The shape and structure of entrepreneurial and innovative places

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Interactions primarily occur between those living and working in close proximity to one another. This essay explores some consequences of that fact for places. It offers three principle propositions: (1) Compact buildings, neighborhoods, and cities, and denser places, should promote higher rates of entrepreneurship, innovation, and economic growth because they reduce the costs of interaction. (2) More integrated places should also promote entrepreneurship and innovation because the average person in those places interacts with a more diverse set of others. (3) In more segregated and unevenly distributed places, people diverge more, as a function of where within the place they live and work, in their propensities to innovate and to found firms.

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Introduction

Much of the research on entrepreneurial ecosystems has focused on the set of elements available within a region (e.g., Etzkowitz and Leydesdorff 2000; Furman et al. 2002; Stam 2015; Spigel 2017). Does a place have firms or universities with an abundance of discoveries in need of commercialization (Huggins and Johnston 2009)? Does it have ample human and financial capital (Stuart and Sorenson 2003)? Does it have a supportive legal and institutional environment (Saxenian 1994; Gilson 1999)?

But even among places that would appear to have the right mix of elements, rates of entrepreneurship and innovation can vary tremendously. Boston and Atlanta, for example, both appear to have most of the elements important to supporting a biotech cluster: world-class hospitals, universities, and research institutes. Yet, one has been a hotbed of innovation and entrepreneurial activity while the other has not (Powell et al. 2002). As with a recipe, the result appears to depend not just on the ingredients but also on the way in which they have been mixed.

One reason why we might see such differences stems from a fundamental aspect of human interaction. People tend to meet and maintain relationships with those who spend time in close proximity to them. That fact holds at every level of spatial resolution. People primarily interact with those living and working in the same country, county, city, and community (Rivera et al. 2010). Even at the scale of a city block or building, people more commonly connect with those closer to them (Bossard 1932; Festinger et al. 1950; Allen 1977). These interactions and the social relationships stemming from them serve as the social infrastructure for innovation and entrepreneurship by facilitating the recombination of ideas and the mobilization of resources (Sorenson 2018).

The shape and structure of a place influence the ease with which and extent to which people interact. Places are spatially-contiguous communities, such as workplaces, neighborhoods, and metropolitan areas. Shape refers to the geometry of the exterior of these places. From above, for example, many cities, neighborhoods, and buildings appear almost as circles or squares, others resemble elongated rectangles or irregular polygons. More compact shapes – those closer to being circles – have shorter average distances between any two points within them. We would therefore expect the average person in these spaces to interact with a broader opportunity set of potential connections. To the extent that those interactions

lead to the useful recombination of ideas and resources, more compact shapes should promote entrepreneurship and innovation.

Structure, meanwhile, has to do with how people and resources are distributed across an area. They could, for example, be dispersed evenly across the space. Or, they might concentrate in the center of it, around a downtown or a high street. Or, people and resources might end up segregated in different areas within a place according to their types. In general, concentration should promote interaction, thereby stimulating entrepreneurship and innovation. Segregation, on the other hand, means that the average person has fewer interactions with dissimilar others, impeding entrepreneurship and innovation (Samila and Sorenson 2017; Sorenson in press).

When resources are not distributed evenly across a place, moreover, organizations located there and people living or working there will diverge in their access to diverse ideas and resources. Inequality will rise in their propensities to succeed as innovators and founders. Those who reside closest to the actors who control important resources, for example, should be better situated to assemble the resources required to found a firm. Those who live or work near the borders of segregated communities or who span communities in their daily lives – for instance, by living in one community but working in another – should innovate and found firms at higher rates.

Descriptive evidence from cross-sectional differences across metropolitan areas in the United States appears consistent with these conjectures. More compact and denser metropolitan areas have higher rates of patenting and entrepreneurship. Residential segregation along ethnic lines, meanwhile, appears associated with lower rates of these innovative activities.

Spatial ecology

In the late-1970s, an important perspective emerged in the sociology of organizations: organizational ecology (Hannan and Freeman 1977). It forwarded a key insight, that organizations themselves form the environment for other organizations. Organizations in a population interact with each other in a variety of ways, both intentionally and unintentionally, and those interactions shape the evolution of industries.

