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POLICY BRIEF

The Case for Algorithmic Pricing: Consumer Welfare, Market Efficiency, and Policy Missteps

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In 2024, after an uproar from fans of the band Oasis, the Competition and Markets Authority (CMA) in the United Kingdom announced they were launching an investigation into Ticketmaster's use of algorithmic pricing.[1] Thousands of Oasis fans had waited for long periods in virtual queues only to be asked to pay more than double the advertised price for tickets. There have been similar instances of consumer uproar in the United States in response to the use of algorithmic pricing. For example, consumers reacted negatively to price discrepancies for Beyoncé concert tickets, surge pricing at fast food chains like Wendy's, and digital pricing shelves at retail stores like Walmart.[2] At both the local and federal levels, policymakers have put forward legislation to ban algorithms that use nonpublic competitor data. Additionally, there are multiple ongoing state and federal civil antitrust court cases alleging that the use of algorithmic pricing tools violates antitrust law, primarily in the real estate and hospitality industries.[3] Underlying these responses are concerns that algorithms are being used in ways that harm consumers by extracting value from them rather than creating value for them.

In some respects, these concerns are understandable because of the asymmetric access to information in these transactions. The businesses that use algorithmic pricing tools know more than consumers do about the external and internal factors that impact pricing. The algorithms themselves are no more than black boxes to consumers, policymakers, and enforcers who either don't know or don't understand what information and data go into these algorithms. For consumers, the speed at which prices may change can be alarming and confusing, and the discrepancies in prices for the same product can seem unfair. The ability to collude and price fix appears bolstered by algorithms to the point that there seems to be a growing sentiment among policymakers and consumers that corporations are simply price gouging. However, while some of these concerns are legitimate, there are benefits to algorithmic pricing, including, among other things, improved allocative efficiency and intensified price competition. Additionally, the negative effects associated with algorithmic pricing tools are wrongly attributed to the tools themselves, when in fact

they are the result of the broader competitive context the tools are used within. Thus, the push to limit or ban the use of algorithmic pricing tools is a misguided policy response.

How Algorithmic Pricing Increases Consumer Welfare

One kind of algorithmic pricing practice is dynamic, or surge, pricing, which is primarily used by ride-sharing companies, airlines, and the hospitality and entertainment industries to adjust prices to real-time supply and demand. This type of algorithmic pricing uses temporal price discrimination, charging different prices for the same product depending on when the product is purchased. Prices fall during periods of low demand and rise during periods of high demand. Consumers who enter the market and buy during lull periods benefit from lower prices, and consumers who either exit the market or buy during high-demand periods lose out due to higher-than-normal prices. While some might argue that these consumer welfare effects offset each other, and others might contend that consumers who bought or exited the market during high-price periods suffered greater welfare losses than the gains experienced by consumers during low-price periods, I will illustrate that there are multiple reasons to believe that consumers are better off under dynamic pricing and surge pricing.

1. Allocative efficiency

Pricing, whether done by algorithm or not, does more than just convey purchase costs to consumers. Prices also signal important information about the relative availability of products at that time. In response to a sudden rise in price, it is easy to mistake price gouging for simply lower product availability. For example, Uber engages in surge pricing, which typically makes rides more expensive on weekend nights than in the middle of a workday. This happens for two reasons: First, more people want or need an Uber ride on a weekend night out than in the middle of a workday, and second, Uber cannot instantaneously adjust driver capacity to surges in demand. As a result, there are more consumers competing for a limited supply of drivers, which inflates the price. Dynamic pricing helps match supply to demand more efficiently by incentivizing consumption during low-demand periods and disincentivizing it when there is an excess of demand relative to supply.

Imagine an alternate world where Uber engages in static pricing instead of dynamic pricing and charges the same average demand price over the course of the week—say, $25 for a 10-mile trip. During low-demand portions of the week, there are consumers who would be willing to pay a dynamically priced $10 and drivers willing to offer rides at that price, but these transactions do not occur because the price is stuck at $25. Conversely, during high-demand portions of the week, there are consumers who are willing to pay the dynamically priced $40 but are not able to get an Uber in a timely manner because, at the uniform price of $25, more consumers are willing to order rides than there are drivers willing to offer them at that price. In both scenarios, the rigidity of static pricing inefficiently allocates supply relative to demand, thereby risking excess supply during low-demand periods and supply shortages during high-demand periods.

