Can Robots Collude?

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Introduction

Businesses are increasingly using, developing and improving their ability to promptly respond to market conditions, innovate product offerings, and set prices using algorithms and artificial intelligence systems (**AI**).

Algorithm pricing systems differ from traditional more 'manual' price setting practices as they can:

- assimilate and process significant amounts of information relating to competitor prices, demand, price and availability of substitutes, and even customer personal data, almost instantaneously;
- respond almost immediately to changes in the market or competitor pricing; and
- set prices to achieve a business objective consistently across all sales.

This increased capacity to process mass amounts of information and data to execute price changes allows business to compete more effectively by responding to changes in the market quickly.

However, concerns have also been raised in relation to the use of AI pricing systems, particularly in relation to compliance with competition laws, including because:

- AI systems could facilitate, or discretely give effect to, price fixing arrangements;
- AI systems could make detection of price fixing arrangements harder; and
- the proliferation of automated AI pricing systems could result in supra competitive price levels for products and extreme forms of price discrimination between buyers.

Introduction to AI and Algorithms: What do we mean by AI and Algorithms?

Generally, AI or Artificial Intelligence refers to "intelligent" or "smart" software systems that can replicate some functions typically associated with human thought processes. There is no firm definition as to when a machine is "intelligent". Computers may be "somewhat intelligent" and others may be less so. However, today the term AI is widely used to refer to computer systems that can learn and make decisions or predictions about future behaviour (as distinct from systems that only perform repetitive tasks involving data processing that is difficult or time consuming for humans to perform).

The use of AI and algorithms is not new. Algorithms have been around since the first computers, and AI was first termed by John McCarthy in 1956. So why is it now a hot topic?

In recent times, the combination of AI, algorithms, developments in software and technology, and the proliferation of big data, has created a new wave of business processes that have relied on algorithms to increasingly make decisions that otherwise would have been performed by humans.

The OECD has broadly categorised two types of applications for algorithms:

- **Predictive analytics**: algorithms which measure the likelihood of future outcomes based on the analysis of historical data. This type of algorithm can be used to estimate demand, forecast price changes, predict customer behaviour, and other changes to the market that might affect the business.
- **Optimise business processes:** algorithms can also be used to gain a competitive advantage by reducing production and transaction cost, segmenting customers or setting optimal prices to respond to market circumstances. This is based on the algorithm's ability to process large datasets, react quickly and incur lower costs in performing functions than humans.[1]

Benefits of using algorithms

For businesses, the use of algorithms is highly compelling:

- Algorithms can perform functions that would otherwise be impossible or too time-consuming for humans to perform.
- Algorithms can make decisions and react to changes in market conditions almost instantaneously. At its simplest, if a competitor reduces its prices, an algorithm can monitor this and match that price immediately.
- Algorithms can produce efficiencies by reducing the cost of production, improving quality and resource utilisation, and streamlining business processes.
- By organising information about consumers, algorithms can help businesses better understand consumer preferences, buying patterns, reduce search costs and deliver more relevant products.

1 OECD, 'Algorithms and Collusion - Background Note by the Secretariat' (21-23 June 2017) p 9-10; accessible at https://one.oecd.org/document/DAF/COMP(2017)4/en/pdf.

2 See, Meyer v Kalonick, No. 15 Civ. 9796 (SDNY, 7 May 2016.

Consumers can also enjoy the benefits of algorithms. Price comparison websites (PCW) are a perfect example. These algorithms search and mine a large number of competing offers for the same product or service across the internet. PCWs then make it easier for consumers to compare the available offers, find the best alternative, and the best prices. In another example, an online start-up, Lemonade, uses AI to allow customers to make an insurance claims online, then verifies the claim online using a number of data sources and approves it within seconds.[3]

Despite these benefits, competition lawyers and regulators have highlighted a number of risks in relation to the use of pricing algorithms, as discussed in the next section.

Competition Law Issues and Risks: What's the issue?

Some of the risks that competition lawyers and regulators have highlighted in relation to AI systems include:

- AI systems could facilitate, or discretely give effect to, price fixing arrangements;
- AI systems could be designed to collude with other similar systems without any human interaction. Additionally, collusion could be an unintended effect, as AI systems can perform in unexpected ways (as was the case with the example referred to above in respect of *"The Making of the Fly"*). The algorithm logic made sense – price at a factor of a competitor's price. However this independent logic had an unintended consequence given the pricing corresponding algorithm);
- AI systems could result in supra competitive price levels for products; and
- The combination of automated pricing as well as big data could lead to extreme price discrimination between buyers (whereby consumers may be paying supra-competitive prices for products based on individual data used to calculate bespoke prices for each consumer).

