Recent background work:

- Bonvillian and Sarma, *Workforce Education, A New Roadmap* (MIT Press 2021)
- Bonvillian and Singer, *Advanced Manufacturing – the New American Innovation Policies* (MIT Press 2018)
- Coauthor, MIT Open Learning, *MassBridge - Advanced Manufacturing Workforce Education Benchmarking Study,* Phase One, April 12, 2022
- Cochair, National Academies National Materials and Manufacturing Board, *DOD Engagement with Its Manufacturing Innovation Institutes* (Phase 2 Final Report (2021)
- Bonvillian, *The Playbook – For workforce education at Manufacturing Innovation Institutes*, Jan. 11, 2022 (not yet released)

We operate in a broken workforce system -- Background on the problem:

- <u>Disconnect</u> between work and learning
- <u>Disinvestment</u> by government and employers
- <u>Labor Dept</u>. training programs don't reach <u>higher technical skills, incumbent</u> workers
- <u>Education Dept</u>. programs focused on <u>college not workforce</u> needs and <u>not linked to</u> the Labor Dept. programs
- <u>Vocational education</u> in secondary schools largely <u>dismantled</u>
- <u>Underfunded community colleges</u>, lack the resources to provide advanced training in new fields and have <u>too low completion rates</u>
- Colleges and <u>universities disconnected</u> from workforce education
- <u>Lifelong learning</u> is missing
- <u>Underfunded advanced technical education</u> programs at NSF ATE and at Advanced Manufacturing Institutes
- A <u>broken labor market information system</u>
- The existing actors are in "legacy" sectors - <u>hard to change</u>

