Challenges for urban innovation - draft

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SMART CITIES: CONTEXT, POLICY AND GOVERNMENT: LECTURE 8

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What we will cover today

- **Lecture 6 – overview** of urban innovation systems
- **Lecture 7 – strategy + policy tools** for urban innovation

- **Lecture 8 – challenges** for smart cities, innovation policies
  - **Part 1: framework**: key concepts and ideas
  - **Part 2: automation**: impacts on wages and employment
  - **Part 3: innovation, tech and inequalities** in cities

  - **Seminar:** Amazon HQ2 and New York City

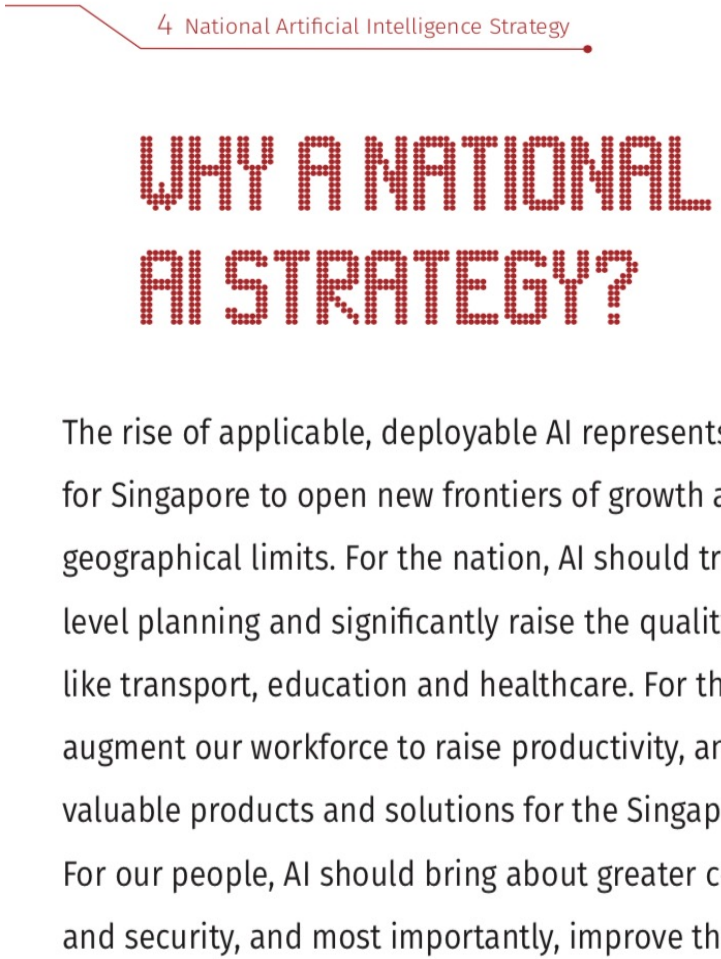
Part 1: overview

Challenges

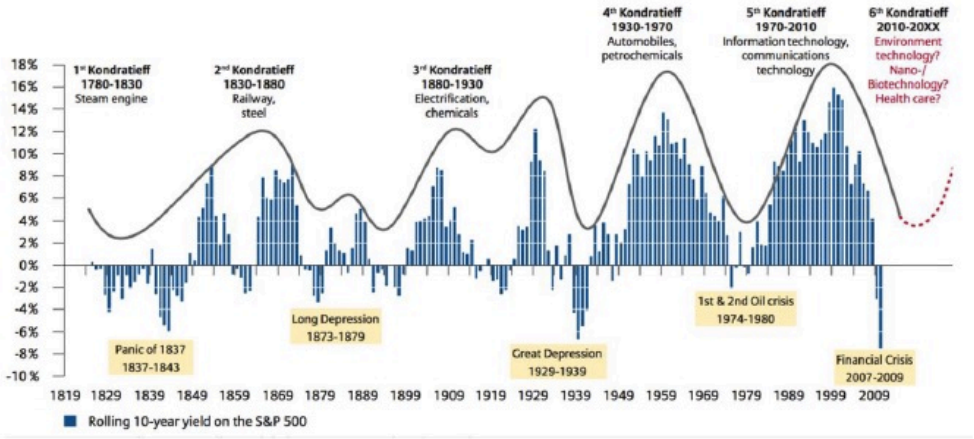
Who are the winners and losers from smart cities, and urban innovation policies?

Many smart city strategies don't talk about these 'wider welfare' issues. Nor do most innovation policies.

But academics – and the public – think about these issues a lot!