Risks associated with collusive behaviour and price fixing are particularly important in the Australian context, more so in light of the new prohibition against concerted practices. These particular risks are examined in more detail in the sections below.

Algorithms: The Famous and the Infamous

- Uber: on 29 January 2016, an Uber rider filed a class action against Uber's CEO on the basis that Uber drivers engaged in price fixing to set supra-competitive prices through Uber's pricing algorithm. According to Uber's website:

  Uber's fares are dynamically priced. This means that the fare a rider sees is based on variables subject to change over time. These variables include (but are not limited to) the estimated time and distance of the predicted route, estimated traffic, and the number of riders and drivers using Uber at a given moment.

- Amazon marketplace: in 2011 a biology textbook *"The Making of a Fly"* was made available on Amazon for $23 million. That particular price was set through the interaction of two different sellers' programmed algorithms (see Financial Times, David J Lynch, Mehra). The first algorithm automatically set the price of the first book for 1.27x the price of the second book (which belonged to another seller). The second algorithm automatically set the price of the second book at 0.9983x the price of the first book. This led to an upward spiral in price.

- Gas stations in Rotterdam are using Denmark-based AI developer company a2I Systems A/S. Ulrik Blichfeldt, chief executive, notes his software models consumer behaviour, and learns when raising prices drives away customers and when it doesn't – leading to lower prices at time when price sensitive customers drive by (see Sam Schechner, *Why do gas station prices constantly change? Blame the algorithm, 8* May 2017, The Wall Street Journal Online). He says *"This is not a matter of stealing more money from your customer. It's about making margin on people who don't care, and giving away margin to people who do care."*

- Algorithms can also figure out what products are usually purchased together, allowing them to optimise the price of a whole shopping cart. In 2002, Andrew Pole was hired by Target to develop an algorithm which used predictive analysis to determine when a woman was entering the third trimester of pregnancy:

  "As Pole's computers crawled through the data, he was able to identify about 25 products that, when analyzed together, allowed him to assign each shopper a "pregnancy prediction" score. More important, he could also estimate her due date to within a small window, so Target could send coupons timed to very specific stages of her pregnancy."

3 OECD, p13-14.

Collusion and concerted practices under Australian laws

Under Australian competition law, prohibited conduct includes:

- entering into a contract, arrangement or understanding with a competitor with respect to cartel conduct (eg, price fixing, bid rigging, market allocation, and supply restrictions);
- "concerted practices" that have the purpose or effect of substantially lessening competition; and
- anticompetitive arrangements with the purpose or effect of substantially lessening competition.

In this framework, some form of mutuality and coordination is required in order to breach the law, and, in the usual course, some form of communication (whether direct or indirect) usually precedes any attempt at mutuality or coordination. Indeed, without any form of communication, these types of conduct would be very difficult if not impossible to engage in. Yet, in the AI world, this presents a challenge as AI systems do not necessarily "communicate" with one another in the same way as humans do.

So, how could algorithms engage in collusion or other anticompetitive conduct?

Algorithms and the facilitation of collusion

The most overt type of anticompetitive use of algorithms are ones which involve traditional forms of collusion, which are somehow aided by the use of technology.

The most obvious example of this is where algorithms are used to give effect to a pre-existing anticompetitive arrangement or understanding between competitors. This was the case in *USA v Topkins.*[4] The Department of Justice took proceedings against David Topkins. It alleged that Mr Topkins agreed with competitors to fix prices of goods sold through the Amazon marketplace by adopting an agreed upon pricing algorithm.

An anticompetitive agreement could also be facilitated if the parties to the agreement are using identical pricing software, effectively creating a "hub and spoke" cartel where the software itself (or more specifically, common knowledge about the pricing rules used by the software) becomes the de--facto "hub" used by the parties to coordinate their conduct (even in the absence of explicit or direct communications).

Generally, current competition laws in Australia could address the conduct in the examples above. However, the use of algorithms may make it harder to discover and to evidence the conduct in question. Indeed, in the second example, there could be very little if any evidence of actual interactions between competitors that could be used to prove the anticompetitive conduct.

AI and the possibility of independent "machine collusion"

Going one step further, can algorithms engage in collusion or some form of concerted conduct independent from humans? For example:

- Pricing algorithms may be developed to respond to competitor action or movement in a set manner, which over time becomes so predicable that it facilitates collusion. Say, an algorithm is set to match a competitor's price change within a particular percentage increase. Over time, the underlying rules of the algorithm become predictable and competitors have the opportunity to also respond in a similarly predictable way. For example, they may choose to only change prices in ways that will not trigger a competitive response. Competitors in that market would be able to operate with a high degree of certainty about competitive responses. Would that amount to collusion or a concerted practice?
- Pricing algorithms could also develop sufficient learning capability to assimilate, test and "understand" market responses. An algorithm may on its own, or together with other algorithms, arrive at a conclusion that "colluding" with a competing algorithm is the best way to, for example, avoid a price war or maintain profits above a certain level.