US Production Productivity Lags Behind Competitor Nations
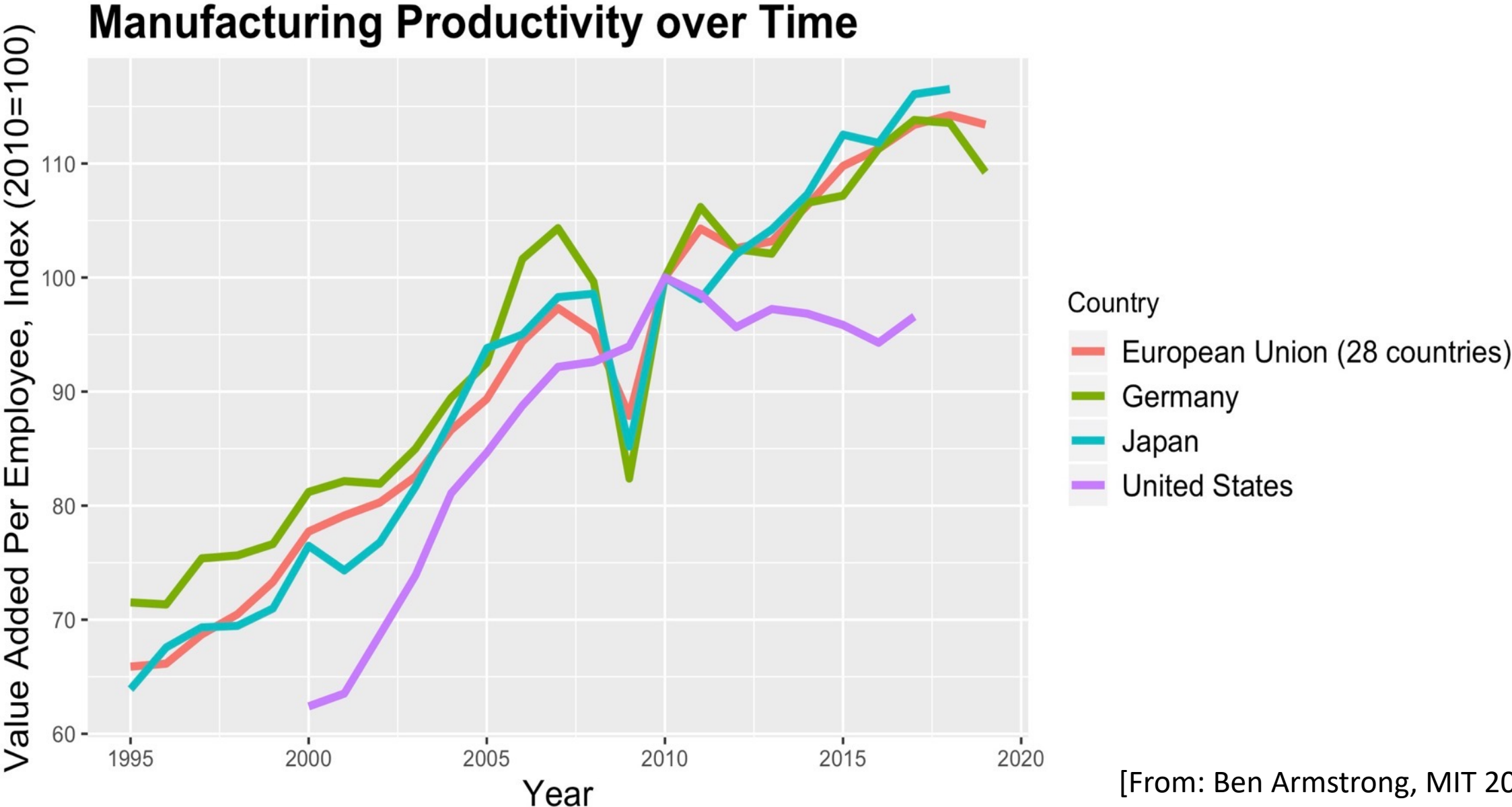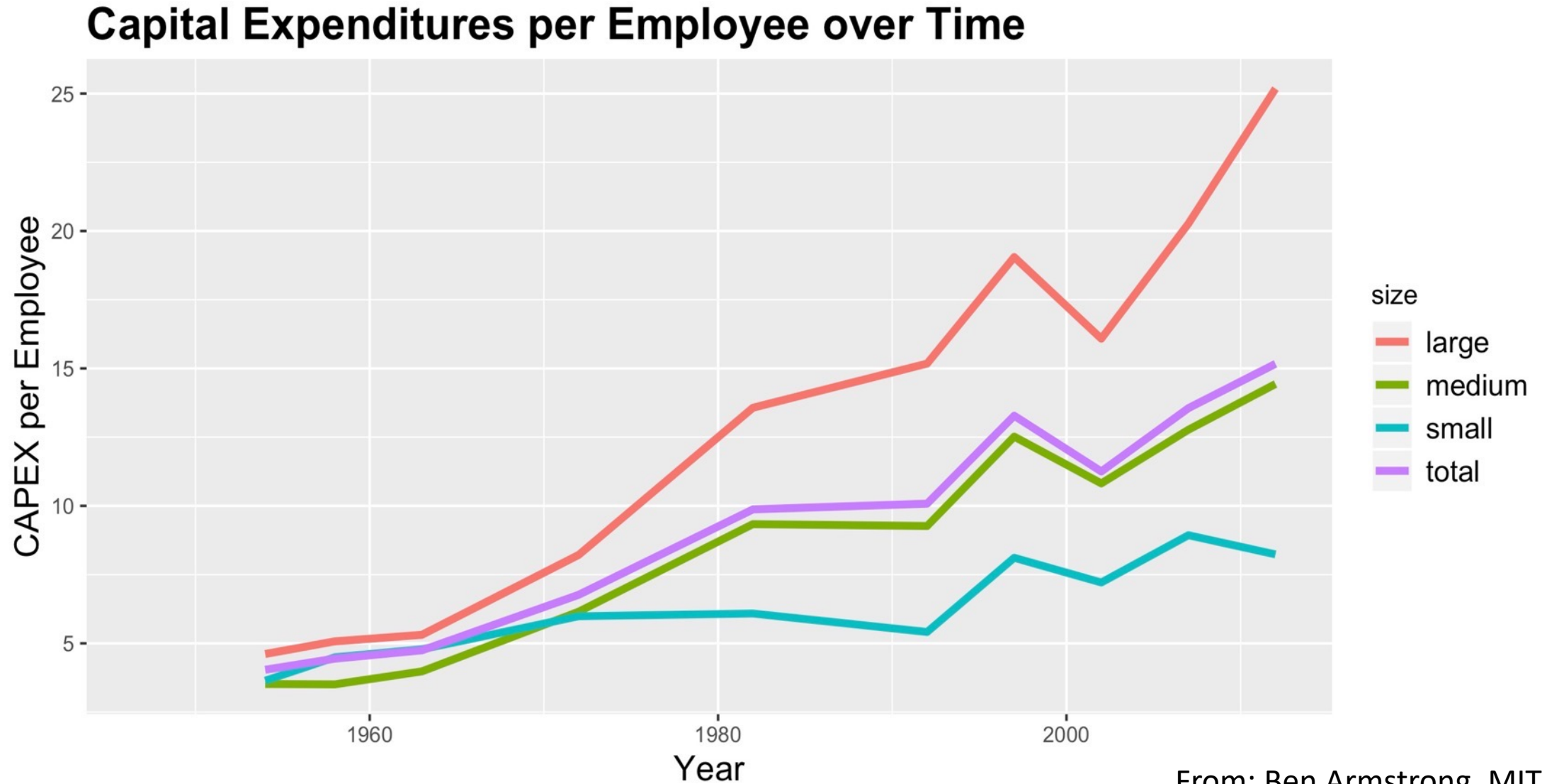

[From: Ben Armstrong, MIT 2021]

