

PIN - Productivity Projects Fund

Small Project Report

The Future of Innovation in the City: Entrepreneurship, Ecosystems and the Pandemic

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About PIN

The Productivity Insights Network was established in January 2018 and is funded by the Economic and Social Research Council. As a multi-disciplinary network of social science researchers engaged with public, private, and third sector partners, our aim is to change the tone of the productivity debate in theory and practice. It is led by the University of Sheffield, with co-investigators at Cambridge Econometrics, Cardiff University, Durham University, University of Sunderland, SQW, University of Cambridge, University of Essex, University of Glasgow, University of Leeds and University of Stirling. The support of the funder is acknowledged. The views expressed in this report are those of the authors and do not necessarily represent those of the funders.

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Executive Summary

The concentration of the COVID-19 disease in densely populated cities may lead to the long-term retreat of both people and economic activity from these urban areas. Furthermore, there is the possibility that an upshot from the pandemic is that human behavioural changes may impact on the nature, rates and spatial configuration of innovation, especially within and across cities.

To examine these potential changes in the urban innovation landscape this report draws on findings from data gathered through interviews and surveys with informants over two time periods: prior to the pandemic (2018/19) and during the fallout from the pandemic (2021).

These informants consist of individuals that can be termed as ‘innovation agents’ operating in the field of innovation and entrepreneurship in the cities of New York, Los Angeles, London, Berlin, Tokyo and Shanghai. This includes entrepreneurs, venture capitalists, the operators of incubators, accelerators, co-working spaces, universities, policymakers, as well as representatives of large corporates.

The report utilises the concept of ‘complex adaptive systems’ to theoretically frame the types of ecosystems that have emerged within cities to foster entrepreneurship-driven innovation. These processes of urban entrepreneurial innovation have developed rapidly in recent years in certain cities, particularly global cities.

The extent to which ecosystems have become embedded and enduring within their respective city environments is unclear. Therefore, this report analyses the adaptability and resilience of these ecosystems, as well as the changing nature of the spatial distribution of innovation agents and the networks that connect them.

Overall, the analysis finds significant adaptability and resilience across the ecosystems addressed, with the large majority of informants forecasting positive and optimistic scenarios in terms of the future of entrepreneurial innovation in their respective city.

The empirical evidence indicates that not only do the ecosystems studied possess the adaptability and resilience to survive, but in some ways they will thrive as the requirement for new technological solutions and applications allows them to maintain their innovative capacity and capability.

Furthermore, it is found that the emergence of more spatially distributed networks across a wider range of cities and regions is leading to changes in the spatial economics of innovation that go beyond traditional agglomeration theories.

This more distributed and diffused spatial pattern of innovation is impacting upon the economics of innovation, with different types of location taking different roles in the city innovation network hierarchy.

Global cities are the hubs of these distributed networks and remain at the apex of this hierarchy, but second tier cities- especially those within city region configurations – are becoming increasingly active as innovation satellite locations.

It is concluded that the COVID-19 pandemic has to some extent facilitated relatively advanced cities the opportunity to forge new innovation paths. However, this is much less so for many

locations, which have primarily sought to remain economically and socially resilient in the face of dwindling finances and other resources.

1. Introduction

In a book published in 2020 the political economist Hilton Root (2020, p. 12) states that ‘... a multipolar world is emerging that is vulnerable to unexpected shocks from any corner ... the entire network structure of international relations is becoming more locally coupled, with increasingly dense connectivity in trade, diplomacy, weapons and finance’. Root (2020) presents a highly convincing thesis of the density of global connectivity and its ongoing progression, and his comments concerning vulnerability with shocks emerging from any corner almost reads as prophetic. Although it is unlikely that he had the Covid-19 pandemic in mind, a result of the crisis that ensued in the aftermath of the pandemic is a potential negative externality in the shape of the fear – perceived or real – of being in close proximity with a health debilitating contagious virus, as well as the networks that allow its global transmission. Furthermore, it is argued by some that the concentration of the Covid-19 disease in densely populated cities may lead to a retreat of both people and economic activity from these urban areas (Batty, 2020; Nathan and Overman, 2020; Florida et al., 2021). For example, Garrett (2020) states that ‘the Covid-19 pandemic will reverse the trends of globalisation and urbanisation, increasing the distance between countries and among people. These changes may make for a safer and more resilient world, but one that is also less prosperous, stable and fulfilling.’

Such arguments indicate a potential double-edged effect, with innovation and economic development suffering as a result of new behavioural trends (Glaeser, 2020). In particular, there is the possibility that an upshot from the pandemic is that human behavioural changes may impact on the nature, rates and spatial configuration of innovation, especially within and across cities. To examine these potential change in the urban innovation landscape, this report draws on findings from data gathered through interviews and surveys with informants over two time periods: prior to the pandemic (2018/19) and during the fallout from the pandemic (2021). These informants consist of individuals that can be termed as ‘innovation agents’ operating in the field of innovation and entrepreneurship in the cities of New York, Los Angeles, London, Berlin, Tokyo and Shanghai. This includes entrepreneurs, venture capitalists, the operators of incubators, accelerators, co-working spaces, universities, policymakers, as well as representatives of large corporates.

The report utilises the concept of ‘complex adaptive systems’ to theoretically frame the types of ecosystems that have emerged within cities to foster entrepreneurship-driven innovation (Autio et al., 2014; Audretsch and Belitski, 2017). These processes of urban entrepreneurial innovation have developed rapidly in recent years in certain cities, particularly global cities (Glaeser et al., 2021). However, what is unclear is the extent to which these ecosystems have become embedded and enduring within their respective city environments. Therefore, the report analyses the adaptability and resilience of these ecosystems, as well as the changing nature of the spatial distribution of innovation agents and the networks that connect them. Overall, the analysis finds significant adaptability and resilience across the ecosystems addressed, with the large majority of informants forecasting positive and optimistic scenarios in terms of the future of entrepreneurial innovation in their respective city. Furthermore, it is found that the emergence of more spatially distributed networks across a wider range of cities and regions is leading to changes in the spatial economics of innovation that go beyond traditional agglomeration theories.

