

Jobs, Skills, and Digital

April 1, 2014



Presenters



Gad Levanon, Director of Macroeconomic and Labor Market Research currently oversees a group of economists conducting research in various macroeconomic and labor market topics. Levanon developed The Conference Board Employment Trends Index™, which aggregates eight labor market indicators to more accurately depict underlying trends in employment. He is also the principal author of The Conference Board Labor Markets in Review.



Desirée van Welsum, Economist, manages The Conference Board Business Scenario Program. She has over 10 years of experience in applied economic research and policy analysis on private and public sectors in the economy. She is an expert in the economic impacts of information and Communication Technologies (ICT), including on growth, economic performance, employment, skills, and offshoring and outsourcing, and has been published widely in these areas.



The impact of technology on jobs and skills

- How fast is technology replacing jobs?
- Will we end up having too many workers for too few jobs?
- How rapidly are STEM jobs being created?
- How does technology impact the skills needed in non-tech jobs?
- Are we likely to experience skill shortages in STEM occupations?





How fast is technology replacing jobs?



The Future of Jobs - The Onrushing Wave, The Economist, January 2014
<http://www.economist.com/news/briefing/21594264-previous-technological-innovation-has-always-delivered-more-long-run-employment-not-less>



Computers (& AI and robots) now also replacing more highly skilled jobs: creation of wealth, not jobs (1)

- ... “companies and the 1 % have never been richer, but they aren’t creating more jobs. Rather, they are buying more software to do the jobs humans used to do. At a **Conference Board event** yesterday **looking at the effects of technology on the workforce**, I was interested in to learn that even as the recovery grows stronger, many companies are considering cutting more jobs, rather than fewer, higher up the food chain, as technology allows them to be done by computers.”
- (Rana Foroohar, Time, <http://time.com/33570/here-comes-the-revenge-of-the-1-percent/>)



Computers (& AI and robots) now also replacing more highly skilled jobs: creation of wealth, not jobs (2)

- Companies like Facebook and Whatsapp have created a lot of wealth, but not much employment
- Erik Brynjolfsson: superstar biased technical change
- The great decoupling:



Computers (& AI and robots) now also replacing more highly skilled jobs: what types of jobs will humans do? What are the kinds of skills people need going forward? (1)

- Frey and Osborne: 47% of US jobs potentially exposed to computerization
- “Our findings imply that as technology races ahead, low-skilled workers will move to tasks that are not susceptible to computerisation — i.e., tasks that require creative and social intelligence,” the paper states. **“For workers to win the race, however, they will have to acquire creative and social skills.”**
- (Frey, C. and M. Osborne (2013), The Future of Employment: How Susceptible are Jobs to Computerisation?
http://www.futuretech.ox.ac.uk/sites/futuretech.ox.ac.uk/files/The_Future_of_Employment_OMS_Working_Paper_1.pdf)