Small and Mid-Sized Production Firms Lag in Productivity:
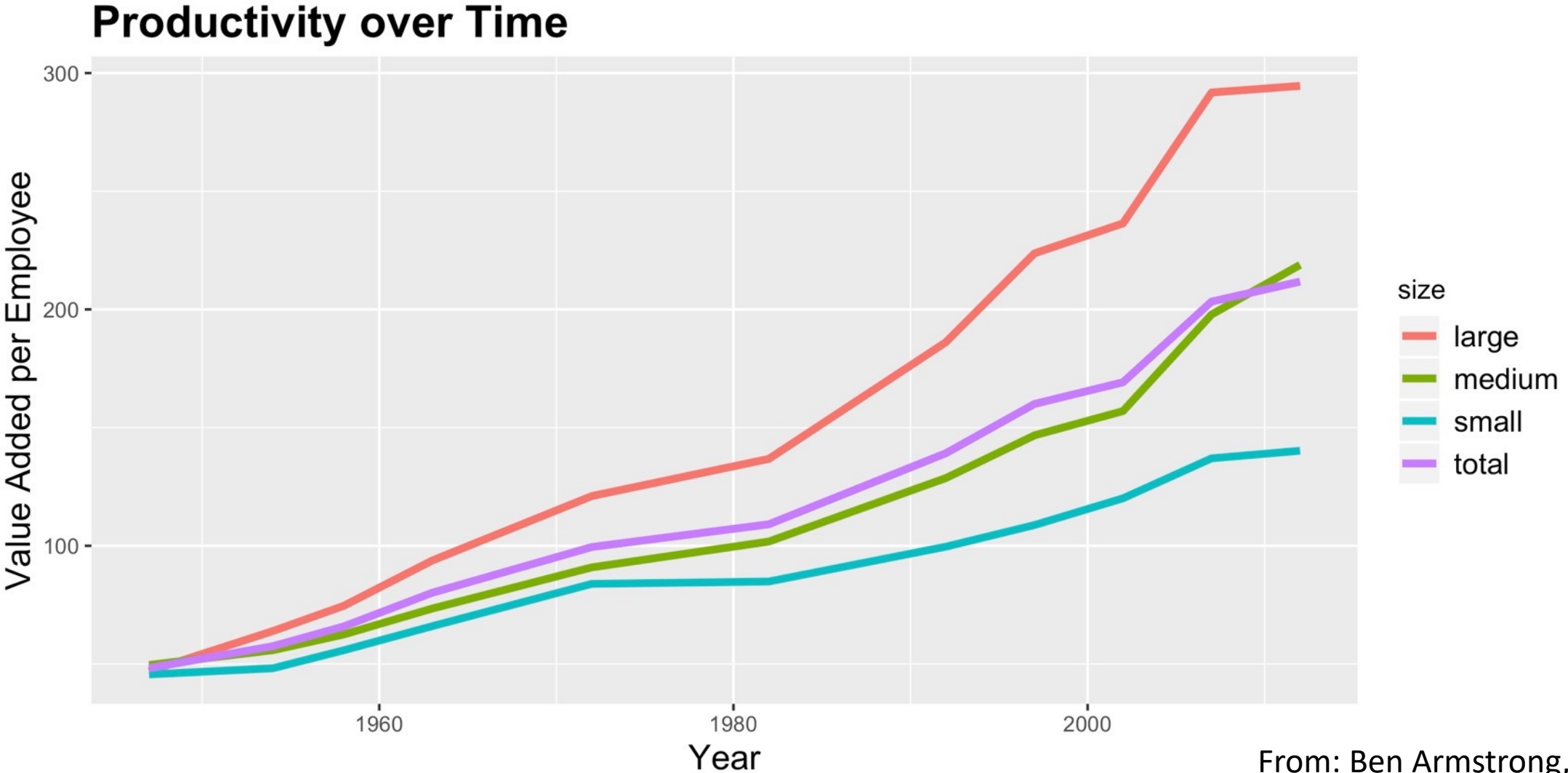
Productivity over Time

Productivity-related Capital Investments Stagnate at Small Production Firms:

Capital Expenditures per Employee over Time

From: Ben Armstrong, MIT 2021]

Workforce is a rapidly rising priority for Production companies

Manufacturing Priorities Over Time
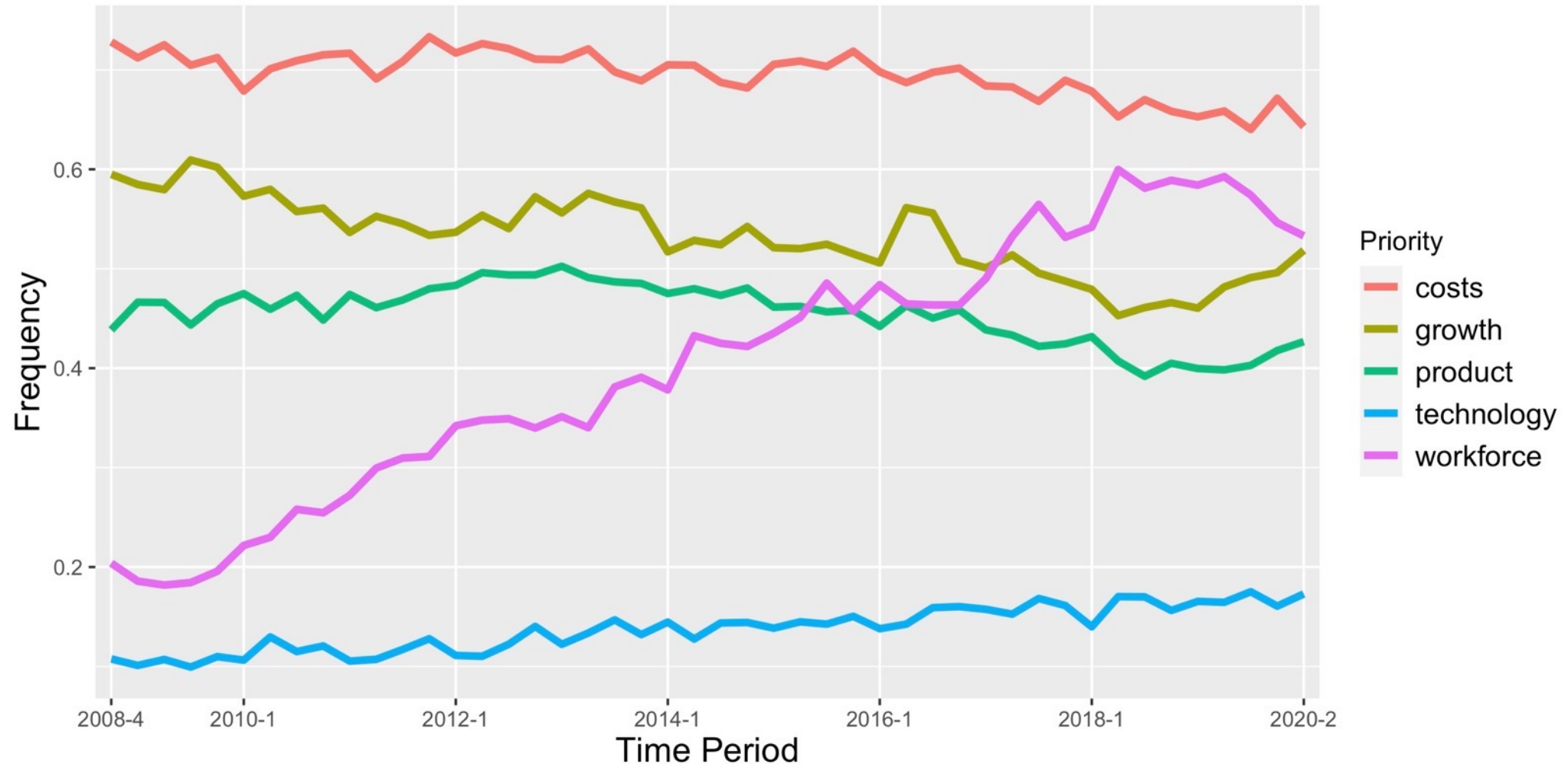
We have longstanding quality job problems

