

Automation v Procreation

Hal Varian

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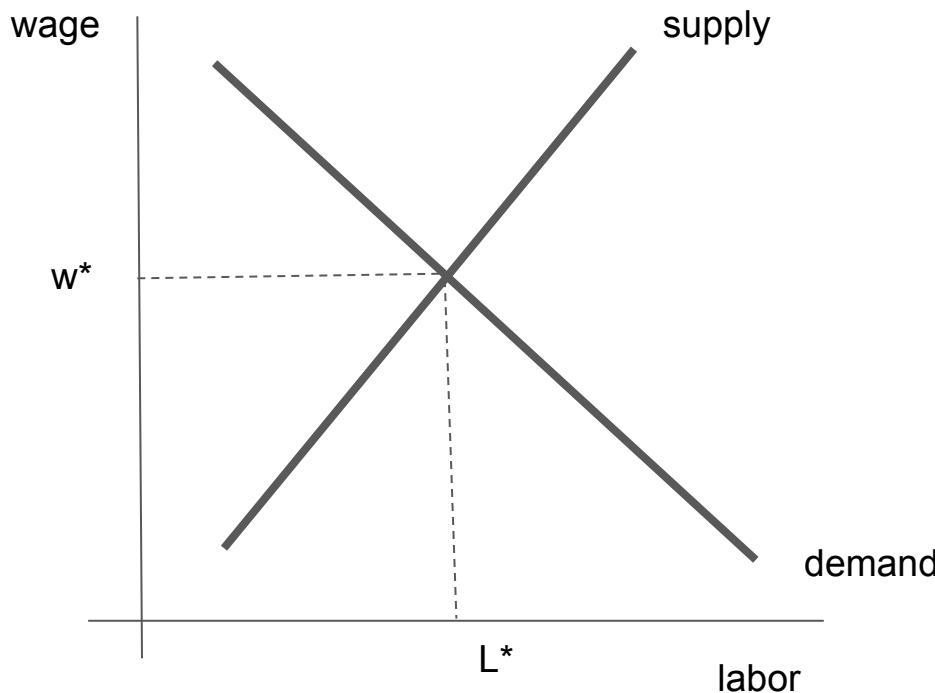
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Bots v Tots

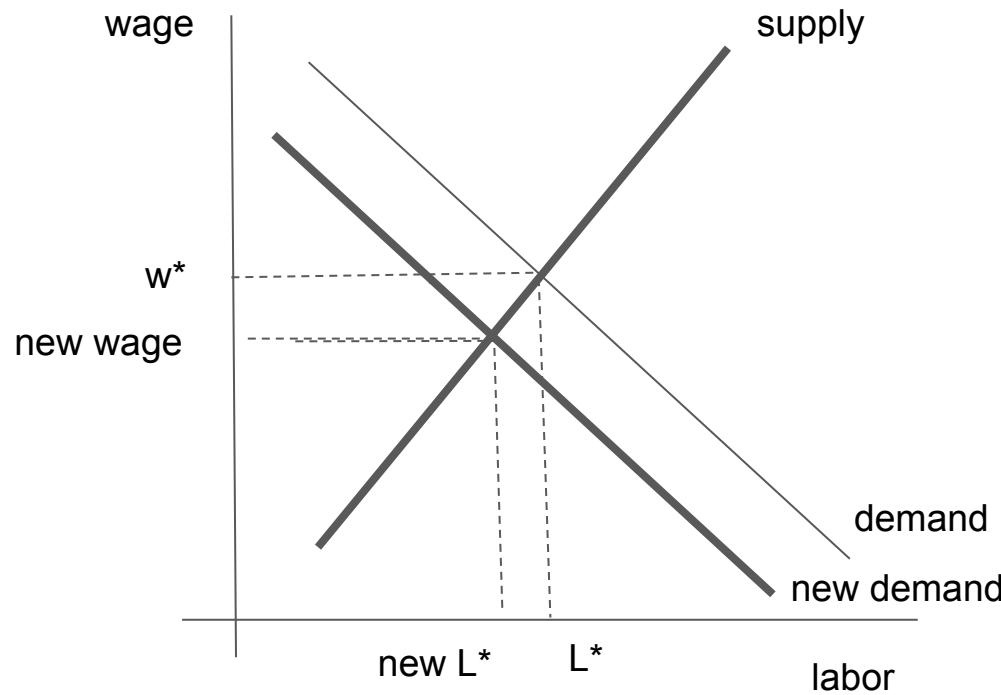


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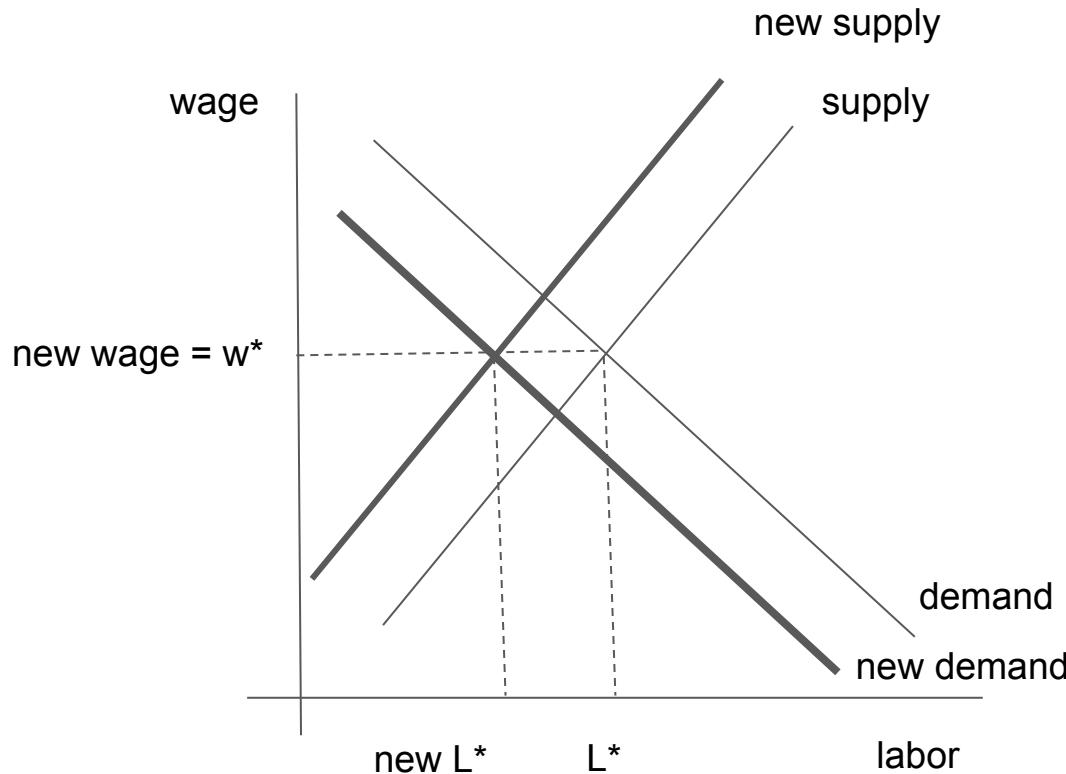
Economics of the labor market



