹⁶ Exploiting the power created by product differentiation to charge above-cost prices is not a less restrictive way of pursuing production differentiation. That instead would be to differentiate and then charge at-cost prices. So exploiting differentiation to charge above-cost prices violates the less restrictive alternatives standard and should always give rise to antitrust liability.⁹⁷ The courts do not actually condemn above-cost pricing as a general matter in these circumstances only because of the absence of an administrable remedy.⁹⁸ Because banning dynamic pricing is an administrable remedy for the peculiar form of above-cost pricing that is dynamic pricing into a surge in demand, the administrability bar is removed and less restrictive alternatives analysis therefore requires that courts condemn the practice.

Normally, courts would treat dynamic pricing under antitrust's default rule of reason, which would require that every instance of dynamic pricing be

93. See C. Scott Hemphill, *Less Restrictive Alternatives in Antitrust Law*, 116 COLUM. L. REV. 927, 938–39 (2016).

94. See *id.* at 929, 937 (“A . . . tool for handling mixed conduct is to compare the conduct to a hypothesized alternative and ask whether the alternative action is less harmful in the particular sense that it is ‘less restrictive.’ If so, then the defendant loses. Courts and agencies apply less this restrictive alternative . . . test widely, from agreements in restraint of trade to monopolization to mergers.”).

95. See *id.* at 937.

96. See *id.* (“The LRA inquiry fits a common analytical pattern—that the restraint goes too far compared to its justification. The issue is sometimes described as overinclusiveness. More informally, courts speak of swinging a sledgehammer to crack a nut, firing a cannon to shoot a sparrow, or ‘burn[ing] the house to roast the pig.’ The alternative might be superior because it harms fewer consumers or because it harms them all to a lesser degree. Similar moves appear in other legal fields that confront mixed conduct, most famously in constitutional law, which scrutinizes a justification for state action in light of alternative means of achieving the goal.” (alteration in original) (citations omitted)).

97. See *id.*

98. See Woodcock, *The Obsolescence of Advertising in the Information Age*, *supra* note 44, at 2311. The determinative role played by administrability is illustrated by the courts’ prohibition on naked price fixing, a different pricing practice that is also used to exploit power created by product differentiation. See *United States v. Socony-Vacuum Oil Co.*, 310 U.S. 150, 218 (1940); HOVENKAMP, *supra* note 25, at 340–41. The ban on price fixing, like a ban on dynamic pricing, is administrable. Similarities between the two pricing practices are discussed immediately following this footnote.

evaluated independently to determine whether the practice gives rise to consumer harm.⁹⁹ But the unambiguity of the harm created by dynamic pricing should not only deliver dynamic pricing from innovation primacy, the exemption generally allowed for pricing practices associated with product differentiation, but actually place dynamic pricing at the other extreme of the antitrust laws: in the category of practices for which case-by-case analysis under the rule of reason is not required because the conduct is condemned as illegal per se.¹⁰⁰ Under the consumer welfare standard, a practice is illegal per se when it always or almost always harms consumers, a characteristic that most certainly exists in the case of dynamic pricing into surges in demand.¹⁰¹ There is no need for courts to undertake an analysis of the effects of dynamic pricing on consumers in each case in which the practice may be challenged, because basic economic theory establishes that the practice must always harm consumers when applied in response to a surge in demand over a period when supply is fixed.¹⁰² A court need only ascertain that a firm sets prices dynamically, and that the firm experienced an unexpected surge in demand, in order for the court to be absolutely certain that the firm exploited power arising from product differentiation to harm consumers.¹⁰³ That makes dynamic pricing the perfect candidate for per se treatment.

99. See *United States v. Microsoft Corp.*, 253 F.3d 34, 58–60 (D.C. Cir. 2001) (per curiam) (“[T]o be condemned as exclusionary, a monopolist’s act must have an ‘anticompetitive effect.’ That is, it must harm the competitive process and thereby harm consumers. In contrast, harm to one or more competitors will not suffice. ‘The [Sherman Act] directs itself not against conduct which is competitive, even severely so, but against conduct which unfairly tends to destroy competition itself.’” (second alteration in original) (citation omitted)); Muris, *supra* note 30, at 859–61. Under Section 2 of the Sherman Act, this rule of reason approach would also require proof of monopoly power. *Microsoft Corp.*, 253 F.3d at 58–60.

100. See HOVENKAMP, *supra* note 25, at 254–55. The “per se” label is generally only applied to bans of coordinated conduct under Section 1 of the Sherman Act. See 15 U.S.C. § 1 (2012); Werden, *supra* note 76, at 418 n.21. But there is no reason why the per se concept, and the rules underlying its application, cannot be applied to single firm conduct under Section 2. See Werden, *supra* note 76, at 420. Another advantage of per se treatment is that plaintiffs would not need to provide the proof of monopoly power normally required to prevail on a Section 2 claim. See *United States v. Grinnell Corp.*, 384 U.S. 563, 570–71 (1966); *Microsoft Corp.*, 253 F.3d at 50–51.

101. See *Broad. Music, Inc. v. Columbia Broad. Sys., Inc.*, 441 U.S. 1, 19–20 (1979) (stating that per se illegality is appropriate only if a “practice facially appears to be one that would always or almost always tend to restrict competition”); see also *Bus. Elecs. Corp. v. Sharp Elecs. Corp.*, 485 U.S. 717, 723–24 (1988).

102. See *supra* Section II.B.

103. See *supra* Section II.B. Distinguishing dynamic pricing in response to surges in demand from dynamic pricing in response to unexpected shortfalls in demand would be important, because, as discussed in Section II.B, dynamic pricing in response to shortfalls in demand can be good for consumers, enabling firms to raise prices to cover costs or to lower them to attract more business, making both firms and consumers better off. Distinguishing the two kinds of dynamic pricing should not be too hard, because evidence of surge-oriented pricing could be found in dynamic pricing software, or confirmed by the defendant’s software engineers. Attempts by firms to mask the practice by, for example, overproducing on purpose, so that demand would always appear unexpectedly to fall short of supply, would be costly for firms, making such a strategy unlikely.

Indeed, dynamic pricing has many characteristics in common with the archetypical example of per se illegal conduct in antitrust: naked price fixing, the joint setting of prices by competitors unaccompanied by any other joint conduct, such as joint investment in new product development, that might make the joint price setting necessary.¹⁰⁴ Probably the most important similarity is that both are pricing practices, rather than examples of anticompetitive conduct, and so the fact that the antitrust laws condemn price fixing establishes that the antitrust laws can target practices, such as dynamic pricing, that exploit monopoly power, and not just practices that create monopoly power. Naked price fixing has the superficial appearance of anticompetitive conduct because when a firm chooses to fix prices, the firm stops competing based on price. But the ability of any two firms to fix higher prices is actually limited by the extent to which the two firms' products are differentiated from those of competitors in ways that consumers prefer.¹⁰⁵ The better the firms' products are, the higher the prices that the firms can fix.¹⁰⁶ The less differentiated the firms' products, the lower the prices the firms can fix.¹⁰⁷ So the power of any two firms to fix higher prices is actually identical in source to the power of an individual firm to raise prices based on product differentiation.¹⁰⁸ What firms do when they fix prices is not, from this perspective, to create monopoly power, for that is already latent in the differentiation of their products in relation to others, but rather to exploit that power through the methods they use to set their prices, namely the agreement between them to set the same prices.¹⁰⁹ Thus naked price fixing, like dynamic pricing, is a pricing practice aimed at exploiting power generated through other means, and so the ban on price fixing sets an important precedent for a ban on dynamic pricing.

