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Gathering round Big Tech: How the market for acquisitions concentrates the digital sector

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Small businesses within the digital sector are spread across the USA. However, a significant number of promising small businesses concentrate in major technology hubs, either initially or through relocation. This phenomenon can be attributed to the influential role played by localized markets for financing and acquisition, which is, in turn, driven by the dominant market positions held by major digital platforms. Our research demonstrates a clear pattern of localized acquisition markets, particularly in sectors frequently targeted by the seven largest American digital giants—Amazon, Alphabet (Google), Apple, Microsoft, Meta (Facebook), Oracle, and Adobe, collectively known as 'Big Tech'. This localization trend has become more pronounced between 2000 and 2020. Our analysis indicates that the gravitational pull of these acquisition markets poses challenges to local initiatives aimed at fostering digital businesses. These efforts would be more successful if measures were taken to limit the market influence of digital platforms.

Keywords: Big Tech, digital start-ups, acquisitions, monopoly, regional inequality

JEL Classifications: R11, R12, F61, F63, O33

Introduction

For a great many reasons, digital technology start-ups *should* be a prime vehicle for local economic development in advanced economies such as the USA. Small digital firms can be found everywhere, and most entrepreneurs would like to keep businesses at home. However, those digital entrepreneurs whose firms have the potential for growth face a dilemma: they may prefer to keep their firm at home, but there are strong forces pulling them to relocate to one of the major technology hubs. To understand the limits to the use of a digital sector for development in most locales—any place outside of a major digital technology hub—we need to understand what pulls the high-growth firms away.

The pull factor for firm migration to big technology hubs is often understood in terms of classical agglomeration economies. In this view, knowledge spillovers, specialized labour and shared infrastructure make the hub a better, more productive place to do digital work. There is, however, a second pull factor: technology hubs serve as localized markets for the acquisition of start-ups by larger companies. The acquisition proceeds in stages, from initial venture capital (VC) funding to ultimate initial public offer (IPO) or acquisition by a larger company. With this second factor, the pull is not the attraction of enhanced productivity, but the prospect of sharing—via the proceeds from sale of the start-up—in the monopoly rents controlled by the big digital platforms, or the dream of establishing such a platform oneself.

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In the explorative analysis presented here, we argue that distinguishing between these two pull factors is important. To begin with, they have different dynamics. The productivity-related benefits of agglomeration trade-off against the benefits of locating in a quieter place. The financing ladder for digital companies, on the other hand, is so concentrated in space as to be effectively discontinuous. The VC needed for growth is spatially located in a few places. A digital entrepreneur seeking a large infusion of equity capital may need to locate in or relocate to a tech hub.

This difference in dynamics implies different policy remedies. To the extent that the pull towards the tech hub is from classical agglomeration economies, the usual local development advice for other places is to find some niche in the larger digital arena and to foster localization economies for that niche. Such a strategy might well be locally determined and executed. To the extent that the pull factor is instead from the acquisition market, the appropriate policy responses are entirely different. As we will argue in more detail below, within the present market structure, entrepreneurs with potentially high-growth digital start-ups *must* move to the hub. Making incremental changes in business conditions where they happen to be living is like telling an aspiring actor they can become a Hollywood movie star at home in Wichita because of the opening of a new repertory theatre. The policy remedies may well be national or even international, not local; they are (in tech, we are not claiming this about movies) in the realm of competition policy, whether anti-trust or regulation. The research agenda we are hoping to set out in this paper focuses on systemic forces that are holding regions back. As we argue, policy that aims to 'fix' an individual place, and make it more like already successful places, will not succeed in an environment where everything is stacked against them. Likewise, policies that react to isolated shocks, such as the China trade shock, are not geared up to the challenge at hand. This paper hopes to encourage more research into policies that may level the playing field for struggling regions.

This paper is organized as follows. In the next section, we briefly put forward the main reasons why digital start-ups *should* be an important element in local economic development generally. Then, we descriptively document the localization of the US acquisition market in digital technology, using data on the location of firms acquired by seven large digital platforms—collectively labelled Big Tech—between 2000 and 2020. We compare our data with other acquisitions and IPOs in the same industries, and with the more inclusive locations of small business administration (SBA) loans in those industries. In the following section, we interpret the localization of the acquisition market with both market structure and technological characteristics of the digital sector. Finally, we conclude, highlighting future research directions.

Why the digital technology sector should be a good bet for local economic development

The growing polarization of wealth between a few highly prosperous regions and regions with socio-economic decline has been at the centre of recent economic geography debates. Declining and impoverished regions around the world have been named 'left behind', 'held back', 'places that don't matter' or 'places with no future', and are seen as the hotspots of political dissatisfaction and rampant populism (Dijkstra et al., 2020; Feldman et al., 2021; Gordon, 2018; MacKinnon et al., 2022; Rodriguez-Pose, 2018; Rodríguez-Pose et al., 2021).

Entrepreneurial start-ups are often seen as promising vehicles for local economic development and potential enablers of improvements to conditions (for example, Feldman, 2014; McCann and Ortega-Argilés, 2016). But entrepreneurship in what? Sometimes, place-based policies are able to find opportunities for entrepreneurs to build on a region's industrial legacy or natural endowment, making the best of path dependency. In other cases, it appears promising to focus on digital technology.

Digital technology is, in historical terms, a general-purpose technology (Basu and Fernald, 2007; Carlsson, 2004; Lipsey et al., 2005): even more so than with mass production methods in the mid-20th century, or steam power in the mid-19th, digital technology is everywhere and in everything; it spreads into new sectors, and it keeps changing. For this reason, demand is strong both for new digital applications and for service of existing ones.

Yet, unlike many previous general-purpose technologies, digital technology is light in weight (Coyle, 1999). When the mass production of automobiles was providing the world's industrial template, the mass of the car (and of the materials and sequence of special-purpose machines required to make it) drove spatial concentration of the industry in places like Detroit and Turin. Today, biotechnology and pharmaceuticals require costly specialized laboratories in the R&D stages, and costly specialized factories in the production stage. Digital products, on the other hand, can be transported instantly anywhere: a small digital product can be made anywhere, and larger products or services are often put together on a distributed basis. Many large digital systems are designed in modular ways to accommodate the introduction of small applications and tools. Whatever barriers there may be to the growth of digital technology in small cities and remote regions, those barriers are not technologically determined scale economies.