The remainder of the report is structured as follows. First, the report outlines the relationship between urban environments and innovative capability and capacity, which is followed by the

theoretical framing of complex adaptive systems as means for examining contemporary forms of entrepreneurial innovation. Following the presentation of the methods for data collection, the empirical results and findings are presented in terms of the emergence, adaptability and resilience of urban entrepreneurial innovation ecosystems, as well as the spatial distribution of the agents and networks associated with these ecosystems. The analysis provides a means for reflecting on the changing spatial economics of innovation, which precedes the presentation of the conclusions.

2. Cities and Innovation

Different crises often bring similar economic challenges in terms of unemployment, weakened markets and demand, and a lack of investment. All of these may either have a causal impact on, or be the result of, lower rates of economic development. Coupled with these factors is a concern that innovation may also be compromised as a result of poor economic conditions, which again hinders development. These arguments are relatively well-rehearsed as a result of the analysis of many crises over time (Tomaney et al., 2010; Giannakis and Bruggeman, 2017; Tan et al., 2020; Hardy and Sever, 2021). This suggestion of negative effects stems from the prevailing theory of the spatial economics of innovation which is based on evidence that strongly points to cities and urban regions being the centres of innovation, with innovation density showing a high level of correlation with urban density (WIPO, 2019; Duranton and Puga, 2020). This is particularly the case for innovation driven by entrepreneurs seeking the advantages of agglomeration (Adler et al., 2019), and the confluence of science, technology and creativity (Johnson, 2008; Rodríguez-Pose and Lee, 2020).

Over a number of years, many important contributions have extolled the advantages of cities and urban regions (e.g. Florida, 2002, Glaeser, 2011), and more recently Bahcall (2019) has introduced an influential theory of the emergence and adoption of radical innovation, which he terms ‘loonshots’. In summary, Bahcall (2019, p. 2) argues that ‘The most important breakthroughs come from loonshots, widely dismissed ideas whose champions are often written off as crazy’ and that ‘Large groups of people are needed to translate those breakthroughs into technologies that win wars, products that saves lives, or strategies that change industries.’

Cosmopolitanism and outwardly facing behaviour may foster greater economic resilience and competitiveness, which suggests the possibility that some cities and regions possess more of the ‘right’ type of behaviour when it comes to catalysing innovation (Huggins and Thompson, 2021a). Therefore, while the configuration and capability of ecosystems determines urban and regional development outcomes, at the micro-level it is the action of certain key human agents within cities who actually shape the nature and evolution of networks of people and organisations (Cook, 2020). In general, the value of these networks within and across cities and regions is regulated by a series of ‘associational institutions’ in the form of conventions with regard to collaboration and cooperation, especially associational business behaviour and the norms of trust and collective action. Cities, in particular, are considered to be key locations for high rates of network formation due to the high density of actors and high frequency of human interactions (Glaeser, 2011; Florida et al., 2017).

Cities that have more inclusive networks of this type are likely to be more advanced and developed, and will also be more equitable in terms of their access to opportunity and ability to partake in a fair urban and regional community. Leading cities and urban regions often possess the most inclusive networks and are also the most equitable (Huggins et al., 2019; Huggins and Thompson, 2021a). The value of these networks lies in the way in which they are able to

overcome the innate uneven distribution of knowledge (Hayek, 1945), especially connecting the originators and users of innovation (von Hippel, 1994). In essence, the value of more spatially distributed networks is their capability to aggregate knowledge that is necessarily located across different organisations and places (Lakhani and Panetta, 2007). In recent years, these processes of aggregation have been captured by the idea of ‘open innovation’, whereby organisations create systems to connect themselves to knowledge and allow the generation, dissemination, and absorption of innovation (Chesbrough, 2020). In particular, the hollowing out of many large firms and organisations with regard to innovative capacity has led to an increased openness in innovative processes across agents, and a key growing component within this new innovation framework are entrepreneurs. In this sense, it is ‘entrepreneurial innovation’ that is now at the centre of efforts to promote economic development (Gumbau Albert, 2017; Nambisan et al., 2018; Qian, 2018; Malerba and McKelvey, 2020).

Networks of knowledge at a range of different levels and the growth of practices such as open innovation point to a complex, connected and dynamic spatial context within which innovation is enacted. Martin and Sunley (2011) argue that the evolution of urban and regional economies can be best analysed by considering them to be manifestations of complex adaptive systems. Such systems consist of numerous components with functions and interrelationships that provide them with a particular identity and a degree of connectedness, with the adaptive perspective highlighting the importance of recombination and reuse of resources (Brown and Mason, 2017). Renewal, Martin and Sunley (2011) argue, depends on reworking the legacies from preceding economic cycles, particularly through the engagement of ‘extrovert’ entrepreneurs.

Martin and Sunley (2011) further suggest that the micro-behaviours - or agency - of individual system components (individuals and firms) are the most significant factor for evolutionary courses during periods of change and transition. The flourishing field of what has been termed ‘complexity economics’ is a way of shifting from a distinction between what has long been labelled as the disciplines of ‘micro-economics’ and ‘macro-economics’ to a more integrated view of the dynamics of the economy based on modelling individual agency and the networks within which these agents interact (Beinhocker, 2006; Martin and Sunley, 2007).