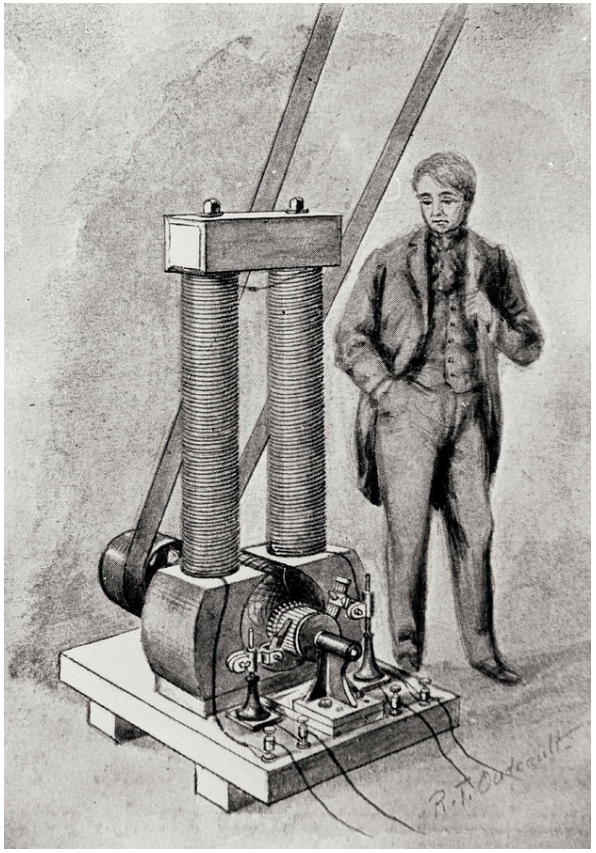
Key concepts from Lecture 6



- Innovation drives long-run growth through **creative destruction**: there are winners and losers (Schumpeter 1939)
- Innovation generates **technological revolutions**, which lead to long waves of growth (Kondratieff 1925, Perez 2010)
- But diffusion can be slow, and uneven

Technology diffuses slowly

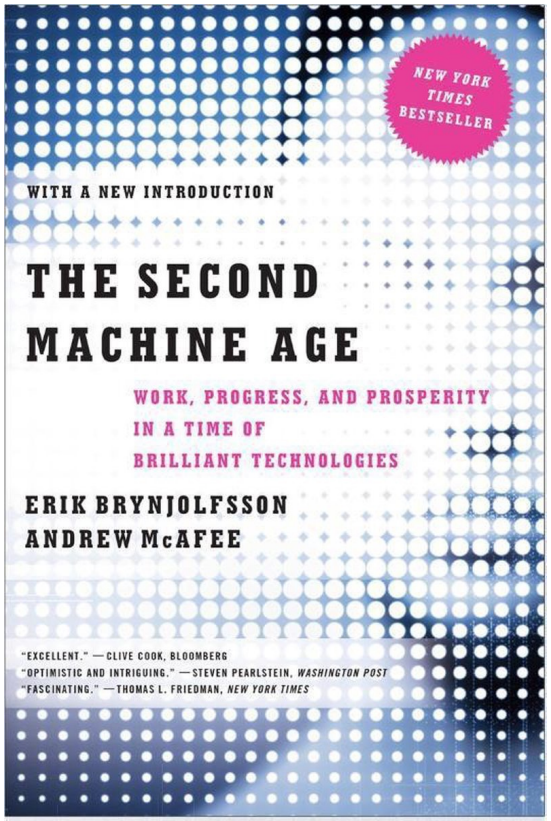
- **The dynamo: a historical GPT** (David 1990)
- It took 40 years from first electric power stations to achieving 50% factory electrification. Why?
    - It takes time to discover benefits
    - Complements are costly
    - Tacit knowledge, barriers to learning
- Direct parallels for automation debates … and role of cities and clusters in diffusing knowledge