Another similarity between naked price fixing and dynamic pricing is their prohibition does not force the courts to measure costs or set prices, delivering both from the administrability concerns that normally prevent antitrust from regulating firms' pricing practices.¹¹⁰ The courts understand that firms have no incentive to employ price fixing to reduce prices, because lower prices mean lower revenues, and so the courts are confident that if firms fix prices, they must fix higher prices.¹¹¹ To ban the practice, then, the courts

104. See HOVENKAMP, *supra* note 25, at 255–57.

105. See Woodcock, *Inconsistency in Antitrust*, *supra* note 79, at 145 n.103; see also GAVIL ET AL., *supra* note 27, at 803–06 (making an equivalent observation in the merger context).

106. See GAVIL ET AL., *supra* note 27, at 803–06.

107. See *id.*

108. See *id.*

109. See *id.*

110. See *Verizon Commc'ns Inc. v. Law Offices of Curtis V. Trinko, LLP*, 540 U.S. 398, 407–08 (2004).

111. See *United States v. Socony-Vacuum Oil Co.*, 310 U.S. 150, 220–21 (1940).

need only to ascertain that firms have reached an accord on price.¹¹² The courts do not need to know what that price is, what the firm's costs are, or the actual magnitude of the difference between the firms' costs and the price fixed.¹¹³ Similarly, courts can ban dynamic pricing of demand surges without inquiry into the nature of the dynamic prices actually charged, because firms only have an incentive to use dynamic pricing, in response to a demand surge, to raise prices.¹¹⁴

If anything, the logic justifying the ban on price fixing is actually weaker than the logic supporting a ban on dynamic pricing, because market prices can fall below costs, and when that happens firms could conceivably use price fixing to raise prices up to cover costs, rather than to extract profits from consumers.¹¹⁵ In this case of "ruinous competition," price fixing could save firms from bankruptcy and thereby benefit consumers, weakening the argument that price fixing almost always harms consumers.¹¹⁶ It is of course possible that a firm engaged in dynamic pricing might be locked in a similar ruinous struggle with competing firms, but unlike price fixing, dynamic pricing will not help the firm to escape that struggle and cover costs, because the firm will continue to face competition from other firms in the market while the firm is engaged in dynamic pricing, limiting the ability of the firm to use dynamic pricing to increase prices.¹¹⁷ And because dynamic pricing takes place in the context of short-run limitations on supply, a firm's dynamic pricing, though it will permit increases in price relative to the price the firm initially chooses based on the firm's incorrect projections regarding demand, can never generate as much income net of variable costs for the firm as the firm would have earned had it judged demand properly.¹¹⁸ As a result, a firm

112. *See id.*

113. *See id.*

114. *See supra* Section II.A.

115. *See* MICHAEL D. WHINSTON, LECTURES ON ANTITRUST ECONOMICS 16–17, 38 (2008) ("Can this ruinous competition argument be dismissed as being simply illogical and preposterous? Like many proposed justifications for price-fixing arrangements, the answer is in fact no. The railroad industry is one of high fixed costs . . .").

116. *See id.*

117. This follows from the fact that when firms selling differentiated products compete, the effect of competition is to reduce demand for each firm's products as competitors siphon away business from each other. *See* VARIAN, *supra* note 1, at 459–63. It follows that as demand falls due to competition, the ability of a firm to raise prices falls as well. *See id.* In the limiting case in which firms sell identical products, demand curves become flat and the firm becomes unable to raise prices at all. *See id.*

118. This follows from a kind of syllogism associated with the definition of the profit maximizing price and quantity of output. *See id.* at 424–25. A firm selling a differentiated product has power over the prices charged and quantities sold of that particular unique product. *See id.* at 459–63. The firm uses its projections regarding demand to choose price and quantity to maximize the surplus generated by the firm, net of variable costs, a quantity economists sometimes call "quasi-profit," because fixed costs have yet to be deducted from it. *See id.* at 424–25. When the firm discovers its demand projections to be flawed, the firm can only adjust prices dynamically in the short run, but not output, so the firm lacks one of the degrees of freedom

suffering losses due to ruinous competition will never be able to use dynamic pricing to escape ruin. The most that can be said in such a situation is that dynamic pricing would help mitigate losses due to bad projections regarding demand that would compound the losses the firm would have experienced anyway due to the ruinous competition. Thus the case against dynamic pricing lacks one of the principal weaknesses of the case against price fixing.¹¹⁹

The case for banning dynamic pricing is stronger than the case for banning naked price fixing also because dynamic pricing is easier to identify, and therefore to prosecute, than is price fixing. The communications that give rise to the agreement necessary to identify an instance of price fixing can consist in no more than a meaningful look, or a few words of code.¹²⁰ They are fleeting and difficult to record.¹²¹ Dynamic pricing, by contrast, requires the creation and maintenance of an IT infrastructure programmed to adjust prices in response to unexpected surges in demand with a frequency that exceeds the frequency with which supplies of the firm's products may be replenished.¹²² The speed with which a firm can refresh inventory is easily ascertained from a firm's own inventory data. And the rest of the evidence is in the software that adjusts prices in response to new information about demand, and in the software technicians required to tend to that software.¹²³ Put these observables together—inventory refreshment times substantially above zero and a dynamic pricing infrastructure—and the inference of dynamic pricing follows immediately. Where in the case of price fixing it is in some sense necessary to get inside the heads of the officers of different corporations to determine whether they have struck an agreement, it is only necessary, in the case of dynamic pricing, to get inside an algorithm.¹²⁴

necessary to choose the profit-maximizing price and quantity given actual, revealed demand, and so the firm cannot maximize profits with respect to actual demand. Because the firm can use dynamic pricing to charge higher prices, the firm will increase its quasi-profits relative to the quasi-profits the firm expected to generate under its mistaken assumptions about demand. *See supra* Section II.B. But the firm can never do better than it would have done had the firm projected demand correctly. If competition is ruinous, then the firm's quasi-profits, had the firm accurately predicted actual demand and chosen the profit-maximizing price and quantity, would have been insufficient to cover fixed costs, and so *a fortiori* the firm will be unable to use dynamic pricing in the aftermath of an inaccurate prediction of demand to generate sufficient quasi-profits to cover fixed costs.

119. *See* WHINSTON, *supra* note 115, at 16–17, 38.

120. *See* GAVIL ET AL., *supra* note 27, at 312–15 (“Skillful, well-disciplined cartels minimize the creation of incriminating written records and strive to hide their illicit activities from employees within their own firms.”).

121. *See id.*

122. *See supra* Section II.A.

123. *Cf.* Ramsi A. Woodcock, *Personalized Pricing as Monopolization*, 51 CONN. L. REV. 311, 331–32 (2019) [hereinafter Woodcock, *Personalized Pricing as Monopolization*] (arguing that the similar need for an infrastructure to carry out personalized pricing makes that practice relatively easy to observe and condemn as well).

124. *See* EZRACHI & STUCKE, *supra* note 38, at 230–32. *But see* FRANK PASQUALE, *THE BLACK BOX SOCIETY: THE SECRET ALGORITHMS THAT CONTROL MONEY AND INFORMATION* 8–9 (2016).

The ability to observe the dynamic pricing infrastructure itself is helpful, because inferring dynamic pricing from price changes themselves would be difficult. The reason is that dynamic pricing is difficult to distinguish, based on price changes alone, from the conceptually distinct practice of personalized pricing.¹²⁵ Personalized pricing is the tailoring of prices, ideally at the individual or unit level, based on past information about demand, in contrast to the price adjustments based on new information about demand undertaken by dynamic pricing.¹²⁶ Personalized pricing can look like dynamic pricing because in order to charge consumers personalized prices based on past information about consumers' willingness to pay, it is necessary, unless all customers buy at the same time, to change the prices at which products are offered over time based on the identity of the shopper making a purchase.¹²⁷ Thus, personalized pricing requires the constant adjustment of prices overtime, just as dynamic pricing does.¹²⁸ The distinguishing feature of dynamic pricing, that the price changes are based on new information about demand and not old information about the identity of purchasers, cannot be inferred from the rate of change of prices alone. Distinguishing the two practices may not ultimately be important for antitrust, however, because, as I argue elsewhere, personalized pricing too should be understood to violate the antitrust laws.¹²⁹

Dynamic pricing into demand surges undoubtedly redistributes wealth from consumers to firms, but it can also do something else that lends it the patina of efficiency, and calls into question whether banning dynamic pricing would be good for the economy, or required by the antitrust laws: Dynamic pricing facilitates rationing during periods of scarcity. If the alternative to rationing with price, which is to let firms' products sell out on a first-come-first-served basis, is inefficient, then consumers might be better off under dynamic pricing, and condemnation inappropriate.

