

# Cities and innovation

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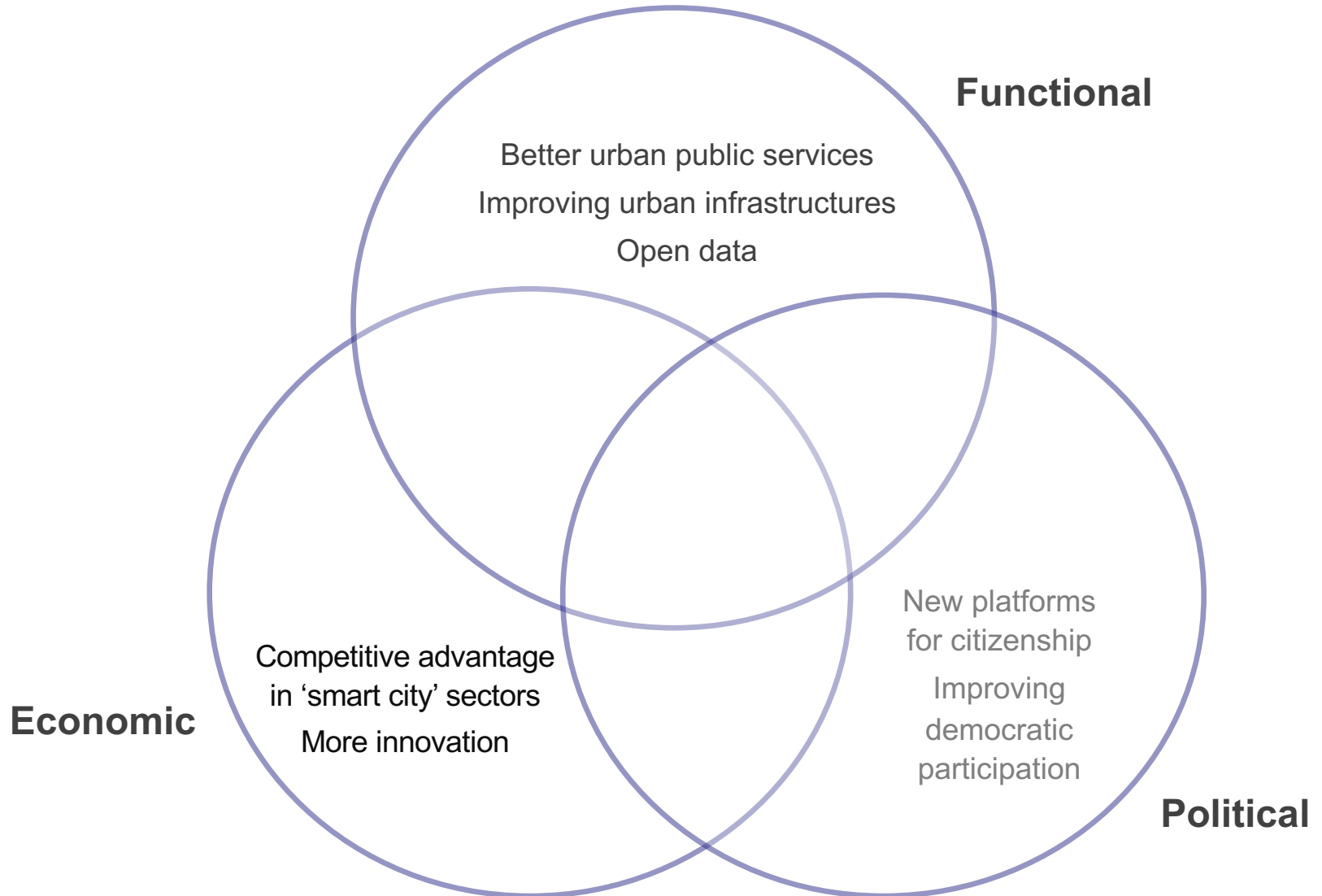
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**SMART CITIES: CONTEXT, POLICY AND GOVERNMENT: LECTURE 6**

# Recap

- Smart city building blocks:
  - Technology stack
  - Players: entrepreneurs, companies, cities, citizens
  - Policy agendas, development and mobilities
  - Data: access, standards, privacy
- Focus on cities and citizens as technology users
- We're now going to shift the focus to cities as producers of technology, and producers of innovation more broadly

# Recap: smart city policy types



# Recap: smart city technology production is urbanised

**Table 1.** Leading urban tech clusters, 2010–19.

Rank	Metro	Deals ( <i>n</i> )	Global (%)	Investment (US\$ '000s)	Mega-deals (%)
1	San Francisco, CA, USA	1527	4.86%	49,011	15.26%
2	New York, USA	1085	3.45%	22,080	11.71%
3	London, UK	908	2.89%	5205	3.08%
4	Los Angeles, CA, USA	537	1.71%	10,631	11.17%
5	San Jose, CA, USA	503	1.60%	9454	15.11%
6	Beijing, China	454	1.44%	62,498	32.82%
7	Paris, France	436	1.39%	2174	2.52%
8	Boston, MA, USA	411	1.31%	3898	9.00%
9	Seattle, WA, USA	279	0.89%	1971	6.09%
10	Bangalore, India	279	0.89%	7369	14.70%
11	Delhi, India	253	0.80%	10,819	15.42%
12	Shanghai, China	250	0.80%	24,514	34.00%
13	Chicago, IL, USA	232	0.74%	877	2.59%
14	Washington, DC, USA	226	0.72%	1589	4.42%
15	Austin, TX, USA	193	0.61%	1934	9.84%
16	Berlin, Germany	192	0.61%	5504	18.75%
17	Tel Aviv, Israel	165	0.52%	2926	13.33%
18	Moscow, Russia	149	0.47%	466	2.68%
19	Barcelona, Spain	142	0.45%	795	3.52%
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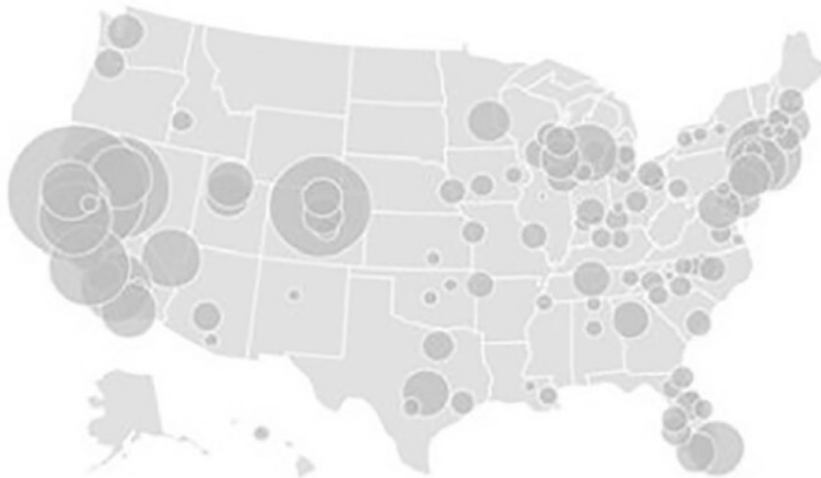
Adler and Florida 2021