Firms, for example, compete with each other for resources, capital, talent, and customers. But they can also influence each other in positive ways. Investors, consumers, and employees, for instance, perceive the entire industry as less risky, as more legitimate, as more and more firms enter it, to the benefit of all firms (Hannan and Freeman 1977). Firms also serve as the primary training grounds for employees and future entrepreneurs in an industry (Freeman 1986; Sorenson and Audia 2000). Hundreds of studies have explored these industry dynamics across dozens of industries (for reviews see Hannan and Carroll 1992; Carroll and Hannan 2000).

Despite the wealth of research from this perspective, organizational ecologists have paid relatively little attention to space, to where organizations in an industry emerge and operate.[1] The dominant approach has been to treat all organizations within a population, usually all firms within an industry in a particular country, as equally influential on each other. It's as if the entire population of firms all crowded onto the head of a pin.

But, of course, organizations vary in their locations. Those closer in space almost certainly interact more with each other – perhaps by competing over the same customers or employees, perhaps just through being perceived as more similar (e.g., Sorenson and Audia 2000; McKendrick et al. 2003). Industries – populations of organizations – also vary in their degrees of geographic dispersion (Krugman 1991).

Much as spatial ecology in the biological sense examines the dispersion of species and how those distributions structure interactions within and across species, a spatial ecology of organizations focuses on the relative locations of organizations and how those distributions influence organizational and industry dynam-

[1] Some early notable exceptions treated states within the United States as subpopulations (Carroll and Wade 1991) or calculated spatially-weighted measures of the proximity to peers (Sorenson and Audia 2000; Stuart and Sorenson 2003).

ics. In this chapter, we consider one aspect of a spatial ecology of organizations, the question of what places produce the most entrepreneurs and innovators.

The importance of proximity

The early literature on economic geography related the spatial distribution of plants and firms, particularly in heavy manufacturing industries, to the locations of natural resources (e.g., Weber 1928). Steel production, for example, requires iron and coal. Both are also relatively heavy. Transportation costs rise rapidly with distance. Not surprisingly, then, these industries became concentrated in close proximity to the sources of these inputs.

The vast majority of businesses in modern economies – information goods, high-tech manufacturing, and tradable services – however, depend mostly on ideas and people. Those resources have been thought of as more mobile (e.g., Cairncross 1997). Information can move at the speed of light with almost no cost. People can travel rapidly and cheaply whether by planes, trains or automobiles. Why then should the spatial distribution of people and organizations matter to entrepreneurship and innovation?

It all stems from one fact: People primarily form and maintain relationships with those who live and work in close proximity to them.

Two factors account for the local nature of these relationships. The first has to do with opportunities for meeting. We encounter people through the course of our daily activities–at work, shopping, attending church services, ferrying kids to school, through sports and other hobbies (e.g., Jacobs 1961; Feld 1981). These activities are almost always highly local, bringing people no more than a mile or two (a few kilometers) from their homes.

The second concerns the cost of strengthening or continuing a relationship. Building or maintaining a relationship, even a casual one, requires regular contact. That might mean bumping into the person every few days or weeks. Or, it might involve arranging coffee or lunch. In either case, the cost of strengthening and maintaining these relationships depends on distance (Zipf 1949). Running into someone regularly by chance requires that the person travels to the same locations at the same times of day. The travel time, and therefore the cost, associated with planned in-person meetings similarly increases with distance, though not as rapidly.[2]

Empirically, at every spatial scale and for nearly every sort of relationship, the probability of a social connection has been found to decline with distance. Early studies in sociology, for example, examined marriage and found that people tended to marry those who lived in a radius of a few city blocks from their home (Bossard 1932). Students in dormitories and employees in offices most frequently interact with and become friends with those in the neighboring rooms and offices (Festinger et al. 1950; Allen 1977; Marmaros and Sacerdote 2006; Roche et al. 2020). Surveys of peoples friends find them heavily concentrated in the cities in which they live (Lansing and Mueller 1967; Rivera et al. 2010). Even online interactions occur more frequently between those who live and work near each other (Kleinbaum et al. 2013; Bailey et al. 2020).

Social connections tend to exist locally not just in physical space but also in social space. Individuals therefore disproportionately have relationships with others similar to them—of the same religion and ethnicity, of the same level of education, with experience in the same firms and industries (Marsden 1988; McPherson et al. 2001). The same processes account for the importance of proximity in social space. Those in the same demographic categories and those of similar backgrounds tend to share interests and to belong to the same organizations (Blau 1977). These activities and organizations act as focal points that provide opportunities for people to meet and to maintain relationships (Feld 1981).

