Automation v Procreation

Hal Varian
Automation v Procreation

Hal Varian
Bots v Tots

Hal Varian
Economics of the labor market

![Graph showing the labor market with wage and labor axes, demonstrating supply and demand intersecting at equilibrium wage W* and equilibrium quantity L*]
Economics of the labor market

Diagram showing the interaction between labor demand and supply, with new demand and new wage indicated as new L* and w* respectively.
Economics of the labor market

new wage = $w^*$

new demand

new supply

new $L^*$
Economics of the labor market

new wage = $w^*$
new demand = $BOTS$
new supply = $TOTS$
new $L^*$
Bots
2016: job stealing

Internet of Things

Smart robots could soon steal your job

by Ivana Kottasova  @ivankottasova

January 15, 2016: 1:53 PM ET

Robots are taking over China's factory floors

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

Jason Furman
DETROIT — Technological innovation is widely billed as a miracle cure for the United States' economic ills. But 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 256,000 indefinite layoffs. Even the faltering Chrysler Corporation has added 138 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 blue-collar occupations that promised jobs to displaced white-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 by 1986. While this hardly seems threatening to a manufacturing work force of 18 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 Shaskan

proportionate 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 “night” and “day” 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 may be premature 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 Shaskan, a research fellow at the Massachusetts Institute of Technology, is completing a book on automation.

Jason Furman
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-looking 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 of 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 de-
vices that perform human functions, or operate with seemingly human intelligence.

1960: job stealing
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
One Thousand
POUNDS
REWARD.

WHEREAS on the Night of Sunday the 19th
of January, 1812, the Mill belonging to
Messrs. Oates, Wood and Smithson,
Situate at Oaklands, near Leeds, was maliciously set on Fire. — And on the Morning of the
Twenty-fourth of March, 1812, several Persons entered the MILL of
MESSRS. WM. THOMPSON & BROTHERS,
Of Halifax, destroyed the MACHINERY therein. — And on the Morning of the 22d, some Persons
in Persons broke into the Town Shop of
Messrs. Dickinson, Carr and Co.

Wantonly destroyed Cloth,
to a CONSIDERABLE AMOUNT.

1000 POUNDS
REWARD

A hereby offered to any Person or Persons who will give such Information
as will lead to the Conviction of any of the Offenders, on Application at
in Town Clerk's Office, or to any of the above-mentioned Sufferers.

MARCH 25, 1812.
2017: Huh?

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

[Diagram showing the increase in the number of women and men in the civilian labor force from 1945 to 2015.]

Dept of Labor
1. Live births by year, 1920–2010

Bureau of Labor Statistics
The Spreadsheet Apocalypse, Revisited

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

1979  Release of VisiCalc
1983  Release of Lotus 1-2-3
1987  Release of Microsoft Excel for Windows

Notes: There is no data for 1992. 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.
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.

Quartz article based on Jim Bessen’s work
Tasks or jobs?

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

Elevator operator

[Image: 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.
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

<table>
<thead>
<tr>
<th>Year</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1850</td>
<td>66</td>
</tr>
<tr>
<td>1870</td>
<td>62</td>
</tr>
<tr>
<td>1890</td>
<td>60.0</td>
</tr>
<tr>
<td>1900</td>
<td>59.6</td>
</tr>
<tr>
<td>1910</td>
<td>57.3</td>
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<tr>
<td>1920</td>
<td>51.2</td>
</tr>
<tr>
<td>1930</td>
<td>50.6</td>
</tr>
<tr>
<td>1940</td>
<td>37.6</td>
</tr>
<tr>
<td>1955</td>
<td>38.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>35.2</td>
</tr>
<tr>
<td>Denmark</td>
<td>32.1</td>
</tr>
<tr>
<td>France</td>
<td>36.1</td>
</tr>
<tr>
<td>Germany</td>
<td>34.5</td>
</tr>
<tr>
<td>Italy</td>
<td>35.5</td>
</tr>
<tr>
<td>Mexico</td>
<td>45.2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>29.1</td>
</tr>
<tr>
<td>Spain</td>
<td>36.5</td>
</tr>
<tr>
<td>Sweden</td>
<td>35.9</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>36.5</td>
</tr>
<tr>
<td>United States</td>
<td>38.6</td>
</tr>
</tbody>
</table>

**Economic History Assoc** and **OECD**
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
Jobs Involving Routine Tasks Aren't Growing
### Unemployment rates and earnings by educational attainment, 2016