125. See Woodcock, *Personalized Pricing as Monopolization*, *supra* note 123, at 313–15; see also Ramsi A. Woodcock, *Big Data, Price Discrimination, and Antitrust*, 68 HASTINGS L.J. 1371, 1388–91 (2017) [hereinafter Woodcock, *Big Data, Price Discrimination, and Antitrust*].

126. This is an original attempt to distinguish the two concepts. A looser distinction, one that seems to drive usage of the two terms in the literature, takes dynamic pricing to be the varying of prices over short time periods and personalized pricing to be a subcategory of dynamic pricing in which the variation over time is based on the identity of the consumer. Compare CHO ET AL., *supra* note 52, at 4, with COUNCIL OF ECON. ADVISERS, EXEC. OFFICE OF THE PRESIDENT OF THE U.S., *BIG DATA AND DIFFERENTIAL PRICING* 4 (2015).

127. See Miller, *supra* note 7, at 47; Stole, *supra* note 50, at 72.

128. See *supra* note 127.

129. See Woodcock, *Personalized Pricing as Monopolization*, *supra* note 123, at 318–21. My arguments for banning personalized pricing follow a different path through the antitrust laws than do my arguments for banning dynamic pricing. But because my arguments for banning dynamic pricing are premised on the certainty of consumer harm arising from them and the ease of administering a ban, and personalized pricing also harms consumers with certainty and would be easy to ban, my arguments for banning dynamic pricing support a ban on personalized pricing with equal force. See *id.* at 318–21, 362–69.

III. THE ALLOCATION PROBLEM

A. DYNAMIC PRICING AS RATIONING WITH PRICE

Dynamic pricing's defenders argue that the practice equilibrates supply and demand.¹³⁰ Uber, for example, claims that surge pricing is just market forces at work.¹³¹ When demand increases, argues Uber, prices must rise because the marginal cost of bringing more rides to market rises.¹³² Drivers must be induced to drive into the surge from distant places, or to rouse themselves from bed, and that costs money.¹³³ This story would be true if the price changes executed by dynamic pricing took place on the same timescales over which firms are able to adjust supply.¹³⁴ If Uber drivers in fact were to flood markets shortly after Uber raises prices, then dynamic pricing would represent market forces in action—prices adjusting to levels that ensure that the maximum amount of output for which buyers are willing to pay the cost of production in fact is produced and distributed to buyers.

But, as turns out to be the case for Uber, and really for all firms engaged in dynamic pricing, given the near-instantaneous changes in price that dynamic pricing makes possible, supply does not in fact adjust in response to dynamic pricing.¹³⁵ The rate of change in prices far outstrips the ability of firms to increase supply, and so dynamic pricing does not operate to equilibrate supply and demand.¹³⁶ Indeed, the inability of supply to adjust to the demand surge in the short run is precisely what it means for demand unexpectedly to exceed supply: A truth that is even clearer to recognize in the retail, airline, hospitality, or events industries, for which the time required for supply to increase is measured in weeks or even years, than in the case of Uber, for which supply increases may be a matter of quarters of an hour (though still too slow for dynamic pricing to operate as an equilibrator of supply and demand for rides).¹³⁷ Economists sometimes argue that even if the price increase does not trigger a contemporaneous increase in supply of the firm's

130. See Sorkin, *supra* note 4.

131. See Popper, *supra* note 9; see also Hall et al., *supra* note 45, at 1–4.

132. See Hall et al., *supra* note 45, at 1–4.

133. See *id.*

134. See *id.*

135. See Nicholas Diakopoulos, *How Uber Surge Pricing Really Works*, WASH. POST (Apr. 17, 2015, 11:19 AM), <https://www.washingtonpost.com/news/wonk/wp/2015/04/17/how-uber-surge-pricing-really-works> [<https://perma.cc/7BH9-Z2LJ>]; see also LE CHEN ET AL., PEEKING BENEATH THE HOOD OF UBER 495, 505–06 (2015) (finding that contrary to Uber's claim that surge pricing increases the number of drivers by 70 to 80 percent, surge pricing increases the number of new drivers by only 3.7 percent on average, and appears to cause current drivers to leave the surge area); Nagaraj, *supra* note 47.

136. See Kaye, *supra* note 10; Kristof, *supra* note 47; Nagaraj, *supra* note 47; Snyder, *supra* note 47; Wallop, *supra* note 9.

137. For these other industries, see *supra* Section II.A. For the time required for a driver to respond to an Uber surge, see Hall et al., *supra* note 45, at 2–3.

own products, the price increase does signal to competitors, who may have inventories of similar products in storage, that they can turn a profit by quickly bringing their products to market, effectively increasing supply to meet the higher demand.¹³⁸ But it is not at all clear why such supply would not be unlocked anyway without dynamic pricing by the signal created when the firm sells out of its inventory at the original low price. Both higher prices and sold out signs speak of profit opportunities for competitors in possession of supply. And so it cannot be said that dynamic pricing has any more of an equilibrating function than its alternative. Dynamic pricing is a matter of something quite different from the equilibration of supply and demand.

Instead, dynamic pricing rations.¹³⁹ Unless the surge in demand is very large, dynamic pricing uses price increases to determine who, out of the surging group of consumers who are willing to pay the initial price the firm wanted to charge for its inventory, and who are therefore willing to pay at least the cost of production, will ultimately gain access to the firm's limited inventories in the short term.¹⁴⁰ The firm raises price until the quantity demanded just equals the firm's available inventory, effectively rationing access to the inventory to the group of consumers who are willing to pay the most for it.¹⁴¹ That is not the same thing as equilibrating supply and demand, which would require the firm to do the impossible, under conditions of fixed supply, and choose a price that ensures that the entire surging group of consumers, who are willing to pay the cost of producing the firm's products, are able to purchase them.¹⁴² Dynamic pricing is not productive, but rather purely allocative here. Firms do not, of course, impose dynamic pricing out of a civic desire to allocate scarce resources in an orderly manner, but rather out of a desire to profit: Ration pricing also happens to be profit maximizing, as discussed in Part II.¹⁴³

138. See VARIAN, *supra* note 1, at 289–90.

139. For an overview of rationing in economics, see WILLIAM J. BAUMOL, SUPERFAIRNESS: APPLICATIONS AND THEORY 75–95 (1986) [hereinafter BAUMOL, SUPERFAIRNESS].

140. If the surge in demand is extreme, then the profit-maximizing price that the firm charges might be so high that the firm does not sell out of its inventory. Instead, the firm holds some of its inventory back in order to keep the price of the other units the firm sells as high as possible. That represents an artificial restriction on output that lacks any efficiency justification. Dynamic pricing that enables a firm to magnify the scarcity associated with an unexpected surge in demand by holding back available supply harms consumers, both those who pay the higher prices and those who are priced out of the market and must violate the antitrust laws for the reasons outlined in Part II. Accordingly, this easy case will not be considered further here.