# Recap: innovation is urbanised ...



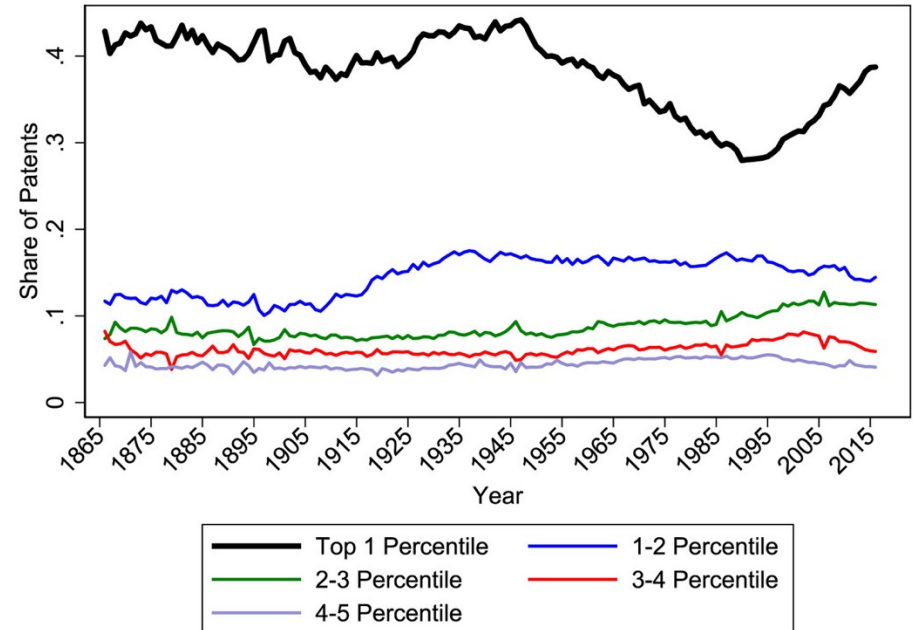
How you measure, matters.  
Location quotients for patents  
(top), and trademarks (bottom)

MSAs, 2010-2015 averages



Source: Castaldi 2023

# ... & clustering is (quite) persistent



Spatial clustering of patenting in the USA, 1866-2016

L: clustering across all commuting zones (CZs)

R: Shares for top 5pc CZs

Source: Andrews & Whalley 2022

# Structure

- **Lecture 6 – overview** of cities as “innovation producers”
  - **Part 1:** definitions + key frameworks
  - **Part 2:** theory + evidence, case studies
  - **Part 3:** possible futures
  - **Seminar: the rise of urban tech, discussing Adler and Florida**
- **Coming up**
  - **Lecture 7 – strategy + policy tools** for urban innovation
  - **Lecture 8 – challenges** for smart cities, innovation policies

# Part 1: overview



# Defining innovation

- **Innovation is a multi-stage process:** ideas generation + commercialisation into products, services + diffusion in society (Fagerberg 2005)
- **Innovation involves many actors.** Firms, entrepreneurs and inventors are central to innovation, but other institutions, regulations and norms also shape innovative activity
- **Some ideas matter more than others. Key class of ideas = General Purpose Technologies.** Very widely used. Building blocks = enable other innovation (Bresnahan 2010)

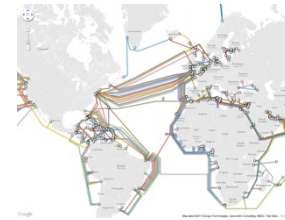
# General Purpose Technologies



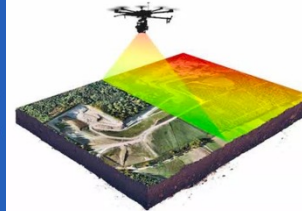
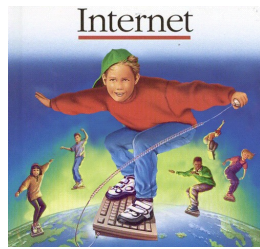
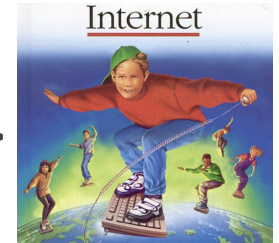
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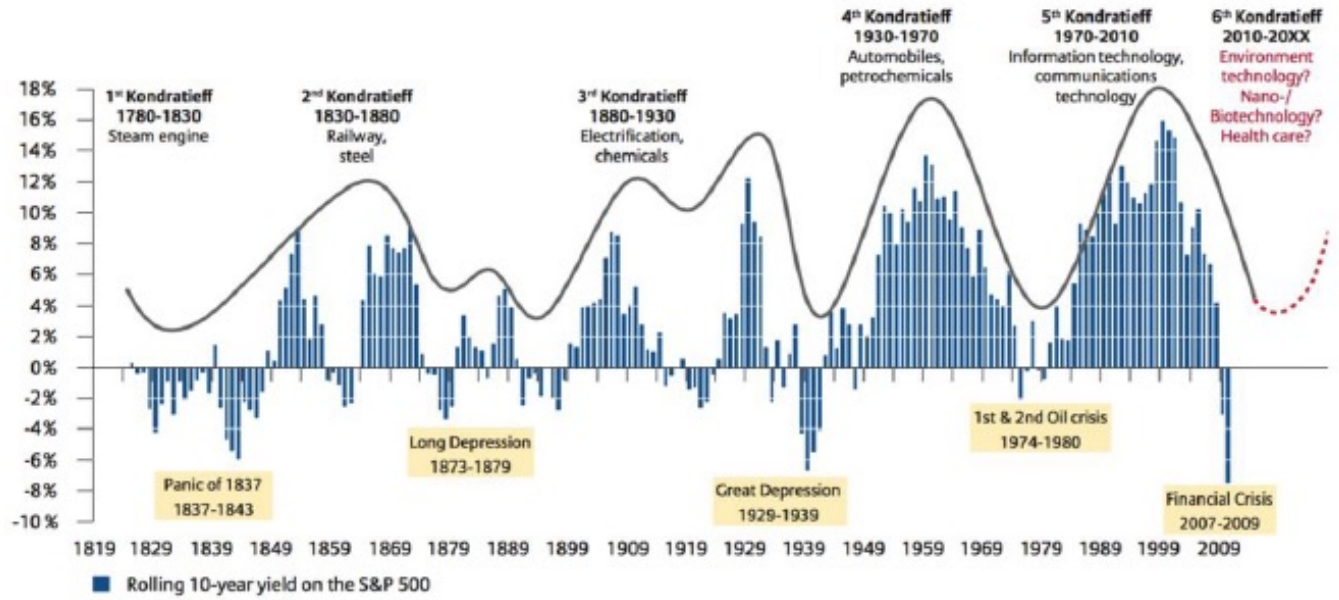
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=> "Smart City"