In these examples, the algorithms in question may not have been designed to engage in collusive conduct. Their objective could well be to "maximise profits", which is a perfectly legitimate business objective – however, the algorithm may discover that the best way to achieve that objective is by engaging in unilateral conduct that closely mimics "collusion". It would also be the case that there is no "communication" between the algorithms. To state the obvious, the algorithms in the example above would not be emailing each other their intentions ahead of any price movements. There is likely to be, however, a certain *pattern* and a degree of *predictability* that allows one algorithm to anticipate with sufficient accuracy what the other algorithm will do, and to adjust its responses accordingly.

Do software-driven forms of "pattern and predictability" amount to a form of communication? Or collusion? A form of concerted practice? Or is it just a machine-driven version of "conscious parallelism"?

Even if not illegal, there are concerns that the above types of algorithmic interactions may result in higher prices and less competition. This typically occurs in concentrated industries with high barriers to entry (as it is easier to establish forms of coordination), regardless of whether it is humans or software making the decisions on pricing. However, technology may also facilitate the conditions for this problem to arise by

4 Case No. 3:15-cr-00201.

making the number of competitors in the market less relevant to defeating this type of conduct (as algorithms can monitor a large number of competitors in a transparent market).

Where to next?

While there may be competition concerns relating to the potential misuse of algorithms, it remains the case that businesses should be capable of developing better technology to optimise their operations and to better compete in the modern economy. However, how can business achieve this without creating a competition law risk?

Designing Algorithms to Minimise Risk

Legal debates aside, AI will continue to develop and business will continue to seek ways to benefit from this technology.

So, what steps could be taken to try to develop pricing algorithms that will comply with competition laws?

Maintain an up-to-date record of the algorithm's design objectives

While the high level objectives of a pricing algorithm may be relatively self-evident ("optimise prices", "save costs"), it will be important to also document the ways in which that objective will be achieved and the design parameters that will be used to measure it. These records should be updated as objectives change and evolve.

It should also be noted that engaging in conduct with a purpose of "lessening competition" is likely to be problematic and could be prohibited under competition laws.

Consider the impact of the algorithm on competition

Businesses should consider whether the use of the algorithm is having an impact on competitive dynamics, in particular in regard to:

- market shares and market concentration;
- the number of competitors using the same algorithm (if any);
- price elasticity;
- barriers to entry/exit; and
- dynamic competition.

There will be many instances where the use of pricing algorithms will not have any material effect on competition. This will be the case if, for example: products are not homogenous, there are a number of different competitive factors (not just price), there are substitutes and there is the ability and incentive for competitors to "defeat" any attempt at creating supra-competitive prices.

Despite this, it will be important to test the effect at regular intervals, if any, in case the algorithm is operating in a way that is different to how it was designed.

Who else is using the same algorithm provider or software?

While bespoke or proprietary algorithms are unlikely to raise a hub and spoke issue, off-the-shelf software or the use of common algorithm providers could present some risks.

To be clear, using the same third party provider as a competitor is not in itself prohibited. In fact, it makes good sense to rely on providers that specialise in the design of algorithms for particular industries. However, to avoid any risk of unintended consequences businesses should consider:

- who else is using the same algorithm;
- whether it is, in fact, the "same" algorithm (and if so, the degree and nature of any similarities);
- what are the protections around the confidentiality of your algorithm, information, prices, and the specific algorithm used;
- retaining flexibility to adjust and vary the algorithm's operation as the need arises; and
- retaining the ability to override the algorithm in particular circumstances.

Dynamic Pricing in the Era of Big Data: An Ethical or a Competitive Problem?