141. See *id.* at 2–3; VARIAN, *supra* note 1, at 15–16.

142. See VARIAN, *supra* note 1, at 289–90.

143. See *supra* Section II.B.

B. THE WEAKNESS OF THE CASE FOR RATIONING WITH PRICE

1. Willingness to Pay vs. Place in Line as Proxies for Desire

But ration pricing could also be efficient, in the sense that the alternative of not raising prices and just allowing the good to sell out on the basis of first-come-first-served might actually so harm consumers, relative to dynamic pricing, as to make consumers worse off in a world in which the antitrust laws were to prohibit dynamic pricing, even after taking into account the lower prices consumers would pay without it. The heart of this line of defense, and a source of great intuition for economists, is the notion that allocating scarce resources to those who are willing to pay the most for them allocates resources to those who actually place the highest value on them.¹⁴⁴ If that is the case, then any alternative that might allocate resources to those who are not willing to pay the most for them, as the alternative of queue rationing would likely do, may ultimately be harmful to consumers as a group.¹⁴⁵ Banning dynamic pricing would amount to taking scarce resources from those who derive the greatest pleasure from them, and giving the resource to others who enjoy them less.¹⁴⁶ Now, the fact that under a ban prices would be lower might compensate for the loss of enjoyment caused by the misallocation. The surplus enjoyed by any consumer depends not only on the value the consumer places on goods, but also on the prices the consumer must pay for them, so the surplus generated by giving a good to a consumer who enjoys it less might not fall if the price the consumer pays for the good falls by even more.¹⁴⁷ But if queue rationing misallocates, the effect of dynamic pricing on consumer welfare is no longer unambiguously harmful, and the case for banning the practice disappears.¹⁴⁸

The intuition that ration pricing allocates resources better than does queuing serves as the foundation for *laissez faire* in a vast number of industries characterized by fixed supply, and not only those in which ration pricing is carried out dynamically. Consider finance. Windfall gains associated with speculation in securities or commodities are an example of ration pricing. The short-run supply of a particular security or commodity is fixed over the near-instantaneous periods of time during which speculators trade, and rather than sell out of the asset at cost, including a reasonable return on investment, the speculator insists instead on using higher prices to ration access to the asset.¹⁴⁹ The justification for permitting speculators to extract

144. See VARIAN, *supra* note 1, at 15–17.

145. See *id.*

146. See *id.*

147. See *id.* at 249–50.

148. For the importance of the unambiguity of the harm of dynamic pricing into demand surges to the antitrust case for banning dynamic pricing, see *supra* Section II.C.

149. See Eric Budish et al., *The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response*, 130 Q.J. ECON. 1547, 1548–49 (2015).

such profits is that in doing so speculators allocate the asset to the party that places the greatest value on it.¹⁵⁰ The logic of ration pricing similarly suggests that the owner of valuable real estate who insists on selling only to the highest bidder is making a social contribution, by ensuring that the property is allocated to the buyer who places the highest value upon it.¹⁵¹ From this perspective, arbitrageurs, too, appear to have the same virtuous function when they buy low and then sell high during a national catastrophe. Their behavior, which looks like hoarding and price gouging to some, is actually efficient, according to this view, because the behavior ensures that goods in scarce supply are sold to the highest bidder, and the highest bidder must be the person who places the highest value on the good.¹⁵² Otherwise, why would the highest bidder be willing to pay so much for the good?

The trouble with this logic is of course that a consumer's willingness to pay is not a perfect measure of the value the consumer places on a good. Happiness cannot yet be measured, and so all methods of allocating scarce resources, including rationing with price, must employ a proxy.¹⁵³ The argument in favor of rationing with price as the best method of allocating scarce resources therefore turns on the question whether willingness to pay is a better proxy for happiness than the proxy used by queuing, which is willingness to get on line first.¹⁵⁴ And the answer to that question is by no means obvious. Willingness to pay is of course a function not just of desire,

150. According to defenders of speculation, this causes asset prices to accurately reflect the true value of financial assets, because when speculators ration with price, they drive the price of the asset up to the maximum price that the market is willing to pay for the asset, which must, according to the view that willingness to pay is a proxy for value, be the maximum value that society places on the asset. See John F. Barry III, *The Economics of Outside Information and Rule 10b-5*, 129 U. PA. L. REV. 1307, 1316–19 (1981) (“Under these conditions, securities prices should continuously reflect all available information, leading to greater accuracy in the pricing of individual securities and to a more efficient allocation of resources. When stocks and their prospects for success or failure are evaluated by a process that reflects all available information, investors can more rationally compare competing companies.”).

It is not, however, clear why having prices accurately reflect the true value placed on an asset by the market is a good thing. In order for production to take place, and for assets to be brought to market, in an efficient manner, it is necessary only that the prices of assets be high enough to cover their production costs, not that they equal the maximum value that buyers place upon them. See BAUMOL, *ECONOMIC THEORY*, *supra* note 63, at 593. Assuming, that is, that non-price alternatives to rationing access to assets for which demand exceeds supply do as good a job as ration pricing at allocating the assets among those who are willing to pay the cost of production. This assumption is considered in detail in the passages immediately following this footnote.

151. See VARIAN, *supra* note 1, at 15–17.

152. See J.D. Tuccille, *Price-Gouging Laws Will Do More Harm Than Good During the Coronavirus Pandemic*, REASON (Mar. 16, 2020, 8:45 AM), <https://reason.com/2020/03/16/price-gouging-laws-will-do-more-harm-than-good-during-the-coronavirus-pandemic> [<https://perma.cc/S99C-5BR7>].

153. See EUGENE SILBERBERG, *THE STRUCTURE OF ECONOMICS: A MATHEMATICAL ANALYSIS* 4–6 (2d ed. 1990).

154. See Barzel, *supra* note 5, at 73.

but also of wealth.¹⁵⁵ As between a rich and a poor consumer who derive the same utility from a good, the rich consumer will be willing to pay more for it, because the rich consumer's wealth ensures that the rich consumer must give up fewer of the other things that the rich consumer cherishes in order to pay a higher price for the good.¹⁵⁶ Spending more, for the rich consumer, means perhaps a slight reduction in the inheritance the consumer can pass on to children, whereas for the poor consumer, spending more might mean less food to eat tomorrow.¹⁵⁷

By contrast, the proxy employed by queue rationing, place in line, has no more obvious flaws than does willingness to pay. Place in line proxies for value to the extent that consumers who place the highest value on a good will line up first for it.¹⁵⁸ This proxy, like willingness to pay, is imperfect. A wealthier consumer, or an older consumer, might have an advantage in the race to queue, because the wealthy and the old often have more leisure time than others.¹⁵⁹ If the queue is physical, those who happen to live closer to the queue may have an advantage, whereas if the queue is an online ordering system, then those with faster computers have an advantage.¹⁶⁰ But it is by no means obvious that these defects in place in line as a proxy for value are more serious than the defects associated with willingness to pay. The most that can be said is that they differ.

In terrorem arguments regarding queuing in the Soviet Union misunderstand the nature of the queuing alternative to ration pricing.¹⁶¹ The alternative to ration pricing is not to have no prices at all, or to impose below-cost prices, and then to allocate goods to those who get on line for them first,

155. See SILBERBERG, *supra* note 153, at 396-402; VARIAN, *supra* note 1, at 141-42; see also BAUMOL, *ECONOMIC THEORY*, *supra* note 63, at 498-500.

156. See BAUMOL, *ECONOMIC THEORY*, *supra* note 63, at 501.

157. See *id.* at 190-91. This might not be a problem if wealth and poverty were to serve as incentive mechanisms, rewarding those who contribute the most to society and punishing the lazy and untalented, sacrificing short-run consumer welfare in order to reward productivity that benefits consumers in the long run. Giving access to scarce resources to those who work the hardest, or who contribute the most to society, as measured by their wealth, rather than to those who value the goods the most, might create incentives to productive labor that make everyone better off in the long run. But few believe today that the prevailing distribution of wealth reflects such a mechanism. See Jonathan B. Baker & Steven C. Salop, *Antitrust, Competition Policy, and Inequality*, 104 GEO. L.J. ONLINE 1, 2-5 (2015).