- We have increasing inequality, not economic convergence – a festering problem for 15 years.
- The Barbell problem identified by economist David Autor:

Growing Upper-Middle Class   Declining Middle Class →   Growing Lower-end Services Sector
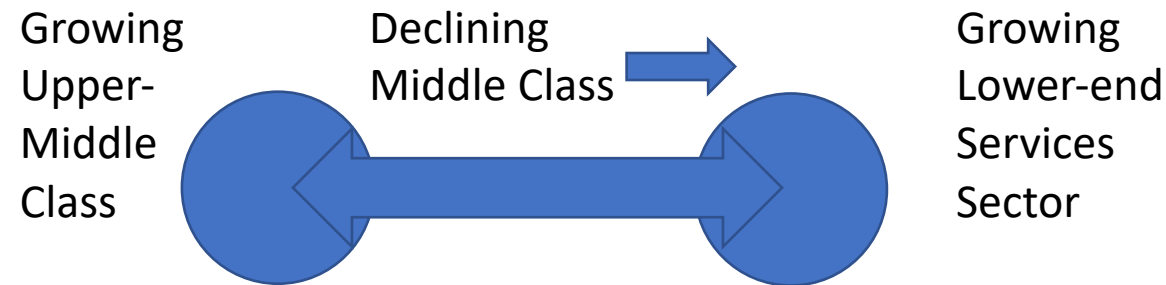
- Technological advances, especially in IT, are putting many quality jobs out of reach for workers who didn't get the proper skills and training.
- And now a series of lower-end services hard hit by Covid-19 so new jobs require higher-end new skills
- *Let's look at workforce needs in several large sectors, over 30% of US employment -*

The Wage Gap for non-Supervisory and Production Workers:
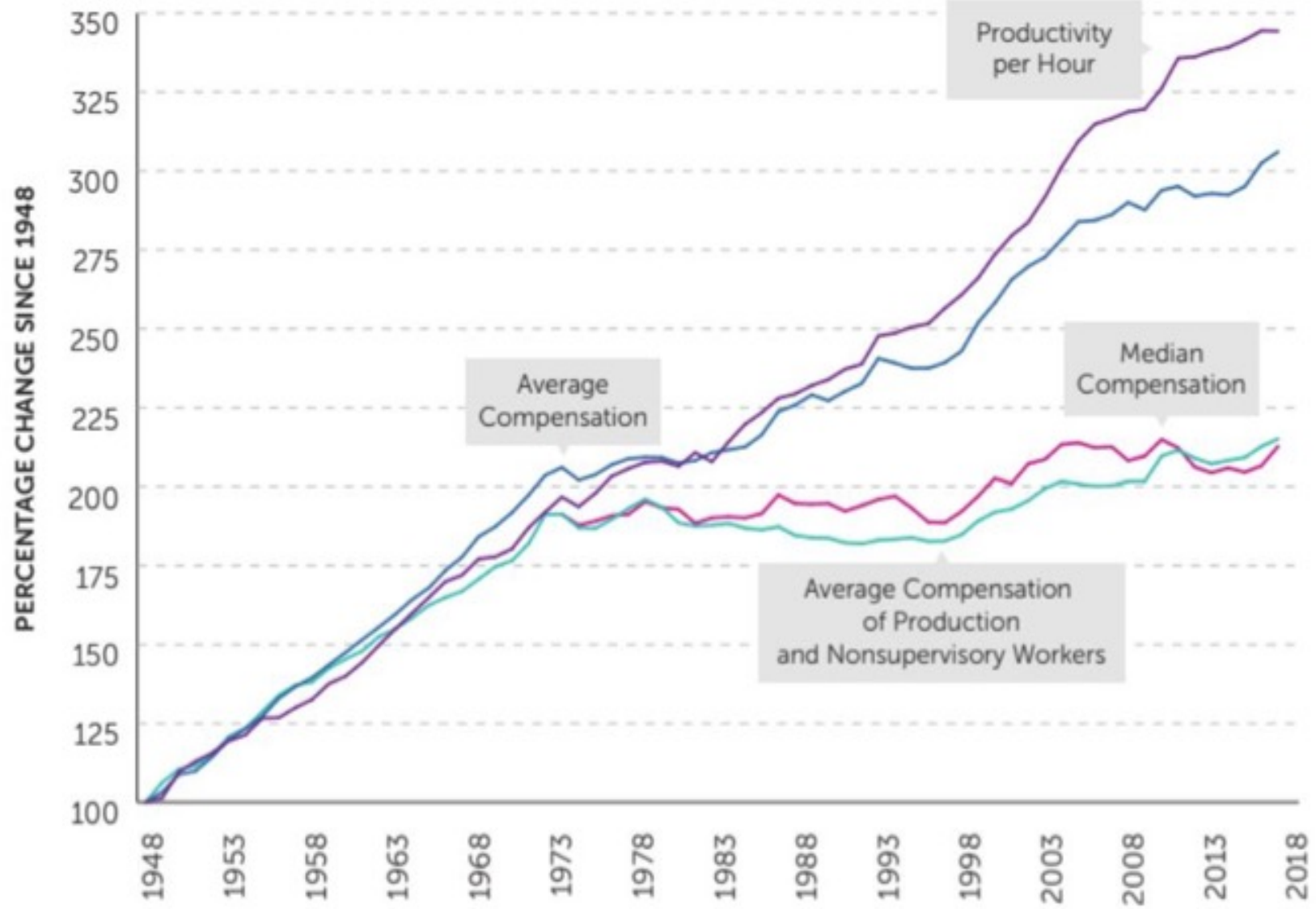
9