Digital technology is important for local and regional economic development as a clean industry that employs highly educated workers and offers opportunities for entrepreneurs (for example, Malecki and Moriset, 2007). Entry barriers for new digital technology firms can be low, not only because many digital products or services can be produced or provided on a small scale, but also because the capital:labour ratio is relatively low, the required capital equipment is generally available, and the skills required very widely taught. Degree courses in computer programming/software engineering are widely offered by universities, as such skills complement the general footloose-ness, general purpose character and relatively low capital requirements of the digital paradigm. Finally, because digital technology is ubiquitous, and fundamental to so much of what we do, the methods and skills it uses are also useful in most other sectors, from heavy manufacturing to finance to public administration. Thus, digitalization diffusion may help reconfigure regional economic advantages also in peripheral or rural places (Anderson et al., 2020).

Founders of any digital start-up must decide where to locate. And for a start-up, digital or otherwise, there would appear to be a strong case staying close to its place of origin, or its founders' homes. There is good evidence that entrepreneurs have a clear preference for locating their firms where they already live or work (Dahl and Sorenson, 2012; see also Sorenson, 2018), and for public administrations to explicitly focus on digital skills, networks and policies with the goal of promoting local business competitiveness and boosting regional growth (OECD, 2019).

Preliminary evidence: the geography of Big Tech acquisitions

Here we contrast the spatial distribution of digital SMEs in the US *generally*, with that of firms in the same sectors which are acquired by the largest digital platforms. We call the latter Big Tech.

Our exploratory investigation relies on original data on all acquisitions made in the USA by the seven largest digital platforms in terms of market capitalization[1]: Alphabet (Google), Adobe, Apple, Meta (Facebook), and Oracle (headquartered in Silicon Valley), Amazon and Microsoft (located in Seattle), from their inception to the current time[2]. In this choice, we are making arbitrary demarcations between these firms and other large firms[3]. All of our seven Big Tech firms began as entrepreneurial start-ups. All received venture capital financing, except for Oracle, which instead leveraged federal procurement contracts. These firms all grew rapidly, went public and became exemplars of digital entrepreneurship. Their phenomenal growth, together with that of hundreds of smaller digital platform companies, contributed to the belief that digital technology offers an attractive building block for local economic development.

We begin by reviewing data on all acquisitions by these firms from their founding until 2020, both in the USA and abroad. After that, we focus on acquisitions in the USA between 2000 and 2020, because for that country and time we are able to do comparisons that would not be possible for the whole time period or for the international sample.

Table 1 provides an accounting of acquisitions, by acquiring company, from their earliest acquisition through 2020. We start with all full (100%) acquisitions made by Big Tech and their subsidiaries. Data are drawn from three databases, Zephyr-Bureau van Dijk, Capital IQ-S&P and SDC Platinum-Refinitiv, and then cross-checked and verified through manual searches. We pay specific attention to the initial location of the acquired firms using company websites and the *Wayback Machine Internet Archive*. Acquisitions which cannot be verified through either mention on the company website or news articles are excluded from our sample on the assumption that these are likely 'acqui-hires' where the start-up's core team joins the Big Tech, and the start-up subsequently ceases operations. The Supplementary Appendix details the procedure used

Table 1. Background on Big Tech acquisitions

Big Tech	Year founded	Year of IPO	Year of first acquisition	Number of world-wide acquisitions	Average number of acquisitions per year (standard deviation)	Number of US-based acquisitions (% of all acquisitions)
Microsoft	1975	1986	1987	235	8 (5)	69%
Apple	1976	1980	1988	109	5 (4)	61%
Oracle	1977	1986	1997	135	6 (4)	84%
Adobe	1982	1986	1990	49	2 (1)	73%
Amazon	1994	1997	1998	94	5 (3)	70%
Alphabet	1998	2004	2001	237	12 (9)	74%
Facebook	2004	2012	2007	81	6 (3)	68%
Total				940		674 (72%)

Source: Compilation by authors of Big Tech acquisitions from: Bureau van Dijk's Zephyr, S&P's Capital IQ and Refinitiv's SDC Platinum. Additional verification of acquisitions was carried out through manual search. Included are all 100% acquisitions.

to construct this list and shows statistics for the various data sources.

In total, the seven Big Tech acquired 940 firms worldwide, with 674 acquisitions based in the USA. Notably, all Big Tech firms started acquiring other firms in the years immediately following their own IPO. Alphabet completed the largest number of acquisitions to date (237), closely followed by Microsoft (235). Acquisitions occur consistently over time, with the annual average number of acquisitions ranging from 12 a year for Alphabet, to two for Adobe.

For all of these firms, the majority of acquisitions were sourced from the USA, with 266 (28%) acquisitions of firms based outside the USA (Table 2): the largest number of international acquisitions are from the UK (50), Canada (42) and Israel (32). This pattern broadly reflects the distribution of major high tech hubs, and their linguistic and political affinities with the USA, as identified in Arora and Gambardella (2005). Thus, with the exception of India, Asia is under-represented, with very few acquisitions from China, Japan or Korea. In most countries for which the numbers are large enough to generalize, we see an overwhelming concentration in the country's financial capital—London, Tel Aviv, Paris, Stockholm, Dublin. However, in Canada and Germany—both federal, polycentric states—the pattern is more geographically dispersed.

We limit our further analysis to 603 acquisition targets with known locations in the USA for the two decades 2001–2020[4]. Table 3 gives a breakdown of the Big Tech acquisitions by metropolitan statistical areas (MSAs) and the percentage that had previously received venture capital investment. Investor (vendor, to Zephyr) data are from Zephyr and include the majority owners at the time of acquisition, which are similar to the ownership information that would be provided in an IPO prospectus. Reliable data are only available after 2001. While VC is the largest source of financing, businesses' founders, angel investors and other entities such as banks and wealth and investment management firms were mentioned. There was only one public-private equity investment from the New York City Investment Fund LLC, now known as Partnership Fund for NYC. Individual investors include founders and angel investors. Two universities were listed: Stanford

Table 2. Big Tech acquisition targets beyond the US: regions within countries with concentrations of acquisitions, 1987–2020.