158. See Barzel, *supra* note 5, at 73.

159. See *id.* (discussing the advantage of the poor in waiting on lines because the poor have a lower "time-cost").

160. See Budish et al., *supra* note 149, at 1548-49.

161. See KORNAI, *supra* note 3, at 228-45 ("Unless lucky, [the shopping of a woman in a socialist system] is not a single action but a process, a sequence of decisions . . . [E]vent 1, beef is available, but customers must queue for it. This is a familiar occurrence; under classical socialism customers very often have to queue. For some goods there is an actual, 'physical' queue at the counter or outside the store . . . [T]he good she seeks may not be available at all, either immediately or after queuing. In that case she must choose from a further set of alternatives.")

as occurred in the Soviet Union.¹⁶² The alternative to ration pricing discussed here is for the firm to charge a price equal to the firm's cost of production in the economic sense, inclusive of a reasonable return on investment, and only then to allow the good to sell out. In the context of dynamic pricing into surges of demand, the queuing alternative is for the firm to continue to charge the original price and allow the good to sell out on the basis of first-come-first-served, instead of using dynamic pricing to ration access to the good.¹⁶³ Because buyers still must pay the costs of production, consumer willingness to pay continues to determine which goods are produced and which are not. If the willingness of consumers to pay the costs of production of a particular good ceases, then the firm will stop producing that good. Queuing, as understood here, therefore does not undermine the ability of the price system to dictate the long-run production decisions of firms.¹⁶⁴ Queuing here serves only to determine how goods for which consumers are willing to pay the costs of production are allocated among only those consumers who are in fact willing to pay those costs, when fixity of supply makes it impossible to distribute the good to the entire group.

2. Queues as Markets and Markets as Queues

Unable to show that willingness to pay is necessarily a better proxy for value, economists sometimes fall back on the argument that queuing always devolves into ration pricing anyway, because consumers will use money to undermine any queuing system.¹⁶⁵ According to this view, consumers who are willing to pay the most for a good will hire others to wait on line, or buy the

162. *See id.*

163. *See supra* Section II.C.

164. *See* KORNAL, *supra* note 3, at 228–45.

165. *See* Robert T. Deacon & Jon Sonstelie, *The Welfare Costs of Rationing by Waiting*, 27 ECON. INQUIRY 179, 179–80 (1989) (“[U]nless the first come/first served rule is precisely specified, consumers will compete for available supplies in ways other than waiting.”). Greg Mankiw put it thus:

High prices are a natural reflection of great demand and scant supply. In a free market, in which private individuals can engage in mutually advantageous gains from trade, they are inevitable until demand subsides or supply expands.

The comedian Jay Leno learned this lesson some years ago. In 2009, while the economy was suffering through the Great Recession, Mr. Leno, a car enthusiast, generously performed two free “Comedy Stimulus” shows for unemployed workers near Detroit.

Yet zero is not, as economists put it, the equilibrium price to see a live performance by Jay Leno. Some of the unemployed who received free tickets tried to turn around and sell them on eBay for about \$800. When Mr. Leno learned about this, he objected, and eBay agreed to take down offers to resell the tickets.

N. Gregory Mankiw, *I Paid \$2,500 for a ‘Hamilton’ Ticket. I’m Happy About It.*, N.Y. TIMES (Oct. 21, 2016), <https://www.nytimes.com/2016/10/23/upshot/i-paid-2500-for-a-hamilton-ticket-im-happy-about-it.html> [https://perma.cc/K7RC-PAAK].

fastest computers to win the race to be first to place online orders.¹⁶⁶ Consumers competing to undermine the queue will spend until the effective price they pay for the good, taking into account expenditures on undermining the queue, equals the price that would be used to ration based on willingness to pay. Only a group with a demand equal to supply will be able to afford that level of expenditure, because the ration price is precisely the price that equilibrates supply and demand, and that group will presumably, thanks to its expenditures, be at the head of the line. Indeed, only the same consumers who would purchase the good at a ration price will be able to afford to be the first on line to obtain the good through queuing, so the outcome of queuing turns out to be identical to the outcome of ration pricing, with one important exception. Unlike in the case of ration pricing, in which the profits generated by the high price are not wasted but only transferred from consumers to firms, the equivalent expenditure on undermining the queue is wasted.¹⁶⁷ The person hired to wait on line could have been put to work moving goods, or doing some other useful thing, and those supercomputers could have been put to work curing cancer. It follows, according to this objection, that direct ration pricing is better.

The defect in this way of thinking is that all rationing systems may become the target of wasteful attempts to undermine the system, including a rationing system based on price. Wealth may well help some get there first, but getting there first is very often also the key to amassing great wealth.¹⁶⁸ It is not the first person to invent, but the first person to file a patent application who gets the wealth that can come with patent ownership, for example, and so it may be said that it is the queuers, the early birds, who are forever undermining the price system, amassing the wealth that allows them to out-bid others and effectively transform all price rationing schemes into queuing schemes.¹⁶⁹ Sometimes this queuing-for-wealth is socially useful, as when an early patent filing hastens a product to market, but queuing-for-wealth sometimes may be wasteful.¹⁷⁰ The additional resources expended in the quest to be first-to-file,

166. See VISCUSI ET AL., *supra* note 85, at 684–87.

167. See *id.*

168. See F.M. Scherer, *First Mover Advantages and Optimal Patent Protection*, 40 J. TECH. TRANSFER 559, 561 (2015) (“[T]he first to market a new product often engrains in the minds of consumers an ‘image’ of superiority—that is, a product differentiation advantage—allowing it to retain a substantial market share while charging prices appreciably higher than those realizable by latecomers.”); see also F.M. SCHERER & DAVID ROSS, *INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE* 626–30 (3d ed. 1990) (“[B]eing first to bring a new product onto the market, with or without patent protection, often confers a substantial reputational advantage over imitators, permitting the innovator to maintain elevated prices while defending a sizeable market share.”).

169. See Mark J. Patterson & M. Andrew Pitchford, *First to File*, TENN. B.J., Nov. 2011, at 14–15.

170. See Richard A. Posner, *The Social Costs of Monopoly and Regulation*, 83 J. POL. ECON. 807, 809–12 (1975) (arguing that the most significant form of waste caused by monopoly arises from attempts by firms to achieve and defend monopolies). Posner explains that:

for example, may have no effect on time-to-market, if another inventor would have filed only a few hours or days later.¹⁷¹ Those additional resources are wasted.

More generally, all expenditures on obtaining first-mover advantages that are not strictly necessary to create an incentive to productive behavior are wasteful attempts to gain an advantage in price rationing.¹⁷² People strive to be the first to market in order to get rich, and thereby to obtain priority of access to goods in fixed supply. It is not immediately clear that the waste in resources arising from the struggle to queue for wealth is greater than the waste would be from the struggle of the wealthy to buy their way onto lines. Of course, the law may be used to reduce wasteful queuing-for-wealth by, for example, altering the patent system to ensure that the first person to invent, rather than to file, gets the patent.¹⁷³ But the law may also be used to restrict the power of wealth to undermine queuing. Banning the hiring of others to stand on line, or the use of fast computers for virtual lines, limits the power of wealth over queues.¹⁷⁴

C. THE LOW COST OF QUEUING IN THE INFORMATION AGE

Before the information age, ration pricing still had one important virtue, relative to queuing, despite the absence of any reason to suppose that ration pricing is the best way to allocate resources to those who value them the most. That virtue was a low cost of implementation.¹⁷⁵ Subject to the important caveat that information on precisely what price clears the market is available, rationing with price is inexpensive to implement because merely posting the price is sufficient to induce consumers to sort themselves based on willingness to pay.¹⁷⁶ By posting a price that is high enough that the number of consumers willing to pay the price just equals available supply of the good, the seller can

Obtaining a monopoly is itself a competitive activity, so that, at the margin, the cost of obtaining a monopoly is exactly equal to the expected profit of being a monopolist. An important corollary of this assumption is that there are no inframarginal monopolies—no cases, that is, where the expected profits of monopoly exceed the total supply price of the inputs used to obtain the monopoly. If there were such an excess, competition in the activity of obtaining the monopoly would induce the competing firms (or new entrants) to hire additional inputs in an effort to engross the additional monopoly profits.