Case Study #1. Manufacturing

- Has been **middle class pathway** for men w/o college
- But **Median income is down for men** w/o HS diploma or w/HS diploma or some college
- U.S. **manufacturing employment fell** by one third, 2000 – 2010
- High overall **labor non-participation rate**
- **Coronavirus** hit some key sectors– recovery ongoing, but many left mfg. jobs
  - Need more resilient supply chains – some reshoring? Flexible mfg. means new mfg. technologies so new skills for the workforce
- 2M+ mfg. jobs will open up from **aging demographics**
- **Advanced manufacturing** will require higher skills

Case Study #2. Retail

- **2005:** US <u>overbuilt</u> with 6x more retail sq.ft. as any European nation; 50% more per capita than Canada

- **2008:** Economic crash led to "<u>discount model</u>" of dumbing down the workforce, emptying stores of staff

- **2015:** <u>Warehousing and robotics</u> provide further disruption

- **2020:** <u>Coronavirus</u> forced massive closings, online take-off

- **New Model?** Sales clerk as personal advisor
  - "<u>Omni-channeling</u>" – online/face-to-face entry
  - <u>Higher skills, IT fluent, guide customer</u> through product options
 - How to train? <u>Train the first level managers</u>
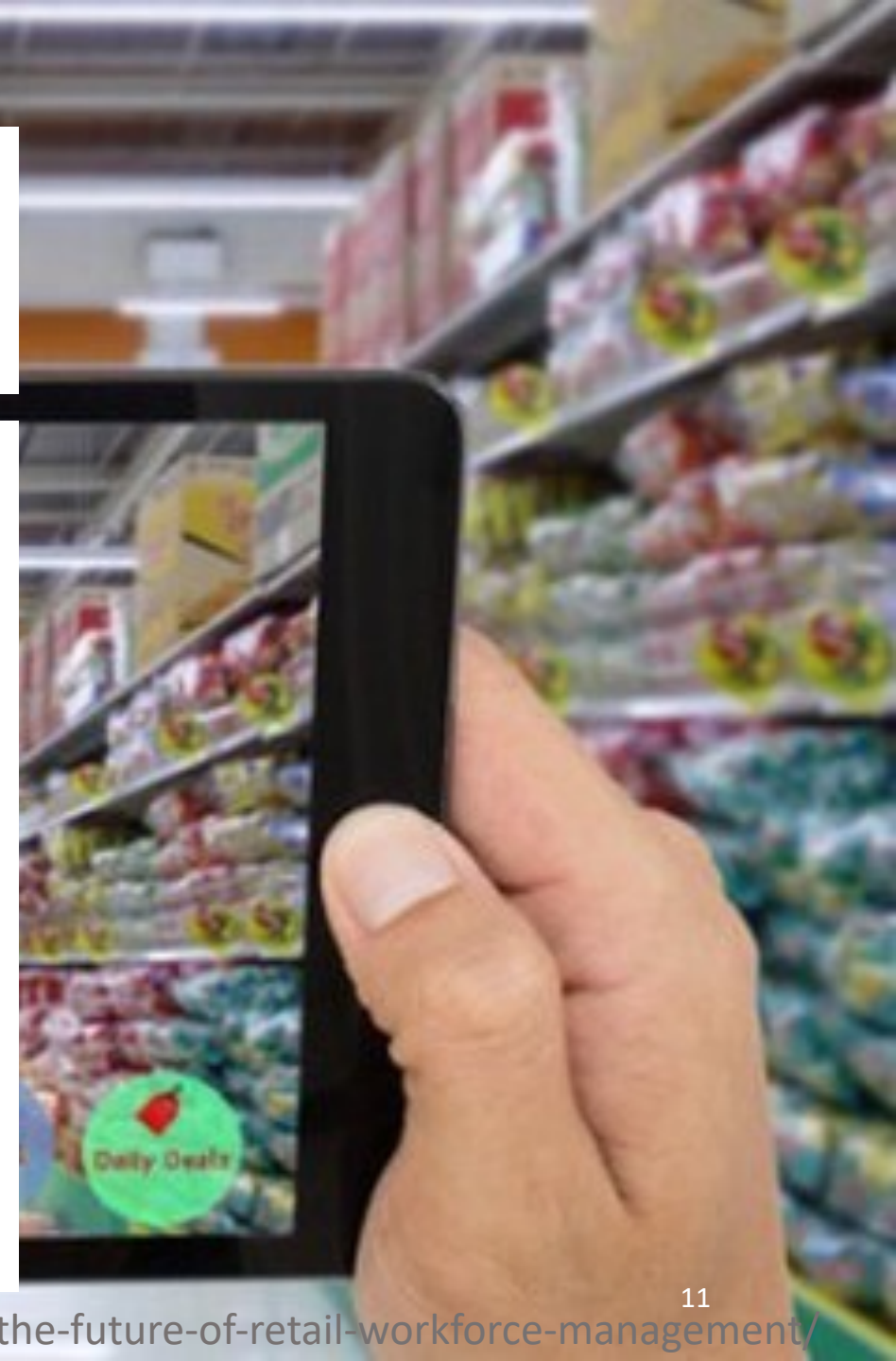
Case Study #3. Healthcare Delivery