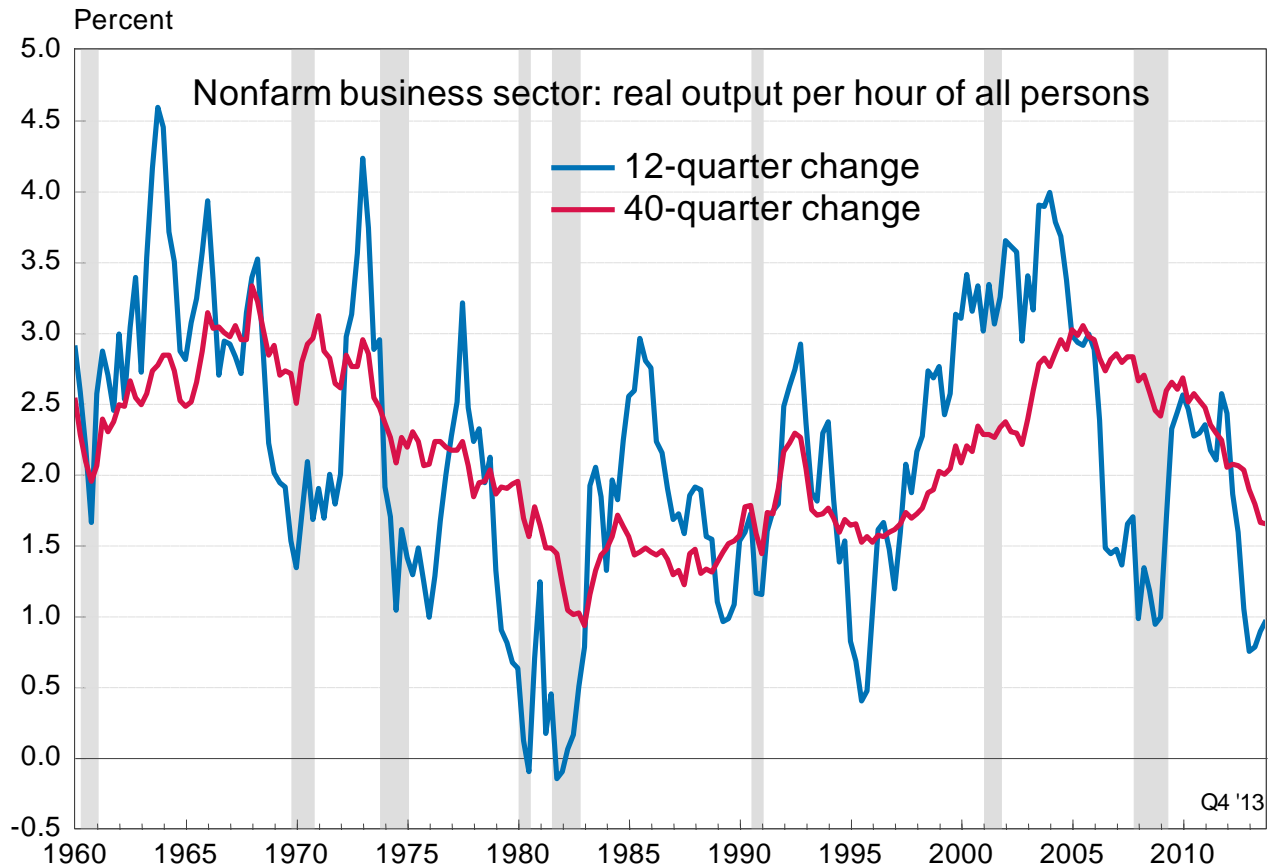


Computers (& AI and robots) now also replacing more highly skilled jobs: what types of jobs will humans do? What are the kinds of skills people need going forward? (2)

- Humans have to become good at things computers/robots/artificial intelligence cannot do, or cannot do as well (yet...):
- **“the human labor market will center on three kinds of work: solving unstructured problems, working with new information, and carrying out non-routine manual tasks.”**
- (Levy, F. and R. Murnane (2012): Dancing with Robots: Human Skills for Computerized Work, Third Way, Fresh Thinking, NEXT.)