These patterns matter to innovation and entrepreneurship because social relationships and interactions with others provide access to

[2]While the travel costs for arranged meetings increase on a roughly linear basis with distance, the odds of chance encounters decrease as a function of the square (or higher power) of the distance between two individuals (Stouffer 1940; Sorenson in press).

information and resources critical to these outcomes.

Innovation

Innovation has typically been thought of as a process of recombination, bringing together existing ideas that have not previously been combined (Schumpeter 1939; Weitzman 1998; Fleming 2001). An inventor, for example, might merge multiple technical components into a new product. Or, an entrepreneur might apply an existing solution to a novel problem.

Although sometimes innovators depend only on their own expertise and experience, more commonly they build on and combine information from others. Would-be entrepreneurs and inventors who are exposed to and who have access to a more diverse range of ideas and components – from interacting with others with expertise and experience in other technologies, industries, and settings – have an advantage in this recombination process (e.g., Reagans and Zuckerman 2001; Burt 2004; Fleming et al. 2007; Uzzi et al. 2013). They have more potential variety available in their repertoires that they can use to recognize new problems, to identify fresh solutions, or to invent novel products and services.

Those who live and work in close proximity to others with a diverse range of expertise and experience should therefore produce more and more novel innovations. Regions with more industrial variety, for example, have higher rates of patenting (Tavassoli and Carbonara 2014; Castaldi et al. 2015). Cities with more ethnic diversity similarly spawn more inventions (Samila and Sorenson 2017).

Many of the interactions important to innovation, moreover, are serendipitous, unplanned. They are more likely to recombine knowledge from distant sources and lead to exploration (Pennington 2020). Unplanned encounters and conversations localize in space even more than other types of interactions (Sorenson in press). Consider, for example, Catalini (2018), who examines the relocations of academic labs within the Université Pierre et Marie Curie. He compares adjacent labs to those further away, though at an average distance of only 170 meters. Being next door to another department increases the probability of collaborating by 3.5 times (350%)! Roche et al. (2020) examine the diffusion of information across teams of entrepreneurs in the same physical office space. They also find that influence drops rapidly, being indistinguishable from zero at a mere 20 meters. Even when working in the same facility for the same firm, inventors who live closer to each other within the same city have higher odds of collaborating (Pennington and Shaver 2020).

Because these unplanned interactions occur over such short distances, the value of being proximate to diverse others for innovation should emerge at the levels of neighborhoods, buildings, and other small spatial scales (Sorenson in press).

Entrepreneurship

Social relationships similarly matter to entrepreneurship in at least three important ways. First, entrepreneurship represents a form of innovation, an insight that a particular product or service might meet an unserved need in a community. The same processes of recombination that stimulate other forms of innovation therefore should also promote entrepreneurial entry.

Second, entrepreneurship begets more entrepreneurship. Seeing others, particularly those perceived as similar, engaged in entrepreneurship encourages people to become entrepreneurs themselves. They become aware of entrepreneurship as a career option. They become more confident that they too could do it (Sorenson and Audia 2000; Bosma et al. 2012). This role model, or demonstration, effect appears to influence most strongly those who have interacted directly with entrepreneurs and former entrepreneurs (Nanda and Sørensen 2010; Kacperczyk 2013).

Third, entrepreneurs depend on social relationships to build effective organizations—to raise capital, to recruit employees, to secure suppliers, and to attract customers. Any new venture involves a great deal of uncertainty, not just about the enterprise but also about the entrepreneur. Would-be employees, investors, and business partners therefore are often reluctant to lend their support to them.

Social relationships help to mitigate these concerns. Connections to the entrepreneur provide channels for access to better information about the ability and trustworthiness of the entrepreneur (Sorenson and Stuart 2001; Shane and Cable 2002; Ruef 2010). Those with social relationships to the entrepreneur may also believe the person more likely to succeed (Sorenson and Waguespack 2006; Sorenson 2018). Entrepreneurs therefore have higher odds of success when they locate their ventures in places where they have denser and deeper social connections (Dahl and Sorenson 2012).

Because the entrepreneurial process depends not just on the recombination of ideas but also on access to resources, entrepreneurs emerge at higher rates in more diverse places (Samila and Sorenson 2017) and in places richer in the resources required—ideas, capital, and people with experience in the industry (Sorenson and Audia 2000; Stuart and Sorenson 2003).