[https://en.wikipedia.org/wiki/General-purpose\\_technology](https://en.wikipedia.org/wiki/General-purpose_technology)

# Innovation and growth



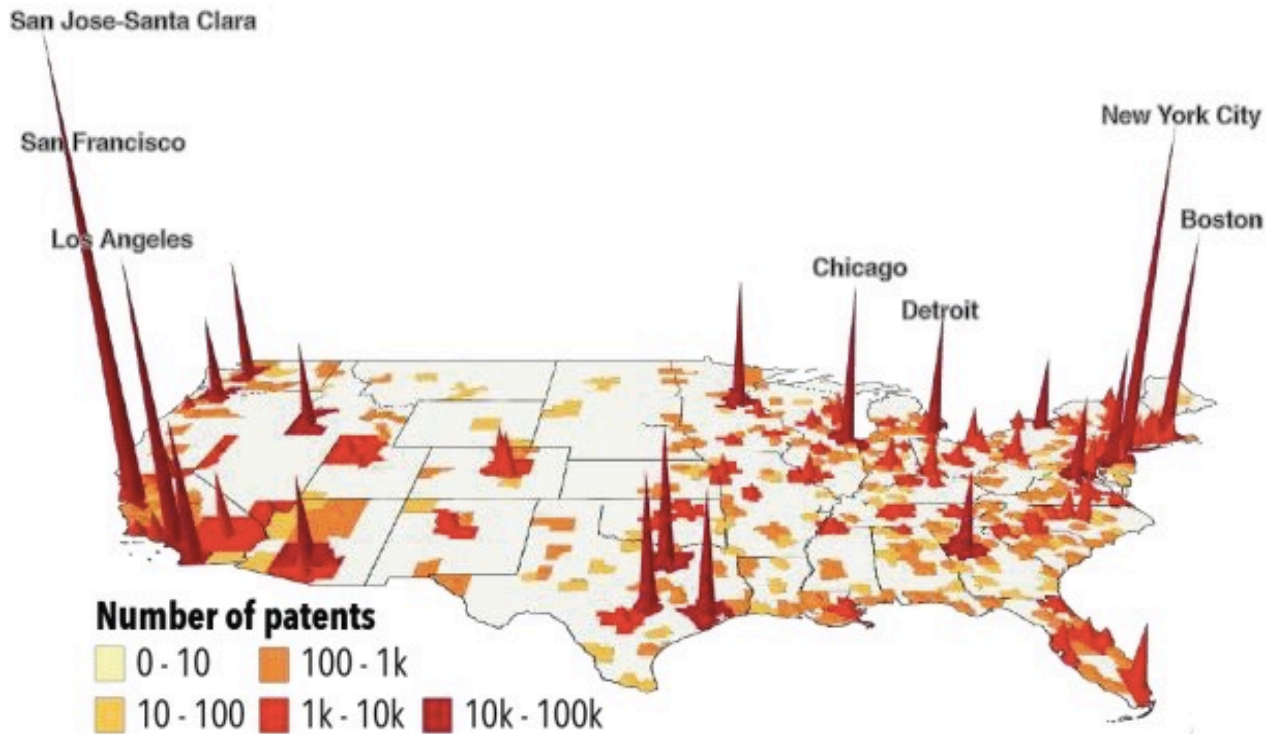
- Innovation drives 'long waves' of economic growth (Kondratieff 1925)
- Technological revolutions (Perez 2010)
  - **S-curves** as the tech is deployed, becomes mature
  - **Technology system** emerges around it [organisation / industry / policy shifts]
  - Shifts in systems = **revolutions**
  - New **paradigms** emerge – importance of visions, key actors in shaping these

# Innovation and growth

- **Schumpeterian view** – innovation drives growth through “creative destruction”
  - Winners and losers when new products/services go on the market
  - Entrepreneurs [startups!] are carriers of new ideas (Schumpeter 1939)
  - Essentially random process? Or can be shaped?
- **Endogenous growth theory** – human capital + research drives growth, through generation and diffusion of new ideas
  - As firms innovate, they become more productive
  - Other firms learn from this; knowledge ‘spills over’ => growth
  - This allows further investment in R&D, education, etc (Romer 1990)
  - Clearer roles for public policy

# Innovation and cities

- Innovation is highly urbanised (Balland et al 2020). City leaders often seek to use this as a lever for growth



# Cities as tech producers

- Urban areas are responsible for the majority of Smart City technologies (Adler and Florida 2021)