However, labor productivity growth in the U.S. has been declining



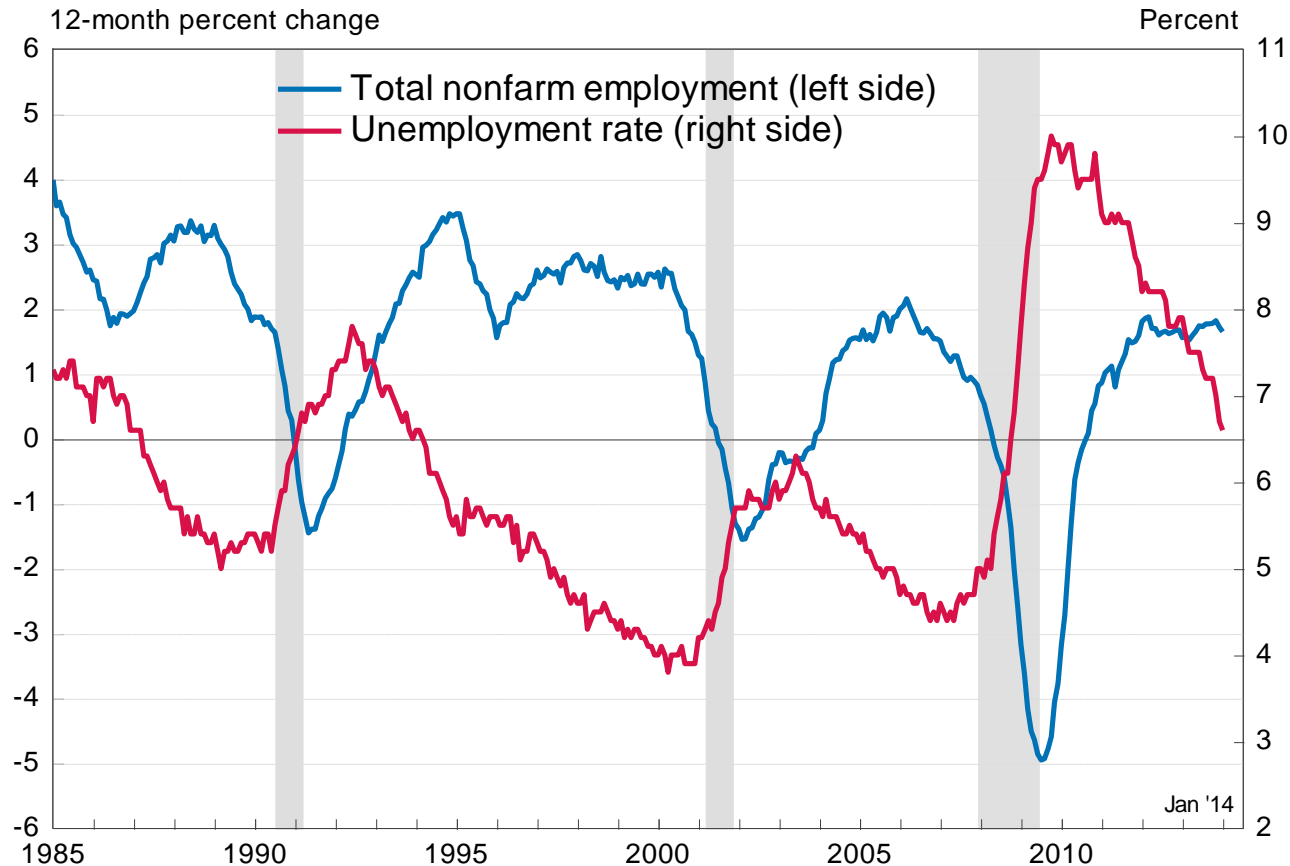
Note: Shaded areas represent recessions.
Source: Bureau of Labor Statistics





Will we end up having too many workers for too few jobs?