The shape and structure of places

What is a place? Places have generally been defined in research on economic geography on a practical basis, in terms of the level of aggregation at which statistics have been collected or reported. Places therefore have usually been defined as administrative units: Countries, states, counties, and cities, for example, have been areal units commonly used in research.

When people discuss places, however, they usually have in mind some spatially-contiguous community. In research on social networks, community detection refers to algorithms for finding clusters of people who interact more with each other than they do with those in other clusters (Moody and White 2003). Places as communities have this same property (e.g., McKenzie 1921; Grannis 2009). They represent spatially-contiguous populations that interact more internally than they do with those outside of the place. These communities exist at many spatial scales. At a more macro level, they include metropolitan areas and labor markets defined by commuting patterns. At a more micro level, they would include neighborhoods and workplaces.

These spatially-contiguous communities may correspond to administrative units. Administrative boundaries influence patterns of interaction. People, for example, rarely cross national borders. School districts similarly may shape who interacts with whom. Administrative units themselves may even have been defined based on natural barriers to movement or pre-existing patterns of interaction.

But the boundaries of spatially-contiguous communities can also diverge from those of any administrative unit. Silicon Valley, for example, spans many cities and counties in the San Francisco Bay Area in California. Lincoln Park, a neighborhood, on the other hand, represents but a small area within Cook County and the city of Chicago.

The spatial boundaries of these communities often reflect geography, the built environment, and architecture. Rivers and mountains, for example, create natural barriers to movement (e.g., Harari 2020; Dutta et al. 2022). Highways, train tracks, and busy streets can similarly impose man-made impediments (e.g., Grannis 2009; Ananat 2011). Conversely, parks, high streets, shopping districts, and schools can serve as focal points, pulling people in from some catchment area (e.g., McKenzie 1921; Jacobs 1961; Feld 1981; Oldenburg 1989). Elevators, bathrooms, and cafeterias similarly influence the movement of people within buildings (e.g., Kabo 2017; Roche et al. 2020).

Research to date has generally treated all places, all spatially-contiguous communities, as being equal in shape and structure (for exceptions, see Samila and Sorenson 2017; Harari 2020). However, the fact that proximity shapes interaction suggests that some places may prove more conducive to these processes. These internal geographies might foster innovation and entrepreneurship because they influence the probabilities of serendipitous interactions and of social connections between potential innovators and entrepreneurs and important information and resource providers.

Moving from the importance of proximity to its implications for the shape and structure of

spatially-contiguous communities, however, requires one additional assumption: People must face a budget constraint in their time (or in how far they will travel). The further they must travel to interact with others, the less time they have for interaction, the fewer people with whom they can interact.

Together, the importance of proximity and the existence of a budget constraint on time or travel, suggest at least three important implications: First, it means that cities and regions with more compact shapes and with greater concentration should have an entrepreneurial and innovative advantage. Second, it suggests that regions with less segregation – across many dimensions – should offer more fertile ground for invention and for startups. Third, it implies that individuals within regions vary in their opportunities to become innovators and entrepreneurs as a function of where they live and work.

Community shape and dispersion

Shape refers to the geometry of the exterior of a region. The more compact the place, the closer together any two points or people within it. A circle represents the most compact possible shape in two dimensions. Squares, pentagons, and other regular polygons similarly have high levels of compactness.

Buildings, neighborhoods, and cities frequently have relatively compact shapes, particularly when unconstrained in their design or growth. Neighborhoods, for example, often resemble squares, cities circles. Compactness has an efficiency to it. Compact buildings need fewer feet of wall per square foot of space. Compact cities require less paving, piping, and wiring to serve their residents (Cervero 2001; Harari 2020).

But buildings, neighborhoods, and cities often deviate from these efficient shapes. Many buildings are elongated rectangles or L-shapes. Neighborhoods may end up long and narrow when hemmed in by busy streets. Rivers, coastlines, hills, and mountains can constrain the shapes of cities.

Because more compact spaces reduce the average distance between any two people, they should promote more interaction. People either spend less time in transit, allowing them to spend more time interacting with others. Or, if they cover similar distances, they encounter more people.