United Kingdom	**50**		**Germany**	**9**	
London		34	**Netherlands**	**8**	
South East		9	Utrecht		3
North West		3	Zuid-Holland		2
Canada	**42**		Helsinki-Uusimaa, Finland		7
Vancouver		12	Dublin, Ireland		7
Toronto		12	**India**	**6**	
Waterloo		6	Karnataka		5
Montreal		5	**Switzerland**	**6**	
Ottawa		4	Zurich		4
Israel	**32**		Hovedstaden, Denmark		5
Tel Aviv		20	**Spain**	**5**	
Central		8	**Australia**	**4**	
France	**15**		**Italy**	**3**	
Ile-De-France		11	**Brazil**	**2**	
Rhône-Alpes		3	**Portugal**	**2**	
Sweden	**11**				
East Sweden - Stockholm		7			
South Sweden		3			

Note: Regions with 2 targets each: East of England, United Kingdom; North & Jerusalem, Israel; Berlin, Germany; Zuid-Holland, Netherlands; Madrid, Spain; New South Wales, Australia; Lombardia, Italy; Minsk, Belarus; Tokyo, Japan; Auckland, New Zealand; Bucharest, Romania; Dubai, United Arab Emirates
Regions with 1 target each: Andalusia, Spain; Baden-Wuerttemberg, Germany; Basel-City, Switzerland; Bayern, Germany; Brandenburg, Germany; Bretagne, France; Catalonia, Spain; Central Bohemian Region, Czech Republic; Edmonton, Canada; Flevoland, Netherlands; Guangdong, China; Hessen, Germany; Kuala Lumpur, Malaysia; Lisbon, Portugal; Lucerne, Switzerland; Luxembourg; Minas Gerais, Brazil; Noord-Brabant, Netherlands; Noord-Holland, Netherlands; Norte, Portugal; North Rhine-Westphalia, Germany; Ostlandet/Viken/Baerum, Norway; Pomorskie/Gdansk, Poland; Quebec City, Canada; Queensland, Australia; Reggio Emilia, Italy; Regina, Canada; Santa Catarina, Brazil; Schleswig-Holstein, Germany; Scotland, United Kingdom; Seoul, South Korea; Singapore; South West, United Kingdom; Telangana, India; Thuringia, Germany; Valencia, Spain; Vastra Gotaland, Sweden; Victoria, Australia.

Table 3. Top US locations for Big Tech acquisitions, 2001–2020.

	Number of acquisitions (share of total)	Companies with VC investment (%)
Total	846 (100%)	35
Non-US	243 (28.7%)	25
Total US	**603 (71.2%)**	**49**
San Francisco-Oakland-Berkeley, CA	168 (19.9%)	51
San Jose-Sunnyvale-Santa Clara, CA	123 (14.5%)	58
New York-Newark-Jersey City, NY-NJ-PA	60 (7.1%)	55
Boston-Cambridge-Newton, MA-NH	39 (4.6%)	51
Los Angeles-Long Beach-Anaheim, CA	37 (4.4%)	41
Seattle-Tacoma-Bellevue, WA	30 (3.5%)	37
Chicago-Naperville-Elgin, IL-IN-WI	11 (1.3%)	27
Austin-Round Rock-Georgetown, TX	10 (1.2%)	60
San Diego-Chula Vista-Carlsbad, CA	10 (1.2%)	20
Washington-Arlington-Alexandria, DC-VA-MD-WV	9 (1.1%)	44
Boulder, CO	8 (0.9%)	50
Pittsburgh, PA	7 (0.8%)	43
Atlanta-Sandy Springs-Alpharetta, GA	6 (0.7%)	50
Baltimore-Columbia-Towson, MD	5 (0.6%)	80
Dallas-Fort Worth-Arlington, TX	5 (0.6%)	40

(in the Silicon Valley) and the University of Washington (in Seattle). About half of the 603 US acquisitions received venture capital investment, whilst that was the case for only one-quarter of non-US acquisitions.

Note the extreme concentration in the Silicon Valley, which we define as the combined San Jose-Sunnyvale-Santa Clara and San Francisco-Oakland-Berkeley MSAs (see Osman, 2015 for a justification). The largest number of firms (291, or almost half of the US Big Tech acquisitions) were in the Silicon Valley at the time of acquisition, with 54% of the companies receiving VC investment. Four other MSAs form a distinct second tier for acquisitions: New York (the US financial capital), Boston and Los Angeles (both important centres of both technology and private equity finance) and Seattle (the home of Microsoft and Amazon). Note that the Seattle MSA has a population less than 1/5 of New York's, but half the number of takeover targets. Overall, 49% of the acquired companies had received VC investment: the percentage is slightly higher, among the main hubs, in the Silicon Valley, New York and Boston.

We compare the spatial distribution of Big Tech acquisition targets to the distribution of four different sets of firms seeking finance in relevant industries. Three-quarters of the seven Big Tech acquisitions are attributed to three Standard Industrial Classification (SIC) codes: 7371—computer programming services, 7372—prepacked software and 7374—computer processing and data preparation and processing services. The remainder of the acquisitions were widely dispersed across SIC codes. The ideal control group would be national longitudinal firm level data for firms in the relevant sector: however, such data are unfortunately not readily available (see also Feldman et al., 2022; Johnson et al., 2022). We construct four comparison groups that are limited to these three SICs, using the sources and definitions described in Table 4. We motivate the use of this sample in more detail in the Supplementary Appendix.

The broadest of the four comparison samples consists of 6213 firms in the three SIC codes that received small business administration (SBA) 7(a) loan guarantees. This is a large national program available to small firms—here in our digital technology sectors—that are seeking investment funding. To qualify, firms need to demonstrate they are a viable going concern and have a plan to grow. Crucially, these loans are nationally available and not dependent on interpersonal connections and thus provide a comparison sample. These businesses indicate a pool of businesses in the tech sector, at least ambitious enough to apply for a government loan, and financially viable enough to receive it. Most of these firms are far removed from the fast-growing acquisition targets. They are of interest to us here as indicators, in their various localities, of a digital technology sector which includes entrepreneurial start-ups seeking finance for growth. Their geographical dispersion suggests, consistent with claims that digital technology *should* be a good focal point for local economic development, that many cities provide environments in which digital technology firms are able to operate and to grow.