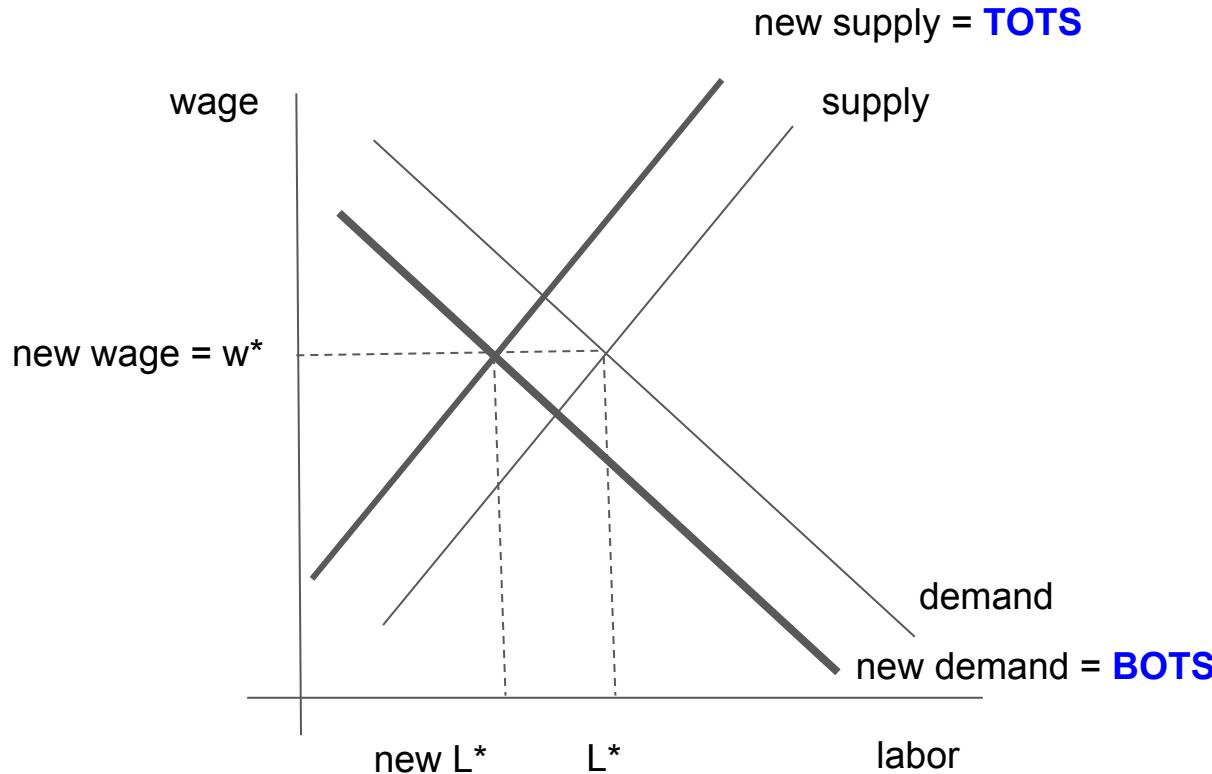
Economics of the labor market



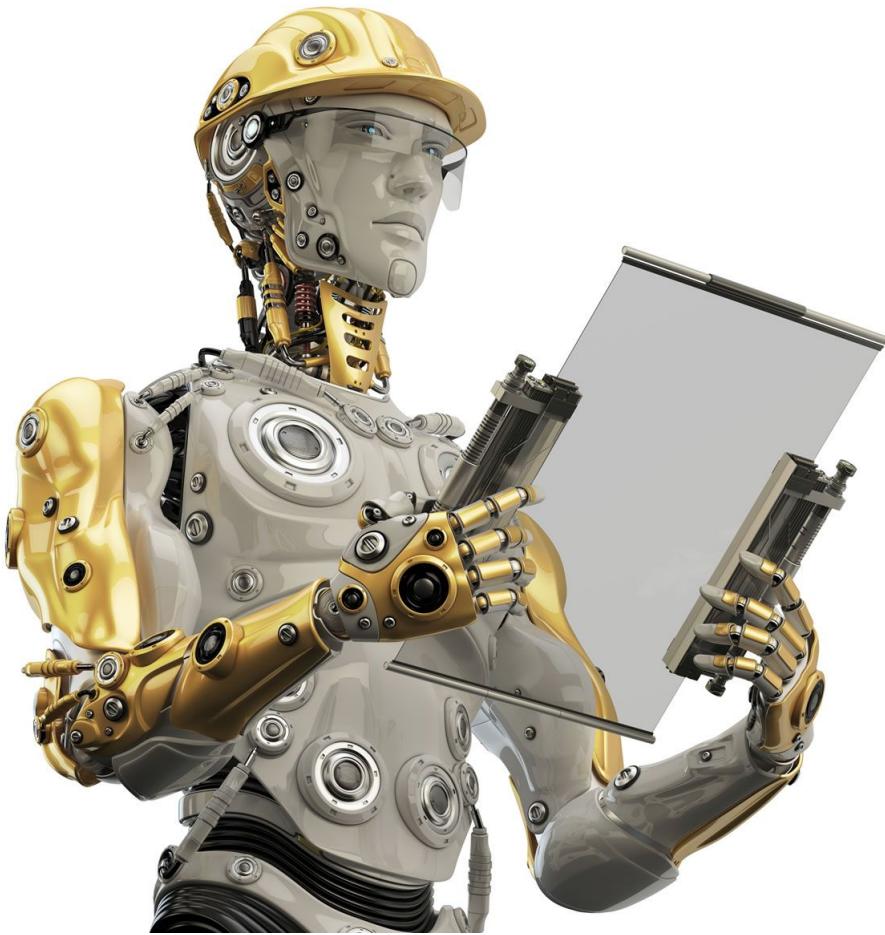
Economics of the labor market



Economics of the labor market



Bots



2016: job stealing

CNN Money u.s. + Business Markets Tech Media Personal Finance Small Biz Luxury Log In stock tickers 

Internet of Things

Smart robots could soon steal your job

by Ivana Kottasova @ivanakottasova

January 15, 2016: 1:33 PM ET



Robots are taking over China's factory floors

Social Surge - What's Trending

- JCPenney, Kohl's, Macy's and Sears sued over misleading prices
- Your data is not safe. Here's how to lock it down
- Ikea renames products after your secret anxieties

Mortgage & Savings Powered by LendingTree

Mortgage Personal Loans Credit Cards

Loan Type	Rate	APR
30-yr fixed	3.63%	3.63%
15-yr fixed	2.00%	2.00%
6/1 ARM	2.83%	3.45%

Think you are too smart to be replaced by a robot in your job?
Think again.

Jason Furman

1980: job stealing

DETROIT — Technological innovation is widely billed as a miracle cure for the United States' economic doldrums. Its aftereffects, however, may be far from benign. The introduction of revolutionary new technologies such as robots — versatile computer-controlled mechanical arms — raise two painful possibilities: sizeable losses of jobs and a deteriorated quality of working life.

The threat of lost jobs, although also dependent on social and economic factors, is especially critical. Auto makers are already buying robots in record numbers, despite a downturn that has resulted in 250,000 indefinite layoffs. Even the faltering Chrysler Corporation has added 128 of these new "recruits" to its work force for the 1981-model year.

But the robot is only one part of a larger computerization that is affecting virtually every productive activity in society from the office to the machine shop. In fact, many white-collar occupations that promised jobs to displaced blue-collar workers in the past are themselves being automated.

In the case of robots, relatively conservative estimates predict that sales in this country will grow at a compound rate of 25 percent a year for the next decade, culminating in annual sales of \$800 million and production of 17,000 robots a year by 1990. While this hardly seems threatening to a manufacturing work force of 20 million people, robots are only one of the labor-displacing technologies being introduced. Moreover, the employment effects are cumulative and have a dis-

A Robot Is After Your Job

By Harley Shaiken

proporionate impact on a few key industries. Robots that begin work tomorrow will still be on the job in 1990, giving us a robot population of about 80,000. If 40 percent wind up in the auto industry (compared to 55 percent worldwide today), 32,000 robots could displace more than 100,000 auto workers. In fact, the potential loss of jobs is more serious than these figures indicate. New breakthroughs in robot technology such as "sight" and "feel" mean that each robot could displace far more workers in a decade. In addition, some industry observers feel that companies that sell computers may enter the market, resulting in a robot-population explosion in the hundreds of thousands, not tens of thousands.

The quality of working life will also change. While the first generation of robots primarily did such hazardous and hot jobs as welding and foundry work, robots are now being created for jobs where workers have the most control over the pace of work: machine loading and light assembly, among the more desirable production tasks.

It is also misleading to be so invasive to assume that enough jobs will automatically be created for the number of people displaced. Economic revitalization no longer means re-employment. And the devastating social cost of unemployment is not reckoned in the savings that technology promises.

Such a socially destructive use of technology need not be inevitable. Jobs for workers displaced and improved working conditions for those who remain ought to be a condition for the introduction of robots. Productivity gains, for example, could translate into a shorter work week at the same pay rather than into fewer jobs. Technology could be designed to enhance human skill and experience rather than make people "interchangeable" with machines. Realistically, these alternatives require worker-union participation in the design and deployment of technology.

The goal, after all, should be a technology that benefits people — not one that destroys them.

Harley Shaiken, a research fellow at the Massachusetts Institute of Technology, is completing a book on automation.

Jason Furman

1960: job stealing

Robots' Rise

They Bid for Big Jobs
Both in Outer Space
And in U.S. Factories

A.M.F. Designs Robot to Send
To Moon; G.E. Works on
One to Paint New Autos

Beetle's Hazardous Mission

BY THOMAS O'TOOLE

Staff Reporter of THE WALL STREET JOURNAL

GREENWICH, Conn.—America's first astronaut to reach another planet may have long spidery arms and a bell-shaped head with a window in it.