All else equal, interacting with more people, in turn, means more access to information and resources, more potential for recombination. We would therefore expect compact places to foster higher levels of innovation and entrepreneurship.

Although the shape of a place could matter at any spatial scale – from the floor of a building up to a city or metropolitan area – shape probably proves particularly important at small spatial scales, where it would influence the probability of serendipitous encounters. By contrast, the cost of planned interactions – such as meeting an existing acquaintance or contracting with a supplier or distributor – increase far less rapidly with the distance between the parties involved (Sorenson in press).

Dispersion meanwhile refers to the internal structure of a place, the extent to which people or organizations within an area concentrate. Imagine two neighborhoods of the same shape and with the same number of inhabitants. In one, the majority of residents concentrate in a cluster of centrally-located skyscrapers. In the other, people live in a large number of houses scattered across the area. The place with the dense central core would have a higher degree of concentration. Communities with more members per spatial unit, per square mile or square meter, similarly, have higher concentration (higher density).

Concentration has a similar effect to compactness. If more people occupy the same space or if most people live and work near the center of an area, then the average distance between any two people in the population declines. Concentration therefore also increases the probability of interaction and the ease of maintaining relationships. It, too, should therefore stimulate innovation and entrepreneurship. New York should out-innovate Los Angeles. Boston should have more entrepreneurs than Phoenix.

Consistent with this expectation, one of the stylized facts about innovation has been that it increasingly happens in dense, urban areas (Balland et al. 2020). Not only do cities account

for ever-larger proportions of patents but also larger and denser cities produce more patents per capita and more novel ideas than smaller ones (Bettencourt et al. 2007; Carlino et al. 2007; Packalen and Bhattacharya 2015; Balland et al. 2020).

As further evidence of the potential connection between shape and dispersion and innovation and entrepreneurship, we examine the cross-sectional relationship between compactness and rates of patenting across Metropolitan Statistical Areas (MSAs) in the United States. Although the ideal analysis would examine these relationships at the level of neighborhoods, small communities within cities, identifying neighborhoods, the places where ideas originated, and calculating shape variables at such a fine-grained scale would require more time than available for this chapter.

Most measures of compactness assess the extent to which a shape approximates that of a circle.[3] For example, the isoperimetric quotient calculates the ratio of the area of a shape relative to a circle with the same perimeter. The Reock Score, meanwhile, represents the ratio of the area of a shape relative to the smallest diameter circle that can bound the shape inside it.

Here, we use the moment of inertia as a combined measure of compactness and concentration. The moment of inertia calculates the average squared distance of each person, organization or resource from the center of a mass. In this case, we use the residential locations of people to calculate the moment of inertia.[4] We normalize it by dividing this product by the squared population of the MSA. Less compact places and those with populations more dispersed across their areas have higher scores on this measure. Figure 1 then plots metropolitan statistical areas according to their compactness and concentration, as measured by the moment of inertia, on the horizontal access. On the vertical access, it positions these places in terms of their patents per capita. To reduce the noise in the figure, it sorts MSAs into 20 groups of cities similar in their compactness, plotting the means for the x and y axes within those groups (using the `binscatter` command in Stata). As the quadratic fit line suggests, the plot reveals a clear negative relationship between the two.

More compact and concentrated metropolitan areas have higher rates of patenting per capita. Particularly for innovation outcomes, because they depend on seridiptous interaction, we would expect even stronger effects of shape and structure at more micro levels, neighborhoods or buildings.

Community integration

Integration captures a second aspect of the internal structure of a place. Our discussion of shape and dispersion has implicitly assumed that all actors spread evenly across the area. But many places exhibit segregation. People of different ethnicity or socio-economic status reside in separate neighborhoods. Industries concentrate within particular parts of a city (e.g., Arzaghi and Henderson 2008). Organizations, such as firms and clubs, employ and attract people with shared expertise, interests, and demographic characteristics (e.g., Feld 1981; Ferguson and Koning 2018).

Segregation – along any dimension – decreases the likelihood of interaction between those with information or resources and those able to use it. Segregation traps information and resources inside social circles, segments of the community.

Segregation, therefore, can impede innovation and entrepreneurship in multiple ways. It reduces the breadth of ideas, expertise, and experience available to any individual within the community, limiting opportunities for recombination. It may hinder the demonstration effects so important to convincing people to pursue entrepreneurship, particularly if they do not have role models or mentors in their own segment of the community. It may also hamper the process of building an organization. To the extent that critical resources reside in different segments of a community, potential entrepreneurs may have difficulty accessing them.