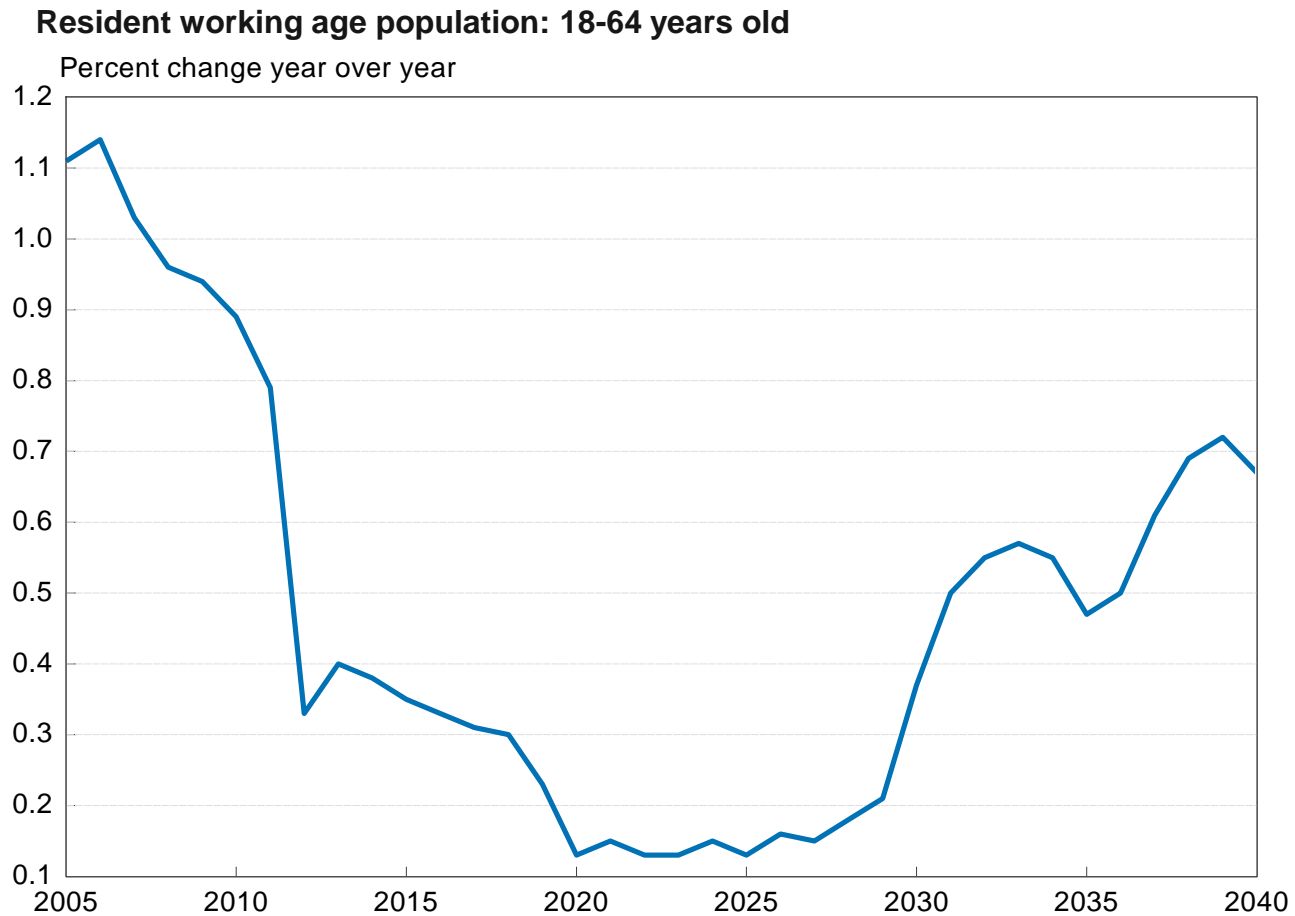
At the moment, no sign of permanently high unemployment rates



Note: Shaded areas represent recessions.
Source: Bureau of Labor Statistics



...followed by 15 more years of tight labor markets



Source: The Census Bureau





How rapidly are STEM jobs being created?