Thomas Edison and dynamo, 1880
Source: Wikimedia

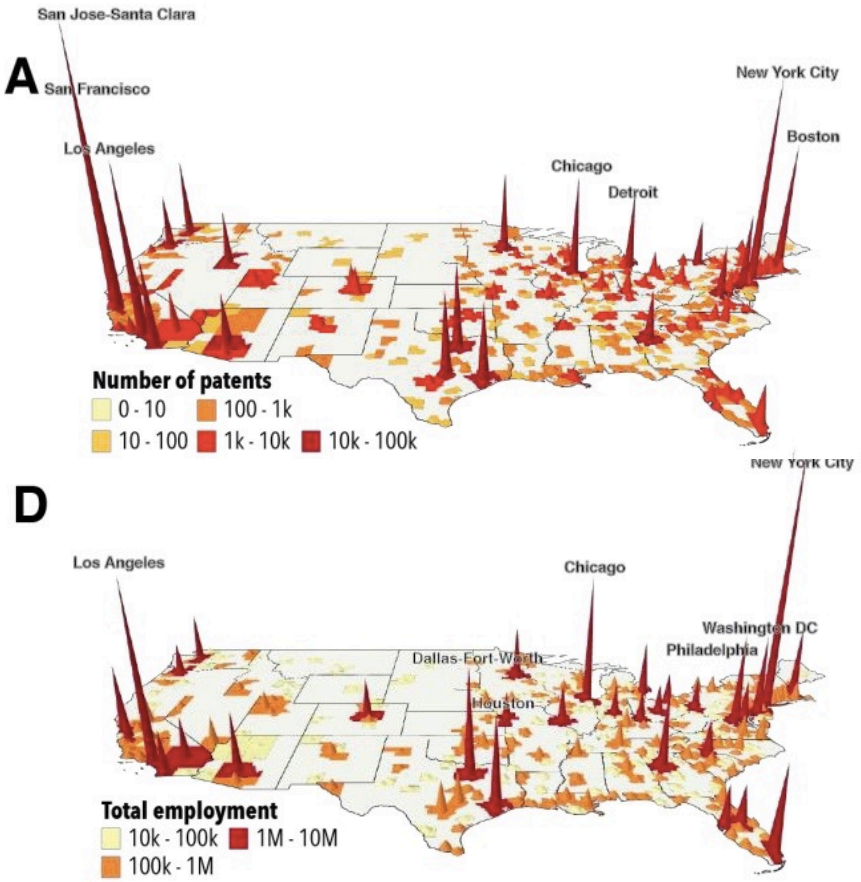
Innovation generates inequality

- Brynjolfsson and McAfee (2014):
  - **Bounty:** innovation and productivity gains from ICT raise aggregate income, wealth
  - **Spread:** gains are concentrated among owners of tech, and skilled workers, so income / wealth inequality also rise
- Capital: Big Tech firms' market power (Eeckhout 2022)
- Labour: new technologies substitute some activities, complement others



Innovation, inequality, cities

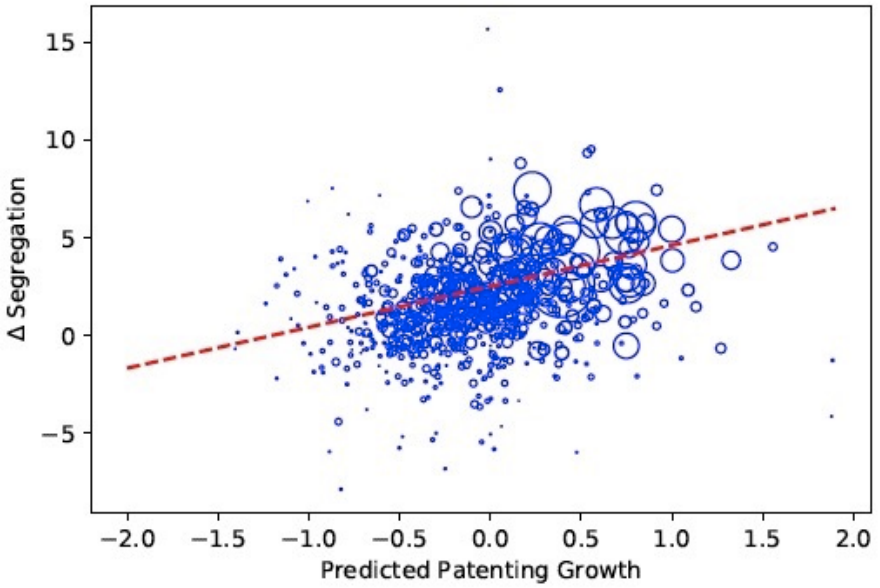
- **The Great Divergence**
- Innovative activity and high-wage jobs are unevenly spread
- Diffusion: ideas spread slowly *and* unevenly across space
- BUT impacts of automation may be uneven too, hitting some places harder



Geographies of patenting and jobs are very uneven. Source: Balland et al, 2020

Innovation, inequality, cities

- **Clustering drives up inequality *within* cities too**
- Complex activities cluster, to take advantage of knowledge spillovers
- High-paid workers sort into areas close by, gentrifying those neighbourhoods
- New ideas generate ‘new work’ alongside old work



Predicted patenting growth vs. change in neighbourhood income segregation, 1990-2010, US Commuting Zones. Weights = 1990 households.

Source: Berkes & Gaetani 2019

Part 2: automation

Basics

- Automation: workplace technologies designed to save labour (Autor 2015)
- **Today's main forms of automation**:
  - Information and communication technologies (ICT)
  - Robots
  - Machine learning (ML) => 'artificial intelligence' (AI)
- Not a new thing. A historical example …

Automation in action

From labour-intensive (and animal-intensive) … to capital-intensive

1900: 41% of US workforce employed in agriculture
2000: 2% of US workforce employed in agriculture

Source: Autor 2015; http://bbrumley.orgfree.com/Agriculture.html

Old worries

- **Technological unemployment:** ‘Unemployment due to our discovery of means of economising the use of labour, outrunning the pace at which we can find new uses for labour’ (Keynes, 1930)
- **Optimists**: losses are temporary, tech creates new opportunities
- **Pessimists:** disruption is much faster than adjustment, so is effectively permanent

Keynes in 1933.
Source: Wikimedia

A simple framework

- Aghion et al (2022) summarise the literature. Two main takes

- **Take 1 – automation destroys routine work, decreases wages in routine jobs, but ultimately be net job-creating**
    - In affected sectors, automation substitutes for routine tasks
        - Examples: assembly line workers, routine office jobs
    - Those workers' labour power reduces, cutting their wages
    - But then goods and services get cheaper; consumers spend money saved elsewhere in the economy …
    - So that overall, more jobs may be created than are lost
    - Q: what kind of new work will be created, and where?