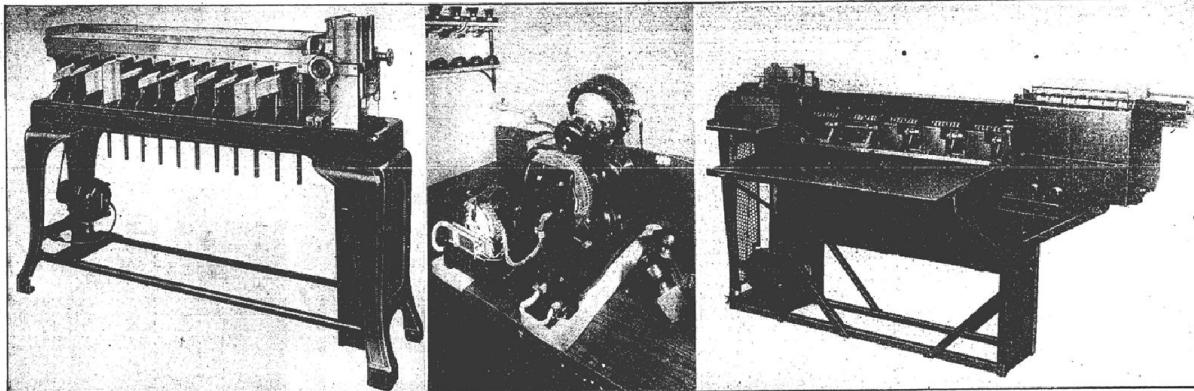
Such an inhuman-appearing space traveler is not as far-fetched as it seems. Even now the creature—a robot—is taking shape here at the Greenwich Engineering division laboratories of American Machine & Foundry Co. A.M.F. engineers believe their robot, remotely controlled from earth, would be far more useful than a human in exploring outer space—at least until rockets can be made powerful enough to be readily capable of returning home from trips to the Moon, Mars, Venus or even more distant targets.

Elsewhere around the country in laboratories and on drawing boards, increasing attention is being paid to robots, once regarded as science-fiction characters with little or no practical value. Indeed, most of the robots in use and development today bear little resemblance to the mechanical bipeds popularized by movie makers and cartoonists. But these machines, nevertheless, are true robots—automatic devices that perform human functions, or operate with seemingly human intelligence.

Jason Furman

1935: job stealing

Robot Brains Outdo Man's Mind in Speed and Accuracy of Results

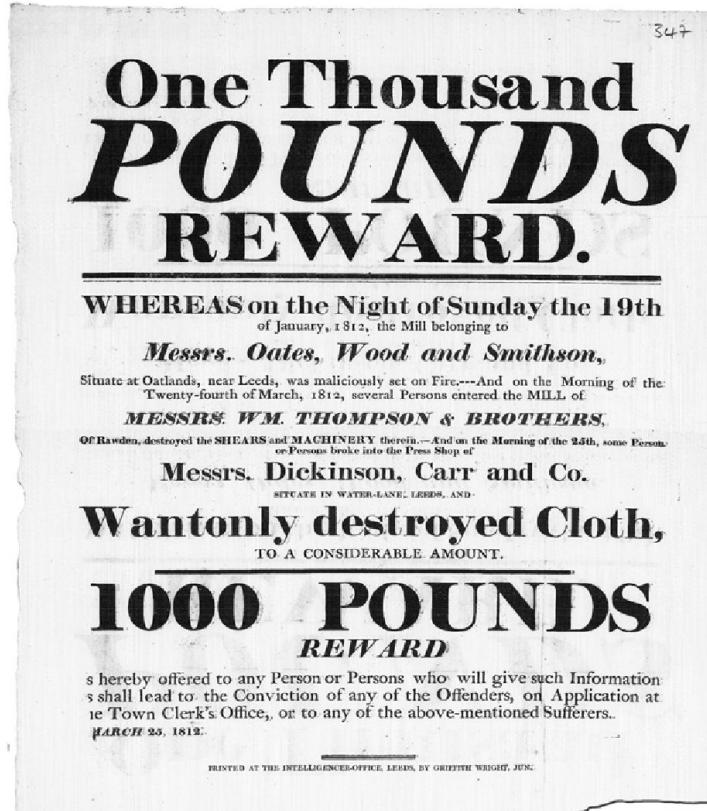


'Thinking Machines' Replace the Thinker

They Predict Tides, Pick Criminals' Fingerprints,
Calculate Mathematical Problems,
and Perform Amazing Tasks.

Jason Furman

1812: job stealing



Jason Furman

2017: Huh?



THE WALL STREET JOURNAL.



REVIEW & OUTLOOK
America's Growing
Labor Shortage



REVIEW & OUTLOOK
Minimum Wage
Reality Check



OPINION | REVIEW & OUTLOOK (U.S.)

America's Growing Labor Shortage

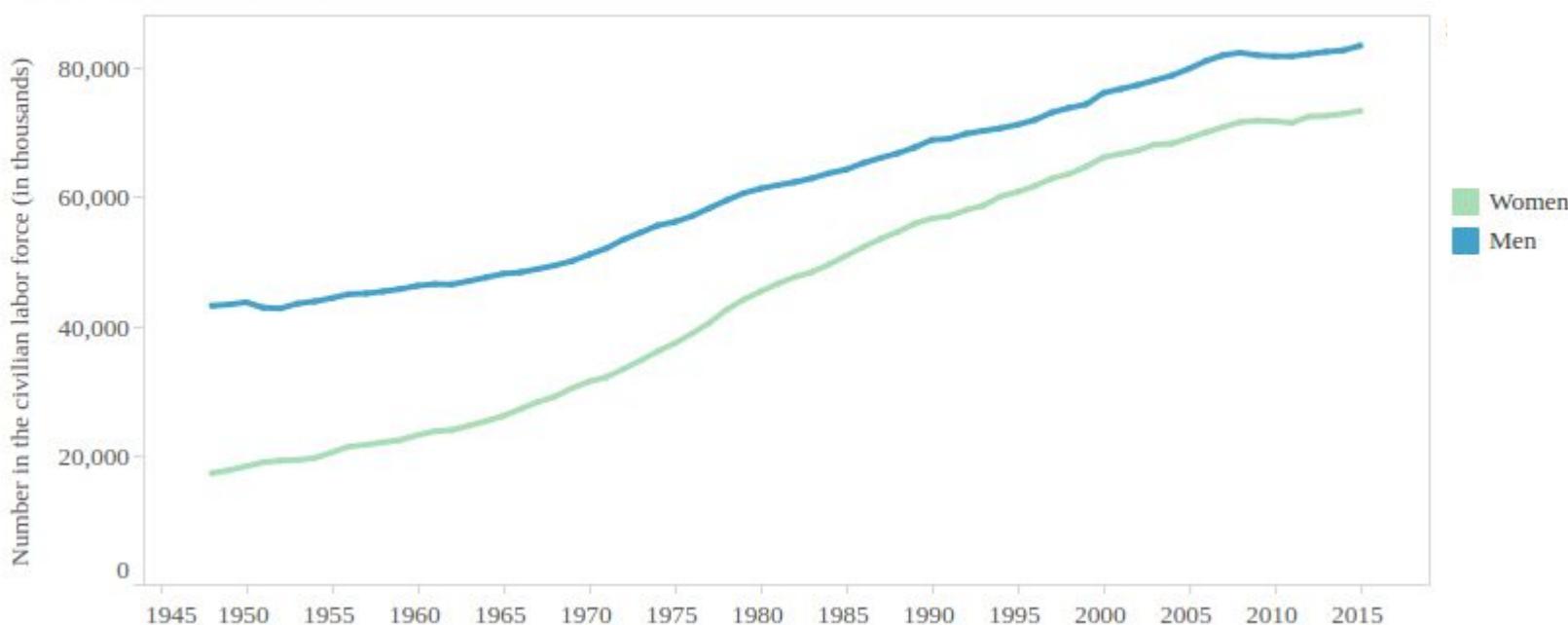
Lack of workers in ag and construction is hurting the economy.

Construction, agriculture, truck drivers, forklift drivers, dairy farms, meat packing ...