Employment in some STEM heavy industries are expected to grow slowly

| Industry | Annual Rate of Change 2012-22 | | |
|--|-------------------------------|--------|--------------|
| | Employment | Output | Productivity |
| Computer systems design and related services | 3.2 | 4.8 | 1.6 |
| Construction | 2.6 | 4.1 | 1.5 |
| Health care and social assistance | 2.6 | 3.1 | 0.5 |
| Software publishers | 2.3 | 5.7 | 3.4 |
| Professional, scientific, and technical services | 2.1 | 3.2 | 1.1 |
| Education services | 1.9 | 2.0 | 0.1 |
| Mining | 1.4 | 2.4 | 1.0 |
| Arts, entertainment, and recreation | 1.1 | 2.2 | 1.1 |
| Total | 1.0 | 2.6 | 1.6 |
| Accommodation and food services | 0.9 | 2.2 | 1.3 |
| Wholesale trade | 0.8 | 3.7 | 2.9 |
| Finance and insurance | 0.8 | 3.3 | 2.5 |
| Retail trade | 0.7 | 3.2 | 2.5 |
| Data processing, hosting, related services, and other information services | 0.7 | 4.7 | 4.0 |
| State and local government | 0.5 | 1.3 | 0.8 |
| Information | -0.2 | 3.5 | 3.7 |
| Manufacturing | -0.5 | 2.4 | 2.9 |
| Telecommunications | -0.6 | 3.4 | 4.0 |
| Semiconductor and other electronic component manufacturing | -0.8 | 4.1 | 4.9 |
| Utilities | -1.1 | 2.3 | 3.4 |
| Computer and peripheral equipment manufacturing | -2.9 | 9.2 | 12.1 |
| Communications equipment manufacturing | -3.3 | 2.6 | 5.9 |

Source: Bureau of Labor Statistics



Not many STEM occupations in the (projected) fastest growing occupations

| 2012 National Employment Matrix title and code | | % change 2012-2022 | Median annual wage, 2012 ⁽¹⁾ | | | |
|--|---|--------------------|---|----|--|----------|
| Total, All Occupations | | 10.8 | \$34,750 | | | |
| 1 | Industrial-organizational psychologists | 53.4 | \$83,580 | 16 | Information security analysts | \$86,170 |
| 2 | Personal care aides | 48.8 | \$19,910 | 17 | Occupational therapy aides | \$26,850 |
| 3 | Home health aides | 48.5 | \$20,820 | 18 | Health specialties teachers, postsecondary | \$81,140 |
| 4 | Insulation workers, mechanical | 46.7 | \$39,170 | 19 | Medical secretaries | \$31,350 |
| 5 | Interpreters and translators | 46.1 | \$45,430 | 20 | Physical therapists | \$79,860 |
| 6 | Diagnostic medical sonographers | 46.0 | \$65,860 | 21 | Orthotists and prosthetists | \$62,670 |
| 7 | Helpers--brickmasons, blockmasons, stonemasons, and tile and marble setters | 43.0 | \$28,220 | 22 | Brickmasons and blockmasons | \$46,440 |
| 8 | Occupational therapy assistants | 42.6 | \$53,240 | 23 | Nursing instructors and teachers, postsecondary | \$64,850 |
| 9 | Genetic counselors | 41.2 | \$56,800 | 24 | Nurse practitioners | \$89,960 |
| 10 | Physical therapist assistants | 41.0 | \$52,160 | 25 | Audiologists | \$69,720 |
| 11 | Physical therapist aides | 40.1 | \$23,880 | 26 | Dental hygienists | \$70,210 |
| 12 | Skincare specialists | 39.8 | \$28,640 | 27 | Meeting, convention, and event planners | \$45,810 |
| 13 | Physician assistants | 38.4 | \$90,930 | 28 | Therapists, all other | \$53,210 |
| 14 | Segmental pavers | 38.1 | \$33,720 | 29 | Market research analysts and marketing specialists | \$60,300 |
| 15 | Helpers--electricians | 36.9 | \$27,670 | 30 | Substance abuse and behavioral disorder counselors | \$38,520 |

Source: Employment Projections program, U.S. Department of Labor, U.S. Bureau of Labor Statistics



Employment is expected to grow faster than average in most, but not all, STEM occupations