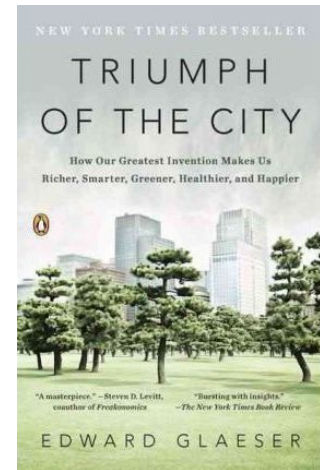
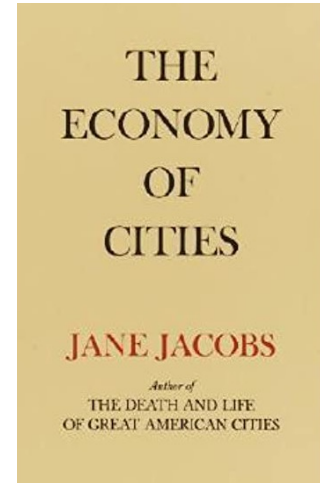
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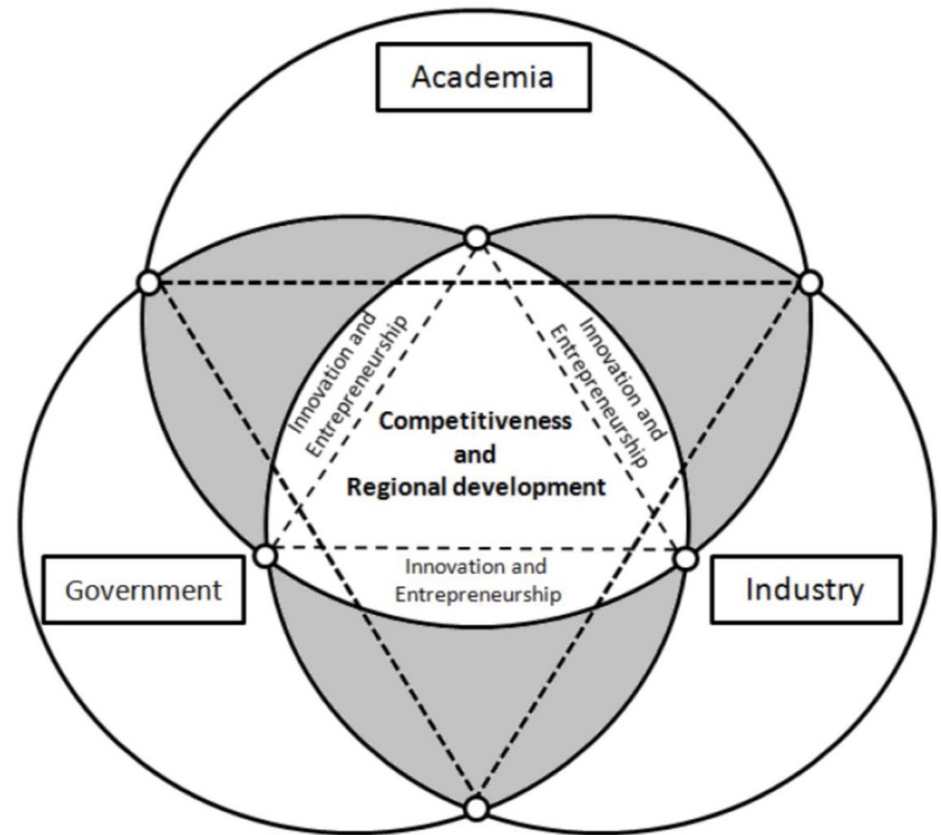
# Innovation, growth and cities

- **Urban economics describes the ‘microfoundations’:** that is, the underlying processes that support innovation
- **Key idea = cities help firms and workers become more productive.** ‘Agglomeration economies’ make this happen
- This helps drive urban *and national* innovation, entrepreneurship and growth
- These ideas also underpin **urban systems** and **urban scaling frameworks**



# Innovation, growth and cities II

- Remember: innovation isn't just what firms do!
- **Innovation systems takes a broader view, emphasising the role of public sector actors**
  - Universities, research labs
  - Urban and national government
  - Public and private sector links



Source: Farinha & Ferreira (2012)



# Part 2: theory + evidence

# Theory: urban economics

- **Key idea = cities help firms and workers become more productive.** ‘Agglomeration economies’ make this happen
- Duranton and Puga (2004) divide these into three types
  - **Sharing** – benefits of shared infrastructure, e.g. public transport
  - **Matching** – deep labour markets help workers and firms find the best job / people at any point
  - **Learning** – generating new ideas, learning from others
- **Production side:** cities connect people; help them observe, learn from each other
- **Consumption side:** urban scale supports a rich set of products, services, experiences

# Evidence: cities and innovation

- Innovation is higher in cities (Carlino & Kerr 2015, Storper & Venables 2004)
- Doubling the jobs density in a city raises patenting/head by 22% (Carlino et al 2007)
- Most innovation happens outside city centres ...
- But dense cores are more important for unconventional ideas (Berkes & Gaetani 2020)