3. Complex Adaptive Systems and Entrepreneurial Innovation

The emphasis within complexity science and theory on context, culture, the heterogeneity and bounded rationality of agentic behaviour provides a useful framework for considering how cities and regions are able to create new development paths (Castañeda, 2020). Building on this, contributions in the fields of economic geography and regional studies have begun to integrate the fundamental concepts of complexity theory to further our understanding as to how urban and regional economic landscapes evolve, especially with regard to innovation (Cooke, 2012; Martin and Sunley, 2007). Key generic properties of complex adaptive systems are: highly distributed networks and open connectivity across components; non-linear dynamics resulting from complex feedback and self-reinforcing interactions; a primacy for emergence, self-organisation and adaptive behaviour, as well as non-tractable and non-deterministic behaviour (Martin and Sunley, 2007). Clearly, the nature of complex adaptive systems is such that they are likely to be characterised by some form of path dependence (Bristow and Healy, 2014a), which may result in either negative lock-in that leads to economic decline, or positive lock-in through new path creation, transformation or renewal.

Martin and Sunley (2007) state that the dynamics of complex adaptive systems will be dependent upon their configuration and the extent to which this structure responds to external changes and shocks. More advanced cities and regions tend to have developed systems within which macro-level behaviours emerge from, and also influence, the micro-level interactions of the elements of these systems, which facilitates the creation of new order. e.g. the emergence of ecosystems of connected agents (Frick and Rodríguez-Pose, 2018; Roundy et al., 2018). A key aspect of these processes concerns the non-linear dynamics operating within these systems, and the higher the degree of complexity and adaptability the greater will be the level of non-linear dynamics within the structure. As Arthur (1994) indicates, complexity is at the heart of increasing returns, whereby relatively small inputs may result in large outputs, or vice versa. Similarly, the non-linear nature of interactions within systems produces the adaptability underpinning innovation, which is influenced by a complex mix of the behaviour of engaged agents, the coherence of activities across the system, and the resources available to agents (Roundy et al., 2018).

From a structural perspective, these systems can be considered to operate as networks that possess varying degrees of complexity and adaptability, with each system being composed of a series of sub-systems and networks that determine development paths and subsequently outcomes (Martin and Sunley, 2007). These outcomes are manifest in economic terms by the competitiveness and resilience of these cities and regions, with the systems governing these outcomes being inherently multi-dimensional and shaping factors relating to economic growth, innovation and entrepreneurial capacity in multiple and nonlinear ways (Martin and Sunley, 2007; Bristow and Healy, 2014b; 2015; Huggins and Thompson, 2017a; Roundy et al., 2018).

These systems also shape and are shaped by the underlying behaviour of agents within each city and region, and are ontologically multi-level incorporating the behaviour of firms and organisations coupled with the behaviour of human agents (Bristow and Healy, 2014a; MacKinnon et al., 2019). Given this, such systems function through networks at the interpersonal, inter-firm and inter-organisational level, which themselves are governed by social, economic and political institutions (MacKinnon et al., 2019). These institutions interact with the underlying psychocultural behavioural traits present in each region, which ultimately determines the formation of the types of human agency enacted, either individually or collectively, within a city or region (Huggins and Thompson, 2021b). These relationships and interactions drive the networks underpinning each city level system.

Within regional studies and regional science, a range of concepts have been employed over time to depict and illustrate structures that are essentially complex adaptive systems, including innovative milieu, technopoles, industrial districts, local production systems, learning regions, clusters, innovation systems, and entrepreneurial ecosystems (Brown and Mason, 2017; Huggins and Thompson, 2021b). Over the last two decades or so the idea of ‘innovation systems’ has been the primary conceptual mode for seeking to describe and theorise economic development dynamics in the urban and regional context. More recently, the field has seen the rapid growth of scholarly work on the concept of ‘entrepreneurial ecosystems’, some of which has firmly looked to complexity theory and thinking on complex adaptive systems as a means of providing a fresh, or at least refreshed, view on urban and regional economic dynamics (Roundy et al., 2018).

To our minds, the conceptualisation of an ecosystem is a manifestation of the growing phenomenon of entrepreneurial innovation and the role of human agents – principally, but not exclusively, entrepreneurs – and their interdependent behaviour in complex and adaptive multi-

scale networks that form the systems that either forge or constrain innovation (Audretsch et al., 2019; Feldman et al., 2019; Spigel, 2020). The majority of cities and regions will possess some form of this complexity and adaptability, but crucially it is the degree of each that will determine the actualisation of innovation. Economically advanced cities and regions are likely to have a relatively high density of active agents generating a complexity of interactions compared with less advanced and more peripheral cities and regions (Cooke and Morgan, 1993; Brown and Mason, 2017; Huggins and Thompson, 2017b; Capone et al., 2021). In the remainder of this report we adopt the metaphor of the ‘ecosystem’ – or more fully the ‘entrepreneurial innovation ecosystem’ - to capture the complex adaptive systems through which entrepreneurial innovation is performed and undertaken through the innate interdependencies existing between the elements and components of such systems.

4. Methodology

The analysis presented below is based on two connected datasets. First, data collected from interviews with 132 individuals undertaken in 2018/19. These individuals can be termed ‘innovation agents’ and are located across six cities: Berlin (28 individuals) London (21 individuals), Los Angeles (15 individuals), New York (21 individuals), Shanghai (17 individuals), and Tokyo (30 individuals). When this study first started in 2018 these relatively large global cities were chosen as case studies due to background research suggesting that they were among a cohort of cities that were rapidly establishing entrepreneurial innovation ecosystems. San Francisco and the Bay Area could also have been included, but considerable research on this location suggested that further data collection would be unlikely to unearth many new or novel findings, and given its atypical nature their relevance for other cities may be limited (Nylund and Cohen, 2017; Spigel, 2017). The interviews were undertaken with entrepreneurs, venture capitalists, the operators of incubators, accelerators, co-working spaces, universities, policymakers, as well as representatives of large corporates. These interviews were undertaken by the report’s authors and were largely administered face-to-face during field visits to each location.