Id. at 809.

171. See Brad Pedersen & Vadim Braginsky, *The Rush to a First-to-File Patent System in the United States: Is a Globally Standardized Patent Reward System Really Beneficial to Patent Quality and Administrative Efficiency?*, 7 MINN. J.L. SCI. & TECH. 757, 765–66 (2006).

172. See Posner, *supra* note 170, at 809–12.

173. See Pedersen & Braginsky, *supra* note 171, at 766–69.

174. See McFadden, *supra* note 51, at 428–29.

175. See VISCUSI ET AL., *supra* note 85, at 684–87; Barzel, *supra* note 5, at 73; Deacon & Sonstelie, *supra* note 165, at 179.

176. See VARIAN, *supra* note 1, at 7.

be sure to distribute the good only to those consumers who are willing to pay the most for it, because only those consumers will show up to buy the good at that price.¹⁷⁷ By contrast, before the internet, queuing could take time.¹⁷⁸ Buying a child a popular toy for the holidays, for example, meant waiting on line before the store opened in the morning, not logging in to Amazon to place a pre-order. Reservations systems, which reduce the cost of queuing by allowing consumers to save a spot on line, were imperfect and burdensome on firms. Taking a number, as at the Department of Motor Vehicles, could save consumers the trouble of actually queuing up, but still required that consumers remain on premises. Phone-based reservations systems required staffing and paper record keeping.

The irony of the information age is that at the same time that information has finally made it possible for firms to use dynamic pricing to avoid the costs of queuing when demand surges, the information age has also all but eliminated the cost of administering queues, eliminating the advantages of dynamic pricing.¹⁷⁹ In the information age, the costs of queuing have been driven very near zero, and will continue to fall as the internet completes its colonization of the brick-and-mortar world, because the time it takes to wait on line *online* for a good in short supply at an online retailer is very near zero.¹⁸⁰ Some will log in and obtain the good, while others will fail to obtain the good, but no time will be wasted waiting for a result. Online ordering is, in other words, low-cost queuing. The consumer logs in, and finds any desired good either available or sold out. As soon as the line is entered, it is done. True, some will face a “sold out” notice, but that is not inefficiency. Those turned away by a high price under ration pricing face a “sold out” sign as well, in the form of the high price those consumers cannot pay.¹⁸¹ From the perspective of cost, the two approaches are now nearly identical.¹⁸²

177. See *id.*

178. See Barzel, *supra* note 5, at 73; Robert T. Deacon & Jon Sonstelie, *Rationing by Waiting and the Value of Time: Results from a Natural Experiment*, 93 J. POL. ECON. 627, 627–28 (1985); Deacon & Sonstelie, *supra* note 165, at 180; see also Cotton M. Lindsay & Bernard Feigenbaum, *Rationing by Waiting Lists*, 74 AM. ECON. REV. 404, 404 (1984).

179. For another irony of the information age, see Woodcock, *The Obsolescence of Advertising in the Information Age*, *supra* note 44, at 2274.

180. See Wingfield et al., *supra* note 42.

181. See VARIAN, *supra* note 1, at 7.

182. Southwest Airlines’ boarding system presents an example of how the information age can eliminate the cost of queuing. See *Boarding the Plane*, SOUTHWEST, https://www.southwest.com/html/generated/help/faqs/boarding_the_plane_faq.html [<https://perma.cc/DCK9-Z6S5>]; see also David C. Nyquist & Kathleen L. McFadden, *A Study of the Airline Boarding Problem*, 14 J. AIR TRANSPORT MGMT. 197, 198 tbl.1 (2008). Rather than sell tickets by seat number, Southwest gives customers a place on the boarding line determined by check-in time. See *Boarding the Plane*, *supra*. The first customer on line can choose to sit in any seat. See *id.* Before the advent of online check-in, this practice would have encouraged customers to waste time on early airport arrivals intended to ensure a favorable boarding position. With the advent of online check-in, this waste has been much reduced, because customers seeking to board early need only

The information age has also greatly reduced the cost of administering reservations systems. Restaurants now take reservations online, freeing up staff for other jobs.¹⁸³ And consumers can preorder products on Amazon, allowing consumers to avoid the trouble of having to log in repeatedly to determine whether a product has become available.¹⁸⁴ The frustrations experienced by some Americans ordering groceries online during the coronavirus pandemic are not to the contrary.¹⁸⁵ The fact that many shoppers were forced to log in repeatedly to obtain delivery times arose from the failure of online grocers, who did not expect a surge in demand, to implement preordering systems.¹⁸⁶ Had grocers put preordering systems in place, consumers could have logged in once and joined a queue that would empty as additional delivery times were added.¹⁸⁷ The fact that even with preordering some consumers would have had to wait to obtain delivery slots does not reflect an inefficiency of queuing, but rather the lack of current supply of delivery services. Even if grocers had dynamically priced delivery services as a means of rationing access, buyers would have had to wait for the slots actually to become available.¹⁸⁸

take a moment to reserve a spot when online check-in opens 24 hours in advance of the flight. Indeed, the online seat reservation methods used by other airlines are an even more efficient form of online queuing. See Nyquist & McFadden, *supra*, at 198 tbl.1. The first consumer to book a seat gets that seat, eliminating entirely the need to wait on line at the gate. See *id.* (Of course, price plays a role in seat rationing for these airlines, because unlike Southwest, these airlines charge based on seat location, with first class seats in the front of the plane selling for higher prices). The fact that customers tend to line up at the gate anyway in advance of boarding reserved-seat flights, despite no obvious need to do so, shows that irrational human behavior should play an important role in any analysis of the efficiency of a rationing system. Taking that behavior into account, a reservation system may not have an efficiency advantage after all. Indeed, Southwest's approach may have an additional efficiency advantage. Southwest's requirement that all fliers commence check-in no earlier than 24 hours before the flight may have an efficiency benefit relative to reserved seating in that it tends to ensure that those who want an early boarding position the most get that position. Reserved seating amounts to a queue as well, but some people may end up at the beginning of the queue because they wanted to purchase their tickets early for reasons unrelated to the value that they place on seat location. Under Southwest's system, only those who expressly seek an early boarding position are likely to log in at precisely the 24-hour mark in order to claim a high position.

183. See Kimes, *supra* note 11, at 190.

184. See Suresh Kotha & Sandip Basu, *Amazon and eBay: Online Retailers as Market Makers*, in THE MARKET MAKERS: HOW RETAILERS ARE RESHAPING THE GLOBAL ECONOMY 155, 165 (Gary G. Hamilton et al. eds., 2011).

185. See Nicole Lee, *Online Grocery Deliveries Are Facing an Unprecedented Stress Test*, ENGADGET (Mar. 30, 2020), <https://www.engadget.com/2020-03-30-coronavirus-online-grocery-delivery.html> [<https://perma.cc/JP4W-JCWP>].

