Humans, Machines and the Future of Work

Tom M. Mitchell

Carnegie Mellon University

July 2016

Think back 15 years to 2001

- iPhone didn't exist (2007)
- iTunes, iPod didn't exist (2001)
- video rental, CD music stores were everywhere
- Wikipedia didn't exist (2001)
- free video phone calls didn't exist (2003)
- GPS-based driving directions didn't exist (2008)
- you'd never have predicted that in 15 years:
    - you would speak routinely to computers
    - your photo album would identify people in pictures
    - self-driving cars would be on the road

Next 15 years?

- Self driving, self flying vehicles
  - taxi drivers, bus drivers, pilots

- Widespread household, workplace robots?
  - household cleaning, lawn maintenance, office deliveries, …

- Intelligent workflow assistants
  - administrative assistants, tax preparers, knowledge workers, …

- Super-human vision, hearing, smelling, sensing…
  - security guards, radiologists, ...

- Computers that read and understand?
  - paralegals, news writers, translators, …

- big surprises? commonsense, argumentation, planning
  - all of us

Computer technology advances are

Growing the wealth pie

- who can be against that?
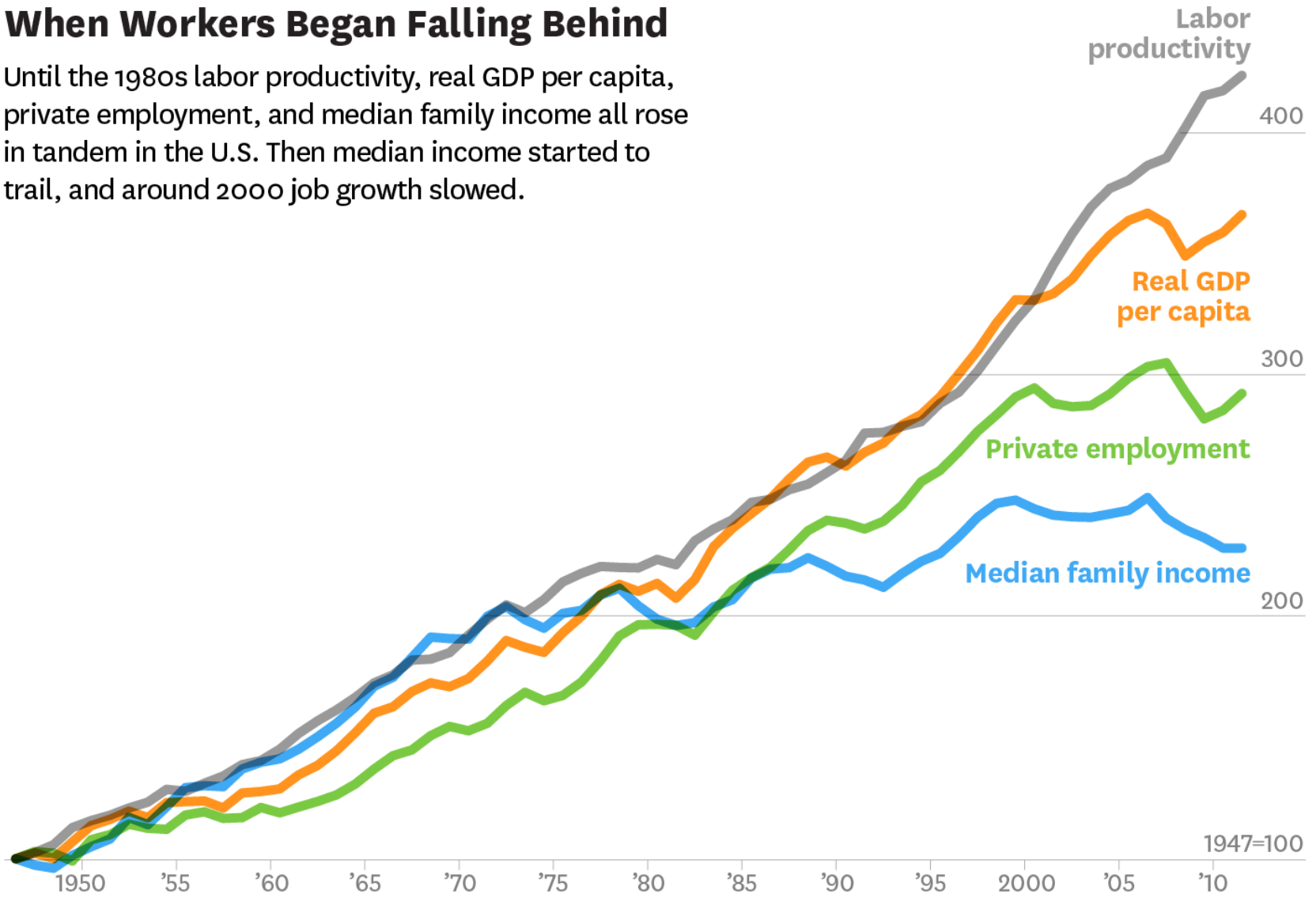
But further skewing distribution of wealth

- who can be for that?