The working hypothesis at the time of the original interviews was the type of ecosystems emerging in the case study cities would shed light on how other cities and regions may need to adopt similar approaches in order to innovate and compete effectively. During the time when the authors were analysing and writing-up the results from the interviews the Covid-19 pandemic took hold. This led to questions regarding the validity of the original findings in the new and unknown world that was emerging (Batty, 2020; Nathan and Overman, 2020; Florida et al., 2021). Initially, the authors undertook a few informal online interviews with previous interviewees to seek to gauge the impact and scale of potential changes emerging as a result of the pandemic. However, it was decided that a more systematic approach to analysing these changes was required.

In 2021 an online survey – mainly consisting of Likert-type scale questions – was administered to all previous interviewees (email messages with a link to the questionnaire were sent to each informant). In total, 46 usable responses were received across the six cities (two respondents in the US had recently relocated to another city but were able to comment on the focus city) consisting of 6 (13.0%) responses from Berlin, 8 (17.4%) from London, 5 (10.9%) from Los Angeles, 8 (17.4) from New York, 12 (26.1) from Shanghai, and 7 (15.2%) from Tokyo. It is the results from this questionnaire that largely informs the analysis presented below along with some of the relevant findings from the original set of interviews.

5. Emergence

Prior to the Covid-19 pandemic changes were already occurring within urban economic systems that were impacting on the relationship between innovation, entrepreneurship and economic development (Nambisan et al., 2019; Feld and Hathaway, 2021). Taken together, it is these changes that partly explain the emergence of entrepreneurial innovation ecosystems in a number of cities. Many of the interviews undertaken in 2018/19 indicated that firms on public markets had become more risk averse, short-term focused, and therefore less innovative, especially with less of an appetite for disruptive innovation. This was accentuated by the 2008 financial crisis with one upshot being that investment for innovation was becoming more focused around private markets, venture capital and entrepreneurship-driven innovation. Initially, these trends were more associated with North America and Europe, but Asia followed due to a realisation that the nature of innovation is rapidly changing.

In summary, the original interviews indicated that the emergence of new ecosystems in certain cities can be captured by three key developments: (1) changes in the forms and types of investment by the public and private sectors in infrastructure – both hard and soft – to promote innovation; (2) the emergence of new innovation practices – especially ‘open’ practices – that have become increasingly associated with the contemporary urban economic landscape; and (3) the efficiency of urban innovation and economic development. In particular, the costs, investments, and inputs required to innovate were shifting, with firms having to invest more and more resources into the networks and relationships that are required to access ideas. Building and maintaining relationships is expensive. There are tangible costs in the form of events – innovation theatre – and the contracting of intermediaries – innovation scouts – as well as significant intangible investment in terms of the time required by firms to generate and sustain the social capital and network capital they need to develop their own ecosystems.

Firms increasingly looked to cities as a location to effectively engage in and manage these activities. At the individual level, within the technology sectors more people across all age groups were taking time to consider if they can develop an idea into a commercially viable innovation and business, especially in areas related to digital technologies. Many of these individuals also turned to cities, especially big cities, experiencing the rapid growth of co-working spaces and incubators attesting to this development. As a result of these changes in both firm level and individual behaviour, many mainstay innovation players moved part of the burden, costs, and to some extent the risk, of innovation to start-up firms, new entrepreneurs, and purely aspirational entrepreneurs, rather than within the safety net of the corporation itself.

Partly as a result of growing open innovation practices and an unstable macroeconomic climate in recent years, the interviews pointed to the emergence of a phenomenon that can perhaps be best described as ‘experimental entrepreneurship’. Fundamentally, more and more individuals were experimenting with the idea of becoming entrepreneurs, especially technology entrepreneurs. This goes beyond the usual upturn in the numbers of self-employed workers during a financial crisis but appeared to have led to the emergence of ecosystems within cities that could become embedded and sustained. Indeed, these were our initial conclusions following the first set of interviews. Of course the pandemic provides us with a context to analyse the extent to which such ecosystems have the endurance to meet the challenges stemming from such a large external shock.

6. Adaptability

In this context of this study, adaptability refers to the capability and capacity of a city's ecosystem to meet the challenges emerging from the pandemic (Mack and Mayer, 2016). Such adaptability is likely to rely on cities remaining an attractive location for entrepreneurial innovation especially in relation to the volume of technology-based entrepreneurs, the finance available to these entrepreneurs to fund innovation, and the availability of the networks required to foster open innovation and collaboration. As indicated by Table 1, the large majority of respondents to online survey undertaken in 2021 consider that the attractiveness of their city would actually improve or at a minimum not suffer over the next five years. Only 15.5% of respondents considered there would be any reduction in the attractiveness of their city for technology-based entrepreneurship or the availability of finance for entrepreneurship and innovation, while a slightly higher percentage (26.1%) believed there would be some reduction in the attractiveness of their city as a location for open innovation and collaboration.

There are no clear differences in responses across cities, but London had a slightly higher percentage of respondents who consider there may be some reduction in the attractiveness of the location for entrepreneurship and innovation. Although we did not explore the issue of Brexit in the questionnaire survey, the earlier round of interviews in London indicated that a reduction in the attractiveness of the city as a destination entrepreneurs and innovative activity as a result of Brexit was a concern for many stakeholders.