<table>
<thead>
<tr>
<th>Educational Attainment</th>
<th>Unemployment rate (%)</th>
<th>Median usual weekly earnings ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctoral degree</td>
<td>1.6</td>
<td>1,664</td>
</tr>
<tr>
<td>Professional degree</td>
<td>1.6</td>
<td>1,745</td>
</tr>
<tr>
<td>Master's degree</td>
<td>2.4</td>
<td>1,380</td>
</tr>
<tr>
<td>Bachelor's degree</td>
<td>2.7</td>
<td>1,156</td>
</tr>
<tr>
<td>Associate's degree</td>
<td>3.6</td>
<td>819</td>
</tr>
<tr>
<td>Some college, no degree</td>
<td>4.4</td>
<td>756</td>
</tr>
<tr>
<td>High school diploma</td>
<td>5.2</td>
<td>692</td>
</tr>
<tr>
<td>Less than a high school diploma</td>
<td>7.4</td>
<td>504</td>
</tr>
</tbody>
</table>

**Total:** 4%

**All workers:** $885

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

Fallacy of composition for education

It’s good for any individual to be more educated, but it is 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!
<table>
<thead>
<tr>
<th>Math by subject</th>
<th>CS by subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early math</td>
<td>Intro to algorithms</td>
</tr>
<tr>
<td>Arithmetic</td>
<td>Binary search</td>
</tr>
<tr>
<td>Pre-algebra</td>
<td>Asymptotic notation</td>
</tr>
<tr>
<td>Algebra</td>
<td>Selection sort</td>
</tr>
<tr>
<td>Geometry</td>
<td>Insertion sort</td>
</tr>
<tr>
<td>Trigonometry</td>
<td>Recursive algorithms</td>
</tr>
<tr>
<td>Precalculus</td>
<td>Towers of Hanoi</td>
</tr>
<tr>
<td>Statistics &amp; probability</td>
<td>Merge sort</td>
</tr>
<tr>
<td>Calculus</td>
<td>Quick sort</td>
</tr>
<tr>
<td>Differential equations</td>
<td>Graph representation</td>
</tr>
<tr>
<td>Linear algebra</td>
<td>Breadth-first search</td>
</tr>
<tr>
<td>Math for fun and glory</td>
<td>Further learning</td>
</tr>
</tbody>
</table>
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

\[
\text{output/person} = \text{output/hour} \times \text{hours/worker} \times \text{workers/person} \\
= \text{productivity} \times \text{employment} \times \text{participation}
\]
Productivity

output/person = output/hour × hours/worker × workers/person

= productivity × employment × participation

full
Productivity

\[
\text{output/person} = \frac{\text{output/hour}}{\text{hours/worker}} \times \text{workers/person} \\
= \text{productivity} \times \text{employment} \times \text{participation}
\]

full declining
Productivity

\[
\text{output/person} = \text{output/hour} \times \text{hours/worker} \times \text{workers/person} = \text{productivity} \times \text{employment} \times \text{participation}
\]

anemic full declining
Growth in productivity

Growth in productivity

Cumulative TFP growth since 1973

Growth of the labor force

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

Annual rates of change

Demography is destiny

1. Live births by year, 1920–2010


Bureau of Labor Statistics
Chart 1: Change in ratio of people aged 20 to 64 over total population, 2015 to 2030 (Click to expand).
Without future immigrants, working-age population in U.S. would decrease by 2035

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

Labor force participation rates

Bureau of Labor Statistics
Growth in population and labor force

<table>
<thead>
<tr>
<th>Decade</th>
<th>Population growth</th>
<th>Labor Force growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>18.4%</td>
<td>7.7%</td>
</tr>
<tr>
<td>2020</td>
<td>10.5%</td>
<td>6.5%</td>
</tr>
<tr>
<td>2030</td>
<td>10.3%</td>
<td>5.5%</td>
</tr>
<tr>
<td>2040</td>
<td>9.3%</td>
<td>7.5%</td>
</tr>
<tr>
<td>2050</td>
<td>8.2%</td>
<td>8.1%</td>
</tr>
</tbody>
</table>

- 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

Gad Levanon, Conference Board
US is in good shape compared to many countries

Dependency ratio

OECD
Korea
Japan
Germany
Spain
Italy
France
UK
China
Sweden
US

People over 65 for every 100 people of working age. Source: OECD
Robots per 1000 workers

Countries with bad demographics are investing in robots.

Source: Robotics and Automation News
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

Harnassing automation for a future that works, McKinsey
Employment gains by occupation

Biggest employment gains by occupation
Projected growth, 2016-26 (health care jobs in bold)

- Personal care aides: +754k
- Food service: +580k
- Registered nurses: +437k
- Home health aides: +426k
- Software developers: +253k
- Janitors and cleaners: +233k
- General managers: +206k
- Laborers and freight: +201k
- Medical assistants: +185k
- Waiters and waitresses: +183k

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