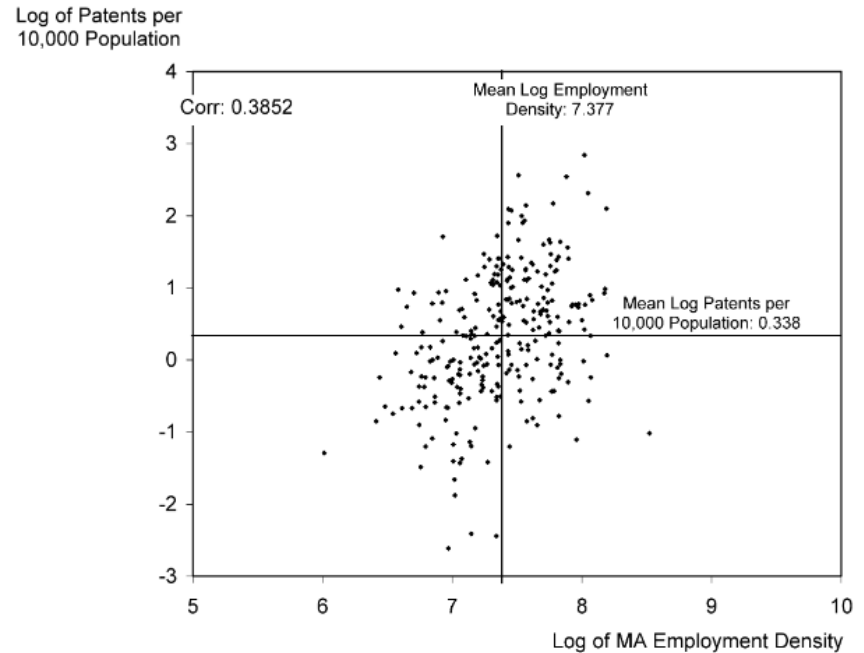
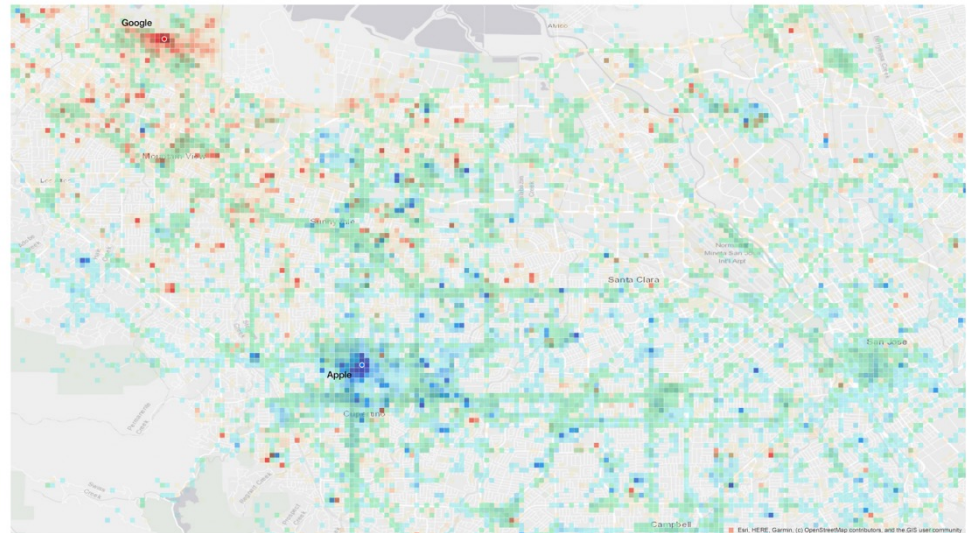


Fig. 2. Patents per capita & MA employment density.

Carlino et al 2007

# Evidence: which bits of cities?

- **City ~ innovation links can be highly localised**
- Historically, face to face interaction has been fundamental to urban innovation (Crookston & Reades 2021)
- Meetings between workers at nearby firms raise knowledge spillovers between the firms (Atkin et al 2022)



Notes: Figure shows overlays of pings for workers at Google headquarters (marked with a red circle) and Apple headquarters (marked with a blue circle). Green denote overlapping pings, darker shades show the number of pings.

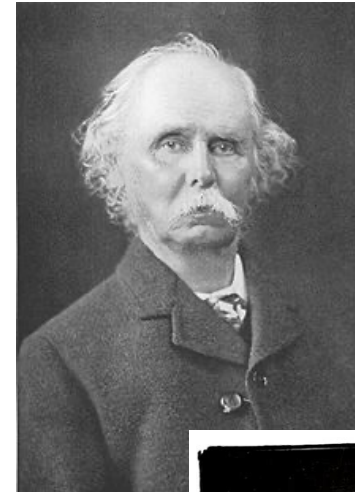
Atkin, Chen, Popov 2022

# Evidence: which bits of cities?

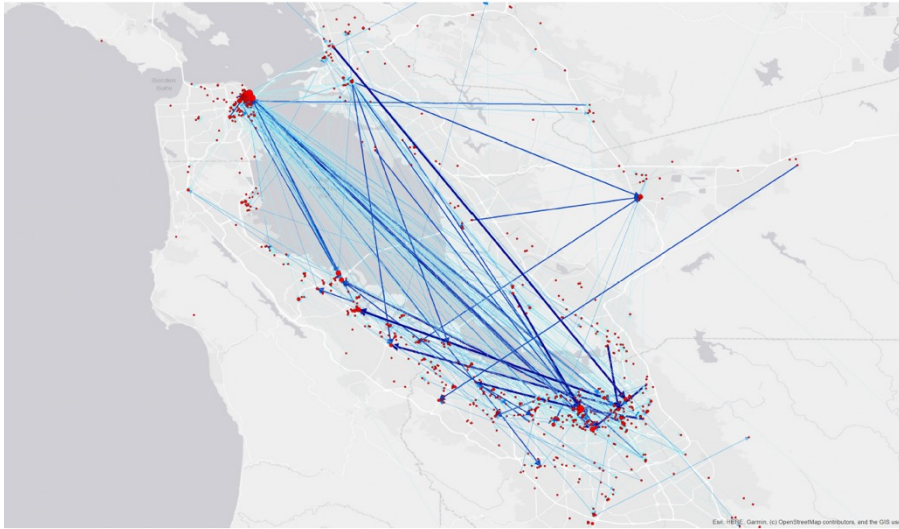
- **City ~ innovation links can be highly localised**
- So, how might we help people meet, exchange ideas, observe each other, collaborate ... ?
  - **Physical infrastructure:** Roche (2020) finds (very) small positive links from walkable streetscapes to patenting
  - **Social infrastructure:** both Roche and Andrews (2019) find that spaces for interaction, e.g. bars and cafes <~> higher patenting
  - **Economic infrastructure:** encouraging co-location and interaction of firms, skilled workers
- More formally, academics talk about **clusters** as local systems for these processes

# Clusters

- Key idea: **colocation, interaction and collaboration by firms in cities** fosters innovation, growth (Marshall 1918)
- In the jargon, ‘industrial production districts’ or ‘milieux’ in cities
  - **Clusters may involve firms in the same industry** (Marshall)
  - **... or involve knowledge spillovers across industry** (Jacobs, 1969)