New AI technologies and algorithms give businesses the ability to crunch through vast quantities of customer data. This allows businesses to set prices with a

Some Arguments Against: With Great Power Comes Great Responsibility

- *Businesses should adhere to an 'equal treatment norm'* – At the core of Krugman's conclusion about dynamic pricing is a moral objection to charging different customers different prices for the same product. This is instinctively appealing: if there is truly no difference in the underlying product, then it would seem that the person receiving the higher price has been exploited, or at least treated unfairly. Acceptance of an 'equal-treatment norm' would seem to be strongly in favour of unitary pricing as the fairest means of pricing.
- *Extreme price discrimination has the potential to defeat the fundamental purpose of certain services* – A key example is insurance, the principal objective of which is to spread risk among many members of a community. If, as a function of its programming to capture the greatest possible number of customers, an algorithm within an automated pricing system were to charge extreme prices to customers based on their exact risk factors, this would be self-defeating insofar as this social objective was concerned.
- *All pervasive algorithms may become impossible to avoid* – Another argument is that as big data becomes even more prevalent, it will become increasingly difficult and costly to avoid these systems. In this argument, customers have limited, if any, tools to protect themselves from high prices.

high degree of sophistication and to fine-tune their response to supply and demand dynamics (eg, seasonality, alternatives, switching costs, bundles, etc). To put it bluntly, algorithms allow businesses to heavily price discriminate in a bespoke way for each consumer as they can trawl through large quantities of consumers' data – such as income, purchasing habits and history, job, search history, family, address, and so on.

For some, this raises ethical questions as prices for goods are not determined by market forces – but rather, by access to customers' personal data. For others, it opens up new possibilities for increased competition.

What is 'dynamic pricing'?

Price discrimination is not a new concept. In pure price discrimination, the seller charges each customer the maximum price the customer is willing to pay. Examples include coupons, age discounts, occupational discounts, retail incentives, gender based pricing, financial aid, and ordinary haggling. Algorithms and big data however give businesses the power to "hyper" discriminate by relying upon very detailed customer information on income, spending habits, etc.

Writing in an opinion column in the New York Times in October 2000, Nobel prize winning economist Paul Krugman neatly described what he perceived as an emerging practice of 'dynamic pricing' in e-commerce:

"Dynamic pricing is a new version of an old practice: price discrimination. It uses a potential buyer's electronic fingerprint – his record of previous purchases, his address, maybe the other sites he has visited – to size up how likely he is to balk if the price is high. If the customer looks price-sensitive, he gets a bargain; if he doesn't he pays a premium."[5]

The *"old practice"* of price discrimination is common in the offline world: for example, charging different rates for male and female haircuts, or 'versioning' products so that it will be possible to charge a higher price to customers with a greater willingness to pay (for example, a novel released first in hardcover, followed later by a cheaper paperback).

However, Krugman was writing in the aftermath of the discovery of Amazon's online "price tests" – the offering of different levels of discounts to different buyers allegedly on the basis of their customer profile. Reflecting a widely held view at the time of the Amazon controversy, Krugman concluded: "dynamic pricing is undeniably unfair: some people pay more just because of who they are."

Is dynamic pricing ethical in a big data driven world?

In the years since the Amazon dynamic pricing controversy, the capacity for businesses to develop or acquire detailed customer profiles has increased. The questions and arguments as to whether these practices are ethical have not gone away either.

Are competition and consumer protection laws the answer to these ethical questions?

It can also be argued that the fact that a seller sells the same good at a lower price to a different buyer will not, by itself, be a problem. So long as data driven algorithms are not used against desperate or vulnerable individuals, or in other unconscionable circumstances, there is nothing inherently unethical in their use. There is a question, however, as to whether our consumer protection laws could address unconscionability scenarios of that nature.

It is also the case that competition itself may provide a form of protection to consumers who may be disadvantaged by dynamic pricing. So long as competition exists in a market, the fact that a company has the capacity to predict perfectly a customer's reservation price will not lead to a permanent state of price discrimination. Even where one or more firms choose to follow the original price discriminator, other rival firms or new entrants will likely be able to use the same technology to undercut those higher prices.

Technology itself may also offer consumers additional tools to fight excessive price discrimination. In the same way that algorithms can be used to determine the best price a consumer is willing to pay, algorithms can be used to find the best price at which a seller is prepared to sell. Some of those algorithms are already commonly used in some industries (eg, accommodation, petrol).

Navigating this new terrain

While there is no set roadmap for the use of these new technologies, some questions that a business may need to ask include the following:

What price discrimination strategies is the business planning to implement?

- Is there a risk that they will detrimentally impact the most vulnerable (eg, elderly customers who book flights offline paying higher prices for airfares, or less informed customers receiving smaller discounts from their electricity bills)?
- Are there regulatory concerns that may arise (eg, are there any regulatory obligations that would limit the ability to price discriminate, and what is the likelihood of a shift in the regulatory landscape in the medium term)?
- Is there enough competition in the market to allow for a healthy competitive response (eg, are there clear barriers which may prevent competitors from responding, such as advanced proprietary technology or datasets that are difficult to replicate)?
- Is the business prepared to manage any consumer backlash?

5 Paul Krugman 'Reckonings; What Price Fairness?', *New York Times*, 4 October 2000.