Table 4. Comparison groups, 2001–2020.

Comparison group	Definition	Source	Number of firms
US Big Tech acquisitions	Acquisitions of the 7 Big Tech firms	Multiple sources (see Supplementary Appendix)	603
Small business administration 7(a) loans	Start-up firms in one of the three relevant SIC codes—7371, 7372 and 7374—that received an SBA7a loan	Small Business Administration	6213
All other US acquisition	Acquisitions in the USA, excluding those of Big Tech, in one of the three relevant SIC codes—7371, 7372 and 7374	Zephyr	3005
Businesses invested in by the same VCs who sold firms to Big Tech	Subsample of the above	Zephyr	1031
Nasdaq IPOs	Initial public offerings (IPOs) of US-based companies in one of the three relevant SIC codes—7371, 7372 and 7374	Zephyr	196

A narrower sample consists of the 3005 firms listed in the Zephyr database as having been fully acquired, but with a purchaser *other* than one of our seven Big Tech (all other acquisitions). The narrowest sample consists of the 196 firms which had IPOs on Nasdaq, the leading exchange for tech company stocks. These latter two comparison groups comprise nearly the full population of successful digital tech start-ups in the USA in recent years. Finally, we also compare with a subset of the all other acquisitions sample: 1030 firms sold by VC firms which also sold firms to Big Tech. Just as the map of international Big Tech acquisitions is not the global map of digital technology, neither is the US acquisitions map the same as the map of the sectors involved.

Table 5 examines the geographic distribution of the comparison data sets. Silicon Valley has the highest count of firms for all the categories except SBA loans, which has a larger geographic reach. Firms that receive SBA loans have the human capital and organizational capabilities required to establish start-ups in these industries and are widely geographically distributed. The counts of firms applying for SBA loans encompass a much larger set of places and suggests that public financing may be an alternative substitute when VC funding is not available. New York City, the largest metropolitan area, is more heavily represented by SBA loans.

Figure 1 summarizes the dispersion, measured as Herfindahl-Hirschman Index (HHI) across metropolitan statistical areas (MSAs), for the different groups, in two periods. In each period the rightmost bar is the HHI for the MSA population itself. The next bar shows SBA loan recipients, somewhat less dispersed than the population. Both IPOs, and acquisitions by other firms, are substantially more concentrated than SBA loans, but less than Big Tech acquisitions, or other businesses sold by Big Tech vendors. All of the more geographically concentrated categories were even more concentrated in 2011–2020 than they had been in 2001–2010.

Figure 2a plots SBA loans against MSA population, while 2b plots a composite measure consisting of firms sold to Big Tech, sold to other firms, or sold to the public in IPOs, against MSA population. The SBA loans are a proxy for the overall activity of digital SMEs in the three relevant SIC codes in a city, and the composite measure captures the overall acquisitions market.

Among the smallest MSAs, there are a significant number with no or very few SBA loans. Above an MSA population of about 500,000, the relationship between SBA loans and population is nearly linear, supporting the view that entrepreneurial firms in digital technology can be established in any agglomeration of more than modest size. For digital acquisitions, the drop-off among smaller MSAs is more extreme, and for larger MSAs the dispersion at any given level of population is also extreme. Compare, for instance, both SBA loans and acquisitions in three MSAs of about the same population: Detroit, San Francisco and Boston. In Figure 2a, we see that Boston and San Francisco each have about twice the number of SBA loans as Detroit does. Comparing the digital acquisitions and IPOs in the same cities (2b), we see that Boston has about 20 times the number as Detroit, while San Francisco weighs in at over 45 times Detroit.

How platform monopoly pulls high-growth digital start-ups away from other places

We assume that the entrepreneur's motivation for location in—and *re*location *to*—a Tech Hub is driven by a combination of Marshallian agglomeration economies intensified by monopoly power (Feldman et al., 2021). The specialized

Table 5. Geographical distribution of comparison datasets (2000–2020).

All acquisitions in relevant industries		**Other businesses sold by Big Tech vendors**		**Nasdaq IPOs**		**SBA 7(a) loans**	
San Francisco	320	San Francisco	153	San Francisco	24	New York	404
New York	285	San Jose	115	San Jose	23	Los Angeles	268
San Jose	264	New York	89	Boston	22	Washington, DC	237
Boston	157	Boston	49	New York	9	Chicago	199
Los Angeles	115	Los Angeles	41	Washington, DC	9	Dallas-Fort Worth	183
Washington, DC	106	Seattle	32	Los Angeles	8	Boston	166
Seattle	89	Austin, TX	32	Chicago I	7	Minneapolis	166
Atlanta, GA	83	Washington, DC	25	Atlanta, GA	6	San Francisco	162
Chicago	70	Chicago	16	Austin, TX	5	Atlanta, GA	141
Austin, TX	67	Philadelphia	15	Dallas-Fort Worth	5	Miami, FL	127
…	…	…	…	…	…	…	…
Total	3005	Total	1031	Total	196	Total	6213

Notes: Includes businesses in SIC codes: 7371, 7372 and 7374. Acquisitions made between 2000 and 2020.
Source: Zephyr, augmented with manual search.