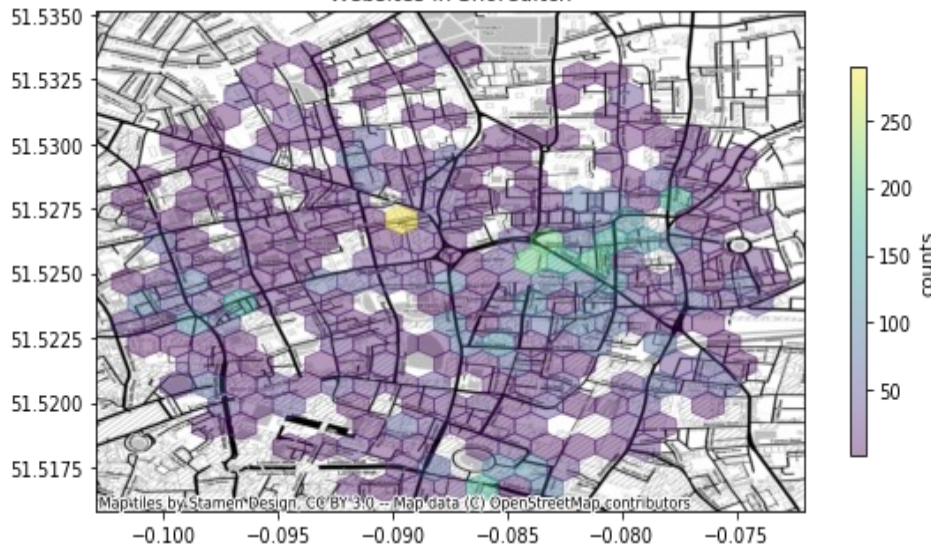


# Clustering at different scales



Top: Patenting in Silicon Valley, Atkin, Chen, Popov 2022. 50-mile distance ring around Stanford University

Websites in Shoreditch



Bottom: Micro-clustering in East London, Stich, Tranos, Nathan 2022. Geolocated websites, 1km distance ring

(c) Max Nathan



# Evidence: what kinds of interaction?

We looked at lots of places, and there were a couple of companies in this area already, and we moved here because the other companies were here. And you know ... the first weekend we were here we went out and got some sandwiches and sat in the park ... and I ran into some friends who worked at [redacted]. And that was, you know we talked about some possible ways we could work together .... (F3)

Nathan, Vandore, Voss 2019

- Many types of interaction going on here!
  - Planned and chance interaction
  - Rich interaction [exchanging detailed / tacit information]
  - Interaction in the same industry space [vs different industries]
  - Interaction with people you already know [vs people you don't]
- Lots of questions about which of these matter more



# Diversity or specialisation?

- **Both! But evidence tells us industrial diversity is especially important for urban innovation (Glaeser 2011)**
- **Why? Learning across (more or less related) industries**
  - **Social media** <= technology + communication + media
  - **Fintech** <= finance + technology + security + crypto
  - **Cleantech** <= energy + environment + technology
- **Why? It helps insulate cities against shocks**
  - Example = a major employer closes down, or 'jumps' production to another country => lots of other types of activity and work available

# Theory: innovation systems

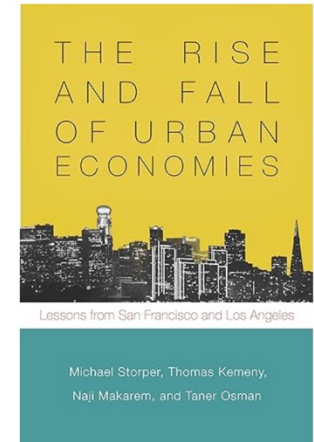
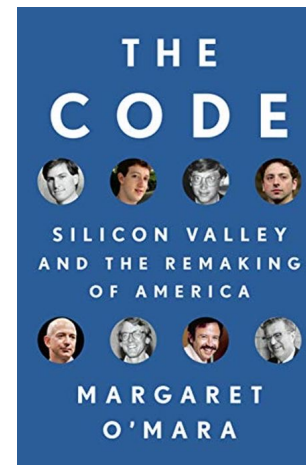
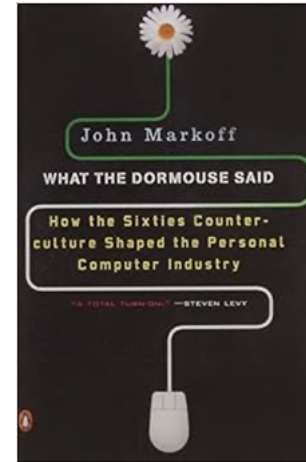
- So far, we've focused on what firms and workers do
- Innovation system = 'the set of institutions directly concerned with scientific and technical activities' (Freeman 1991)
- In practice, these systems may be sub-national
- **Regional innovation (eco)system** (Cooke et al 1997)
  - Productive system = what firms do
  - Financial system = private and public support for R&D
  - State system = budgets, policy levers, ability to use them
  - Social system = how actors interact, learn from each other
  - Institutional structure – tacit conventions, formal rules of the game

# Example: Silicon Valley

- **Most important tech cluster in the world?** Many places and policymakers want to build ‘the next Silicon Valley’
- **Four core phases of development, with ‘branching’ from sets of related technologies**
  - **Transistors, 1950s:** Hewlett Packard, Fairchild
  - **Integrated circuits, 1960s-70s:** Intel, AMD
  - **Personal computing, 1970s-90s:** Xerox PARC, Apple, Adobe
  - **Web and social media, 1990s-10s:** Alphabet, Meta, Twitter/X
- **Broader diversification** from IT into software, web/social media, plus life sciences, biotech and ‘cleantech’

# Example: Silicon Valley

- **Key socio-economic features**  
(Markoff 2006, O'Mara, 2020; Storper et al, 2015; Atkin et al, 2022)
  - Startup culture: rapid company formation, serial entrepreneurs
  - Very large VC system: allows vast scaling without profit
  - Networking: informal, intensive. Importance of informal / chance interactions in shaping knowledge flows
  - Culture: utopian / anarchist / libertarian