2. Availability for time-pressured or desperate consumers

Allocative efficiency involves allocating resources to their highest-valued use. Dynamic pricing benefits consumers by reserving a portion of product availability for those who value or need a product the most. For example, because the airline industry engages in dynamic algorithmic pricing, a flight between two cities will typically be more expensive the closer to the departure date it is booked. This price increase partly reflects the decreasing availability of seats on the flight. However, the rise in price also reflects the airline industry's anticipation that there will be last-minute travelers, particularly business travelers, whose urgent need to travel will justify paying that increased price. Consumers who are more indifferent or who have less urgent travel needs tend to drop out of the market as the price increases, leaving seats available for travelers with more urgent needs.[4]

In general, dynamic pricing creates a trade-off in consumer welfare between high- and low-valuation consumers during high demand periods: Those who value a product less are priced out, while those who need or want a product the most have priority access to purchase the product if they can afford to do so. However, a version of this trade-off between consumers also exists without dynamic pricing when access to a product is determined largely by coincidence and chance. With or without dynamic pricing, a portion of consumers will be worse off by not getting what they want, but with dynamic pricing, the group of consumers who value or need products the most are more likely to have access to them. Low-valuation consumers with more elastic demand may lose out, as they are less likely to purchase at higher prices. However, overall consumer welfare may increase because products are more efficiently allocated to consumers on the inelastic portion of the demand curve—those who place the highest value on the product. In terms of airplane tickets, a leisure traveler has less to lose by postponing their flight than a business traveler, or a traveler visiting a terminally ill family, hoping to book last minute.

3. Enhanced business and consumer adaptability

Dynamic pricing also benefits businesses and consumers by improving their ability to evaluate prior purchases and adjust future economic decisions accordingly. Dynamic pricing quickly tells businesses where, when, and how much their goods or services are needed. This allows businesses to make quick adjustments that better serve consumers in the short run, and to make improved projections and plans for production and service in the long run, both of which improve businesses' competitive ability. Surges in Uber pricing, for example, quickly incentivize inactive drivers to become available in the areas where surge pricing is active, relieving potential shortages and lowering waiting times.[5]

This same adjustment can and does happen on the consumer side, to the consumer's benefit, as dynamic pricing discourages demand during high-demand periods and, conversely, incentivizes purchasing during low-demand periods. A consumer on their lunch break who is repeatedly

confronted with higher prices during lunch rush hours may adjust by either taking lunch early or delaying lunch an hour or two, thereby facing a lower price. A traveler who knows that flight prices increase closer to the departure date and on peak travel days of the week will benefit by purchasing weeks in advance and choosing to leave on a Tuesday night instead of a Friday afternoon.

4. Lower nonmonetary costs to consumers

When prices are less responsive to real-time market conditions, consumer welfare can suffer due to non-monetary costs and, in some cases, higher monetary costs. An artificially low price is effectively a price ceiling, and it creates additional demand for a product, which can lead to shortages and force consumers to wait in physical or virtual lines.[6] Consumers who camp out overnight at stores or wait for hours in virtual ticket lines forgo time that could be used to do something more valuable. Dynamic pricing might come at a higher monetary price to consumers, but the savings in time and convenience to the consumer also need to be considered.

Further, absent dynamic pricing, consumer welfare may suffer due to scalping and reselling. Scalpers anticipate high demand for products and buy up large quantities of those products at artificially low prices in order to resell them at higher prices. This arbitrage not only limits product availability for consumers in the short term, but it increases search costs for consumers who go to secondary resale markets. In cases where consumers are particularly desperate for a product, purchasing in secondary markets from resellers can raise the risk of fraud. Scalping also increases prices paid by consumers through "double marginalization,"[7] a process by which the original seller, such as Ticketmaster, adds a price markup, and then the scalpers add an additional markup to the resale price. By accurately pricing products in their original markets, dynamic pricing removes the incentive to scalp, lowers nonmonetary costs, and lessens the prospect of defrauding consumers in secondary markets.

5. Intensifies business price competition

Businesses often use algorithms to set more competitive prices by tracking competitors' pricing and identifying historical patterns in customer behavior. This use of algorithms can benefit consumers when businesses use greater price visibility to undercut their competitors on price in a timely manner. For example, beyond stock availability and customer demand, Amazon's competitive pricing algorithm also factors in competitors' prices on other platforms. This is done, in part, to ensure that the prices of the most visible products on the platform, those that feature the "Buy Box," are the lowest on the market.[8] Having access to competitor prices, these competitive algorithms allow businesses to undercut their competitors, and either consumers migrate to the firm with lower prices or competitor firms lower their own prices to remain competitive.