- An **aging** population, higher health care demands

- New medical **technologies** creating new professions

- Results: More jobs with **higher skills needs**, so **new training** systems

- **Barriers:** Established health professions, limited entry

- Could online entry help?

Case Study #4. Construction

Agriculture
Manufacturing
Wholesale and retail
Overall economy
Mining
Construction
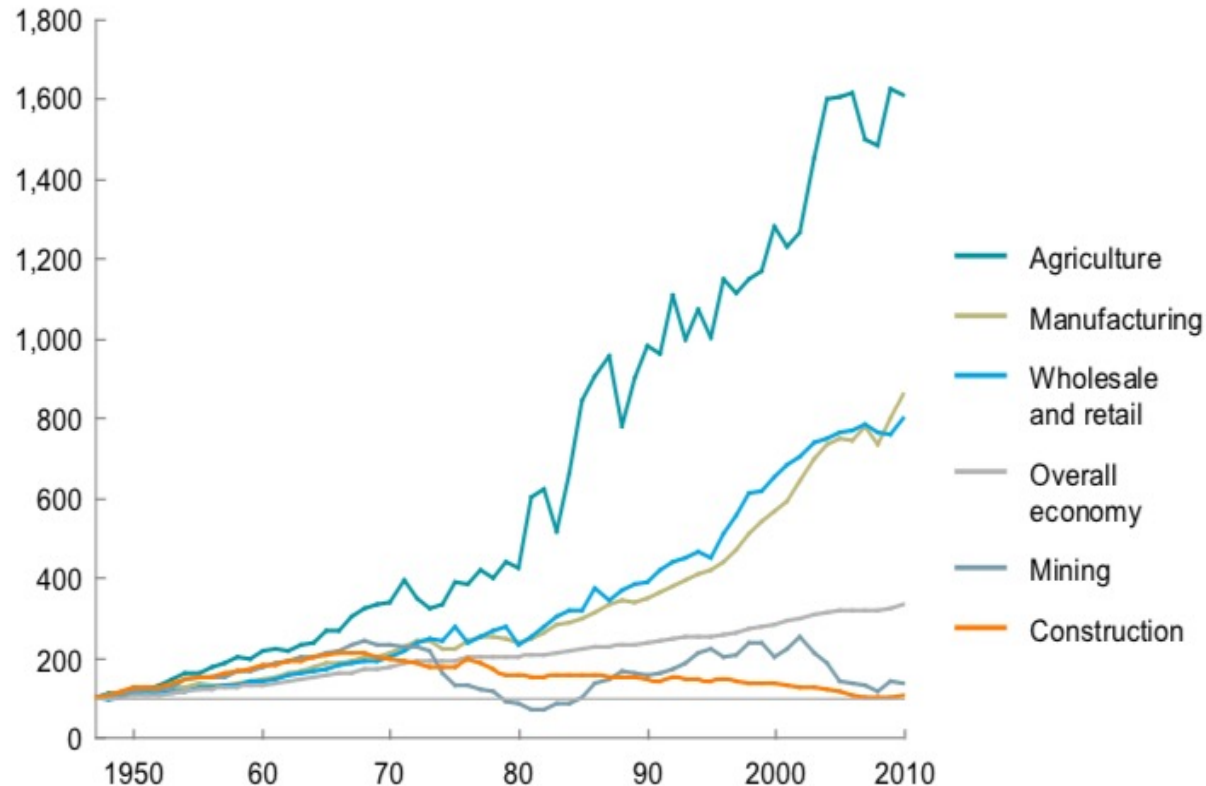
Note: New Technology and Workforce improvement Are the 2 ways to productivity gain

- **Labor productivity** in construction has *declined* since 1968, in contrast to rising productivity in other sectors – *calls out for change*
- 7.2 million more affordable housing units are needed for **low-income families**
- **Climate change** on the horizon - billion-dollar disasters have increased 4X in the last four decades
- 500,000+ people **homeless** each night
- Only a **small percentage of U.S. construction is industrialized** (e.g., ~3% modular).
- But a large part of the $1.4T+ U.S. construction **market can be reached with industrialized construction – panelization -** which can offer faster deployment and reduced schedule risk.
- Industrialized construction can **embed smart tech and new energy technology**
- **Will international firms take the US market?**

Each of these four major sectors is different but each has a major workforce education need:

- ***Manufacturing*** – <u>stabilizing sector</u>, but will need to replace 2 to 4 million workers in the next decade due to retirements with higher skills

- ***In-Person Retail*** –<u>declining sector</u>, but successful firms will need higher level skills

- ***Health*** – <u>expanding sector</u>, with new health technical professions being created with new skills required

- ***Construction*** – 3.7% annual growth projected – but low productivity – needs new technology, therefore new workforce skills

- ***All*** characterized by extensive tech entry requiring new skills

The Work/Learn Gap

- Jobs increasingly tend to go to **college educated**
- But growing IT, demanding new skills
  - Result: new high or middle skills jobs will require education beyond high school
  - Barrier: only 1/3 of Americans over 25 have a 4-year college degree
- Colleges/universities not engaged –
  - they own the crucial credential, the college degree, but they still think it's a high school/community college problem
- And High Schools, Community colleges not well connected to workplaces
- Need:
  - A new *system* for workforce education
  - A new credentialling system
- *But most of all, a new connection between work and school*

Policy Implications

- **New education technologies** - need development and implementation – VR/AR, gaming, digital tutors/AI (DOD role)

- **Short Courses** - BUT modules that connect to CC certificates, degrees (NSF ATE dev. models, DOL workforce bds.)

- **"Trifecta"** - CC programs for CC students, plus incumbent workers, HS students (NSF ATE, Dept. of Ed, states)

- **Apprenticeships or "Apprenticeship Light"-** youth and CC – in fields that have clear lines for increased responsibility and wages, 'er-'ee agreements (DOL)
  - Need for actors to coordinate: CC's, employers and regional associations, state gov't

- **CC completion rate**

- **Technical and Comprehensive HS's** – state role

- **Expanded employer role** – appren./training, standards

- **New curriculum for advanced fields** – start with adv'd mfg. – Adv'd Mfg. Institutes/DOD Mantech/DOE/states

- **Unifying efforts at the state level** – states – across Labor/Ed

- **Labor market Information system** – DOL

Let's briefly look at 4 areas --

- Employer role
- University role
- Community College role
- Online Education role
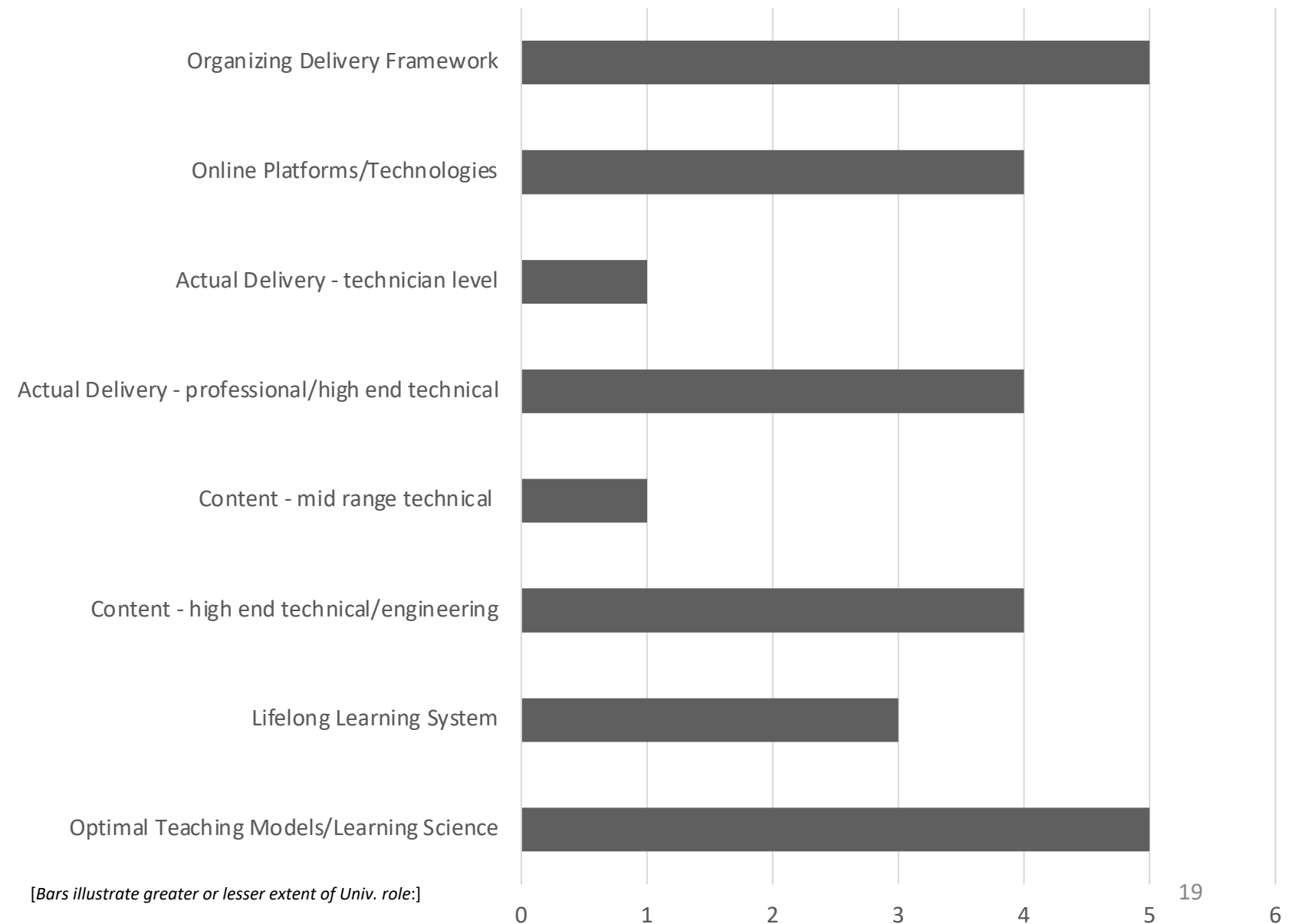
1) *Critical* Employer Role