186. See *id.*

187. See *id.*

188. Information age queuing efficiencies are also evident in the purchase of event tickets, with wasteful box office lines replaced by online ticket sales. See Irwin, *supra* note 11. Although online ticket sales do lead to wasteful efforts to undermine the queue, through expenditures on software designed to purchase within milliseconds of tickets going on sale, those costs are not due to the queuing process itself, which requires only the time to log in and attempt a purchase, but rather to efforts to undermine the queue, which, as described in Section III.B.2, beset ration

Today, ration pricing may well be more expensive to administer than queuing, because ration pricing requires investment in the acquisition of a piece of information that queuing does not require: the particular price that only a group of consumers sufficiently small to be satisfied by existing supply are willing to pay.¹⁸⁹ To use willingness to pay as a proxy for value, it is necessary to know enough about the distribution of willingness to pay among consumers to pick the cutoff price that separates the wealthy few who should take from those who should not. Queuing does not have this information requirement. With queuing, the seller simply sells until supply runs out.¹⁹⁰ The problem of acquiring new information about demand with which to recalibrate price, which is the heart of dynamic pricing, is eliminated. The price-rationer can try to minimize information costs by starting to sell at a very high price, and then lowering price bit by bit until all inventory has sold, but unless those increments are very small, and all potential buyers are ready to purchase at the same time, the possibility remains that the owner may overshoot, reducing price by too far, leading to an excess of demand that must be resolved in the end by queuing. Thus the additional information requirement for ration pricing in fact causes ration pricing to shade into the simpler queuing system.¹⁹¹ The information age has, of course, reduced the information cost of ration pricing, but it has not yet sent that cost to zero.¹⁹²

Instantaneous queuing is just the first of many consumer-friendly alternatives to ration pricing that the information age is likely to create, because information does not only make it easier to identify and charge a ration price. It also makes it easier directly to identify desire and route supply to satisfy it. Consider, for example, the downtown parking problem that a San Francisco startup tried to solve by occupying parking spots and then selling them at ration prices. Studies show that perhaps 30 percent of downtown driving involves searching for parking spaces.¹⁹³ That is the cost of queuing, and ration pricing would no doubt have reduced that cost, but at the expense of consumers.¹⁹⁴ The information age will, however, soon make it possible to

pricing as well as queuing. See McFadden, *supra* note 51, at 428–29; Ben Sisario, *Congress Moves to Curb Ticket Scalping, Banning Bots Used Online*, N.Y. TIMES (Dec. 8, 2016), <https://www.nytimes.com/2016/12/08/business/media/ticket-scalping-bots-act.html> [https://perma.cc/7ESH-B7RN].

189. See KIMBROUGH, *supra* note 2, at 193–98.

190. See Barzel, *supra* note 5, at 73–74; Lindsay & Feigenbaum, *supra* note 178, at 404–06.

191. See Lindsay & Feigenbaum, *supra* note 178, at 405–06; see also KIMBROUGH, *supra* note 2, at 193–98.

192. See Lynn DeLain & Edward O'Meara, *Building a Business Case for Revenue Management*, 2 J. REVENUE & PRICING MGMT. 368, 370 (2004) (discussing the costs of implementing a “revenue management” system).

193. See Paul Barter, *Is 30% of Traffic Actually Searching for Parking?*, REINVENTING PARKING (Oct. 7, 2013), <https://www.reinventingparking.org/2013/10/is-30-of-traffic-actually-searching-for.html> [https://perma.cc/43VL-26YS].

194. See *supra* Section II.C.

eliminate the cost of queuing for parking without embracing ration pricing. Networked parking meters will guide drivers to available spaces, eliminating the need for wasteful circling of downtown blocks, and perhaps also prioritize drivers with special needs.¹⁹⁵ Just as Google Maps has reduced congestion by routing drivers through unused roads, cities may turn to driving software dynamically to allocate access to downtown streets to drivers on the most important business, in lieu of using price to ration access through congestion pricing schemes.¹⁹⁶ With each new allocative innovation, the argument for the efficiency of ration pricing will weaken even further, and the argument for the prohibition of dynamic pricing in response to surges in demand will strengthen.

IV. BEYOND DYNAMIC PRICING

The heart of the theory of harm in the case against dynamic pricing is the observation that ration pricing represents pure redistribution of wealth from consumers to firms.¹⁹⁷ But dynamic pricing in response to an unexpected surge in demand is not the only way in which firms might come to engage in ration pricing. Firms can ration price as well, with or without the aid of new technology, when firms know in advance that demand will exceed supply.¹⁹⁸ In situations such as these, which are common in markets for unique pieces of real estate, access to congested highways or roads, and space on high-demand flights, in high-demand hotels, or at high-demand events, the firm faces the problem whether to ration with prices or queues from the very beginning when the firm sets its initial prices, rather than later on when the firm discovers that demand exceeds supply.¹⁹⁹ The response that the analysis in this Article suggests that the law should give to all examples of ration pricing, and not just those undertaken through dynamic pricing of

195. See Trista Lin et al., *A Survey of Smart Parking Solutions*, 18 IEEE TRANSACTIONS ON INTELLIGENT TRANSP. SYS. 3229, 3229 (2017).

196. See Ramsi Woodcock, *Congestion Pricing Is Class Warfare. Here's a Better Idea*, OZY (Mar. 31, 2019), <http://www.ozy.com/immodest-proposal/congestion-pricing-is-class-warfare-heres-a-better-idea/93503> [<https://perma.cc/DVA4-EUVN>].

197. See *supra* Section II.C. Part of the case against dynamic pricing also involves plain old monopoly pricing. See *supra* note 140. The arguments that follow *infra* apply to both parts.

198. See VARIAN, *supra* note 1, at 410–14.

199. See *id.*

unexpected increases in demand, is: “no.”²⁰⁰ For the timing of the firm’s decision to ration price does not reduce the harm to consumers.²⁰¹

What prevents the antitrust laws from addressing ration pricing outside of the context of dynamic pricing, however, is the problem of judicial price setting, highlighting the uniqueness of the opportunity presented by dynamic pricing for antitrust action in this area.²⁰² Antitrust cannot intervene when firms ration price based upon *expected* surges in demand, even when firms employ the same kinds of data and algorithms that firms use to engage in dynamic pricing of unexpected surges in demand, because antitrust has no way of knowing whether firms that engage in ration pricing based upon expected surges in demand need their ration prices to cover costs.²⁰³ The situation is different in the case of dynamic pricing in response to unexpected increases in demand, because in that context courts can reasonably assume that the lower price the firm initially sets, before the firm encounters the unexpected increase in demand, is calculated at least to cover costs.²⁰⁴ That baseline does not exist when firms know in advance that demand will exceed supply and factor the excess demand into their prices from the beginning. But while antitrust, with its lack of expertise in price setting, cannot reach ration pricing in these contexts, rate regulation can.²⁰⁵ Indeed, rate regulation was conceived with little else in mind.²⁰⁶

There is good reason for Congress to consider creating a general rate regulator to attack this conduct, because in recent years an ardor for ration

200. See *supra* Section II.B. The implications of the analysis in this Article for real estate are particularly interesting. The sale of real estate, the supply of which is of course perpetually fixed, and the demand for which in urban areas always exceeds supply, to the highest bidder is perhaps the oldest form of ration pricing. See DAVID RICARDO, *THE PRINCIPLES OF POLITICAL ECONOMY AND TAXATION* 48 (J.M. Dent & Sons Ltd. 1911) (photo. reprinted 1933) (1817). Prohibiting ration pricing of real estate and rationing real estate via queue instead would force owners to sell to the first bidder willing to pay the owner’s opportunity cost, usually the purchase price paid by the owner plus cost of improvements. See VARIAN, *supra* note 1, at 411. Although prohibiting ration pricing of real estate would no doubt please those who do not own their own homes, doing so would impoverish a great many others. Real property is the principal store of wealth for the average American, and home price appreciation the major way in which the middle class maintains its status. See Zhu Xiao Di et al., *Do Homeowners Achieve More Household Wealth in the Long Run?*, 16 J. HOUSING ECON. 274, 275 (2007); Edward N. Wolff, *Recent Trends in Household Wealth in the United States: Rising Debt and the Middle-Class Squeeze—An Update to 2007*, at 8–9 (Levy Econ. Inst. Bard Coll., Working Paper No. 589, 2010), available at http://www.levyinstitute.org/pubs/wp_589.pdf [<https://perma.cc/6SHU-4RUS>]. To deprive the homeowner of the ability to enjoy the windfall of home price appreciation would break a perceived commitment on the part of the government to allow homeowners to extract that value.