The economy can absorb workers
humans or robots

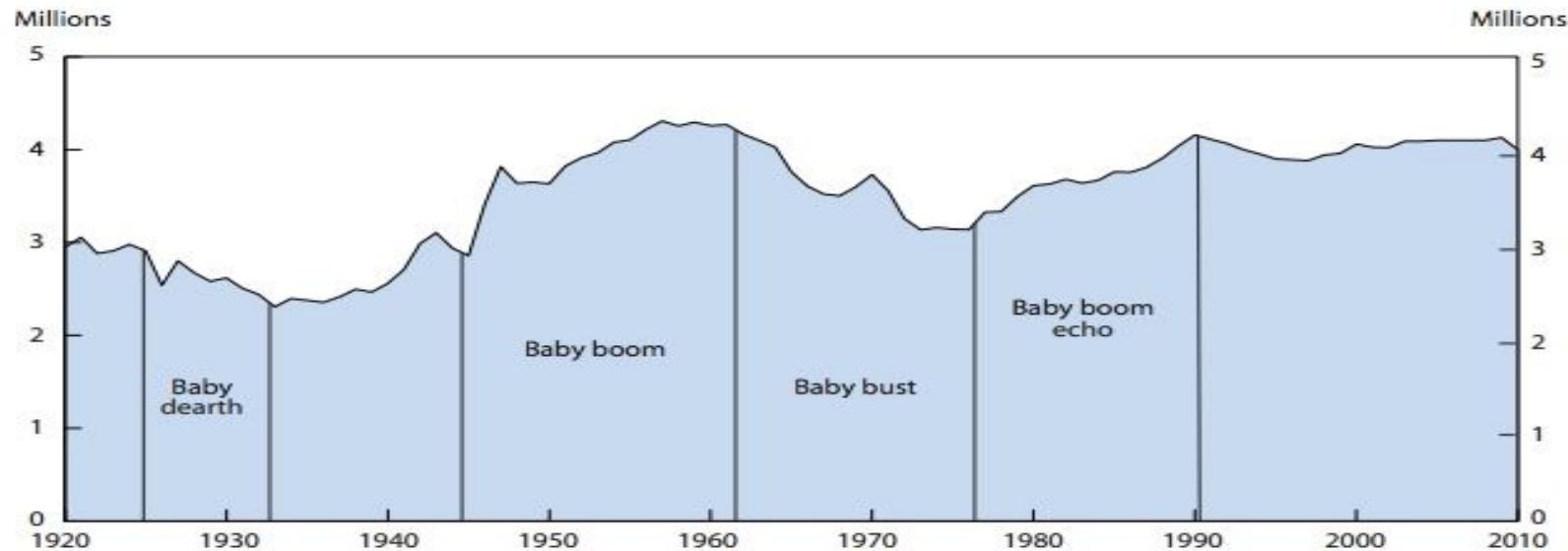
Women entering the (paid) labor force

Civilian labor force by sex
1948-2015 annual averages



Baby boomers

1. Live births by year, 1920–2010

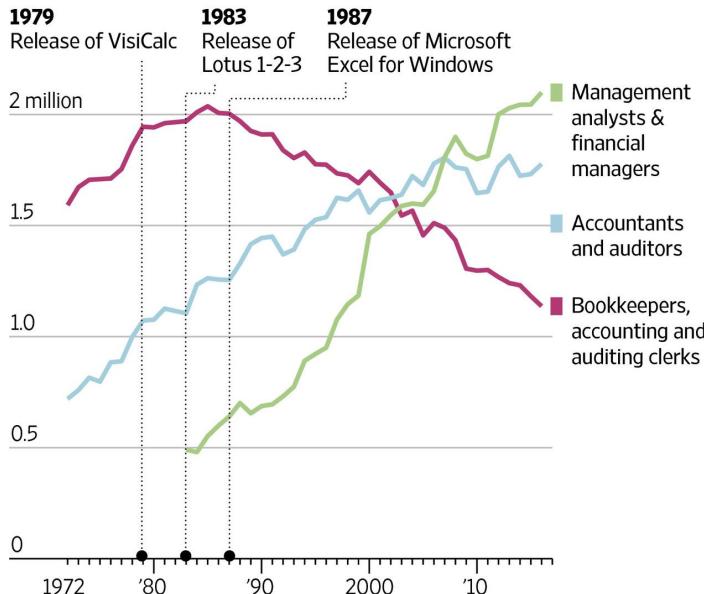


[Bureau of Labor Statistics](#)

Spreadsheet apocalypse

The Spreadsheet Apocalypse, Revisited

Jobs in bookkeeping plummeted after the introduction of spreadsheet software, but jobs in accounting and analysis took off.



Notes: There is no data for 1982. Changes in occupational definitions in 1983, 2000 and 2011 mean that data is not strictly comparable across time. There was no category for management analysts or financial managers prior to 1983.

Source: Bureau of Labor Statistics

THE WALL STREET JOURNAL.

Wall Street Journal

Video rental clerks

Employment, Hours, and Earnings from the Current Employment Statistics survey (National)

Series Id: CES5553223001 (I)

Seasonally Adjusted

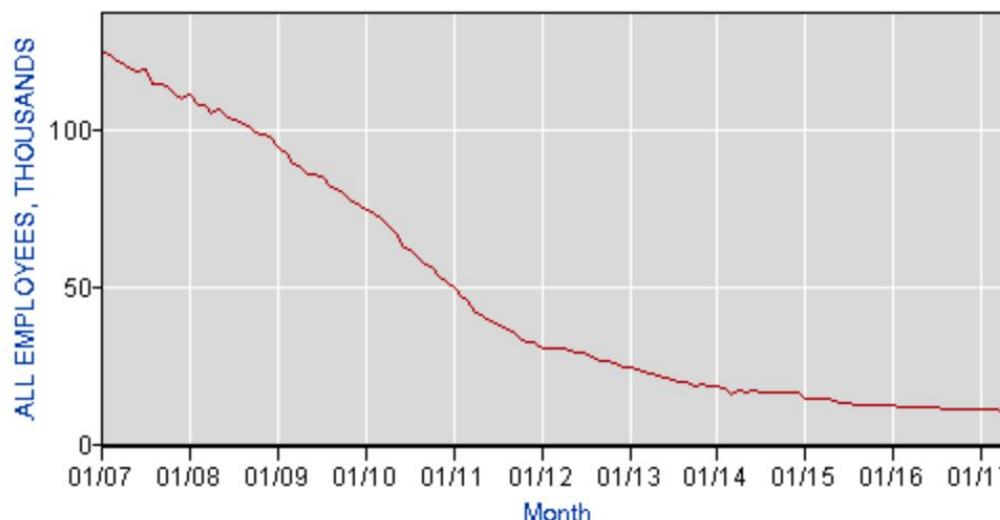
Series Title: All employees, thousands, video tape and disc rental, seasonally adjusted

Super Sector: Financial activities

Industry: Video tape and disc rental

NAICS Code: 53223

Data Type: ALL EMPLOYEES, THOUSANDS



Jobs and tasks

Automation, jobs and tasks

Automation doesn't generally eliminate jobs. Automation generally eliminates dull, tedious, and repetitive **tasks**.

- **Manual:** washing clothes, drying dishes, mowing lawn, digging holes
- **Cognitive:** making change for purchase, memorizing maps, adding columns of numbers

If you eliminate *all* the tasks associated with a job, you have eliminated a job. But this is rare.

Tasks and jobs

There were 270 detailed occupations listed in the 1950 US Census. Only 1 has been eliminated due to automation.

Tasks or jobs?

There were 270 detailed occupations listed in the 1950 US Census. Only 1 has been eliminated due to automation.

Elevator operator



[Quartz article](#) based on [Jim Bessen's work](#)

Even elevator operators had other tasks...

- Operation
 - Safety monitor
 - Security monitor
 - Greeter
 - Provide answers to questions
 - Provide services to residents
 - Announced special prices or offers
- Many such tasks were folded into other jobs (reception, security)
- Most jobs are more complicated than we think...

Groundskeeper tasks: O*NET

- Gather and remove litter.
- Use hand tools, such as shovels, rakes, pruning saws, saws, hedge or brush trimmers, or axes.
- Operate vehicles or powered equipment, such as mowers, tractors, twin-axle vehicles, snow blowers, chain-saws, electric clippers, sod cutters, or pruning saws.
- Water lawns, trees, or plants, using portable sprinkler systems, hoses, or watering cans.
- Prune or trim trees, shrubs, or hedges, using shears, pruners, or chain saws.
- Mix and spray or spread fertilizers, herbicides, or insecticides onto grass, shrubs, or trees, using hand or automatic sprayers or spreaders.
- Care for established lawns by mulching, aerating, weeding, grubbing, removing thatch, or trimming or edging around flower beds, walks, or walls.
- Follow planned landscaping designs to determine where to lay sod, sow grass, or plant flowers or foliage.