- It's not someone else's problem – can't leave it to schools and governments to fix –
  - They don't know what co.'s need
  - Must have a better school/work transition – and co's control work
- Requires a new level of engagement
  - It's bigger than company HR departments
- Shortages in skilled workers - Covid may have accelerated an ongoing demographics shift – the next generation is smaller, *and* not educated in the needed skills
- Employers:
  - Must work together –
    - Single company solutions aren't long lasting, they endure only until a shortage is filled, or there's a downturn
    - Programs shared across companies are more lasting – pool resources – key to small co's
    - Building shared solutions tends to reduce raiding each other's trained employees
- Key: paid internships/apprenticeships; collaborations with Community Colleges, High Schools, Colleges – requires collaborations
  - Get your state and local governments to help make this happen
  - The three-way alliance: employers, schools, state/local government

2) Univ. Role: What can you urge your Universities to do?

What is the University Role?
Roles in Different Areas:
("notional" chart)

Area	Value
Organizing Delivery Framework	5
Online Platforms/Technologies	4
Actual Delivery - technician level	1
Actual Delivery - professional/high end technical	4
Content - mid range technical	1
Content - high end technical/engineering	4
Lifelong Learning System	3
Optimal Teaching Models/Learning Science	5

[Bars illustrate greater or lesser extent of Univ. role:]

3) Exemplary CC programs – all link to employers:

- Lorrain Co. CC, Ohio
  - Ohio Assoc. of Manufacturers – industry alliance, develop curriculum, state support
  - Ohio Tech Net – independent CCs, but way to collaboration across state CCs in developing curriculum
- Ivy Tech, Indiana – unified state CC system
  - Curriculum developed in concert across state
  - Industry-recognized credentials imbedded into courses – building short/modular course system
  - But 1/3 of curriculum is up to specific school, so flexible, adopt to regional needs
- Asnuntuck CC, Enfield, Conn.
  - Equipment sharing – 4 mfg. tech centers across state – shared by groups of CCs
  - Reaches incumbent workers and HS students, as well as CC students
- Tennessee TCATs - Tenn. Colleges of Applied Technologies
  - 81% completion rate, 86% job placement rate in field of study
  - Integrate remedial/development courses with technical courses – relate the two
- Trident Tech, Charleston, SC
  - Youth apprenticeship program with 5 area HS's
  - Created by small employers – local Chamber of Commerce key player, administrated by Tech College
  - What the apprentice's day looks like
- MassBridge
  - State of Mass effort to build an advanced manufacturing curriculum and program in Mass. CC's and HS's
  - Collaborations: State of Mass., co's, CC's, univ's, Ed, Labor & Economic Dev. agencies

4) ONLINE: *There's a big problem of scale* – the existing system is not at the scale to meet the upskilling need -- The New Online Education Technologies can help scale - But beware the *--Perils of Zoom*:

- So - Covid-19 boosted online education – colleges and universities would not have survived without it
- But "zoom/teams/webex" classes didn't take advantage of the opportunities in the online medium
  - They were a stage play, but we can do movies
  - Asynchronous can build new features, synchronous cannot
- --> if online is to scale – including into workforce education -- the learning lessons need to be absorbed
- What are the new pedagogies from online education?

4) con't: EdTech and the new pedagogy -

- ***Can use New Delivery Modalities***
  - Enablers: Online Platforms with broadband access, MOOC's, certificates, Open EdX, bootcamps
  - Online and "Solving the Access Problem"
- ***Bite-sized chunks*** – 10 Minute Segments and the mind-wandering problem,
- ***Spaced Learning*** – *reiterate before you forget*
- ***Continuous Assessment/Feedback loops***
- ***Desirable Difficulties***

- ***Mind and Hand*** – hands-on learning – examples:
  - Generative Learning
  - Tactile and Active Learning
  - Blended Learning
  - Enabler: **VR/AR** and prototyping technologies
- ***New Pedagogy*** through new, oncoming ***EdTech opportunities*:**
  - AI and digital tutors – personalized education
  - Digital certificates and badging (blockchain)

Recommendations: New Delivery Models backed by Industry Consortium

- <u>Regional</u> workforce efforts by <u>groups of employers, w/state, CCs</u>
- <u>New Content</u> – for oncoming advanced skills
- The <u>Trifecta</u> – reach incumbent workers, H.S., CC students in CCs
- <u>Youth and CC level Apprenticeships</u> to break the work/learn barrier
- improve the <u>CC completion</u> rate
- <u>Short modular programs</u> (stackable, connected to degrees, w/industry credentials)
- <u>Integrate the stove-piped federal programs</u> at the state level
- <u>Lifelong learning</u> system must be built – need lifetime skill upgrades
- New <u>labor market information systems</u> – industry recognized credential-base
- <u>New education technologies</u> – a key to the scale-up needed
- *<u>ALL</u> REQUIRE EMPLOYER-EDUCATOR-GOV'T ENGAGEMENT*
- *CONSORTIUM MODEL IS KEY – work w/gov't and education partners*