A simple framework

- Aghion et al (2022) summarise the literature. Two main takes

- **Take 2 – automation complements skilled work, helps productivity; but creative destruction at the macro level**
  - In affected sectors, automation complements skilled work
    - Examples: lawyers, doctors, bankers, lecturers
  - Workers become more productive; may get higher wages
  - Automating firms lower prices, gain market share, add jobs …
  - … But there's creative destruction: automating firms may get bigger at the expense of others
  - Q: Do workers share productivity gains?

Evidence (1)

- Haldane (2018) reviews **projected impacts of automation:**
  - 16 studies projecting future employment effects
  - Project between 10% to 50% (!) of the world's workforce will lose their jobs as a result of robots, ML/AI or both
  - Range: partly driven by whether tasks or jobs are modelled
  - NB many studies also predict job *creation*
- **Several issues with these studies:**
  - very wide range of projected impacts
  - lots of assumptions needed, including about future tech
  - hard to model social responses (size of substitute / complement / indirect effects)

Evidence (2)

- **Ex-post studies give us better information.** Aghion et al (2022) review this literature
- First wave of studies looking at **area-level impacts of robots**
    - US studies find that areas with more robotisation lose more jobs
    - But we don't get this result in other countries (e.g. Germany)
    - And some limitations in data quality
- Second wave of better studies **looking within the firm**
    - Firms that automate add jobs overall; no clear wage effects
    - Creative destruction may be limited – everyone gains?
    - But overall job gains may hide some low-skill job losses

Geographies of automation

- O'Connor 2017: **automation shocks will be worse if affected jobs cluster together.** Where might this happen?

- **Small / one-industry towns with lots of routine work**, say in call centres or warehousing
  - By contrast – retail, delivery, accounting, transport are fairly evenly spread across most countries as a share of jobs

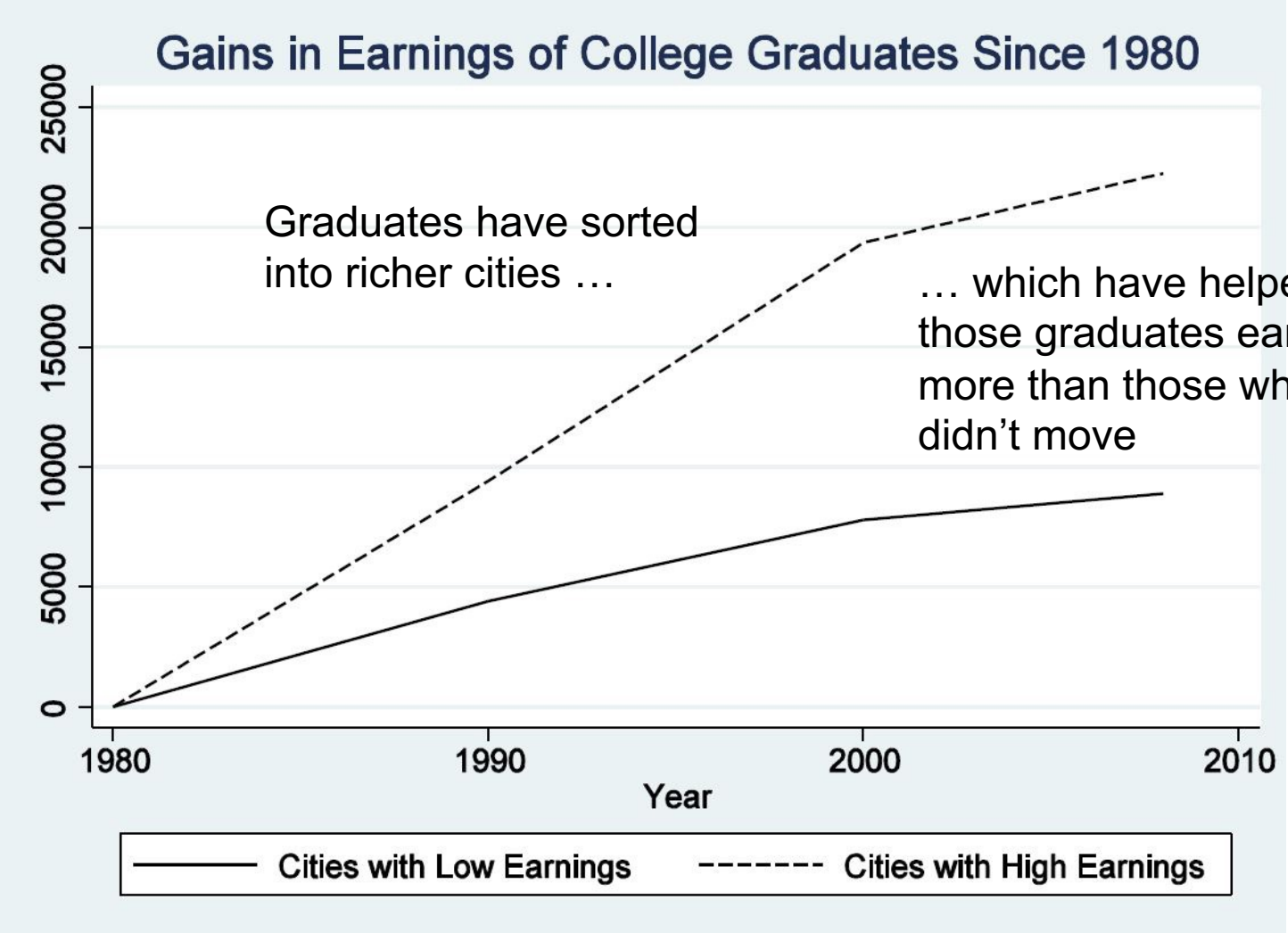
- **Big 'post-industrial' cities with large service sectors**, like London or New York
  - Overall, economic diversity makes big cities resilient – but automation may still affect *classes of urban workers*