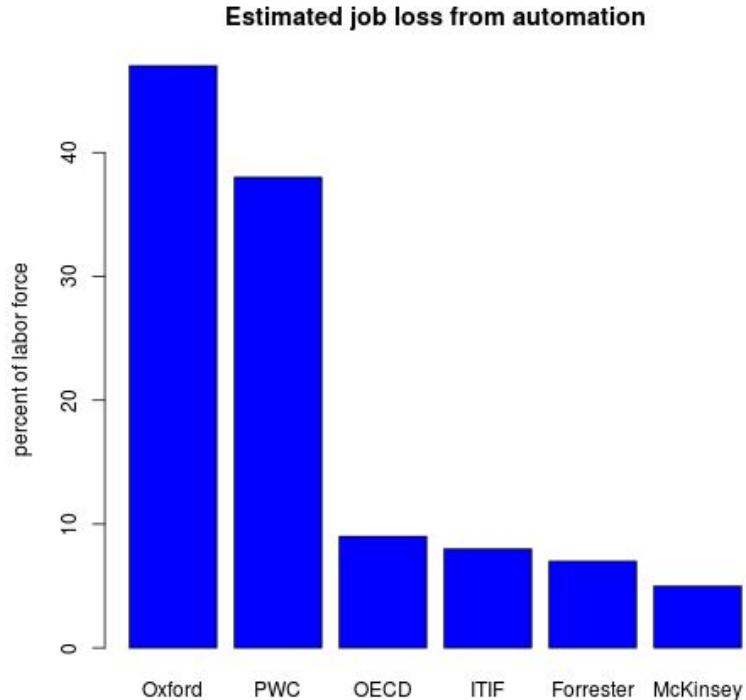
[MORE](#)

Groundskeeper tasks, continued

- Trim or pick flowers and clean flower beds.
- Attach wires from planted trees to support stakes.
- Plant seeds, bulbs, foliage, flowering plants, grass, ground covers, trees, or shrubs and apply mulch for protection, using gardening tools.
- Mow or edge lawns, using power mowers or edgers.
- Rake, mulch, and compost leaves.
- Decorate gardens with stones or plants.
- Provide proper upkeep of sidewalks, driveways, parking lots, fountains, planters, burial sites, or other grounds features.
- Shovel snow from walks, driveways, or parking lots and spread salt in those areas.
- Maintain irrigation systems, including winterizing the systems and starting them up in spring.
- Plan or cultivate lawns or gardens.
- Install rock gardens, ponds, decks, drainage systems, irrigation systems, retaining walls, fences, planters, or playground equipment.

Tasks and jobs

- Some of these tasks can be automated
- But can *all* of them be automated?
- What fraction of jobs can be automated?
- What fraction does it make economic sense to automate?
- Depends who you ask...



Ten largest occupations in US

Retail salesperson, cashier, food preparation and serving, general office clerk, registered nurse, customer service representative, waiter/ waitress, laborer, administrative assistant, and janitor.

Note: most jobs are in services: 80% of private US employment.

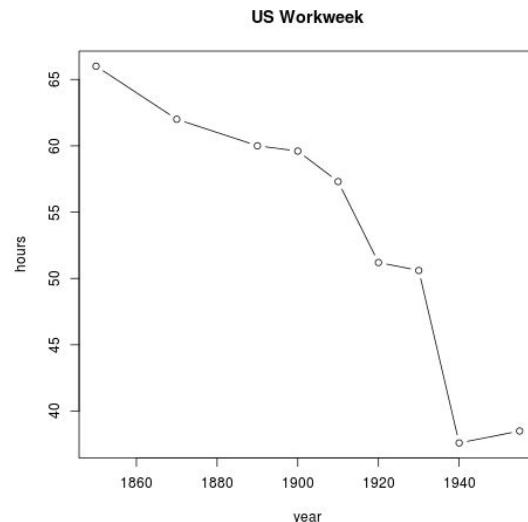
These 10 jobs account for 21% of total employment. Only registered nurses command a mean income above the national average of \$47,230. (Registered Nurse average wage is \$69,790.)

In contrast, food service worker, including fast food cook and dishwasher, is one of the lowest paid occupations, averaging \$19,110 per year.

Workweek across time and space

Workweek

Year	Hours
1850	66
1870	62
1890	60.0
1900	59.6
1910	57.3
1920	51.2
1930	50.6
1940	37.6
1955	38.5



Country	Hours
Belgium	35.2
Denmark	32.1
France	36.1
Germany	34.5
Italy	35.5
Mexico	45.2
Netherlands	29.1
Spain	36.5
Sweden	35.9
United Kingdom	36.5
United States	38.6

What do people want?

What do people want?

“More jobs and less work”

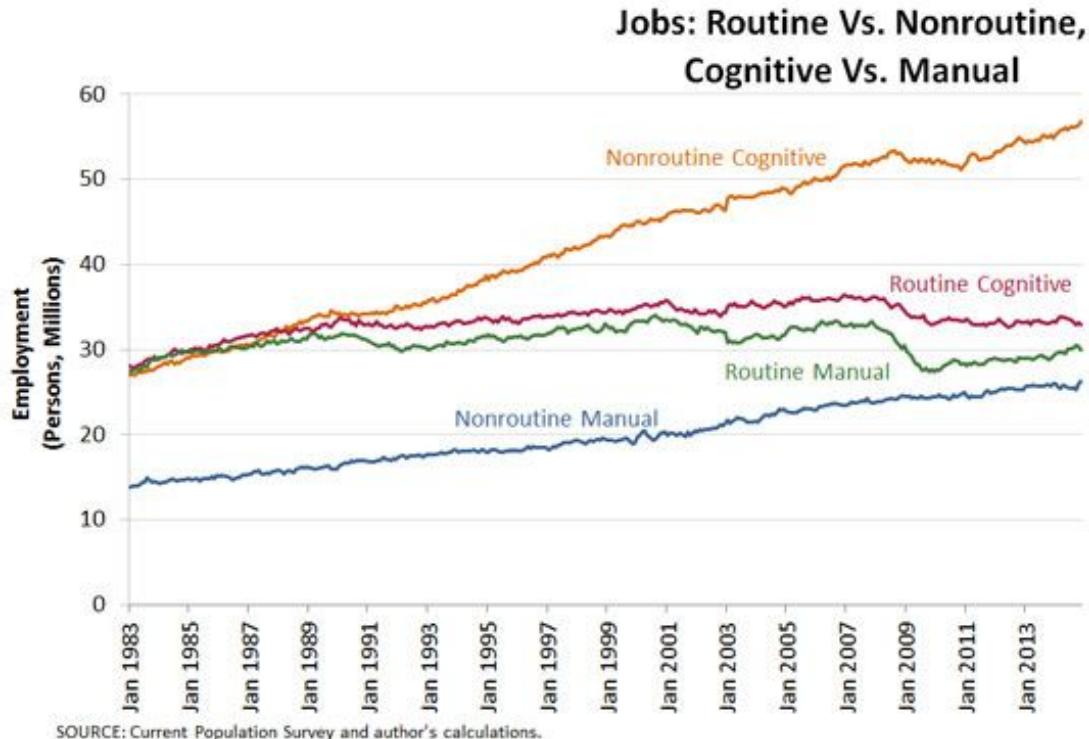
What do people want?

“More jobs and less work”

And that's exactly what technology can deliver.