Table 1: Forecast Impact of the Covid-19 Pandemic on the Attractiveness of the City as a Location for Entrepreneurship, Finance and Innovation over the Next Five Years

	Significantly Reduced	Slightly Reduced	No Change	Slightly Improved	Significantly Improved
Technology-based entrepreneurship	2.2%	13.3%	31.1%	44.4%	8.9%
Finance for entrepreneurship and innovation	2.2%	13.3%	31.1%	37.8%	15.6%
Open innovation and collaboration	2.2%	23.9%	17.4%	47.8%	8.7%

In the context of entrepreneurial innovation ecosystems, adaptability relates to the manner in which entrepreneurs and innovative firms are capable of adjusting to significant changes in working conditions, especially the rapid growth in remote working. As shown by Table 2, by far the majority of respondents consider that new forms of working will actually have either a beneficial impact or no negative impact on a number of factors. In particular, 82.3% of respondents suggest that new patterns of working will either improve or have no negative impacts on disruptive and radical innovation. Similarly, only 20.0% consider that there are likely to be negative impacts on more incremental innovation.

Alongside innovation, the capacity and capability to develop new markets for innovation is paramount to the success of ecosystems. Again, the majority of respondents do not see this area of activity suffering to any great extent, although a higher percentage (26.6%) suggest that this may have some negative impact. This is to be expected given that face-to-face interactions and the requirement for conveying tacit knowledge are acknowledged as being important features

of markets for technology and innovation (Howells, 2002). Finally, the nurturing of skills and the development of new talent is obviously the lifeblood of innovation, with more than three-quarters (77.7%) of respondents believing that there will either be an improvement or no change on human capital development. This suggests that the rapid advances being made in digital learning and network systems appear to be providing adequate substitutes for face-to-face learning.

Table 2: Forecast Impact of New Patterns of Working on Innovation, Markets and Talent over the Longer-Term

	Significantly Reduced	Slightly Reduced	No Change	Slightly Improved	Significantly Improved
Disruptive/Radical Innovation	2.2%	15.6%	35.6%	35.6%	11.1%
Incremental Innovation	4.4%	15.6%	28.9%	35.6%	15.6%
Developing New Markets	2.2%	24.4%	11.1%	46.7%	15.6%
Developing New Talent	6.7%	15.6%	24.4%	42.2%	11.1%

A major consideration regarding the future of urban ecosystems is the on-going nature of the institutional environment within which these ecosystems previously flourished (Mack and Mayer, 2016; Audretsch and Belitski, 2017; Audretsch et al., 2021). As already indicated, the hallmark of these urban ecosystems is the self-organisation that has arisen in cities as a result of the growth of entrepreneurially innovative environments such as co-working and incubator spaces, as well as the local availability of capital for innovation and the plethora of opportunities through networking events such as meet-ups and the like (Stam, 2015; Madaleno et al., 2021). Table 3 indicates that although the majority of respondents consider that demand for innovation spaces and networks will either be unchanged or improve, there are also a significant proportion of respondents who anticipate some reduction in demand over the next five years. This is to be expected given that much remains unknown as to the probable balance between online and face-to-face interaction. There are no discernible differences in responses across cities, with the exception of the number of respondents from London showing a higher than average level of scepticism for demand. As can be anticipated, demand for both financial and human capital is largely expected to remain high or increased.

Table 3: Forecast Impact of the Covid-19 Pandemic on the Demand for Hard and Soft Entrepreneurial Infrastructure over the Next Five Years

	Significantly Reduced	Slightly Reduced	No Change	Slightly Improved	Significantly Improved
Co-working spaces	10.9%	30.4%	13.0%	30.4%	15.2%
Incubator space	6.7%	26.7%	22.2%	40.0%	4.4%
Finance for entrepreneurship and innovation	2.2%	8.7%	37.0%	37.0%	15.2%
Networks and networking events	6.5%	34.8%	21.7%	26.1%	10.9%
Human capital, skills and talent	4.4%	15.2%	39.1%	28.3%	13.0%

Any adaptability stemming from the pandemic across urban ecosystems is likely to be associated with firm-level strategic change (Nambisan et al., 2019; Cooper, 2021). Respondents were asked to assess strategic changes that are most likely to be the focus of firms within their ecosystems over the next five years. As shown by Table 4, the majority of respondents indicated that most areas of business activity are likely to witness change, with the two areas seeing the most increased focus being a refocusing on new products/sectors with improved prospects (80.5% significant or slight increased focus) and a refocusing on core products/sectors (78.3% significant or slight increased focus).

A refocusing on both new and existing products and markets strongly indicates that firms within these ecosystems will be highly engaged in adaptability efforts as they seek to continue to innovate. This suggests that firms will develop new strategic plans, which is confirmed by the finding that 73.9% of respondents expect this area of activity to be a focus for most firms. New methods of working, and the need for creative solutions to meet new working and living conditions, indicate that there may need to be more adaptability in terms of the level of autonomy and independence given to staff. Almost three-quarters of respondents (71.7%) consider that this is likely to be increased focus for firms within their ecosystems. Finally, a focus on cost cutting is considered to be the least likely focus of strategic change (52.2%), which implies that adaptability will be centred on attracting new investment rather than reducing running costs.