6. Expanded availability to lower-income consumers

Businesses are increasingly using algorithms and machine-learning models that incorporate large swaths of consumer data, such as purchasing history, browsing behavior, and location, to tailor product discounts and prices to individual consumers. In cases where firms can perfectly price discriminate—setting prices exactly at what each consumer is willing to pay—all consumer surplus is eliminated and consumer welfare suffers, as consumers are charged the maximum price they are willing to pay. When competition is robust, personalized pricing can improve consumer welfare by offering tailored discounts and pricing below competitors. There is also research that suggests that personalized pricing algorithms have redistributive benefits to certain segments of consumers.[9] Lower-income or disadvantaged consumers may benefit from lower prices and the ability to purchase products that they otherwise could not afford, while consumer welfare falls for the consumers willing to pay the highest prices.

In a study of personalized pricing on the employment platform ZipRecruiter, economists Jean-Pierre Dubé and Sanjog Misra find that, without accounting for distributive effects, consumer welfare falls by about 25 percent when pricing is personalized.[10] However, they qualify this finding by stating that "this decline in total surplus comes from less than half of the consumers," and further show that 63 percent of the consumers under personalized pricing face lower prices than in the uniform case.[11] Lastly, Dubé and Misra provide evidence that restricting the type and amount of data that can be used for personalized pricing "could in fact exacerbate rather than offset the declines in consumer welfare."[12] Policy interventions that seek to limit the use of these algorithms could lead not only to potential losses in welfare for lower-income consumers but also to lower total consumer welfare.

The Collusive Danger of Pricing Algorithms

While pricing algorithms can be a tool used by businesses to the benefit of consumers, they can certainly also be used in ways that harm consumer welfare, namely through collusion. Whether companies formally agree to raise and fix prices (explicit collusion) or coordinate to raise prices without explicit agreement (tacit collusion), pricing algorithms can be used to artificially inflate prices. Economist Emilia Calvano and her colleagues, in their paper studying price competition and pricing algorithms powered by artificial intelligence (AI), find that "the algorithms consistently learn to charge supra-competitive prices, without communicating with one another."[13] Pricing algorithms also potentially make price-fixing agreements more sustainable and make detecting explicit collusion among competitors much harder for antitrust enforcers. Collusion is traditionally unstable because an individual firm in a price-fixing conspiracy has an incentive to cheat on the agreement due to monitoring costs, covertly lowering prices to capture more of the market and increase individual profits. Collusive agreements facilitated through a pricing algorithm significantly lower monitoring costs, thereby making it easier for members of the cartel to detect when another member cheats.

However, the pricing algorithms themselves do not cause collusion—they are merely neutral tools that can facilitate it. The competitive conditions of collusion are contingent on several factors, such as product homogeneity, a small number of firms, high barriers to entry, inelastic demand, and symmetrical market shares and costs across firms. If collusion is occurring and consumer welfare is being harmed, that is the result of the wider competitive business environment and not the pricing algorithm itself.

For example, recent regulatory and legal scrutiny has focused on the use of pricing algorithms in housing and rental markets amidst rising rents across American metropolitan areas.[14] However, while pricing algorithms and nonpublic competitor data are sometimes used to determine housing costs, the algorithms are not the source of collusion or rising prices. In housing markets, landlords competing with other landlords for tenants puts downward pressure on rents, and residents competing with other residents for housing puts upward pressure on rents. It is the difference in the intensity of these two sides of competition that impacts rent prices. Local regulations that slow down or make the building of new supply more costly, such as overly strict zoning and lengthy permitting processes, are barriers to entry that insulate existing landlords from competition. The result is that an increasing number of potential tenants compete with each other for a more limited supply of housing, thereby bidding up the rent prices.[15] Landlords might use pricing algorithms in order to get the highest rent possible or to collude with each other, but the algorithm is simply the tool, not the underlying cause of rising housing costs.