Education and training

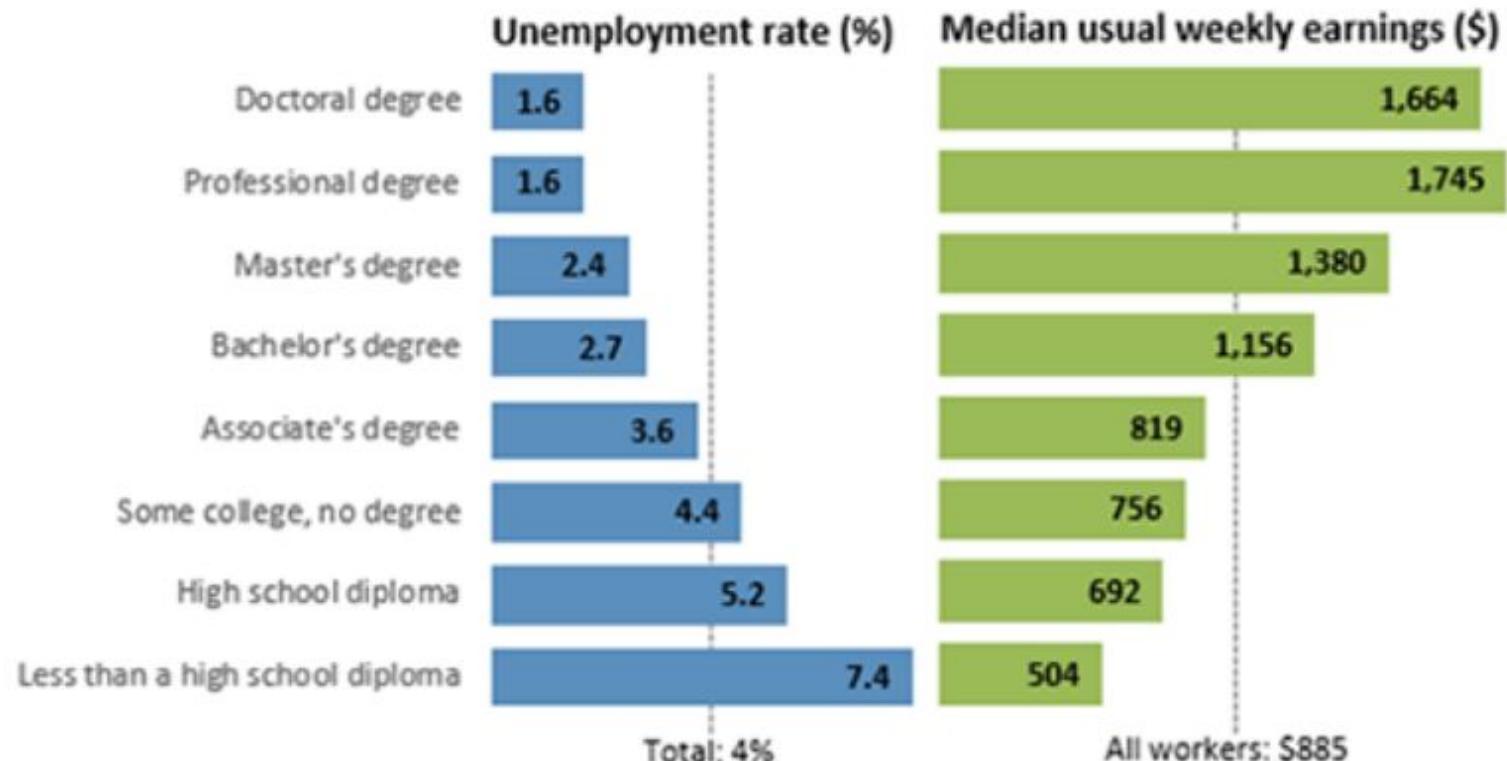
Routine/nonroutine, cognitive/manual



FEDERAL RESERVE BANK of ST. LOUIS

Jobs Involving Routine Tasks Aren't Growing

Unemployment rates and earnings by educational attainment, 2016



Note: Data are for persons age 25 and over. Earnings are for full-time wage and salary workers.

Source: U.S. Bureau of Labor Statistics, Current Population Survey.

Fallacy of composition for education

It's good for any individual to be more educated, but is it good for *everyone* to become more educated? Who will do the jobs that don't require much education?

The best way to acquire skills is on the job.

- Cheaper
- More relevant
- More focused
- Higher motivation

Can technology help deliver on-the-job skills?

Cognitive assistance

It used to be that being a

- ...cashier required knowing how to make change
- ...writer required knowing how to spell
- ...taxi driver meant knowing city streets
- ...a hospitality worker in an international you know a bit of foreign languages
- ...gardener, you needed to recognize plants
- ...veterinarian how to recognize dog breeds

Where there is a skills gap, you can bring the worker's skills up to the requirement, or bring the job down to workers' competencies. Cognitive assistance is like manual assistance became available 100 years ago.

Access to training is unprecedented: there are 500M views a day of "how to videos" on YouTube!

How to videos on You Tube: cognitive

Math by subject

- [Early math](#)
- [Arithmetic](#)
- [Pre-algebra](#)
- [Algebra](#)
- [Geometry](#)
- [Trigonometry](#)
- [Precalculus](#)
- [Statistics & probability](#)
- [Calculus](#)
- [Differential equations](#)
- [Linear algebra](#)
- [Math for fun and glory](#)

CS by subject

- [Intro to algorithms](#)
- [Binary search](#)
- [Asymptotic notation](#)
- [Selection sort](#)
- [Insertion sort](#)
- [Recursive algorithms](#)
- [Towers of Hanoi](#)
- [Merge sort](#)
- [Quick sort](#)
- [Graph representation](#)
- [Breadth-first search](#)
- [Further learning](#)

How to videos on You Tube: manual

- **how to** sweat copper pipe
- **how to** install a prehung door
- **how to care** for mums
- **how to** do planks
- **how to** weld cast iron
- **how to** remove a stripped bolt
- **how to** shorten blinds
- **how to** clean glass pipe
- **how to** program a garage door opener
- **how to** get a stripped screw out
- **how to** remove a stripped screw
- **how to** clean a pipe
- **how to** shingle a roof
- **how to** tig weld
- **how to** solder copper pipe
- **how to** weld aluminum
- **how to** mig weld
- **how to** balance a ceiling fan
- **how to** install a storm door

Tots: demography



Productivity

output/person = output/hour \times hours/worker \times workers/person
= productivity \times employment \times participation

Productivity

output/person = output/hour \times hours/worker \times workers/person
= productivity \times employment \times participation

full

Productivity

output/person = output/hour \times hours/worker \times workers/person
= productivity \times employment \times participation

full

declining

Productivity

output/person = output/hour \times hours/worker \times workers/person
= productivity \times employment \times participation

anemic

full

declining

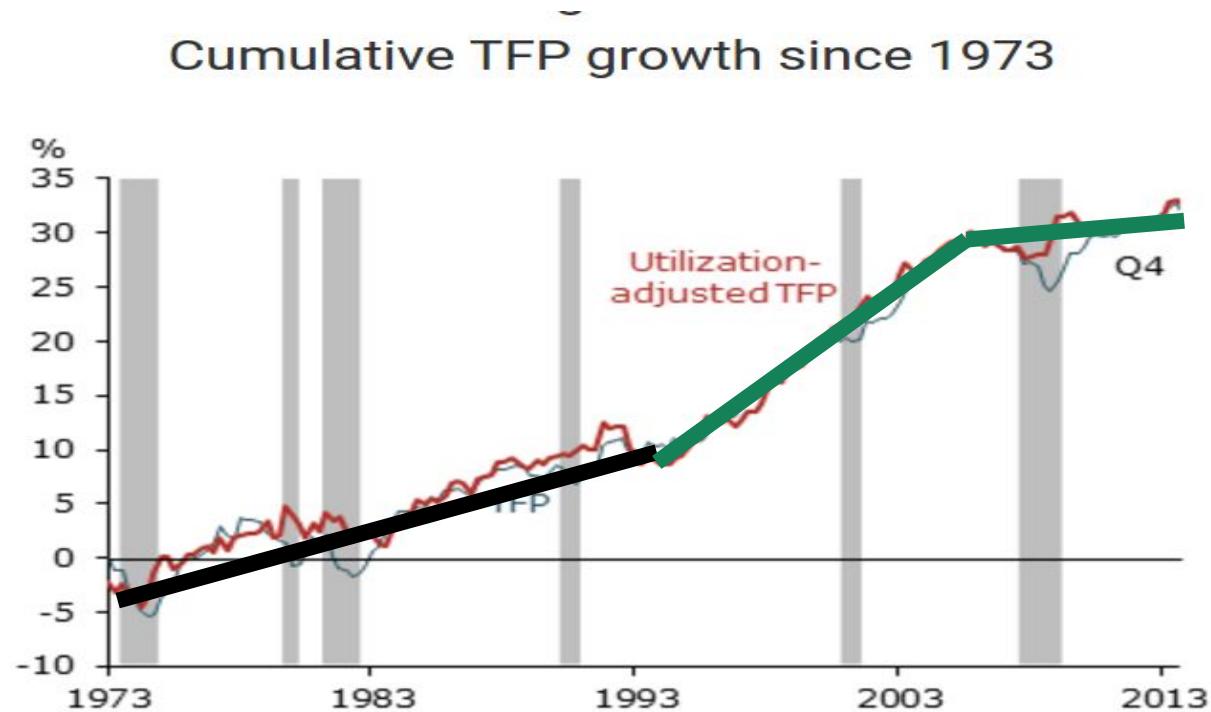
Growth in productivity

Cumulative TFP growth since 1973



Source: Fernald and Wang, "[The Recent Rise and Fall of Rapid Productivity Growth](#)", SF Fed, Feb 2015