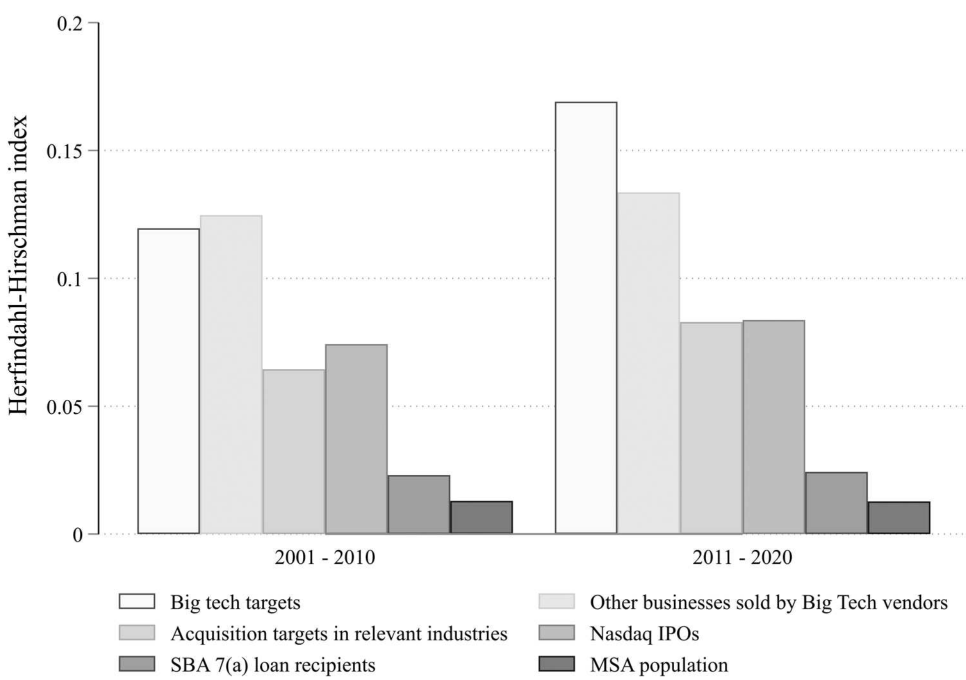

Figure 1. HHI across MSAs, for comparison datasets (2001–2010, 2011–2020).

Note: The Herfindahl–Hirschman index is defined as the sum of MSA shares in each category, that is, the number of firms based in a particular MSA as a share of the total number of firms in a given sample. Includes businesses in SIC codes: 7371, 7372 and 7374. Acquisitions made between 2000 and 2020.

Source: Zephyr, manual search.

agglomeration—our *hub*—can offer advantages of better matching (of workers to jobs; of firms to suppliers, customers, sources of finance), knowledge (learning through spillovers, collaborations), and sharing (use of indivisible specialized resources and infrastructure). For Marshall, and also for Duranton and Puga (2004), all of these advantages come into play simply due to proximity, while neo-Marshallian accounts (for example, Piore and Sabel,

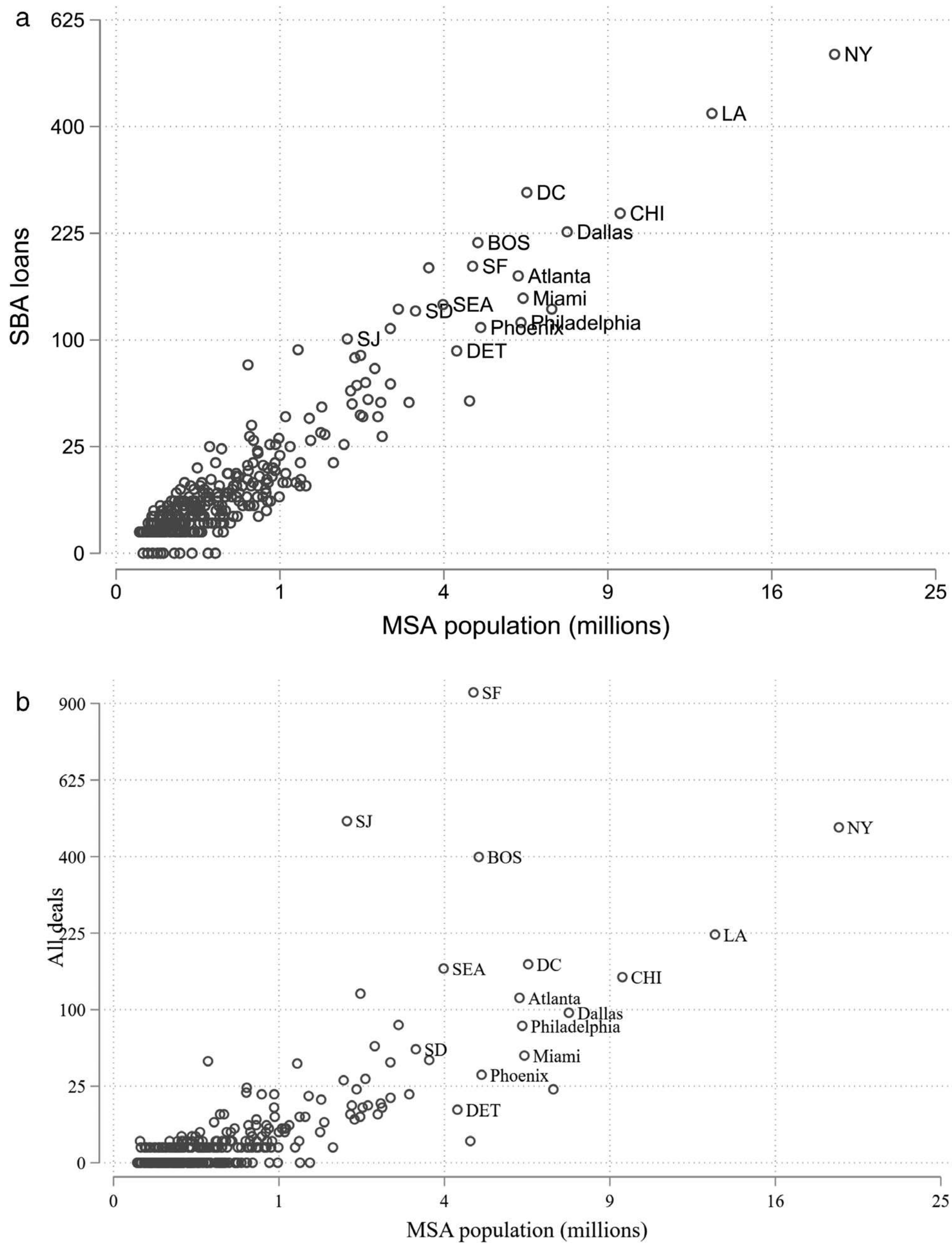

Figure 2. Geographical dispersion across MSA of (a) SBA loans and (b) acquisitions + IPOs.