| | Annual rate of change 2012-2022 | | Annual rate of change 2012-2022 |
|---|---------------------------------|--|---------------------------------|
| Information security analysts | 36.5 | Business and financial operations occupations | 12.5 |
| Healthcare support occupations | 28.1 | Building and grounds cleaning and maintenance occupations | 12.5 |
| Biomedical engineers | 26.6 | Network and computer systems administrators | 11.7 |
| Computer and information analysts | 26.1 | Education, training, and library occupations | 11.1 |
| Mathematical science occupations | 26.1 | Total, all occupations | 10.8 |
| Petroleum engineers | 25.5 | Legal occupations | 10.7 |
| Computer systems analysts | 24.5 | Physical scientists | 10.3 |
| Health technologists and technicians | 24.1 | Installation, maintenance, and repair occupations | 9.6 |
| Software developers, applications | 22.8 | Life, physical, and social science technicians | 9.5 |
| Construction and extraction occupations | 21.4 | Food preparation and serving related occupations | 9.4 |
| Personal care and service occupations | 20.9 | Life scientists | 9.2 |
| Health diagnosing and treating practitioners | 20.3 | Engineers | 8.6 |
| Computer user support specialists | 20.2 | Computer programmers | 8.3 |
| Software developers and programmers | 18.6 | Protective service occupations | 7.9 |
| Biochemists and biophysicists | 18.6 | Sales and related occupations | 7.3 |
| Physicians and surgeons | 17.8 | Management occupations | 7.2 |
| Computer occupations | 17.7 | Arts, design, entertainment, sports, and media occupations | 7.0 |
| Community and social service occupations | 17.2 | Computer network support specialists | 6.9 |
| Computer control programmers and operators | 16.5 | Office and administrative support occupations | 6.8 |
| Computer and information systems managers | 15.3 | Natural sciences managers | 5.7 |
| Environmental engineers | 15.3 | Industrial engineers, including health and safety | 5.1 |
| Environmental scientists and geoscientists | 14.7 | Electrical and electronics engineers | 4.1 |
| Computer-controlled machine tool operators, metal and plastic | 14.5 | Materials engineers | 0.9 |
| Database and systems administrators and network architects | 13.0 | Computer operators | -17.0 |

Source: Bureau of Labor Statistics



The size of the app economy (Mandel and Scherer (2012)) and the 'Facebook app economy' (Hann *et al*, 2011)

- Looking at the “App Intensity” of each state (the percentage of App Economy jobs in a state as a percentage of total jobs, indexed to the national average) shows that in addition to Washington and California, the app economy is also important to states such as Massachusetts, Oregon, Georgia, New Jersey, and New York.
- The economic impacts at state level are also considerable, “conservatively estimated” (in April 2012) at \$8.2 bn in California, \$2.7 bn in Washington, \$2.3 bn in New York, and over \$1 bn in states like Texas, Massachusetts, New Jersey and Georgia.
- Estimates of the employment impact of developers building apps on the Facebook Platform in the United States in 2011 range from 182,744 full time jobs (resulting in a total employment value of Facebook’s app economy of \$2.19 bn) to 235,644 jobs (adding a value of \$15.71 bn dollars to the U.S. economy).





How does technology impact the skills needed in non-tech jobs?

New skills supply

- Technology evolves so quickly, skills become obsolete very quickly, some say every 2-3 years
- Has implications for the supply of these skills: people are reluctant to get trained on skills that don't stay valuable/competitive long
- Companies are reluctant to train people because skills are fungible and can be taken to other companies
- Educational systems are too slow to be able to adapt to such changing skills needs
- So: who is responsible to for reskilling people and equipping workforce with the right skills?
- Above observations, combined with increasing use of 'alternative work arrangements', part-time jobs and freelancers, suggest increasingly the skilling burden shifts to people rather than business or government