Table 4: Forecast Changes in Strategic Focus for Innovative Businesses over the Next Five Years

	Significantly Reduced Focus	Slightly Reduced Focus	No Change in Focus	Slightly Increased Focus	Significantly Increased Focus
Cutting costs for short term survival	2.2%	10.9%	34.8%	43.5%	8.7%
Development of new strategic plans	2.2%	8.7%	15.2%	39.1%	34.8%
Refocusing on new products/sectors with improved prospects	0.0%	4.4%	15.2%	60.9%	19.6%
Refocusing on core products/sectors	0.0%	4.4%	37.0%	41.3%	17.4%
Autonomy given to staff to adapt to new demands	4.4%	8.7%	15.2%	47.8%	23.9%

7. Resilience

The findings presented above strongly suggest that entrepreneurial innovation ecosystems are showing, and will continue to show, considerable resilience in the global cities studied. In fact, it can be argued that some are actually flourishing further and building solidly upon their initial emergence. However, it is also important to consider the resilience of cities as a whole in terms of rates of innovation and entrepreneurship, as well as economic competitiveness. As shown by Table 5, the majority of respondents consider that over the next five years rates of innovation will improve (60.9% of respondents) as well as rates of entrepreneurship (63.1%). This indicates that stakeholders generally consider that their cities will maintain an upward trajectory in terms of entrepreneurially-driven innovation. This general optimism is evidenced by a number of open comments in relation to this:

“Cities have a natural agglomeration effect that pulls labour and capital towards it. This effect will return once the pandemic is in the rear-view mirror as happened after all previous interruptions.” (Respondent from London).

“I see positive changes in the city. More and more people feel the necessity for innovative changes and becoming acceptable of an entrepreneurial approach, which does not necessarily require established results or brand.” (Respondent from Tokyo).

“In Shanghai everything has recovered as to what it looks like before the pandemic, so I’m super optimistic about innovative activities” (Respondent from Shanghai).

“Some industrial innovation in cities like Munich slowed down when the pandemic hit but tech based innovation seemed steady and then picked up even more speed”
(Respondent from Berlin).

“I think NYC will continue to flourish, however the issue of equity and accessibility will continue to serve as a reminder of the divide between the haves and have nots.”
(Respondent from New York).

“I remain optimistic as to London's resilience as a hub for tech entrepreneurship, principally due to the infrastructure, and existing agglomeration economies that exist across and within the city.” (Respondent from London).

“The LA area seems to have handled the pandemic well and is emerging more quickly than other parts of the world.” (Respondent from Los Angeles).

“C19 has opened up the necessity for people to stay home which has led to the fostering of interests for outside Tokyo. This open innovation momentum will continue after the current situation.” (Respondent from Tokyo).

This relatively high level of optimism towards entrepreneurial innovation can be somewhat tempered by the respondents' views on the broader future economic competitiveness of their city. As indicated by Table 5, less than one-half of all respondents (41.3%) considered that the economic competitiveness of their city would improve over the next five years, with a further 39.1% indicating that economic competitiveness will fall. This suggests that while entrepreneurship and innovation will be relatively unharmed as a result of the pandemic, wider urban economies may not continue to grow in tandem. A number of respondents commented on this, with the view being that as new ways of working become normalised the density of people working in cities at any one time will be reduced. Inevitably, this is likely to have a negative impact on a number of areas of the urban economy especially in the service sectors.

Table 5: Forecast Impact of the Covid-19 Pandemic on Innovation, Entrepreneurship and Economic Competitiveness over the Next Five Years

	Significantly Reduced	Slightly Reduced	No Change	Slightly Improved	Significantly Improved
Rates of Innovation	4.4%	21.7%	13.0%	43.5%	17.4%
Rates of Entrepreneurship	6.5%	17.4%	13.0%	43.5%	19.6%
Economic Competitiveness	6.5%	32.6%	19.6%	30.4%	10.9%

Finally, for city or regional resilience it is not only important that entrepreneurs adapt to the changing environment, but that this also manifests itself in an evolving entrepreneurial innovation ecosystem (Mack and Mayer, 2016; Feld and Hathaway, 2020). As such, respondents were asked to rank a number of policy areas which they consider to be the most important for ensuring that their city remains a highly attractive and effective environment to engage in innovation. By far the most important area was considered to ‘access to finance’, with 47.7% of respondents ranking it as their top priority, followed by ‘education and skills development’ (25.0% of respondents) and ‘housing’ (20.0%). ‘Transport’ (2.3%) and

‘infrastructure for business’ (4.8%) was considered to be the top priority by only one or two respondents. Interestingly, in the first round of interviews in 2018/19 transport and infrastructure featured far more prominently in discussions of policy intervention, now finance, skills and talent, and housing are clearly considered to be the focus for public policy:

“Financial systems including loan, investment, and others are the key for all start-ups.”
(Respondent from Tokyo).

“Finance is always the most important incentive for business in hard times”
(Respondent from Shanghai).

“Finance and skills are key.” (Respondent from London).

“The more expensive a city gets the more difficult it is to have innovative businesses with international talent.” (Respondent from Berlin).

“The main advantage of Berlin over London and Paris has been the low cost of living and general attractiveness of the area for young people. We are about to lose this advantage because of rising prices for housing” (Respondent from Berlin).

“Housing is by far number one, especially the cost of housing in the suburbs. Young people can't afford to live there.” (Respondent from Los Angeles).

8. The Spatial Distribution of Networks

The initial interviews undertaken in 2018/19 indicated that many of the observations and trends relating to the now apparent resilience of ecosystems in these cities form part of ongoing evolutionary processes that are reshaping these cities and their interconnections. Large and often global cities have become the hubs of innovation, having their own complex entrepreneurial innovation ecosystems based on a myriad of knowledge networks both within and beyond the city (Glaeser et al., 2021; Tavassoli et al., 2021). Many of these hubs have cemented their position as innovation hubs since the financial crisis of 2008 due to their greater ability to attract resources and capital. Coupled with the rapid development of these large urban innovation hubs, the first round of interviews found a complementary development to be the emergence of innovation ‘satellite’ cities and regions that are independent but connected with hubs. Therefore, the networks underpinning existing ecosystems appear to have become more spatially distributed.