Part 3: innovation, tech and urban inequalities

Basics

- **We'll look at three aspects of urbanised inequality**
  - The Great Divergence *between* cities, and especially tech centres vs. everywhere else
  - Innovative activity and income inequality *within* cities
  - Spillovers from urban tech to the local service economy.

The Great Divergence



Moretti (2012)

The Great Divergence

- **Complex work (still?) needs face to face interaction**
- Big cities help these workers get more productive

- So there's an '**urban wage premium**' for these workers, which rises with city size
- Urban wage premia are particularly large in sectors like **finance, law and tech**

- **NB** automation is a *complement* for these workers – it makes them more productive, and they may earn more

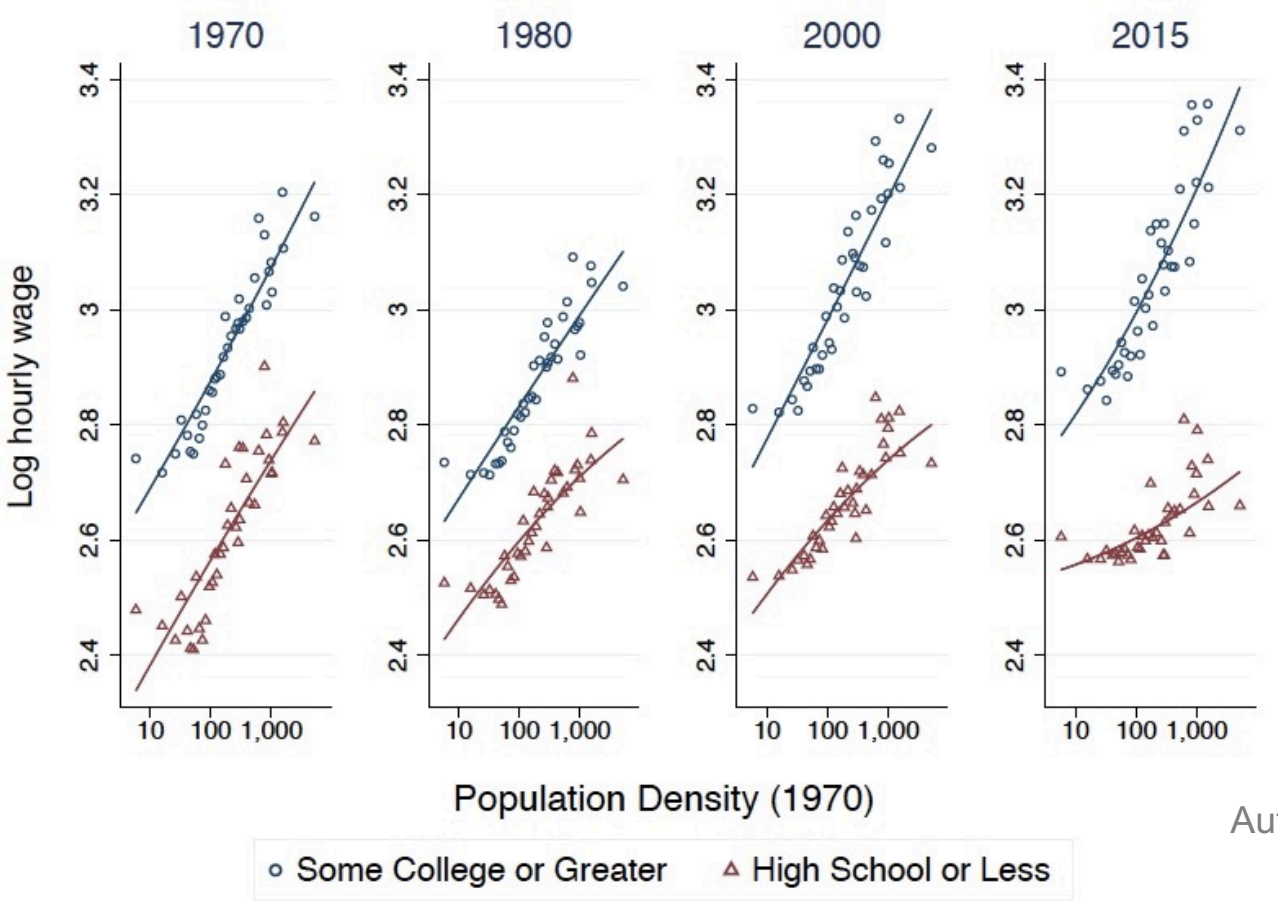
Unequal cities

- Autor (2019) looks at the **changing urban wage premium across US cities** since the 1970s:

    1) The urban wage premium is bigger in bigger cities, and higher for graduates vs non-graduates
    2) For graduates , it's getting bigger over time, and that's driven by the biggest places
    3) For non-graduates, it's flattening, especially in the biggest places. Most change since 2000.