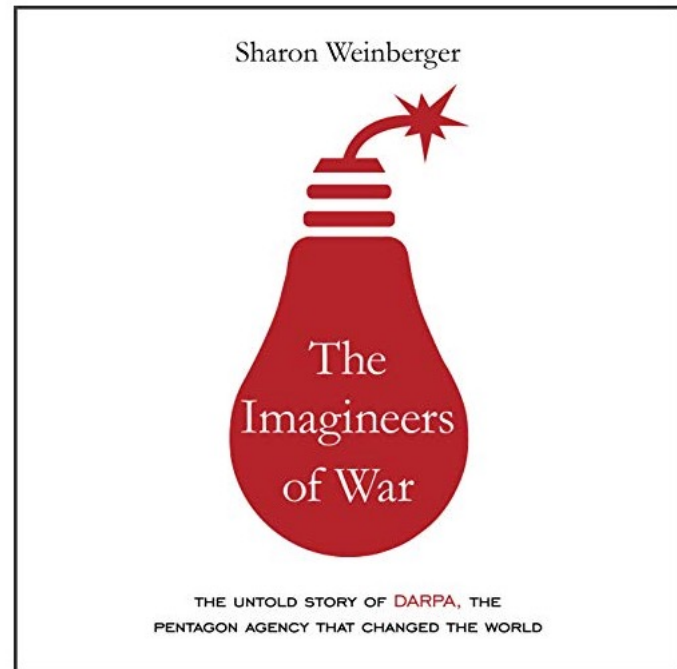
# Example: Silicon Valley

- Ecosystem with a **'hidden developmental state'** (Block, 2008)
- **University research, often funded by Government**
  - Fred Terman founds Stanford Research Park in 1951
  - 'Mother of all demos' by Doug Engelbart at SRI in 1968
  - Stanford grads found Hewlett-Packard (1939) and Google (1998)



# Example: Silicon Valley

- Ecosystem with a ‘**hidden developmental state**’ (Block, 2008)
- **Military-industrial complex**
  - Deep roots: Bay Area naval base and shipyards (Voss, 2024)
  - GPTs: radar, transistors, circuits
  - Public sector as lead client: Fairchild, Lockheed, DARPA (Weinberger 2017)



# Part 3: possible futures

# Glaeser's Paradox

**“The central paradox of the modern metropolis:  
proximity has become ever more valuable as the cost of  
connecting across long distances has fallen”**

(Glaeser, 2011)



# Putting it another way

- We've seen that **innovation is urbanised**. Let's recap why:
  - Knowledge spillovers
  - Ease of interaction, planned + chance meetings
  - Supporting roles of urban pooling and matching
  - Rich supporting ecosystems
- **But for innovation in individuals and teams**, proximity seems to matter more for first interactions and less for continued interactions (Clancy 2022, Crescenzi et al 2016)
  - Social, professional, institutional links > geography
  - Cheaper, better communications technology and transport
- **So why do cities still matter for innovation?**

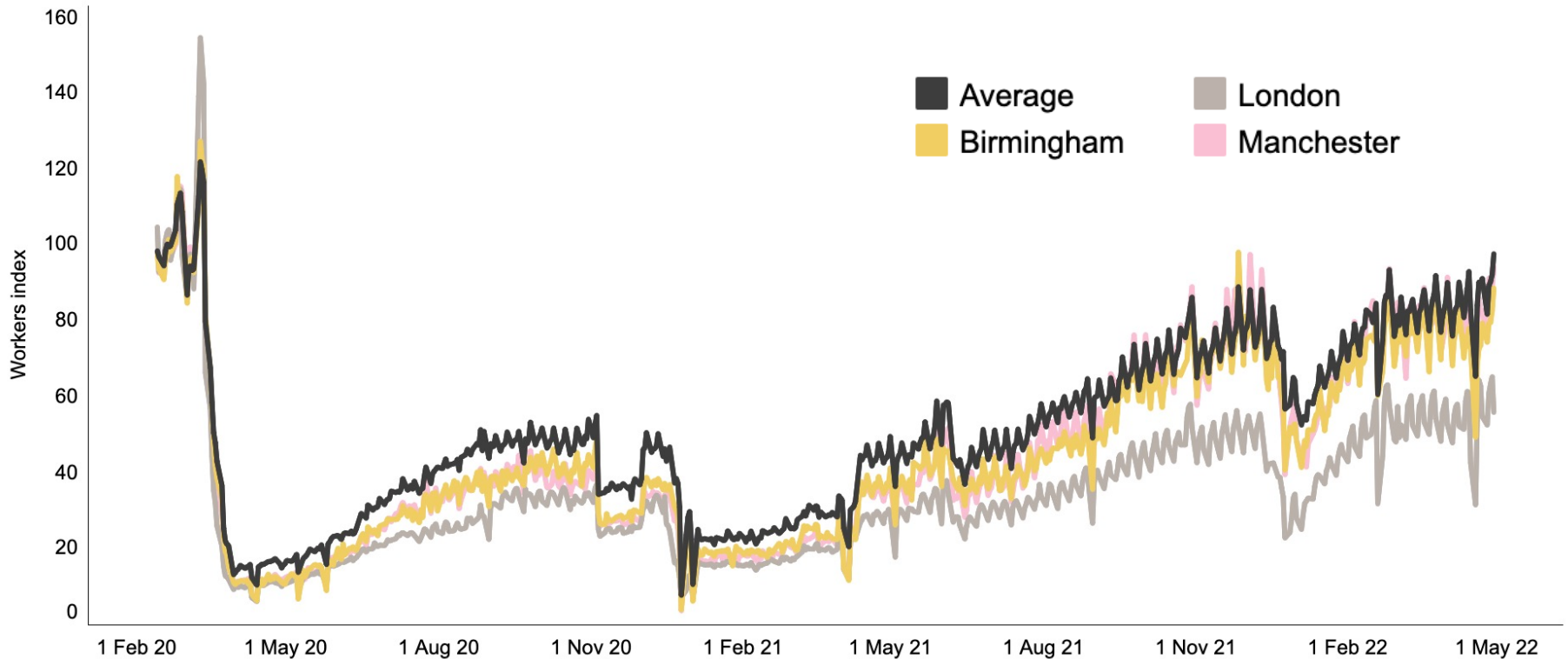
# Paradox solved?

