The Centralization of Information and Authority in the Digital Economy

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"Ipsa scientia potestas est"

Francis Bacon

The rapid advances of information and communication technologies (ICTs) bring opportunities and dangers. On the positive side, they speed the sharing of information and knowledge. This directly increases productivity and, what's more, increases market size, augmenting the incentive to produce additional information and knowledge. More ambiguously, ICTs make it possible to radically increase the centralization of previously decentralized information. While this can be valuable, centralization of information also facilitates the centralization of decision-making authority, and thereby inequality, corruption or even totalitarianism.

Pre-Information Age civilizations faced important constraints in what types of and how much information could be collected and processed. First, as highlighted by Hayek (1945), a great deal of the information essential for decision making is dispersed. It spans the myriad small opportunities for gaining efficiencies in production or transportation to the tastes of local consumers. Second, information processing was bounded by the capacity of the human brain. Organizations, from companies to states, which sought to draw on greater amounts of knowledge required the participation of large numbers of people, directly or indirectly, in decision making. Human brains are inherently decentralized. These twin facts restricted the maximum power of corporations and their leaders. CEOs needed to rely on information from other people, to solicit special knowledge from advisors, and to delegate decisions and authority to others. These other people could be part of the same organization, or in different organizations. The need for any large-scale enterprise to delegate and collaborate placed inherent and inescapable limits on the centralization of power.

The rise of AI, big data, and digital networks are challenging the twin facts that historically limited information centralization. Digital networks make it possible for detailed data, including the increasingly ubiquitous sensors that comprise the Internet of Things, to transfer information

almost instantly and costlessly. Meanwhile, modern digital technologies, including AI systems and their cloud connected embodiments, can continuously and cheaply upgrade their decision-making functionality, and by many metrics, already vastly exceed the computational power of the human brain. The digitization of information and decision-making capabilities can centralize information and in turn authority.

Consider the following example, in the spirit of Brynjolfsson (1994).

Under the old technology regime, the wholesaler had to collaborate with a local retailer to make sales. Both sides needed to make non-contractible investments in effort: the wholesaler in product innovation and quality and the retailer in understanding customer demand. Suppose total net revenue for the store is

$$Y = L_W^{1/2} L_R^{1/2} \tag{1}$$

Where W and R are effort exerted by the wholesaler and retailer respectively. They know that during ex-post bargaining, each will get one half of the surplus, since each controls essential information. Assume both have a cost of effort of the form $c_W(L_W) = \frac{1}{2}L_W^2$ and $c_W(L_W) = \frac{1}{2}L_W^2$. Then, both shirking slightly, they will split a modest surplus of $\frac{1}{8}$.

Now consider the situation where new digital technologies, such as the Internet of Things (IoT) and predictive analytics, enable the wholesaler to obtain the Hayekian local information of the retailer and equal or surpass their ability to make inferences about local demand. Now the retailer has no essential information. Rather than negotiate with the retailer for a share of the surplus, the AI enabled wholesaler can contract for the optimal amount of labor, paying the retailer's opportunity cost. By commoditizing her complement, the wholesaler internalizes all benefits and costs of production. This leads both to a higher and more efficient level of production, but it also removes all bargaining power from the retailer.

Table 1 summarizes the implications of this technological shift.

Table 1: Who Benefits from Data Centralization?

	Bargaining with Retailer	Information Centralized
Total Revenues	$\frac{1}{4}$	$\frac{1}{2}$
Total Economic Surplus	$\frac{3}{16}$	$\frac{1}{4}$
Wholesaler Revenue	$\frac{1}{8}$	$\frac{3}{8}$
Retailer Revenue	$\frac{1}{8}$	$\frac{1}{8}$
Wholesaler Surplus	$\frac{3}{32}$	$\frac{1}{4}$
Retailer Surplus	$\frac{3}{32}$	0

Wal-mart is an exemplar in the use of information systems to monitor logistics and consumer

demand. These powerful technologies allow Wal-mart to build dramatically more efficient supply chains. In 1989, the mayor of Independence, Iowa recalled how powerless he felt when Wal-Mart announced its desire to build its 750th location there. "They told us if they didn't build here, they'd build in a nearby town, and that would have been equally hard on Main Street. Our people were going to shop there whether it was in Independence or 25 miles away. You simply cannot beat Wal-Mart, so we joined them." In 1985, its first full year in Independence, Wal-Mart had $10 million in sales; yet total retail sales for the town increased by only $2.1 million, reflecting a sharp decline in sales of the other local retailers. Over the next four years a dozen local businesses were closed (Bowermaster, 1989).

The increasing strength of large corporations is borne out in aggregate statistics. Jarmin et al. (2005) report that the share of US retail sales at 'mom-and-pop' firms fell from 70 percent in 1948 to 39 percent in 1997. Meanwhile, the share of US retail sales at 'Warehouse Clubs and Supercenters' and "Electronic Shopping and Mail Order House' rose from 2.2% and 1.9% of sales respectively in 1992 to 9.3% and 10% percent in 2016 (United States Census Bureau, 2018). These trends have contributed to the decline of the share of employment in firms less than five years old from about 18% in 1982 to 11% in 2011 (Decker et al., 2014). The underlying technological trends that enabled these changes not only continue, but are becoming more pervasive as other industries are affected (Brynjolfsson et al., 2008) .

What should regulators do about these changes?

One class of solutions is to modify data and information property rights, for instance by curtailing patent and trade secret laws protecting proprietary data systems. Weakening AI IP protection may increase small scale entrepreneurship and reduce top-percentile inequality, but also reduce total output and wages for those who create and work with AI (Benzell et al., 2015).

IP law can also empower ordinary people against large corporations by shifting the terms of negotiations. If AI faces decreasing returns from additional data, or if data from different individuals are close substitutes, then ordinary individuals have little market power in negotiating a price for the use of their information. Governments can empower citizens by enabling (or directly) collective bargaining on their behalf (see, for example, Posner and Weyl (2018)).

Another batch of solutions is to redistribute ex-post the surplus created by information-enabled monopoly power. There are powerful economies of scale inherit in competition in the age of AI.[1] Given a group of *ex-ante* nearly identical digital ventures, one may become dominant because of idiosyncratic and unpredictable circumstances amplified by positive feedback dynamics. Therefore, titans of industry may be analogous to lucky lottery winners, some of whose windfall can be safely

[1] In addition to increasing bargaining power via information centralization, AI and other digital technologies may create economies of scale because of high fixed and low marginal costs, network effects, because top innovators prefer to work together on cutting edge projects, and because AI itself is an increasingly important input in the development of AI.

shared without significantly hurting their incentives. This could be done through special taxes or social responsibilities for superstar firms. It could also be done through assigning liability for those harmed, directly or indirectly, by cloud devices.

There are a variety of reasons decentralized authority and power is attractive. By radically changing the speed with which information can be transmitted and analyzed, digital technologies have created opportunities for centralization at unprecedented levels of scale and scope. Accordingly, IP policymakers face a challenge on par with that faced upon the invention of the printing press. They will need economic research to identify options on the 'societal production possibility frontier' of fairness, equality and efficiency. They will need wisdom to select a point on this virtue frontier.

Technology has allowed us to overcome the biological limits on the concentration of power inherent in the limits of the human eyes, ears and brains. But given the economics of digital information and processing power, it may be up to IP law to create new limits on centralization. In today's economy knowledge is power, and IP policymakers are important power brokers.

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