- Autor argues that innovation – specifically, automation – is a major driver of these changes

Unequal cities



Autor (2019)

Rising urban wage premium for college graduates (blue)

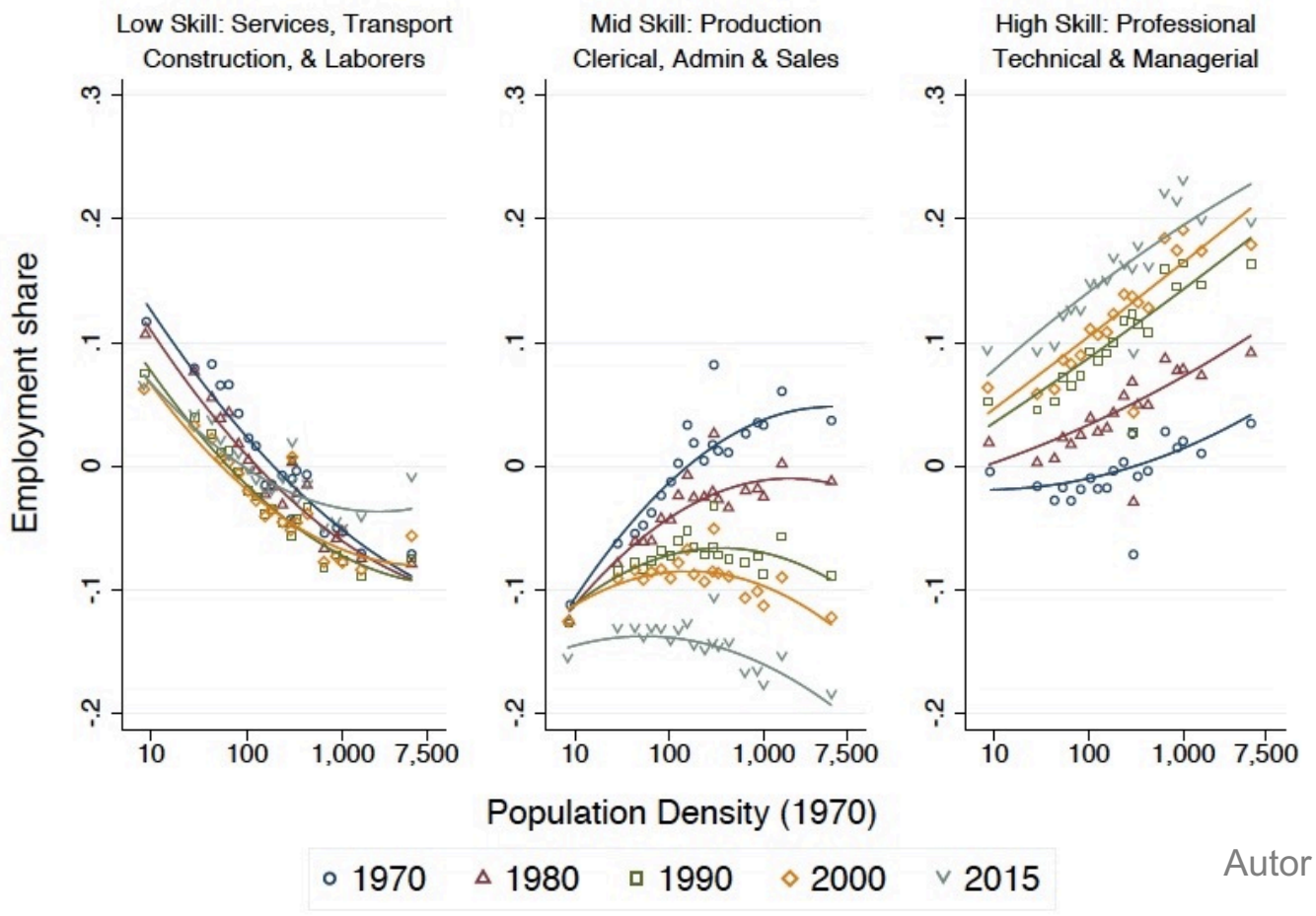
Flattening wages for urban non-graduates (red)

What explains these shifts?