→ We need to

- understand what is really happening, and how
- address this at societal level

When Workers Began Falling Behind

Until the 1980s labor productivity, real GDP per capita, private employment, and median family income all rose in tandem in the U.S. Then median income started to trail, and around 2000 job growth slowed.

Labor productivity

400

Real GDP per capita

300

Private employment

Median family income

200

1947=100

1950　'55　'60　'65　'70　'75　'80　'85　'90　'95　2000　'05　'10
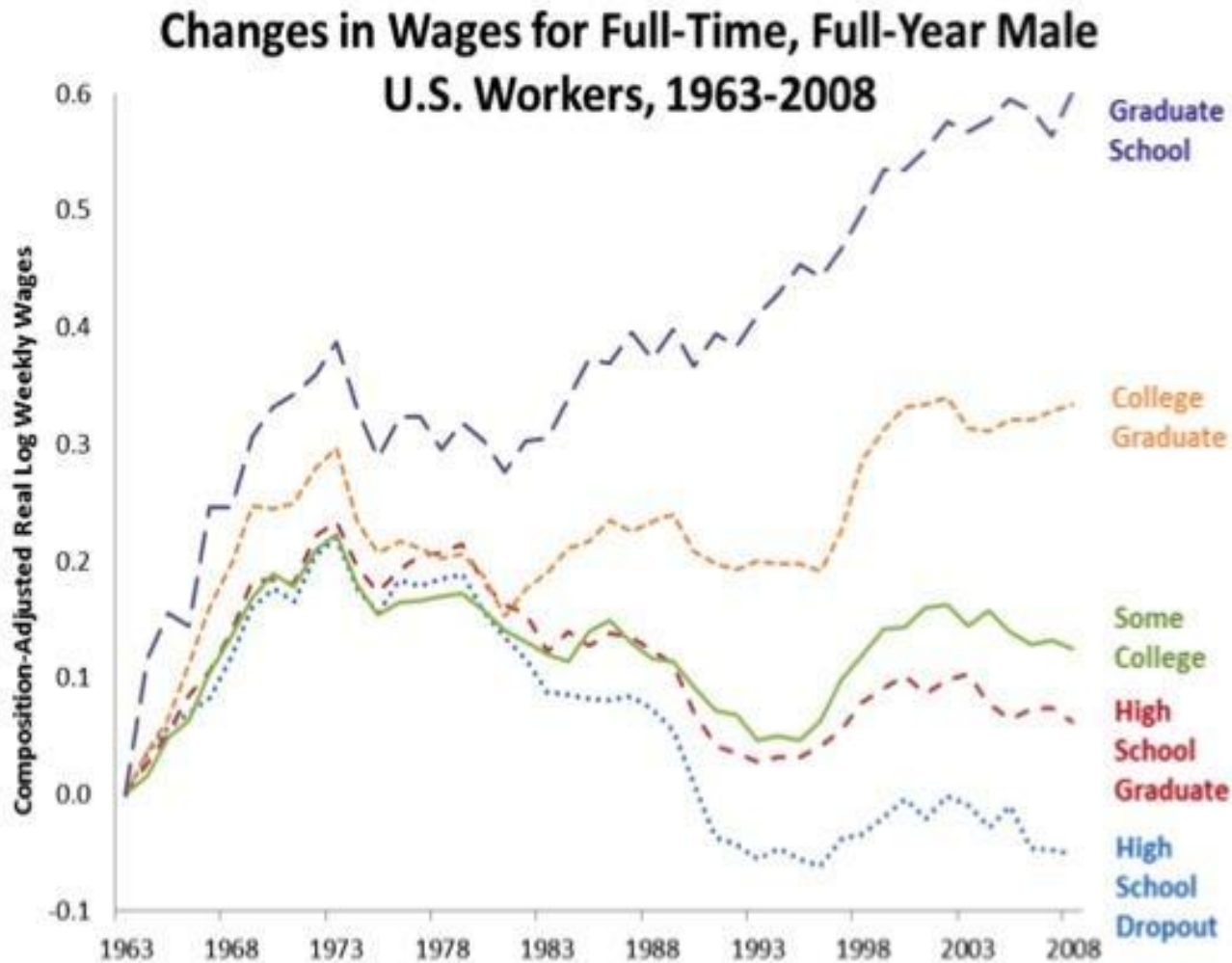
IT Advances Impact Jobs