201. See *supra* Section II.B.

202. See *supra* Section II.C.

203. See *supra* Section II.C.

204. See *supra* Section II.C.

205. See HOVENKAMP, *supra* note 25, at 393–94.

206. See Herbert Hovenkamp, *Regulatory Conflict in the Gilded Age: Federalism and the Railroad Problem*, 97 YALE L.J. 1017, 1056–58 (1988).

pricing has swept the country, alongside dynamic pricing.²⁰⁷ Firms that have adopted dynamic pricing do not stop at dynamically pricing unexpected surges in demand, but engage in ration pricing of expected surges as well.²⁰⁸ This may in part be because use of dynamic pricing technology has trained firms to think more exploitatively about their pricing. But another explanation may be a change in culture. Disney World, for example, could have charged higher prices during peak periods before the advent of the information age, as it takes no computer to divine that lines will be longer in the summer than the winter, and that at least small increases in price during the summer season will be profitable.²⁰⁹ Why did Disney not do so? Airlines, too, always could have charged higher prices for window and aisle seats within the economy class cabin, as they are starting to do today, even without reams of data on precisely how much more consumers are willing to pay for those seats.²¹⁰ Why did airlines not do so? The fact that these firms chose not to attempt to ration price until recently cannot be explained by the profit motive, and may instead reflect the demise of firms' former commitment to balancing the competing claims of workers, investors, managers, and indeed consumers to the wealth generated by the firm.²¹¹ Firms once pursued pricing strategies that were good enough for the purpose of covering costs, but which were not intended to optimize against consumers.²¹² By contrast, the present maxim of corporate action is that investors and managers must take all in order for the economy to function properly.²¹³

The result of this new attitude toward ration pricing cannot be greater economic efficiency, because ration pricing, as shown in Parts II and III, has nothing to do with efficiency. Instead, the result is both redistribution of wealth from consumers to firms, and, more perniciously, the promulgation of the bad civic lesson that dignity resides in wealth rather than in membership in the community.²¹⁴ For ration pricing not only redistributes wealth from those consumers who pay higher prices to firms, but also gives the rich priority

207. Cf. Woodcock, *Big Data, Price Discrimination, and Antitrust*, *supra* note 125, at 1406–13 (suggesting that rate regulation might also be an appropriate response to personalized pricing).

208. See, e.g., Stewart, *supra* note 51.

209. See S.K., *supra* note 9.

210. See Rick Seaney, *The Airline Fee You May Have Never Heard of: Some Airlines Have Been Charging for Seats for Years and More Are Joining in*, ABC NEWS (Feb. 13, 2016, 11:33 PM), <https://abcnews.go.com/Travel/airline-fee-heard/story?id=36899705> [<https://perma.cc/JZN8-LS33>]; see also Eric Pels, *Airline Network Competition: Full-Service Airlines, Low-Cost Airlines and Long-Haul Markets*, 24 RES. TRANSP. ECON. 68, 73 (2008).

211. See GERALD F. DAVIS, *MANAGED BY THE MARKETS: HOW FINANCE RESHAPED AMERICA* 59–81 (2011).

212. See *id.* at 72–81.

213. See Michael C. Jensen, *Value Maximization, Stakeholder Theory, and the Corporate Objective Function*, 22 J. APPLIED CORP. FIN. 32, 32–33 (2010).

214. See BAUMOL, *SUPERFAIRNESS*, *supra* note 139, at 1–6.

access to scarce resources, and excludes the poor.²¹⁵ The lesson that ration pricing teaches about access is all the more profound because many of the industries that, due to scarcity and excess demand, are peculiarly suited to ration pricing, and have adopted it in recent years, are infrastructural, including housing, transportation, and events.²¹⁶ When ration pricing allocates access to them based on wealth, it sends a clear message about belonging.²¹⁷ The fact that governments have failed to appreciate this problem, and have instead embraced ration pricing themselves in the highway and congestion areas reinforces the impression that the problem runs to culture.²¹⁸ Of course the rich have always had priority in private markets in the sense that only those who can pay the costs of production ever have the chance to buy a product, and ration pricing does not change that.²¹⁹ But ration pricing gives the wealthiest within this group priority.²²⁰ It is no longer good enough to be able to afford a product, one must now be the richest of those who can afford the product in order to have it.

Because the choice to ration based on wealth is not driven by efficiency, the symbolic meaning of the decision to use that criterion is rendered all the stronger, and more harmful to the integrity of the community. It is for this reason that many governments have tended not only to discourage ration pricing with respect to the infrastructures in which it is now becoming popular, but to subsidize access to those infrastructures, to ensure that wealth would play no role in access, even for those unable to pay the costs of production.²²¹ The deregulatory movement has curbed these impulses, and the spread of ration pricing has taken policy to the other extreme.²²²

V. CONCLUSION

The information age has created a mismatch between the near-instantaneous timescales over which firms can now adjust their prices and the

215. See *supra* Section III.B.1.

216. See Cross et al., *supra* note 11, at 11–16; Hu, *supra* note 9; see also Lou et al., *supra* note 58, at 64–65; Shapiro & Drayer, *supra* note 53, at 533–35.

217. Indeed, each of these corresponds to a fundamental constitutional right. See JESSE H. CHOPER, CONSTITUTIONAL LAW: CASES, COMMENTS, QUESTIONS 507–11, 849–53, 969–1005, 1374–88 (2001).

218. See *supra* Section III.B.1.

219. See *supra* text accompanying notes 161–64.

220. See *supra* Section III.A.

221. See Jason Hackworth, *Progressive Activism in a Neoliberal Context: The Case of Efforts to Retain Public Housing in the United States*, 75 STUD. POL. ECON. 33–37 (2005) (discussing public housing in the United States); J. Pucher, *Renaissance of Public Transport in the United States?*, 56 TRANSP. Q. 33–35 (2002) (discussing public transportation in the United States). See generally Alicia M. Schatteman & Ben Bingle, *Government Funding of Arts Organizations: Impact and Implications*, 47 J. ARTS MGMT. L. & SOC'Y 34 (2017) (discussing public funding for the arts in the United States).

222. See Robert L. Rabin, *Federal Regulation in Historical Perspective*, 38 STAN. L. REV. 1189, 1315–26 (1986).

much longer timescales over which firms must still wait to adjust their output. As a result, when a firm encounters an unanticipated surge in demand, one that will exhaust the firm's inventories, the firm can raise prices but cannot increase its output to satisfy the extra demand. That is a recipe for ration pricing, the use of price to allocate a good in short supply to the consumers with the highest willingness to pay for the good. When deployed to respond to an unexpected surge in demand, ration pricing always amounts to above-cost pricing and therefore always harms consumers, because the firm would presumably have chosen the initial price the firm charged before learning of the surge in demand and dynamically adjusting prices in response, to cover costs. It follows that any dynamic price increases the firm pursues must raise prices above costs.

This certainty of harm to consumers, combined with the fact that dynamic pricing can be banned without putting courts in the position of having to set prices, creates a basis for treating dynamic pricing as a per se violation of Section 2 of the Sherman Act. Liability should not attach, however, if the ration pricing to which dynamic pricing gives rise represents the most efficient means by which to ration access to goods in short supply. But there is no reason to think that price is any better at allocating scarce resources to those who value them the most than is the alternative of queuing. Both allocate using imperfect proxies for value: willingness to pay, in the case of price, and willingness to get on line first, in the case of queuing. And in the information age the burden of queuing has been driven almost to zero, because now waiting on line takes only the time needed to log into a website and check to see whether a product is available. Dynamic pricing in response to unexpected demand surges is therefore unambiguously harmful to consumers and should be made per se illegal.