Furthermore, the interviews indicated that the deep circulation of actionable knowledge goes on within the city, whereas the circulation of knowledge across cities tends to be more explorative and tentative. In the past these network patterns have been conceptualised in the form of ‘local buzz’ and ‘global pipelines’, representing the nature of local tacit exchange compared with the exchange of more explicit and codified knowledge across places (Bathelt et al., 2004). However, the interviews suggested that it is the interaction of actionable and explorative knowledge – rather than its tacit or codified nature - that determines the value of the more distributed ecosystems.

The current survey results further suggest that more spatially distributed ecosystems are likely to continue to emerge. Furthermore, these more spatially distributed forms of open innovation will be accelerated as a result of the outcomes of changes stemming from the pandemic. In

particular, more than one-half of all respondents consider that new collaborations and relationships between ecosystem actors across cities within the same nation are likely to increase (56.9% of respondents) (Table 6). Furthermore, 55.5% of respondents expect there to be an increase international collaboration and relationships across urban ecosystems. If realised, this evolution will result in an increasingly globalised ecosystem through which innovation occurs. Alongside these more spatially distributed patterns of open innovation the majority of respondents expect these to be complemented by an increased level of localised collaboration and relationships within particular urban ecosystems. This highlights the expected continuing importance of infrastructure and institutions such as co-working spaces and communities of support more broadly (Feld and Hathaway, 2020; Madaleno et al., 2021).

Table 6: Forecast Impact of New Patterns of Working on the Spatial Distribution of Innovation Collaborations and Relationships over the Longer-Term

	Significantly Reduced	Slightly Reduced	No Change	Slightly Improved	Significantly Improved
New Local (same city) Collaborations and Relationships	6.7%	11.1%	28.9%	42.2%	11.1%
New National (same country different city) Collaborations and Relationships	4.6%	9.1%	29.6%	36.4%	20.5%
New Global (different country) Collaborations and Relationships	6.7%	6.7%	31.1%	33.3%	22.2%

Table 7 indicates the types of places that respondents consider are most likely to become more attractive locations as nodes within more spatially distributed ecosystems. Small cities and towns in close proximity to larger cities are considered to be the most attractive (80.4% of respondents). This suggests that the spatial configuration of these ecosystem networks may take the form of a hub and spoke configuration, which to some extent is already the case with a large city such as London having strong existing innovation networks with Cambridge, Oxford and the Thames Valley. Berlin also has growing connectivity with second tier cities in relative close proximity such as Dresden, Leipzig and Potsdam. Indeed, medium-sized and second tier cities as a whole are considered to gain in the attractiveness (65.2%).

Rural locations are also viewed as growing in attractiveness (44.4%), which indicates that alternative working arrangements will lead to some entrepreneurs and innovators heading to alternative locations to live and work. Less likely to grow in attractiveness (32.7%) are small cities and towns not in close proximity to larger cities. Many of these places will be situated in relatively peripheral and economically lagging regions and locations outside of city regions and metropolitan areas. It is these places that are likely to face the biggest challenges in the post-pandemic environment, where limited scale means attempts to create local buzz may continue to be problematic, coupled with a lack of pre-existing connections to larger core cities and regions (Rodríguez-Pose and Fitjar, 2013). This is likely to result in a similar pattern of uneven development faced prior to the crisis (Florida et al., 2021). Finally, it should be noted that 37.8% of respondents suggest that large and global cities will become slightly less attractive as locations for entrepreneurship and innovation. This makes intuitive sense given that some

actors are likely to move to ‘spoke’ locations and second tier cities. However, the overall findings indicate that rather than there being a zero-sum movement of agents, over time there is likely to be an aggregate increase in the number of agents engaged in entrepreneurial innovation.

Table 7: Forecast Changes in the Attractiveness of Location Types as Places to Engage in Innovation and Entrepreneurship over the Longer-Term

	Significantly Less Attractive	Slightly Less Attractive	No Change	Slightly More Attractive	Significantly More Attractive
Large/global cities	2.2%	37.8%	37.8%	8.9%	13.3%
Medium-sized/second tier cities	2.2%	13.0%	19.6%	50.0%	15.2%
Small cities and towns in close proximity to larger cities	0.0%	6.5%	13.0%	63.0%	17.4%
Small cities and towns NOT in close proximity to larger cities	6.5%	26.1%	34.8%	28.3%	4.4%
Rural locations	13.3%	8.9%	33.3%	40.0%	4.4%

9. The Spatial Economics of Innovation

The above findings indicate that changes relating to the spatial economics of innovation are already underway, and these are likely to continue and become embedded in a post-Covid-19 environment. Cities are enduring locations for innovation, but behavioural changes across society as a whole, as well as those engaged in the innovation economy, are leading to the emergence of more spatially distributed innovation systems. The outcome of these emerging distributed ecosystems stems from a range of dynamic forces that can be encapsulated by the three primary factors: (1) the search for new knowledge and ideas – which both pull people and firms to established innovation hubs and also push them to more frontier locations; (2) the pull factor of hubs due to agglomeration and amenity forces; and (3) push factors from behavioural changes resulting from negative externalities.

In terms of the spatial economics of innovation, we see an ever evolving process of spatial fixes emerging from the changing nature of the competition for innovation and the costs of joining and maintaining a position in this competition. Innovation agents gain advantages from entering the highly competitive networks and markets that evolve in innovation hubs (Florida et al., 2020), but they may come at a cost in terms of factors such as affordability and congestion, as well as the emergence of hyper competitive markets and networks within which it is difficult to make viable returns on investment in innovation (Glaeser et al., 2021).