Note: Axes are on an exponential scale. All deals include Big Tech acquisitions in relevant sectors and Nasdaq IPOs in relevant sectors.

1984; Pyke et al., 1990) stress social networks and local institutions in facilitating (or in other cases, impeding) the matching, learning and sharing processes.

It is common in the literature to associate the pecuniary benefits of a specialized agglomeration with both competition and efficiency. Workers (and here we can include entrepreneurs) locating in the hub are more productive; localized increasing returns are a positive externality created by the co-location of firms. In formal microeconomic models, the firms are in a monopolistic competition equilibrium. In the less formal, more discursive Marshallian and neo-Marshallian literature, the localized external benefits found in a healthy specialized agglomeration ('industrial district') are seen as substituting for scale economies, allowing SMEs to compete in a world that might otherwise be dominated by giants.

Large digital technology firms are not simply present but are part of what draws high-growth start-ups to the hubs through the potential of an acquisition. This is beyond the case of co-location for the purpose of efficient supply of inputs to a large firm—*not* what is variously called an industrial complex (Gordon and McCann, 2000), hub-and-spoke (Markusen, 1996) or solar (Piore and Sabel, 1984) model. In the digital case, the start-ups locate in the hub to sell their entire young company to the large firms. In the process, the entrepreneurs aim to share in the Big Tech's monopoly rents.

The literature often fails to distinguish between these two pecuniary motives for a digital start-up's move to a hub—productivity and rent sharing. This is particularly conspicuous in understanding the role of venture capital. Start-ups which seek to grow rapidly are well advised to locate close to venture capital firms: VCs speak of a 'one hour rule', meaning the maximum travel time to a start-up for which the VC is the lead funder (Griffith et al., 2007; Wray, 2012). If we think of the VC as simply a source of finance for the growth of the firm, then proximity to VCs could be just one part of the agglomeration economy picture, on the same footing as knowledge spillovers or better matching with specialized labour (see, for example, the treatments by Guzman (2019) or Storper et al. (2015)). VCs do not simply bring in more capital to the start-up: their funding is a control transaction which is the beginning of a chain of control transactions. The VC seldom seeks to continue control of the start-up in the long term. Instead, their plan to realize a liquidity event, which often results in positioning the start-ups to participate in the market for acquisitions (Breznitz, 2021, ch. 3). The ultimate buyers for successful high-growth digital start-ups are most often large, monopoly, digital platforms.

We are interested in the role of monopoly, and the pursuit of a share of monopoly rents, not because it undermines the normatively favourable portrayal of specialized agglomerations—efficiency! Competition! SMEs!—but because of its implication for the policies needed to foster a digital sector in non-core, peripheral regions and left-behind places.

Networks, monopoly and platforms

A digital platform is a type of *network* business. In economic terms, networks are systems in which the value to individual participants grows as the number of participants increases. Some networks are open public systems. For instance, what we call a 'free market' is an idealized open public network, in which buyers and sellers connect in a setting mediated by a minimal set of institutions. The benefits of such open networks are distributed widely among their users—in the case of markets, we call this 'gains from trade'. Open networks, however, have always attracted would-be toll collectors—robber barons, empires, corporations, etc. Toll collectors appropriate some of the gains to trade; they may also offer protection for the market, or management services.

Like a free market, the Internet is an open public network; so is the layer of Internet applications called the World Wide Web. These open networks offer settings within which various smaller networks may be created, and often controlled, by one toll collector or another. Big Tech firms are the most successful such toll collectors, having developed seemingly unassailable market positions, and very high ratios of market value to book value of assets (Feldman et al., 2021), despite relying largely on widely available general-purpose technologies and delivering their services via what are largely open, common carrier networks (the Internet, the Web).

Although some platforms are very large, have very high ratios of market value-to-book value of assets, and in some cases have no remotely comparable competitor, it is often difficult to see just where the barriers to entry are, or over what sphere monopoly power is exercised. It is worth taking a moment to consider how these giant firms have created their networks and then created and defended their toll gates.

The use of the digital medium of word processing files gives us networks among those users who save documents in a common format; proprietary control of the precise format codes gave an advantage to software vendors with large user bases. Microsoft leveraged its exclusive control over the tiny read-only memory for IBM-standard personal computers into dominance of PC operating systems, and from that to word processing software. Following the same strategy, Microsoft built Word into Microsoft Office, built MS-DOS into Windows, and extended the dominant position of Windows as an operating system for personal computers into certain classes of server (European Committee for Interoperable Systems, 2009).

All of our Big Tech—and many smaller digital platform firms as well—are monopolists in the following sense: they have unique (monopoly) control of key points of access to some large network of users, and are thus able to turn some portion of the network externality into rent. In this respect the Microsoft example may be confusing, because Microsoft is also a monopoly in the ordinary, non-network sense: it has overwhelming dominance in the provision of certain kinds of desktop software. Its dominance in these product categories happens to have grown out of—and is maintained by—its control of user networks. The unique thing Microsoft has to sell is not word processing capability, but the ability to share documents with others. In its particular case, the network effect has been so powerful as to make one company dominant, globally, in a certain product space.

Yet a company may have monopoly control of a network without monopoly control of any particular type of product. Thus, while Google and Apple are duopolists in the world of mobile phone operating systems (Android and iOS), from the standpoint of a company that makes a phone app, both Google and Apple are network monopolists—there is only one route to iPhone users, and that is through Apple.

Finally, the digital network businesses which concern us here are *platforms* (Kenney and Zysman, 2016; Rikap, 2020). Although each has a network which may initially have been based on connecting users of a single service or product, the network is then employed as a platform from which to sell other goods and services to the same customers, or to sell more information about those customers to advertisers (Ducci, 2020; Stallkamp and Schotter, 2021). What we see here are economies of scope—often a complement to economies of scale (Chandler, 1990)—applied by network monopolists. For example, Amazon grew from selling books into 'the everything store', both as vendor and as gatekeeper to a vast marketplace (Stone, 2013); Google's and Facebook's growing portfolios of free services help them to assemble profiles of their users, which then becomes a revenue source as a product valuable for advertisers (Zuboff, 2019).