- Today's urbanised innovation systems reflect three C20 trends: 1) **structural shifts in the world economy** 2) **how tech has been used in practice** and 3) **effective urban public policy** (Glaeser 2011)
  - 'Western' cities largely produce services and experiences
  - Firms put high-value / complex activities in urban cores, and these benefit from rich face-to-face interaction
  - Cheaper / better tech and transport *enables* all of this: it reinforces big cities' economic positions
  - Urban policymakers have improved amenities and public services, so that cities are more attractive places to be

# Future shocks

- **These macro forces are powerful.** And cities are resilient to macro shocks (Nathan and Overman 2020, Glaeser 2022)
- What kinds of change might still threaten cities' position?
  - Climate: most major cities are low-lying / coastal
  - Economic: distributed manufacturing (e.g. 3D printing) that shifts patterns of production
  - Technological: automation, especially current AI wave
  - Social/political: urbanised inequality, Big Tech
  - Economic/technological: shift to hybrid working and consumption

# Forced experiments

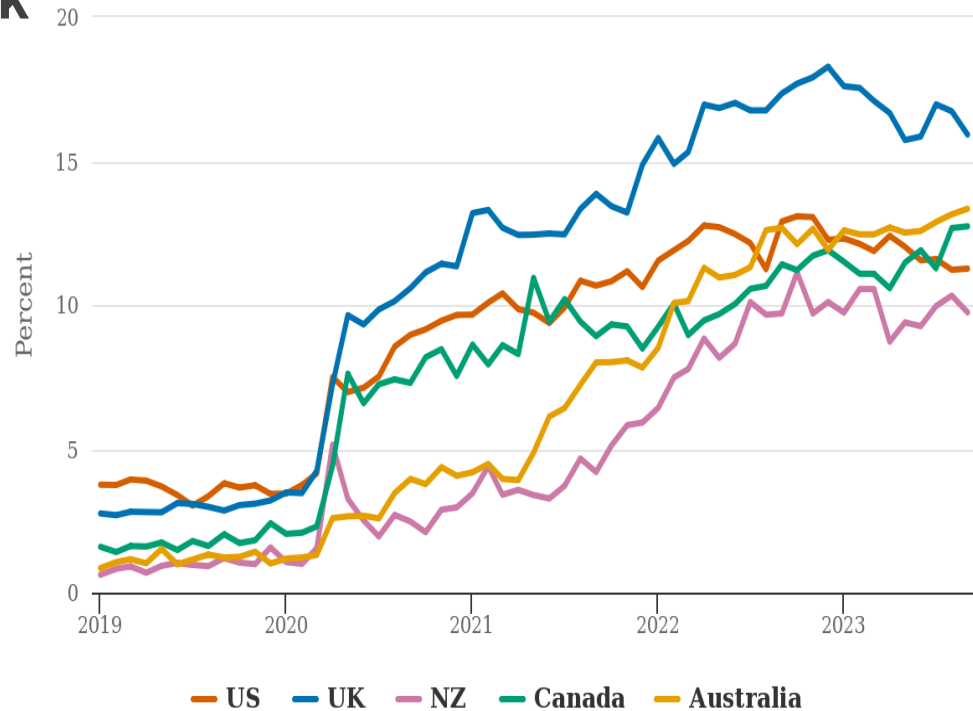


Source: Centre for Cities High Street Recovery Tracker. <https://www.centreforcities.org/data/high-streets-recovery-tracker/>  
This index covers daytime footfall on weekdays, compared to a pre-lockdown baseline of 100.

The pandemic led to huge drops in urban mobility  
For workers in big cities, especially in London, these persist

# Forced experiments

- **COVID-19 was a triple shock to urban economies**
- Office work done remotely
- Consumption shifted online
- Massive jumps in urban unemployment, poverty
- Consumer footfall is largely back where it was
- Huge jump + continued growth in hybrid / remote working (Hansen et al 2023)



www.everviz.com

% of new jobs offering either hybrid or remote working, Lightcast data (Hansen et al 2023)

# The 'post-COVID' world

- **Biggest activity shifts *within* big cities** – a doughnut effect, benefitting rich suburbs (Bloom and Ramani 2022)
- The predicted **urban exodus hasn't happened ... yet. We're in the middle of a lot of messy experimentation:**
  1. Is hybrid working 'good enough' for complex / creative tasks?
  2. Office workers want 2x the WFH that managers want (Barrero et al 2023)
  3. In cities like London, hybrid ~> 40% less demand for office space? What happens to those buildings, and to local services? (Van Nieuwerburgh 2022)
  4. Permanent rise in 'pandemic risk' = more drastic changes (Glaeser 2022)
- Big cities may switch to permanently more hybrid, smaller cities return to pre-pandemic norms (Monte et al 2023)

# Hybrid consumption?

- **Detaching consumers from consumption spaces**

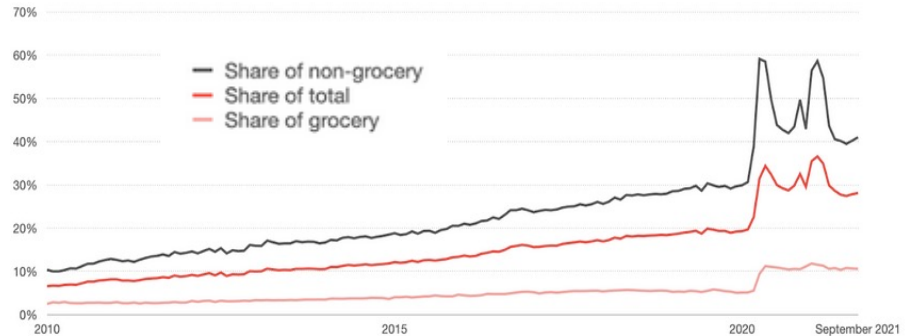
- Online retail
- On-demand grocery
- Dark kitchens, dark stores

- **Disruptive urban innovation!**

- Decline / reconfiguration of high streets; growth of warehouses, fulfilment space
- New types of urban work

- **Much less clear which bits of this will stick ...**

UK ecommerce as % retail\*



Source: ONS



# Summary

- Innovation = invention + commercialisation + diffusion
- Not just something firms do
- Consensus on importance of innovation to long term economic growth – Schumpeterian view, Endogenous Growth Theory view
- General Purpose Technologies are building blocks in this innovation~growth process, as well as foundational to Smart City tools
  
- Innovation helps produce the tools and infrastructures for Smart Cities
- Consensus on the importance of urban areas in supporting innovation
- Differences of opinion about how this happens – urban economics vs innovation systems
- Case studies suggest both perspectives add value – but it's not just about the market!



# Summary

- Why is urbanised innovation still important today?
- A big part of the answer: contrary to predictions, to date cheaper/better tech and transport have helped reinforce big city economies – rather than spread activity out
- Cities and clusters have globalised, with clusters often nodes in bigger production systems
- All this could still be disrupted by technological, economic or environmental shocks
- For example, remote/hybrid working may yet radically change urban innovation systems – big open questions here

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