In many ways, these processes conform to the underlying theories of the spatiality of innovation. McCann (2007) develops a model indicating that innovation is partly a function of face-to-face interaction as well as cost-related externalities. This model facilitates a better understanding as to how differing forms of innovation are likely to be either spatially concentrated or more geographically dispersed. It is this recursive relationship between these centripetal and centrifugal forces that underpin the emergence of distributed ecosystems. This

is important as innovation does not just happen within cities but is actually a force underlying their formation and evolution (Florida et al., 2017). The attraction of entrepreneurial and innovative individuals represents a long-term factor in promoting economic development. Given that these agents tend to migrate to places that are conducive to their talents (Hall, 1998; Akcigit et al., 2017; Huggins and Izushi, 2020), sorting mechanisms are at play whereby people choose to live and work in particular places based on their preferences, tastes and values (Storper and Manville, 2006).

If size matters for innovation, this potentially calls into question the extent to which predictions that cities, especially big expensive cities, will hollow out as a result of the Covid-19 pandemic (Carlino and Kerr, 2015; Florida et al., 2017). Some influential commentators already argue that these processes were gaining momentum prior to the pandemic (Florida, 2017), but in many ways this can be considered part of the natural evolution of cities and places as a result of known changing preferences. A fear of nearness to other people is something much more unknown (Batty, 2020). In part, government policy responses to the pandemic will drive how this evolves (Nathan and Overman, 2020). However, from an innovation perspective this issue of location is perhaps more complex than it first appears in a number of respects: first, the type and nature of innovation that occurs at different locations; and second, and more fundamentally, the extent to which innovation should be conceptualised and analysed as a place-based phenomenon rather than, or at least as well as, the networks through which it is generated and distributed (Shearmur, 2012; Huggins and Thompson, 2014).

In terms of the nature of innovation, there is a growing evidence base indicating that cities are far from being the only sources and that more peripheral and rural locations often generate significant levels of innovation (Shearmur, 2015; Fitjar and Rodríguez-Pose, 2020; Fritsch and Wyrwich, 2021). However, this type of innovation may take a different form to that found more generally in cities. Innovation in cities tends to be reliant on frequent interaction, new technology and market information, whilst innovation in more remote locations are less network and market information dependent and more reliant on existing technologies (Shearmur and Doloreux, 2016).

In a stylised manner, cities are the home of ‘fast innovators’, while other locations are a base for more ‘slow innovators’ that may have a higher level of enduring value (Shearmur and Doloreux, 2016). Therefore, different locations offer different forms of innovation, with each location playing their own role within the networks underpinning distributed networks and ecosystems. Indeed, these networks are populated by innovation agents who can move across cities and other locations as part of their activities, interacting with others who facilitate the generation and dissemination of innovation, as well as connecting through more virtual means (Shearmur, 2012). An example of this are the types of ‘temporary clusters’ generated through trade fairs, international conferences and exhibitions, which are a mainstay of the network environment of many cities (Bathelt and Schuldt, 2008). Given this, it could be argued that the value of cities for innovation lies as much in the networks they facilitate as the agents that populate them.

10. Conclusions

This report has sought to examine the future of innovation in cities, especially in light of the crisis brought upon by the Covid-19 pandemic. It has taken a complex adaptive systems perspective to consider the extent to which innovative agents in cities have the adaptability to remain resilient in the face of crisis. It has suggested that cities have become bases for innovation driven by entrepreneurship partly as a result of the outcomes from the 2008 financial crisis. This entrepreneurial innovation has been facilitated through the emergence of ecosystems that possess many of the relevant traits associated with complex adaptive systems. The analysis has focused on six global cities across North America, Europe and Asia and the empirical evidence forecasts that not only do their ecosystems possess the adaptability and resilience to survive, but in some ways they will thrive as the requirement for new technological solutions and applications allows them to maintain their innovative capacity and capability.

Alongside adaptability, ecosystems are becoming increasingly complex as networks and connections are being forged across cities and regions of different sizes (Nambisan et al., 2019). This more distributed and diffused spatial pattern of innovation is impacting upon the economics of innovation, with different types of location taking different roles in the city innovation network hierarchy. Global cities are the hubs of these distributed networks and remain at the apex of this hierarchy, but second tier cities- especially those within city region configurations – are becoming increasingly active as innovation satellite locations.

From the perspective of broader industrial organisation, open and entrepreneurial innovation are organisational features that will remain at the heart of economic development. This has implications for future public policy in a number of ways. Throughout much of the 21st century to date, cities and regions across the globe have been functioning within a relatively volatile macro-economic framework, with the great recession beginning in 2008 and now the 2020 COVID-19 pandemic. The narrative and evidence presented in this report indicates that relatively advanced cities have been able to utilise the opportunity spaces available to them to forge new innovation paths. However, this is much less so for many locations, which have primarily sought to remain resilient in the face of dwindling finances and other resources. Indeed, this is substantiated by much of the comparative analysis of regional development over the first two decades of the 21st century suggesting a more uneven and divergent economic landscape across regions (Iammarino et al., 2019; Kemeny and Storper, 2020).

Within this environment, lagging cities and regions that remain tightly bound in the economic structures and systems of the past will not be able to easily move to alternative development paths. When hit by exogenous shocks, they will therefore be unable to escape from a declining growth spiral (Martin and Sunley, 2006). The evidence from the above analysis suggests that these lagging locations should focus on formulating and implementing an entrepreneurially-driven economic development strategy that itself configures a framework to support the establishment of entrepreneurial innovation ecosystems. Clearly this is no easy task, but it is one that should be addressed by establishing and nurturing the types of strategic networks that are hallmarks of ecosystems in leading cities.

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