impacts of IT advances

- automate & replace human
- help/amplify human performance
- generate new jobs

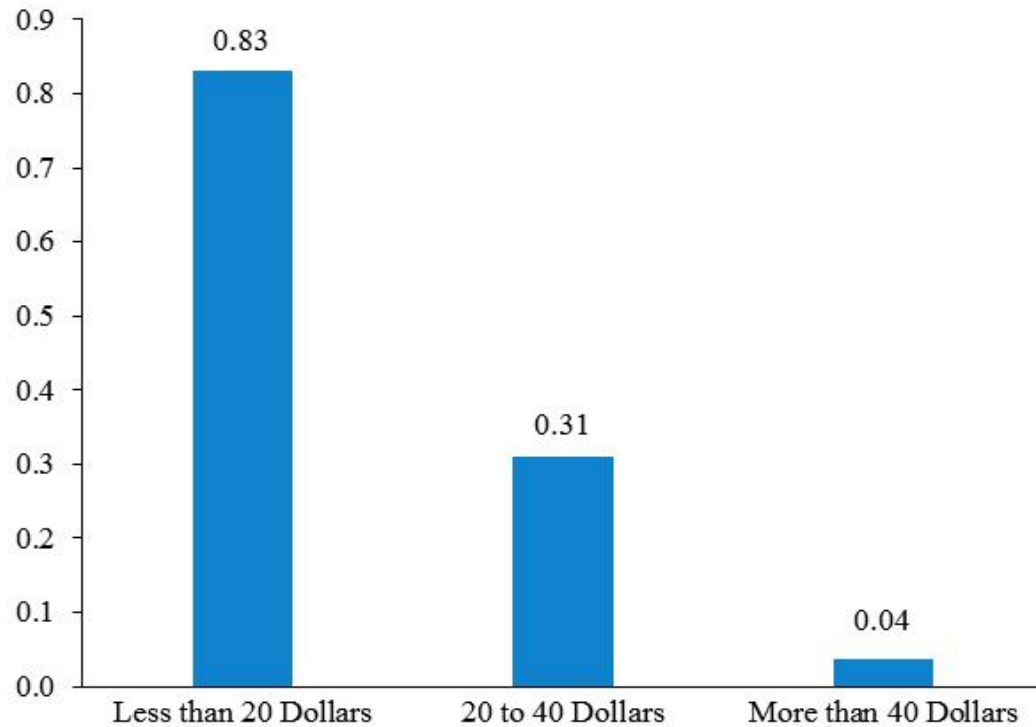Impacts of IT advances take years to play out

- technology invention
- technology diffusion
- technology maturation

- need for "co-inventions" to convert to productivity
- software diffusion can be much faster than hardware

Growing disparity in wages by education

Changes in Wages for Full-Time, Full-Year Male U.S. Workers, 1963-2008

from [Acemoglu and Autor, 2012]

Probability of Automation by Job's Hourly Wage

from [Frey & Osborne, 2013]
included in 2016 Economic Report of the President

IT advances exacerbate wealth disparity

1. low wage jobs more prone to full automation

2. new high-tech IT companies distribute their new wealth to fewer employees (Google vs. ATT, GM)

3. software companies (vs. auto companies) involve little manufacturing or transport (jobs accessible to low education)

But IT advances also improve education

Online courses

Access to education
- accessible to all who have internet connection[1]
- Khan Academy, EdX, Coursera, Udacity, …

→ just-in-time training for job searchers

[1] still not everybody

IT advances help in other ways

Creating new jobs
- data scientist, web page designer

Enabling new freelance forms of just-in-time work
- Uber, Amazon Mechanical Turk, HourlyNerd, ...

Enabling new peer-to-peer economy
- Airbnb, E-Bay, ...

Enabling totally new types of businesses
- learning apprentice model (e.g., claralabs.com)

Information Technology and the Workforce

- Technology clearly having impact on
  - nature of jobs
  - existence of jobs
  - access to jobs

- Impacts both positive and negative
  - job destruction (e.g., toll both operator, assembly line)
  - job creation (e.g., data scientists, website designers)
  - access to employment (e.g., Mech.Turk, UpWork.com)
  - delivery of education
  - skewed wealth distribution

- Net impact hard to predict
  - easier to predict technical advances than their impacts

What to do? 1. Understand what's happening

Get more data to help track/model
- public/private data partnerships (BLS, job sites, payroll,..)
- technology indices to project advances, e.g., AI Index
- expert CS panels similar to panels of economists

Understand mechanisms at work
- what influences decisions to replace/augment workers?
- will Gig-economy dry up as unemployment rate drops?
- what types of education can best prepare for future jobs?

What to do? 2. Implement policy responses

Provide free retraining to those who lose jobs due to automation?   Other types of assistance?

Free education to all?

Create benefits programs for free-lance workers?

Predict and publicize at-risk careers? Pro-actively train workers already in them?

Shorter work week?

Make skew in income, and inequality in opportunity domestic priority