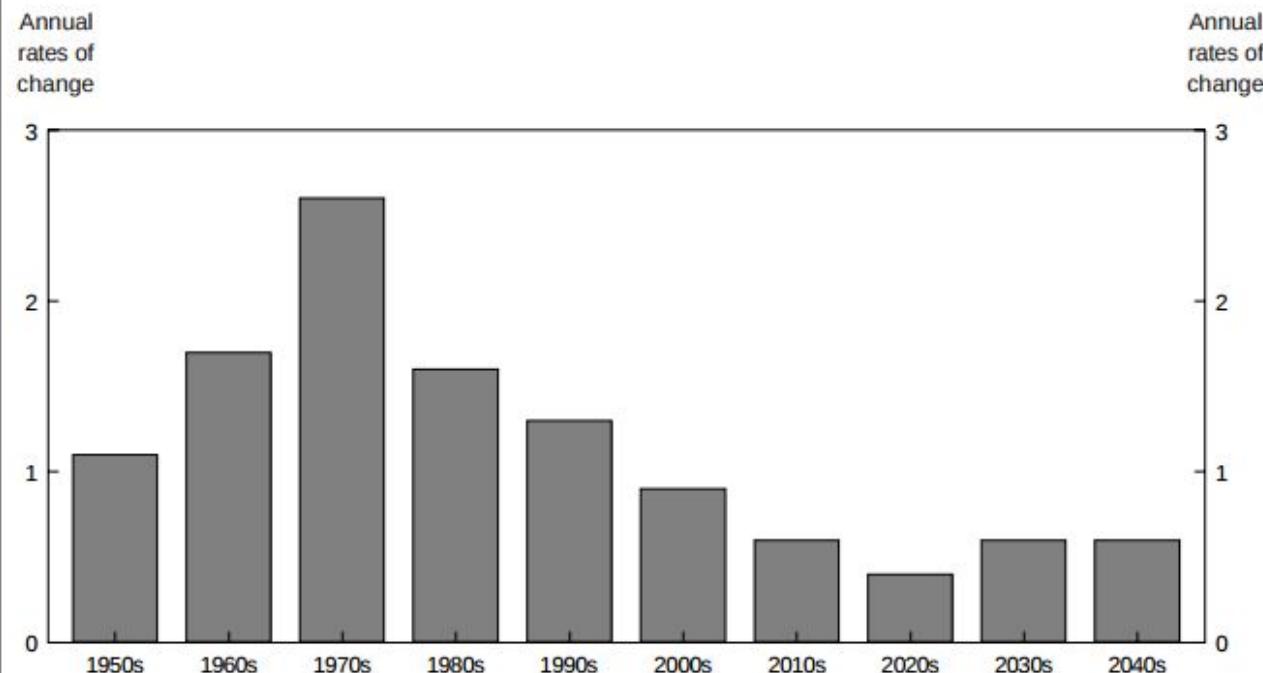
Growth in productivity



Source: Fernald and Wang, "[The Recent Rise and Fall of Rapid Productivity Growth](#)", SF Fed, Feb 2015

Growth of the labor force

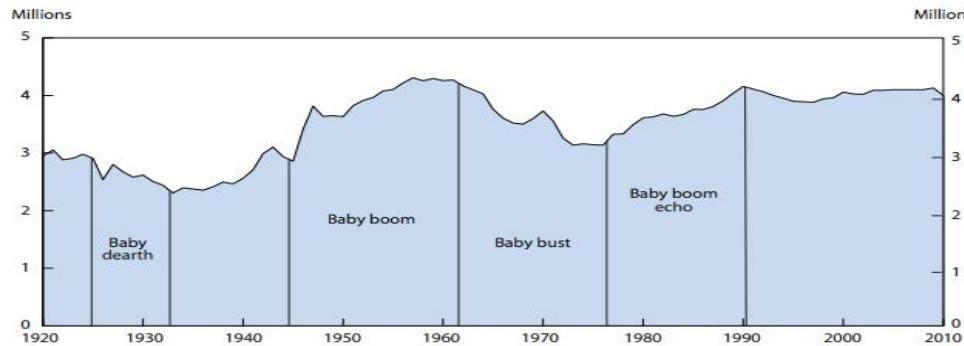
Chart 1. Labor force growth, by decades, 1950s to 2005 and projected to 2040s



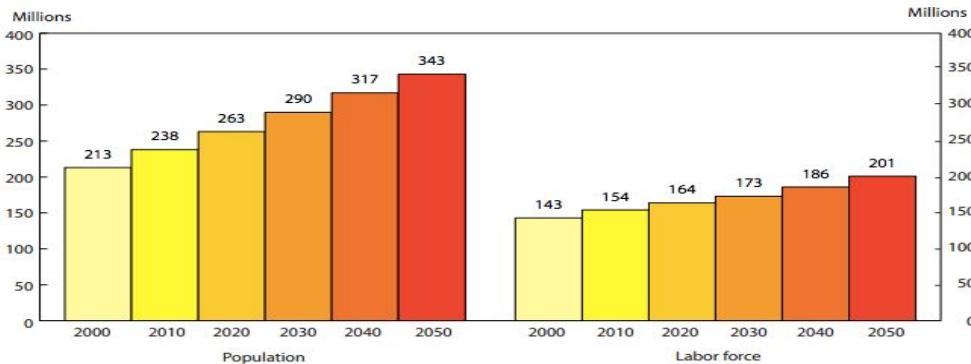
Source: Bureau of Labor Statistics.

Demography is destiny

1. Live births by year, 1920–2010

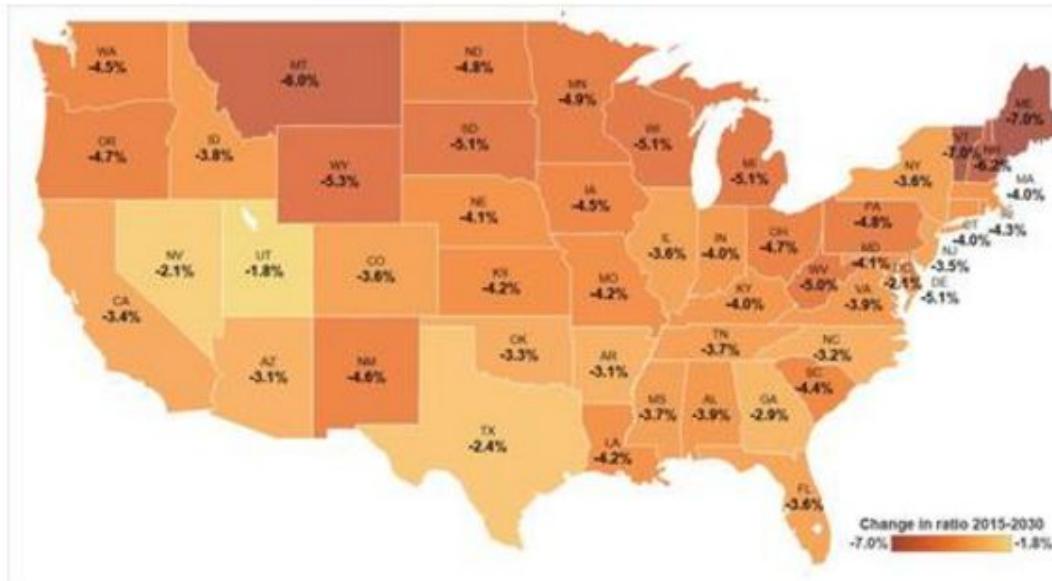


2. Population and labor force, 2000, 2010, and projected 2020, 2030, 2040, and 2050



Where will labor shortage be worst?

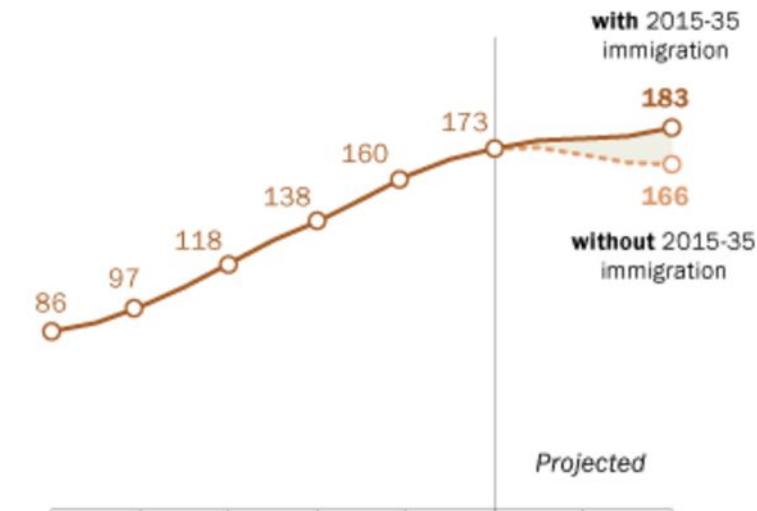
Chart 1: Change in ratio of people aged 20 to 64 over total population, 2015 to 2030 (*Click to expand*).



Immigration

**Without future immigrants,
working-age population in U.S.
would decrease by 2035**

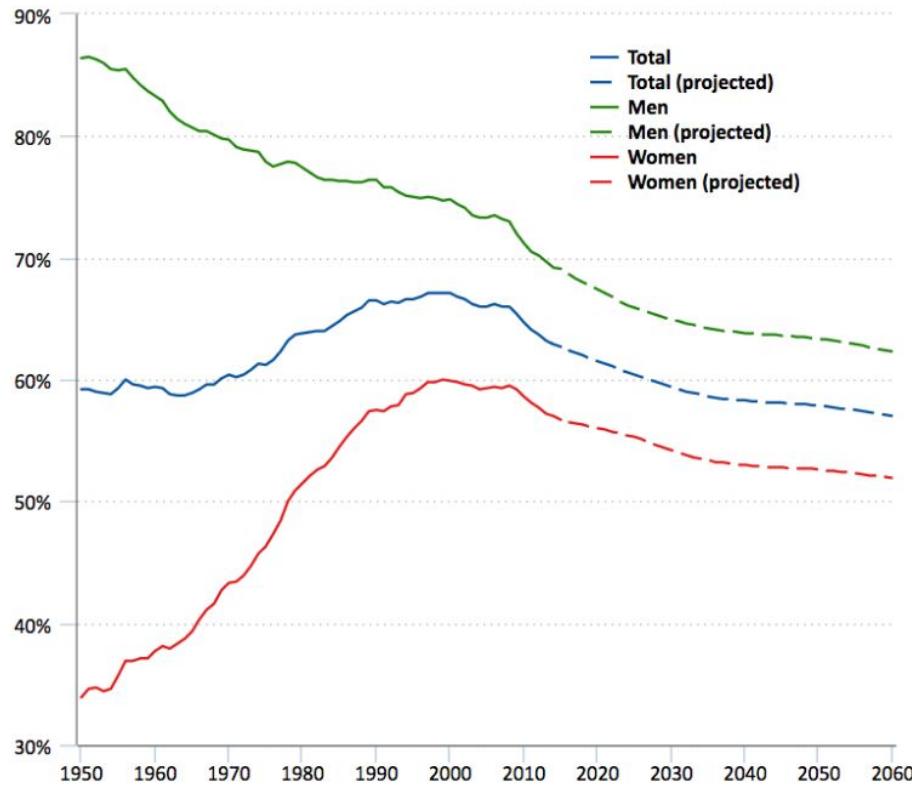
*Working-age population (25-64),
in millions*



Source: Pew Research Center estimates
for 1965-2015 based on adjusted census
data; Pew Research Center projections
for 2015-35.