- **Autor is clear that the main driver of change is 'job polarisation'** – that is, growth in high-wage and low-wage work, and shrinking of mid-wage work
- What drives polarisation? Autor is also clear that innovation ~> automation is one of the main forces, at least in the US
- Although there are others: trade shocks, weak unions …

- **These macro shifts have an urban footprint, generate winners and losers**

Geography of job polarisation



Autor (2019)

US cities have seen growth in lowest-paid and highest-paid jobs

Biggest changes in the biggest cities

Autor and Salomons (2019)

‘New work’

Table 1: Examples of New Job Titles by New Work Category and Decade

	Frontier work	Last Mile Work	Wealth Work
1980	Supervisor, Word Processing	Check Writer	Hypnotherapist
	Controller, Remotely-Piloted Vehicle	Tamale-Machine Feeder	Gift Wrapper
1990	Circuit Layout Designer	Vending-Machine Attendant	Dance Therapist
	Robotic Machine Operator	Film Touch-Up Inspector	Singing Messenger
2000	Artificial Intelligence Specialist	Chat Room Host/Monitor	Counselor, Marriage-Family
	Echocardiographer	Bicycle Messenger	Employee Wellness Crdnr
2010	Technician, Wind Turbine	Underground Utility Cable Locator	Exercise physiologist
	Intelligence Analyst	Technician, Prepress	Sommelier

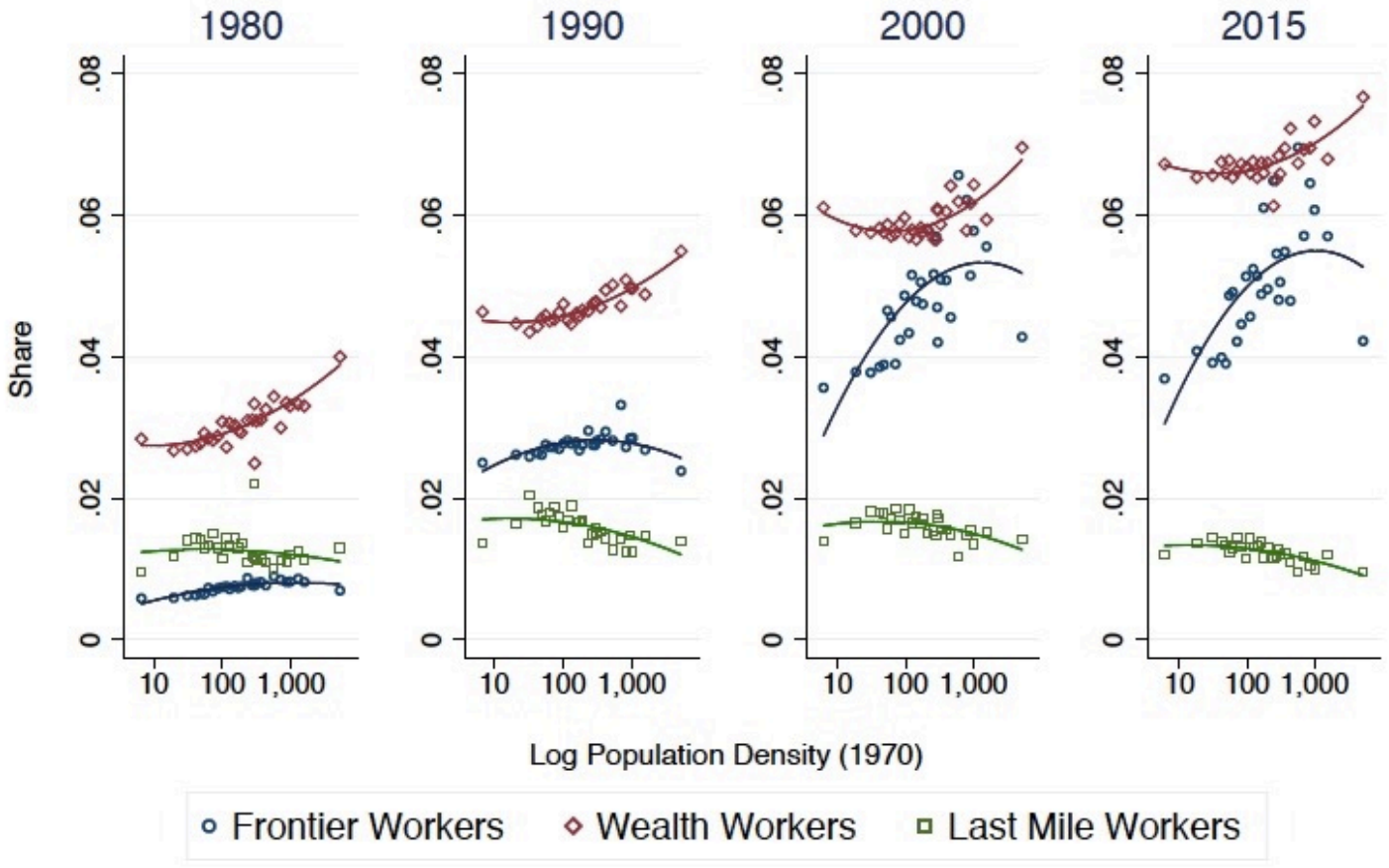
Table reports examples of new job titles added to the 1977 and 1991 Dictionary of Occupational Titles, and the 2000 and 2010 Census Classified Indices of Occupations.

