SPECIAL REPORT

More knock-on than network

The story of the internet is all about layers

How the internet lost its decentralised innocence



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IN "INFORMATION RULES"—published in 1999 but still one of the best books on digital economics—Carl Shapiro and Hal Varian, two economists, popularised the term "network effects", which means that in the digital world size easily begets size. The more popular a computer operating system, the more applications it will attract, drawing in even more users, and so on. Two decades ago the idea helped people understand the power of Microsoft and its Windows software. Today it is the default explanation for how Facebook, Google and other tech giants became dominant. The more people sign up to a social network, for instance, the more valuable it becomes for present and prospective users.

Yet Mr Varian is not too happy about how his intellectual offspring is being used, and abused. "The only thing more dangerous than an economist is an amateur economist," he said at a conference in Brussels in late 2016, "and there are a lot of amateur economists out there who like to talk about network effects." He agreed that some firms had benefited from network effects, in particular Microsoft and Facebook. But for Amazon's e-commerce business and Google's search engine, for instance, they have been of little help.



inRead invented by Teads



Critics might point out that this assessment is a tad self-serving: Mr Varian has been Google's chief economist since 2002. But he does have a point. Although economic flywheels played an important role, the story of how the internet became centralised is more complex. It is more about knock-on effects than network effects.

Digging deep

To understand the internet's recent history, it helps to keep in mind that, like most digital systems, it is designed in layers. At the

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Welcome internet). At that level, it is still largely decentralised: no single

company controls these protocols (although the number of firms providing internet access has dropped sharply, too; most Americans have a choice between only two offerings).

Yet the next layer up—everything that happens on top of the internet itself—has become much more concentrated. This is particularly true of the web and other internet applications, which include many consumer services, from online search to social networking.

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Centralisation is also rampant in what could be called the "third layer" of the internet: all the extensions it has spawned. Most people use one of two smartphone operating systems: Apple's iOS or Google's Android. Cloud computing is a three-horse race among Amazon, Google and Microsoft. And then there are data. Amazon, Facebook and Google not only dominate their respective core markets; they have accumulated more digital information than any other online company in the West. Indeed, they can be seen as data a son a planetary scale which

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original protocols, the Internet Engineering Task Force and the World Wide Web Consortium, could have added to the rule book. But they did not do so, or only belatedly.

One reason was ideological: many internet pioneers believed that the protocols would be enough to prevent centralisation. The other was that, even though they moved faster than conventional standard-setting bodies, they were still slow. "If the internet's governance mechanisms had worked better, we wouldn't have had all these private actors rush into the void," says Kevin Werbach of Wharton, the University of Pennsylvania's business school.

And rush in they did. The lack of built-in memory on the web made it difficult to offer certain applications. Online shops, for instance, had no way of knowing what a customer had previously ordered from them. Netscape, a now-defunct software firm, developed a workaround in the form of "cookies", small files that live in a browser, which originally served as a digital shopping cart. Later, as e-commerce became more sophisticated, these became digital identifiers, with the corresponding data residing on a server.

These subtle technical changes created an opportunity for a few firms to become the internet's memory. At its core, Google is a list of websites and a database of people's search histories. Facebook keeps track of their identity and the interactions between them. Amazon collects credit-card numbers and purchasing behaviour. Yet being the repository of such information does not entirely explain how these firms came to dominate their respective markets. This is where the network effects come in.

The internet fundamentally changes the economics of content of all sorts, from news to video. Ben Thompson, the author of *Stratechery*, a widely read newsletter, has summarised this shift in what he calls "aggregation theory". In the offline world, he explains, power and profits accrue to firms that control distribution, such as printing presses and cable networks. But online, distribution is essentially free and the hard part is to aggregate content, find the best and serve it up to consumers.

So the first priority is to attract as many users as possible, which today's online giants did by creating a great "user experience". Google, for instance, won out against Alta Vista, the leading search engine in the late 1990s, because its interface was cleaner, searches came up more quickly and the results were more accurate. Once such advantages have been established, they start up all kinds of flywheels. The service attracts users, which attracts suppliers of content (in Google's case, websites that want to be listed in its index), which in turn improves the user experience, and so on. Similarly, the more people use Google's search service, the more data it will collect, which helps to make the results more relevant.

At some point, Google and the other tech titans also came to benefit from good old economies of scale. Each of them now operates dozens of vast data centres around the world, manages millions of servers and uses superfast private networks. Google, which has the biggest one, handles about a quarter of the internet's total traffic. To boost its cloud-computing business, the firm is also building three new underwater fibre-optic cables to run along ocean floors from the Pacific to the North Sea. Such investments make it harder for competitors to catch up.

Although Google understood the importance of the user experience right from the start, it took longer to work out how to make money from search. Having tried to sell its technology to companies, it went for advertising, later followed by Facebook and other big internet firms. That choice meant they had to collect ever more data about their users. The more information they have, the better they can target their ads and the more they can charge for them.

That approach has proved a huge success, as Google's results remind investors every quarter (the company took in \$31bn in the first three months of this year). Yet as a business model online advertising has two big drawbacks, says Ethan Zuckerman of MIT's Centre for Civic Media. It requires companies to track users ever more closely, and it encourages even more concentration. And advertisers tend to flock to the biggest ad networks to get the widest exposure. Between them, Facebook and Google now collect nearly 60% of online advertising dollars in America, according to eMarketer, a data outfit.

Being large-scale data collectors for advertising purposes has also been the perfect preparation for the firms' next incarnation as AI companies, says Glen Weyl, an economist at Microsoft Research who also teaches at Yale University. They not only have reams of data but plenty of engineering talent and the necessary computing infrastructure to turn their digital hoard into all kinds of "cognitive" services, from speech and facial recognition to software for drones and self-driving cars.

Critics of big tech, such as Jonathan Taplin, a former director of the Annenberg Innovation Lab at the University of Southern California and author of "Move Fast and Break Things", worry that AI could trigger another round of concentration. It certainly introduces another set of network effects: more data means better and more popular services, which generate more data. The big fear is that in the future one of the online giants will turn into some sort of "Master AI", ruling not just the online world but many other industries too.

For now, that has a whiff of science fiction about it, and it may never materialise. But meanwhile the dream of changing the economic laws of the internet to bring it closer to its decentralised roots is being vigorously pursued by a plethora of blockchain startups and activists.

This article appeared in the Special report section of the print edition under the headline "More knock-on than network"

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