In short, the large digital platforms offer services which can be extended, at very low marginal cost, to global markets, which has led to the accumulation of vast financial power. They also have a business model geared to the ongoing addition of new services and features. It should therefore be no surprise that they have emerged as important acquirers of digital start-ups. Both the monopoly power of the tech giants, and their appetite for acquisitions, have drawn both public and academic scrutiny. We turn here to the latter.

Attractive start-up seeks generous older platform

We return now to the question of what it is about proximity to big monopoly platforms which attracts digital start-ups. We argue that it is a matching process as the monopoly platforms, by providing a market for digital start-ups, foster winner-take-all tournaments in which the platforms fund the prizes (Frank and Cook, 1995; Lazear and Rosen, 1981). Contestants in these tournaments are far more likely to succeed if they are in close geographical proximity to their VC and to offices of the platforms themselves; and, the platforms and the acquisition tournament shape innovation in the sector.

Digital products have high sunk costs in R&D and high fixed costs in maintenance, but very low marginal costs in distribution to additional users. The current regulatory environment permits network monopoly: we have seen this in the networks on which large digital platforms are based, but it applies on a smaller scale to various apps and digital services. Moreover, new digital products draw from a common well of existing general-purpose technologies, and it is usual for competing start-ups to be trying to solve the same problem, aiming for the same product space. Proprietary digital products in this competitive environment must be scaled quickly, before a competitor has a chance to establish a de facto technical standard or enlist a certain set of users in a network. Even then, the odds favour failure for most firms (Schilling, 2002). Digital firms competing in markets with this winner-take-all structure do not have the time for gradual growth financed from retained earnings. They are undertaking something too risky to be financed by debt. Thus, digital firms require a rapid infusion of equity capital, such as that provided by a VC. The VCs can be seen as selling admission tickets to a tournament; ultimately, it is the large platforms which fund the tournament and select the winners.

Many have noted the localization of VC funding and other resources for the growth of digital start-ups (for example, Florida and Mellander, 2016; Kenney, 2011). Yet acquisitions and market power are absent from these analyses, as from Guzman's (2019) study of motivations for firm decisions to locate in the Silicon Valley, and Kerr and Robert-Nicoud's (2020) review of the frantic attempts of places to brand themselves as 'Silicon Something'. There is also a substantial literature on acquisitions by the tech giants, some of it recalled in connection with innovation. But this latter literature is strangely silent on geography; reference is made to 'space', 'cluster' or 'zone', but these refer to products or technologies.

The inclusion of geography and places in the digital start-up and VC literature allows us to imagine tech hubs as classical Marshallian or neo-Marshallian entrepreneurial clusters, with a bit of venture capital added. However, most of the digital firms funded by VCs will soon either be sold on to one of the big companies in the cluster, or closed down altogether. This raises the additional question of why the tournament is so localized.

Much has been made of the importance of geographical proximity, and face-to-face contact, for knowledge flows (where tacit content is high) and for the reduction of transaction costs in buyer-supplier relations (where the hazard from opportunism is great). This begins with Marshall's knowledge 'in the air'. Other important modern contributions include Storper and Venables (2004) on knowledge flows, and Owen-Smith and Powell (2004) on the way face-to-face contact facilitates communication between organizations. The particular importance of face-to-face meeting for innovation has been shown, among others, by Arita and McCann (2000) for R&D collaborations by Silicon Valley firms with others, and by Catalini et al. (2020) for research projects involving multiple universities. It is plausible that both the knowledge exchange and the opportunism risks in the decision about buying a company would necessitate an ever higher level of face-to-face contact, as Bathelt and Henn (2021) indeed find. In light of this, the strong geographic and industry localization of VC investment, shown by Sorenson and Stuart (2001), and concisely expressed in the one-hour travel rule, is not surprising. As Breznitz (2021, ch. 2) shows, for the venture capitalist the focus is always on realizing a return from the exit, ideally within five years, and the stakes are extremely high. For this reason, VCs like to locate start-ups close to themselves as well as in front of potential acquirors. Given these dynamics, even when founded elsewhere, promising start-ups never get embedded in their local communities and move to the location of their investors soon after receiving VC finance (Breznitz and Taylor, 2014).

The chain of events from the creation of a digital start-up, to its dissolution, acquisition or IPO, could be seen as a hothouse for innovation. Whether this produces more or less innovation than would occur in a system not so bound up with acquisitions, we cannot know. What can be seen is that it both localizes innovative activity in the tech hubs, and shapes the direction of digital innovation to meet the needs of the big platforms.

The major digital platforms do have considerable internal research capabilities. Yet they conduct less research when compared with the industrial giants of the previous century, such as General Electric, IBM and AT&T (Arora et al., 2020). Big Tech tends instead to source through acquisition rather than internal development (Lazonick, 2009; Rikap and Lundvall, 2020).

There is evidence that this narrows the range of digital innovation. Gautier and Lamesch (2020) review the acquisitions by five Big Tech companies (Google, Amazon, Facebook, Amazon and Microsoft or GAFAM) during 2015–2017. They find that such acquisitions mostly fall in GAFAM's core markets segments or product spaces, and that most of the acquired products are discontinued soon after. This pattern implies the acquisitions are largely motivated to gain intangible assets such as intellectual property rights and talent. Similarly, Argentesi et al. (2019) conclude that acquired products and services are largely complementary to those already supplied by the three companies. This is supported by Lopez Giron and Vialle (2017) in their study of Microsoft's acquisitions in the period 1992–2016, focusing on acquired resources and competences: the largest share of acquisitions complements (rather than diversifies) Microsoft's core businesses, as also found for Amazon by Zhu and Liu (2018). Bryan and Hovenkamp (2020) show that start-ups which aim to be acquired are biased toward inventions that improve the leader's technology, rather than offering alternatives. A tech giant's acquisition or development of a product can thus create a 'kill zone', in which competing projects struggle to get both users and capital (Kamepalli et al., 2020)[5]. This can happen whether the new product is acquired externally or developed within the big firm. Thus, Wen and Zhu (2019) find that smaller competitors reduce innovation and raise prices when Google signals internal development of a new app or capability for Android.