Autor and Salomons look how new types of job have appeared over time

Three groups of job, organised by tasks

Differ by a) qualifications b) salary c) gender

‘New work’ in cities

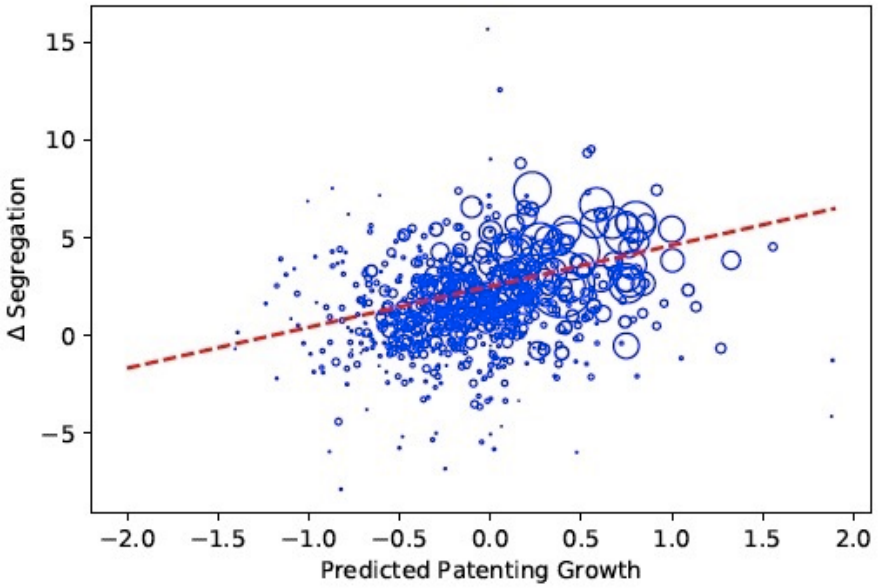


Higher-skilled and better-paid types of ‘new work’ cluster in bigger cities

Clustering has got stronger over time

Innovation and segregation

- **Complex activities cluster**, because of knowledge spillovers …
- **High-paid workers sort into areas close by**, gentrifying those areas
- Biggest effects: medical, pharma and tech patents
- **Impacts for poorer urban workers: gentrification, plus labour market shocks**



Predicted patenting growth vs. change in neighbourhood income segregation, 1990-2010, US Commuting Zones. Weights = 1990 households.

Source: Berkes & Gaetani 2019

Trickle-down from tech?

- **Does urban tech support other jobs in cities?**
- Moretti 2010: in the US, each new tech job supports four local service jobs
- **The jobs multiplier:** high-paid tech workers in SF buy lots of expensive coffee, meals, clothes, etc
- However, Moretti's design has its critics (Van Dijk 2018) …

Top: Blue Bottle Coffee
Bottom: Mission Workshop

Trickle-down from tech?

- **More recent estimates of job multipliers are much lower**
  - WWC 2018: cross-OECD study: each new high-tech job creates ~ 2.5 non-tradable jobs
  - Lee and Clarke 2019: UK: 0.7 non-tradable jobs
  - Osman and Kemeny 2021: US: 0.79 non-tradable jobs
- Also, **small (or negative) links from urban tech jobs to real wages in urban service sectors**
  - Kemeny and Osman 2018: each new US tech job raises service sector wages by 0.1-0.7%, once cost of living is taken into account
  - Lee and Clarke 2019: new UK tech jobs *lower* real wages of lowest-skilled local service workers

Summary 1

- Who are the winners and losers from smart cities, and urban innovation policies? Policymakers don't often admit / discuss these issues
- Schumpeter: innovation drives growth through creative destruction
- The Bounty and the Spread: innovation raises overall productivity, income, wealth. But the winners are 1) owners of capital and 2) workers for whom innovations complement the jobs they do

- These macro processes have urban footprints, for several reasons:
  - 1) innovation is urbanised
  - 2) new ideas diffuse slowly and unevenly
  - 3) affected jobs / workers may also be clustered in particular places
  - 4) interaction with urban housing markets and gentrification

- Impacts between cities (tech centres vs the rest) and within cities (more qualified / less qualified workers, and richer / poorer neighbourhoods)
- Big Tech industry structure and geography probably amplifies this

Summary 2

- We look at three linked ways in which innovation affects labour market outcomes : 1/ Automation: 2/ urban job polarisation 3/ Multiplier effects

- Long history of worries about 'technology taking all the jobs'
- Three big forces: tech as a substitute for labour, tech as a complement for labour, wider / indirect effects of tech on the rest of the economy
- Not clear how important each of these is, in practice
- Pessimists focus on substitution effects, optimists on complement effects

- Real-world evidence is (kind of) positive
- Area-level studies found negative effects of robotisation, richer studies find automation raises firm-level productivity

- But: even if there's aggregate gains from automation, there may still be losses, and these may be clustered in space

Summary 3

- The Great Divergence - skilled work and workers cluster in big cities, and experience rising wage gains
- Localised segregation - clustering within cities, and links to gentrification ~ neighbourhood segregation

- Strong evidence from the US that urban real wage premia are rising for skilled workers, and flattening for workers without degrees
- Innovation ~> automation helps drive job polarisation, and this restructures urban labour markets - more high-wage and low-wage, less mid-wage work
- Innovation also generates 'new work' - in ways which are making polarisation stronger
- There may also be multiplier effects from tech jobs to local service jobs - but evidence suggests these are quite small

- Raises big questions for national and urban policymakers!

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