[3] The attractiveness of one measure over another depends on the data available. Natural borders, such as coastlines, for example, can cause problems for the isoperimetric quotient because of the fractal dimensionality of their perimeters.

[4] A moment of inertia based on the number of people working at particular locations within a metropolitan area also seems interesting but we could not locate comparable workplace data to calculate such a measure.

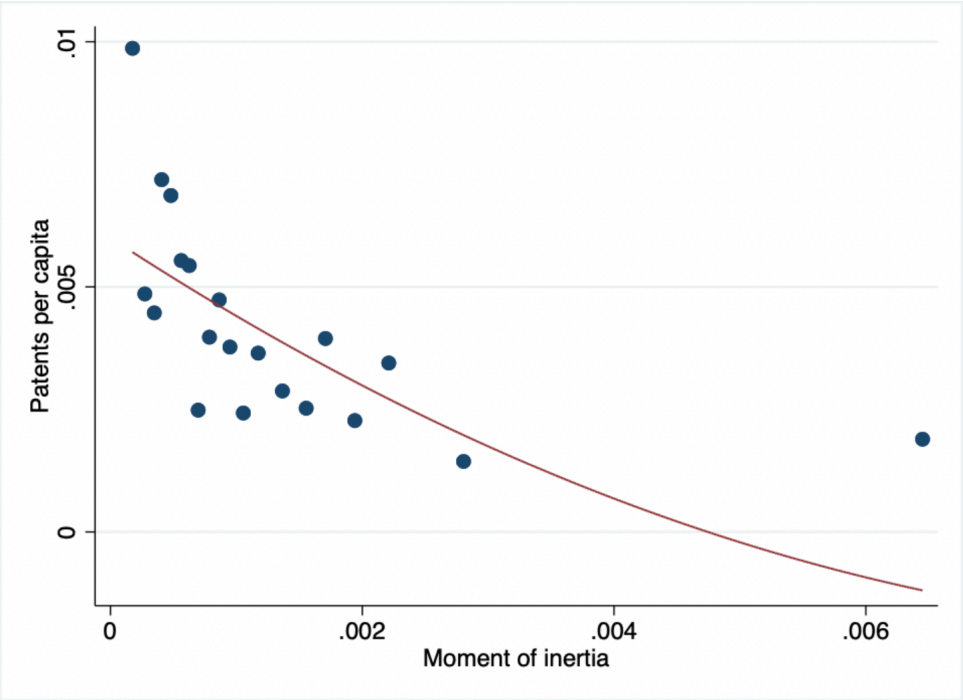

Figure 1: Innovation rates by MSA compactness and concentration

Integration and segregation can also vary across spatial scales (Sorenson in press). At more fine-grained levels, places that appear uniform often become varied. Consider Chicago and New York City. As cities, both have similar levels of ethnic diversity. But at the level of neighborhoods, New York combines a mix of homogeneous and diverse places while Chicago consists primarily of ethnically-uniform places.

Finer-grained spatial resolutions provide a more accurate picture of the probable unplanned interactions among individuals (Sorenson in press). Although the city of Chicago has a great deal of diversity, on a day-to-day basis, most Chicagoans interact almost exclusively with people similar to themselves. As noted earlier, these unplanned interactions prove particularly important to innovation. Segregation measured at these more fine-grained levels should more strongly predict rates of innovation and entrepreneurship. New York, on this basis, should have higher rates of innovation and entrepreneurship than Chicago.

Diversity across a variety of dimensions undoubtedly matters to innovation and entrepreneurship. Places with greater educational, industrial, and occupational diversity, for example, have been found to have higher rates of innovation (Sorenson in press).

In the United States, race, or ethnicity, has been an usually salient dimension of diversity. Samila and Sorenson (2017) examined the relationship between the ethnic integration of an MSA and its rates of innovation and entrepreneurship. Their integration measure used census-tract-level information to calculate the probability that two randomly-chosen individuals within a tract would have the same ethnic or racial identity. Census tracts – though not communities in the sense defined above – cover an area similar to a neighborhood. California, for example, has 39 MSAs

but more than 8,000 census tracts. This integration measure therefore captures the potential for interaction within small spatially-contiguous communities.