Transparency and Disclosure Legislation

Because pricing algorithms are neutral tools that can be used to both benefit and harm consumers, bans and limits on the use of pricing algorithms are the incorrect policy response. Competition enforcement agencies need to have the tools to gather relevant evidence to prosecute anticompetitive uses of pricing algorithms when businesses misuse these tools. An optimal policy response might require businesses to keep records of the type of information that goes into their pricing algorithms, including the decisions that algorithm makes, which must be produced if requested by an enforcement agency. Record keeping is costly, so policymakers could set a minimum revenue threshold so that smaller enterprises are exempt from that record-keeping burden. Alternatively, record keeping can be voluntary, but if businesses do not keep a record of their algorithms or do not comply with a subpoena of these records, enforcers can create "an adverse inference of a tacit anticompetitive scheme or agreement."[16]

Additionally, consumers should not be subject to confusing or misleading situations when purchasing goods due to algorithms. To address these problems, policymakers should require businesses to disclose to consumers that the price they are seeing is the result of a pricing algorithm. Specific to dynamic and surge pricing, this disclosure should either make consumers aware of when prices are subject to dynamic pricing or that the displayed price is subject to change, thus accurately shaping consumer expectations. There is also reason to believe that consumer concerns

about pricing algorithms may resolve organically over time. Research by economists Arnd Vomberg, Christian Homburg, and Panagiotis Sarantopoulos suggests that algorithmic dynamic pricing initially reduces consumer trust in retailers but that this backlash can be short-term.[17] As algorithmic pricing becomes the market norm and retailers work to "actively build consumers' trust," this backlash can dissipate.[18] Firms will quickly discover if it is efficient or profitable to use these algorithmic tools in light of consumer reactions and will ostensibly adapt to use algorithms to compete in a manner that benefits consumers. Additionally, because the fields of AI and machine learning are rapidly evolving industries, entrepreneurs may find better and more innovative ways to use these algorithms; policy should not close off this potential by limiting the use pricing of algorithms.

At the federal level, several pieces of legislation related to algorithms have been introduced in the House of Representatives and the Senate. For example, S. 2325 and H.R. 4624 mandate that social media platforms disclose to users what personal data is collected, how it is used, and how content algorithms interact with their data.[19] However, S. 3686 and S. 3692 address pricing algorithms specifically, and while there are some problematic sections in S. 3686, it better addresses the potential downsides of algorithmic pricing than S. 3692.[20] S. 3692 makes it illegal for rental property owners to use a third-party business pricing algorithm to set rent prices, thereby restricting a potential welfare-enhancing business practice. Furthermore, the bill is unnecessary, as it prohibits coordinating third-party firms from facilitating "an agreement among rental property owners to not compete" and from acquiring another third party if the merger poses a significant risk of lessening competition, both of which are already illegal under current antitrust law.[21]

Conversely, S. 3686 empowers enforcement agencies to audit pricing algorithms, ensures the confidentiality of any information submitted in these audits, and requires that any firm that makes more than $5,000,000 in annual revenue clearly disclose to its consumers that its prices are the result of an algorithm.[22] However, the bill is flawed because two sections—four and five—ban the use of nonpublic competitor data to train pricing algorithms and create a presumption of illegality if such an algorithm is used and shared. Removal of those sections would make S. 3686 more optimal legislation in dealing with pricing algorithms.

It is certainly true that algorithms trained on nonpublic competitor data, such as profit margins, business plans, and output capacity, can make collusion easier by lowering strategic uncertainty. However, it is also the case that access to this information could help firms compete more vigorously with one another. Because accessing nonpublic competitor data is not inherently detrimental to consumer welfare, the proper policy and enforcement response is not to ban access, but to apply the rule of reason on a case-by-case basis. If competitive factors (similar costs, homogenous products, high concentration, etc.) are present, and high prices are stable for long periods of time, enforcement agencies can create a presumption of illegality and place the burden of proof for efficiencies and consumer welfare on defendant firms.

Conclusion

Adjusting prices to external and internal market conditions such as inventory levels, consumer demand, the prices of competitors, and the characteristics of individual consumers has always occurred in markets. No price is ever truly static. Algorithms simply incorporate larger quantities of accurate information, making price adjustments quickly and efficiently. Pricing algorithms are neutral tools that can be used to benefit businesses and consumers alike. Some businesses can and will use this tool in ways that harm consumer welfare, but the existence of bad actors should not justify preventing those who want to use the tool in productive ways from having access to that tool. Policymakers and enforcement agencies should go after the bad actors who use algorithms in malicious ways but should not ban or limit the use of the tool itself.

About the Author

Cody Taylor is a graduating MA student in economics at George Mason University. He earned an MPP and a BA in economics from the College of William and Mary. His research interests include antitrust enforcement, consumer protection, and industrial organization.

Notes

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