Conclusions

Theories of cluster dynamics have addressed the relationships between large and small firms (for example, Feldman and Lowe, 2015; Feldman et al., 2005). Large firms are seen as anchors to a cluster, connecting the cluster to distant markets and sources of knowledge. Such have variously been labelled hub-and-spoke cluster, solar cluster, or industrial complex serving the needs of larger client firms (Gordon and McCann, 2000; Markusen, 1996; Piore and Sabel, 1984). Small firms may also be clustered close to large firms because they were founded by former employees (Klepper 2011, 2015).

We add a different spatial dynamic between large and small firms, which we observe in the marketplace for acquisition of the small firms by the Big Tech firms. Some start-ups seek venture capital finance to scale and establish market position. Finance for start-ups which take this path typically comes in several stages, but the final stage is a liquidity event—an IPO or (far more often) the sale to another company (Stuart and Sorenson, 2003). Through this mechanism the large platforms are able to outsource much of their research and development. From these factors, the market for acquisitions is born and it is highly localized.

This dynamic involves the interaction of monopoly power, with the financing of the growth and acquisition of tech start-ups. Monopoly and finance are seldom addressed in the literatures of agglomeration generally, or specialized clusters in particular. We must stress that we are not making an argument here about acquisition markets and monopoly *in general*, nor about acquisition markets and new technology *in general*. There are particular characteristics of digital technology and the network-based digital platform business model which appear to drive this localized market. These platform businesses are able to use existing and open network infrastructure to reach global user networks from very small geographical bases. Their control of network access gives them monopoly power, and financial resources to match. An existing platform enjoys a low marginal cost of reaching customers for new features and services, so it seeks new ones to add. The large platforms' monopoly power gives them a privileged position for the introduction of new services to the market, which raises the amount they can offer for a start-up. Digital start-ups, particularly those located in more peripheral regions, have relatively small work forces and scant physical capital, so are easy to move. Many of these characteristics can be found in one sector or another, but digital products distributed over the Web are perhaps unique in having all of them.

It is possible to start and operate a digital SME far from any of the tech hubs—we see this in the distribution of digital firms applying for SBA loan guarantees. Digital firms with the potential for high growth, however, are best off locating where the acquisition market is: cities where VCs and big platforms are concentrated. As we cannot show directly with the data at hand, but Breznitz (2021) has demonstrated, this pulls high-growth start-ups away from other, less central, places.

Place-based policies may be effective for helping an area nurture and retain digital firms which are not candidates for the acquisition market. In most places, there is little that such policies can do to retain firms whose best prospects do lie with that market. The larger and richer the monopoly platforms, the larger will be the share of digital start-ups that fall in the second category, beyond the reach of local policies. For this reason, we suggest that policies which reduce the market power of the big platforms may make place-based policies in other, often peripheral, areas, more effective.

The problem of network monopoly has been faced before. In the late 19th and early 20th centuries, for instance, then-new network industries such as electric power, telephones and railways developed huge power, and were subsequently brought either under public ownership or public regulation, almost everywhere in the world. The various modes of regulation are beyond the scope of this paper. The geography of a digital platform firm is much different from the old network industries, and that different geography makes for a different politics of regulation. The platform firm typically has assets and employment concentrated in a few locations, for which it is an important export industry—that is precisely why state and local governments seek to foster tech clusters. Big platform firms exercise market power nationally in the USA, and internationally. Within the USA, the economic interests of the major tech clusters are in conflict with those of other, often disadvantaged, regions. Internationally, the maintenance of Big Tech's monopolies has become a central pillar of US trade policy (Guy, 2007; Rodrik, 2018). Should this situation change—following, perhaps, the sorts of measures outlined by Kamepalli et al. (2020)—the consequent decline in the acquisition market should make it more feasible to foster the growth of digital start-ups in what are now peripheral left-behind places.

Our exploratory study leaves many questions for future research to answer. First, our data have tried to identify the location of acquired firms using the best archival methods that we have available. In the absence of longitudinal data, we have tried to discern the initial location of small digital firms at the time of acquisition. The question of exact timing of when a firm begins is often difficult to pinpoint, as the entrepreneurs may have incubated the idea earlier and in a different location. Thus, our results may not capture the full geographic distribution of the earliest stage of firm formation. Second, our results are merely descriptive: further analysis could consider a matched sample of small digital firms that are *not* acquired. Moreover, what we have observed in the case of seven large digital platform companies is just one corner of the larger picture of the geography of market power and acquisitions. What goes for digital platforms may, or may not, go for other types of information-based product with extreme increasing returns and wide geographical reach, such as pharma, biotech, and digital media. Moreover, with digital platforms and with others, how much of the acquisition market is held by giant firms, as opposed to merely large ones? In the first instance, both questions could be addressed through a mapping of takeover relationships—locations, distances—in relevant industries. Finally, the relationship between technology, market structure and geography may likely vary across countries. Our future research will examine this in the case of Europe.

Endnotes

1 As of 30 April 2020, www.statista.com

2 Oracle has moved its headquarters to Austin, Texas in 2020. The headquarter was located in Silicon Valley for the time period covered by the empirical data.

3 Examples of neighbouring categories are: non-US platforms (China has at least two, on the basis of market valuation, Alibaba and Tencent Holdings); payment platforms (inclusion of American payment platforms with similar market valuations would have changed the geographical picture little, with two in the Silicon Valley (Visa and PayPal), and one in New York (Mastercard)); hardware (the standards of Intel or Nvidia can be regarded as platforms; both had market capitalization within a comparable range and are based in the Silicon Valley); telecommunications (mobile phone networks, although network businesses, are as much physical as digital, with assets and employees accordingly dispersed); and entertainment (Netflix and Disney are network services with digital products, but also substantially production companies).

4 There were 6 (0.9%) US acquisitions for which the location of origin could not be reliably identified.

5 A kill zone like this needs to be distinguished from the strategy of 'acquire to kill', which is seen in the pharmaceutical industry (Cunningham et al., 2021), where patents are more powerful while network monopolies are absent. The kill zone, on the other hand, is not a strategy, but a by-product of a market structure dominated by a few large customers.

Supplementary material

Supplementary material is available at *Cambridge Journal of Regions, Economy and Society* online.

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