Samila and Sorenson (2017) found strong effects of tract-level integration on innovation. Highly-integrated metropolitan areas produced nearly 80% more patents than segregated ones. These communities also created more valuable innovations: the average patent in ethnically-integrated communities received more forward citations, had relevance to a wider range of technology classes, and appeared more novel (Samila and Sorenson 2017). They also found evidence that more integrated communities produced more high-quality startups. At least at the scale of metropolitan areas and along ethnic lines, segregation appears to impede innovation and entrepreneurship.

Inequality of opportunity

The final implication concerns who and which firms might innovate and who might become an entrepreneur within a place.

Even in an integrated community with a compact shape, individuals and organizations within that place vary in their opportunities for interaction, and consequently in their propensities to innovate or become entrepreneurs. Consider a circle. Although this shape has the shortest average distance between any two points, not all points within it have the same distance from all other points. The center has the shortest average distance to any other point in the area. Points on the perimeter have the longest average distances. Given the importance of proximity to diverse others and to resource holders, those situated closer to the center of a circular place should be better positioned to become inventors and entrepreneurs.

These actor-level differences in opportunities, moreover, become even more pronounced for places with less compact shapes and more concentrated internal distributions. On average, as shapes become less compact not only does the average distance between any two actors rise but so too does the variation in these distances. Those near the center become even more advantaged relative to those at the periphery. Concentration, by clustering resources, favors those near the center relative to those further from it.

Segregation may introduce even more inequality into these opportunities. To the extent that segregation occurs along lines that lead particular ideas or resources to reside within some segment, only those actors who have connections across these lines – whether ethnic, class, or organizational – have the ability to recombine ideas and resources otherwise trapped in separate segments. Those who span boundaries have been found to have more novel and higher-quality ideas in a variety of contexts (Burt 2004; Fleming et al. 2007; Vedres and Stark 2010). Those at the borders of segregated groups therefore have more opportunities than those surrounded on all sides by similar others.

These dynamics might prove particularly interesting within organizations. Offices near the perimeter of a building, for example, are usually seen as desirable because they have windows. The corner offices are the most attractive, with windows on two sides. Organizations therefore reserve these offices for their highest-status employees. But the corners of a square also represent the most peripheral locations, those furthest from other points on average. The individuals occupying these offices may therefore find themselves "out of the loop"—excluded from gossip and casual conversations.

Conversely, offices near to locations that attract people – such as restrooms, coffee and vending machines, and elevators – offer numerous and diverse opportunities for interaction as people travel to and fro (e.g., Kabo et al. 2014). These offices therefore help their occupants to become central in the informal network of relationships between employees.

Segregation within organizations meanwhile often follows the organization chart. Employees within a function or division sit in neighboring offices along a hallway. Large groups may occupy entire floors. Universities similarly group members of academic departments in the same buildings, floors, and corridors. This spatial organization of the firm fosters collaboration within these departments, functions, and divisions but it simultaneously contrains the opportunities for interaction across them.

Those who sit at the edges of a group, however, may have connections both within their own group and to an adjacent group. They become brokers and boundary spanners. Liu (2020), for example, finds that those who occupy the offices adjacent to those of other research labs more commonly become boundary spanners across these labs in the life sciences firm that he studies (see also, Catalini 2018). Because these brokers and boundary spanners have access to a more diverse set of ideas and resources within the firm, they may have better and more innovative ideas, and may rise faster up the corporate ladder (Burt 2004).

Although the literature has often viewed these brokers and boundary spanners in positive light (e.g., Burt 2004), they also imply a higher degree of inequality within these firms. Some people have access to a large range of ideas, others do not. Segregation may therefore lead to greater within-firm inequality in pay and in rates of promotion.

Discussion

People live local lives. They primarily meet and maintain relationships with those living and working in close proximity to them. That fact holds across all spatial scales.

Because of this fact, the shape and structure of places – cities, neighborhoods, workplaces – influence the probabilities that people within them meet and maintain relationships. Those relationships, in turn, shape the opportunities for people to invent, to innovate, and to become entrepreneurs.

Our chapter has outlined three conjectures based on these assumptions. First, places with more compact shapes – those closer to being circles or squares – should foster higher rates of innovation and entrepreneurship. These shapes offer shorter average distances between any two points within them, suggesting that the average person in these places interacts with more people, giving them a larger repertoire for recombining ideas and resources.