PEW RESEARCH CENTER

Labor force participation rates

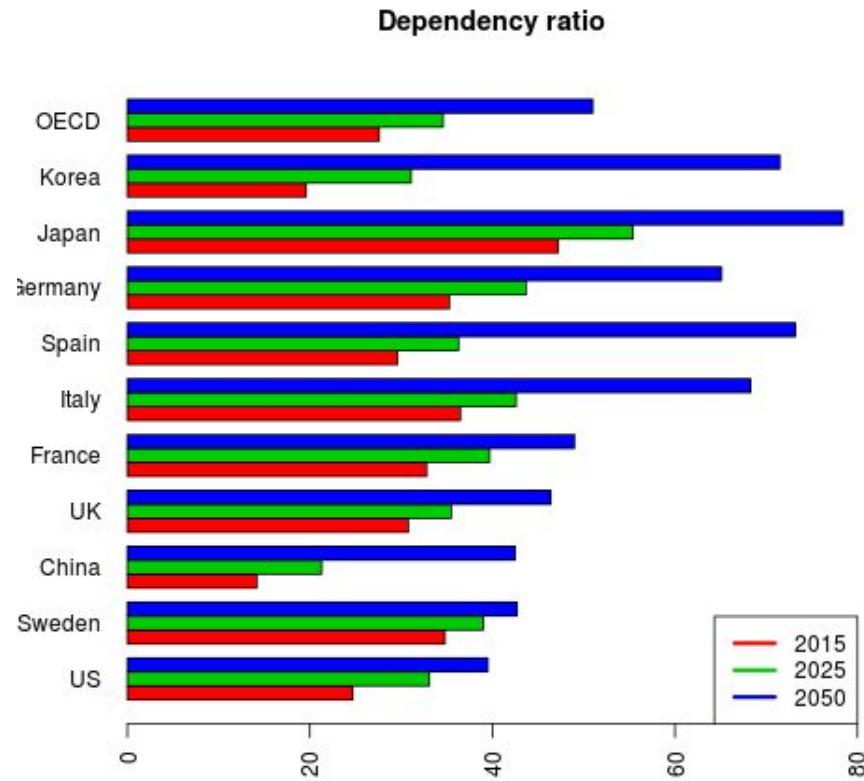


Growth in population and labor force

Decade	Population growth	Labor Force growth
2010	18.4%	7.7%
2020	10.5%	6.5%
2030	10.3%	5.5%
2040	9.3%	7.5%
2050	8.2%	8.1%

- US labor market is already beginning to tighten
- Expect a tight labor market for the next 15-25 years
- Retirees continue to consume
- Robots don't consume
- Labor supply is growing more slowly than labor demand.
- Old intuitions no longer helpful

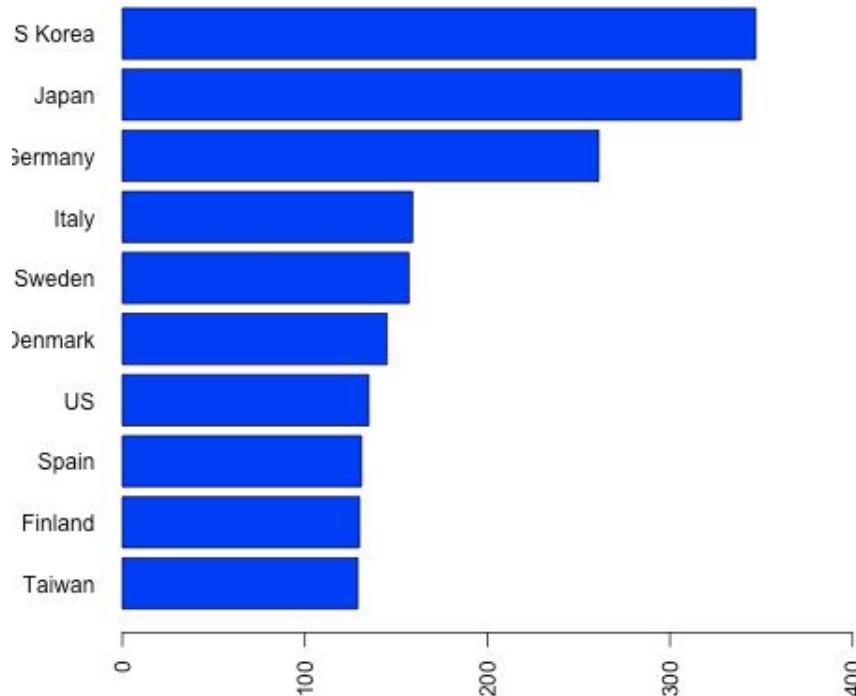
US is in good shape compared to many countries



People over 65 for every 100 people of working age. Source: OECD

[OECD](#)

Robots per 1000 workers



Countries with bad demographics are investing in robots.

As population ages, they become more costly

Fact sheet: Aging in the United States

- People over 65 in US today: 46 million, 15 percent
- People over 65 in US in 2060: 98 million, 24 percent
- People with Alzheimer's today: 5 million
- People with Alzheimer's 2050: 14 million

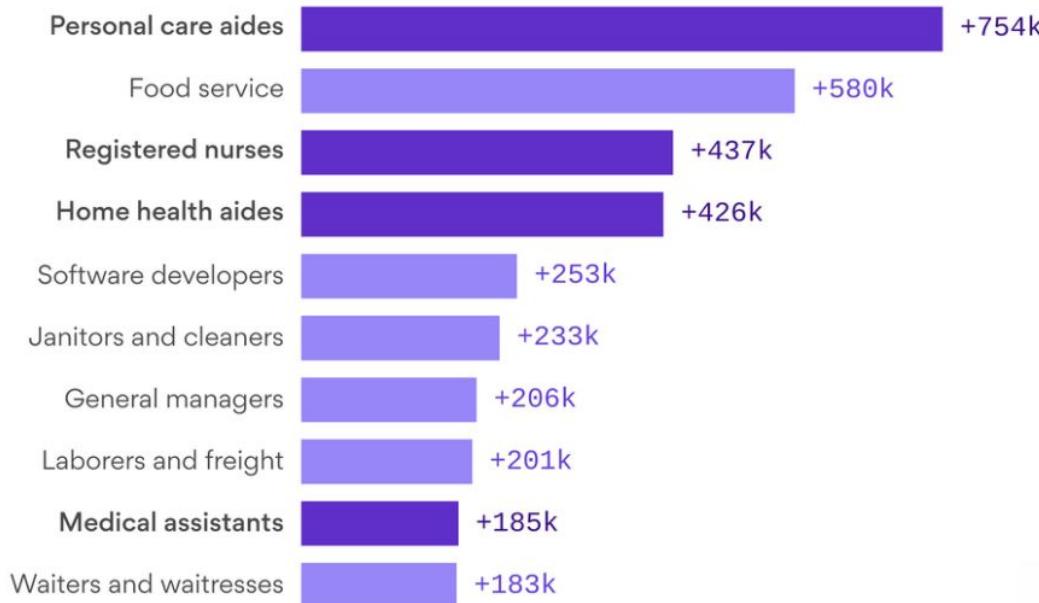
Productivity growth in 2015:

- 1.3% productivity growth implies GDP will be 78% larger in 2060 than today
- Population over 65 doubles, Alzheimer's triples, and GDP only goes up by 78%
- If productivity growth were 1.6% we would could cover the doubling of the elderly

Employment gains by occupation

Biggest employment gains by occupation

Projected growth, 2016-26 (health care jobs in bold)



Data: Bureau of Labor Statistics; Chart: Chris Canipe / Axios

THE END