Second, the internal structure of places matters. The concentration of people, organizations, and resources within an area also reduces the average distance between them. Concentration therefore should also promote innovation and entrepreneurship. The segregation of actors and resources, meanwhile, acts in the opposite direction. It decreases the odds that any individual or organization has access to a diverse set of ideas and resources, impeding entrepreneurship and innovation.

Third, the more people and resources within a space deviate from being evenly distributed across it, the more people will differ in their opportunities, in their access to diverse ideas and resources. Concentration favors those at the center relative to those in the periphery. Segregation, meanwhile, creates more opportunities for those at the borders of these segments than those surrounded by similar others. Inequality in innovation and entrepreneurship opportunities should therefore rise with concentration and segregation.

Although our discussion of the importance of shape and structure has focused on the supply side of innovation and entrepreneurship, these attributes probably matter also to the demand side, particularly for local services. Long travel times, whether caused by less compact shapes or dispersion increase the cost of consumption. Given the choice, most people would prefer a shop two minutes away over one twenty minutes out. Less compact and more dispersed places may therefore also reduce demand (or fragment it into smaller niches), potentially to the point where these places cannot support more specialized services.

To a large extent, our discussion of these issues has also assumed that people move about on foot. That assumption seems reasonable in terms of how people move around an office building. It may also hold as a mode of transportation for moving around a neighborhood and explains why multi-modal streets appear to promote innovation (Roche 2020).

But the dominant mode of transportation varies across and within cities. Cars and public transportation change the meaning of proximity. These technologies allow people to move more rapidly from one place to another. They may also create interesting connections that would not otherwise exist. Transportation systems bridging physical barriers may therefore foster entrepreneurship and recombination (e.g., Dutta et al. 2022). Someone who commutes from one part of a city to another

becomes a social bridge between the communities at each end.

These technologies, however, do not simply increase the speed of movement and allow for travel across longer distances, they also qualitatively change how people move through space. When people walk, they may stop and interact with someone along the way to their destination (Jacobs 1961). Cars, on the other hand, isolate people. Drivers rarely interact with anyone between the origin and the destination of their trip. Car-based cities may therefore have extremely complex and interesting geometries, dependent on where people live, shop, and work.

Tall buildings similarly introduce another complication into our conjectures. Research suggests that vertical distance reduces the probability of interaction more than horizontal distance (e.g., Allen 1977; Roche et al. 2020). Places therefore may not benefit as much from increases in concentration that come in the form of multi-story buildings.

Lastly, the dynamics of shape and structure might depend also on density. Past a certain point of population density, more opportunities for encounters do not necessarily translate to more meaningful interactions. On a crowded sidewalk in downtown London or Manhattan, people rarely stop and strike up random conversations. If people only interact with a limited number of others per day, too many options might lead them to retreat to the familiar – just as most people would only stop for a familiar face on a busy street.

All of these issues strike us as fertile research ground. Although architects and urban planners have long had beliefs about optimal building and city design, the importance of the shape and structure of places to economic and social outcomes has received little empirical attention. Yet, shape and structure may represent an important piece of the puzzle of entrepreneurial ecosystems. The success of some places in fostering innovation and entrepreneurship may depend not just on the elements in these places – whether they have talent, capital, and role models – but also in the potential for those elements to interact and combine, a function of shape and structure.

Returning to our earlier example, Atlanta would appear to have all of the elements necessary to become a biotech hub. But compared to the compactness and concentration of Cambridge or Seattle, it sprawls across a vast expanse. In our calculations, it had the highest moment of inertia of any major metropolitan area. Atlanta has a diverse population but also one segregated along many lines. Despite having the right elements, they might never meet to recombine, to invent, to form firms.

Shape and structure are attractive objects of research attention not only because they may represent the secret sauce of innovative and entrepreneurial places, or entrepreneurial ecosystems, but also because they reside to a large extent within the control of managers and planners (Samila and Sorenson 2017). Social relationships have been found to matter to a very wide range of outcomes, not just entrepreneurship and innovation. Yet these findings have not been particularly useful to policy. Managers, for example, have limited ability to force people to interact. But they can shape the opportunities for interaction through the design of buildings and the assignment of employees to spaces within them. City planners and policymakers similarly have the opportunity to design places, ecosystems, that encourage more interaction. We therefore hope that many will join us in studying these dynamics.

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