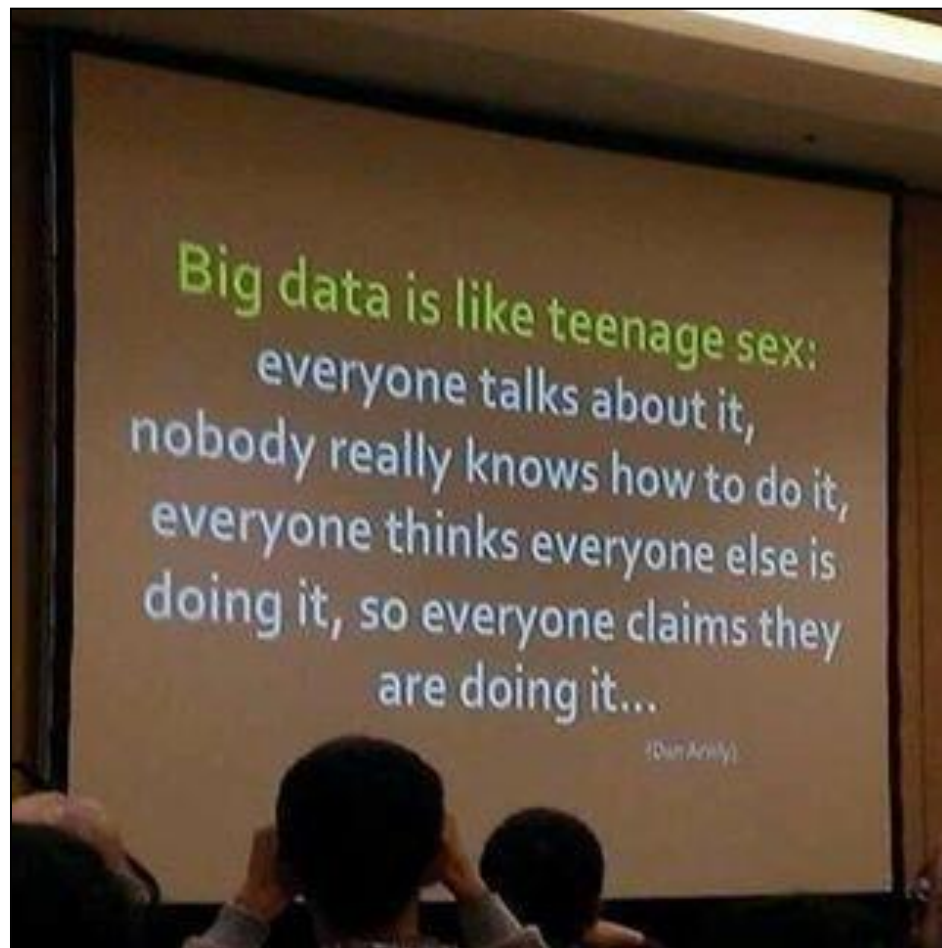
What new skills?

- Some (technology) skills needs are clearly gaining momentum:
 - ✓ 'big data' related skills: data scientists and engineers, data analysts, data visualization
 - ✓ App developers, designers of high level services to run over networks
- However, new “skills” needs are also found in **combinations of skills sets**: it is increasingly important to have “technology + business skills”, and to have “business skills + technological savviness/awareness”
- The big data and app development skills (and other technology skills) need to be combined with business acumen to identify business opportunities and communicate them to management
- Do companies/management have the right skills to identify what skills they need for their business (and the courage to implement the disruptive changes technology brings)? Do they have sufficient tech awareness to realize the value technology can unlock, and how?



“Everybody's Talking At Me” (I Don't Hear a Word They Are Saying)

- Big data will be big in all industries, all company sizes
- Do you have the skills to identify the skills you need?
- It is not just about “big data”, but really about “smart data” : making smart use of data to create new business opportunities , e.g. by identifying new relationships and correlations in rapidly increasing amounts of data (and weeding out information that is not useful or is spurious)



Become relevant, stay relevant (1):

- England will become the first country in the world to mandate computer programming in primary and secondary schools in the announced 2014 curriculum. Children will start learning to write code when they enter school the age of five, and will not stop until at least 16. <http://www.telegraph.co.uk/technology/news/10410036/Teaching-our-children-to-code-a-quiet-revolution.html>)
- “In order to prepare young people to do the jobs computers cannot do we must re-focus our education system around one objective: giving students the foundational skills in problem solving and communication that computers don’t have.” (Levy and Murnane, Dancing with Robots)
- “Race with the machines” is the key to growth (Erik Brynjolfsson: http://www.ted.com/talks/erik_brynjolfsson_the_key_to_growth_race_em_with_em_the_machines)



Become relevant, stay relevant (2):

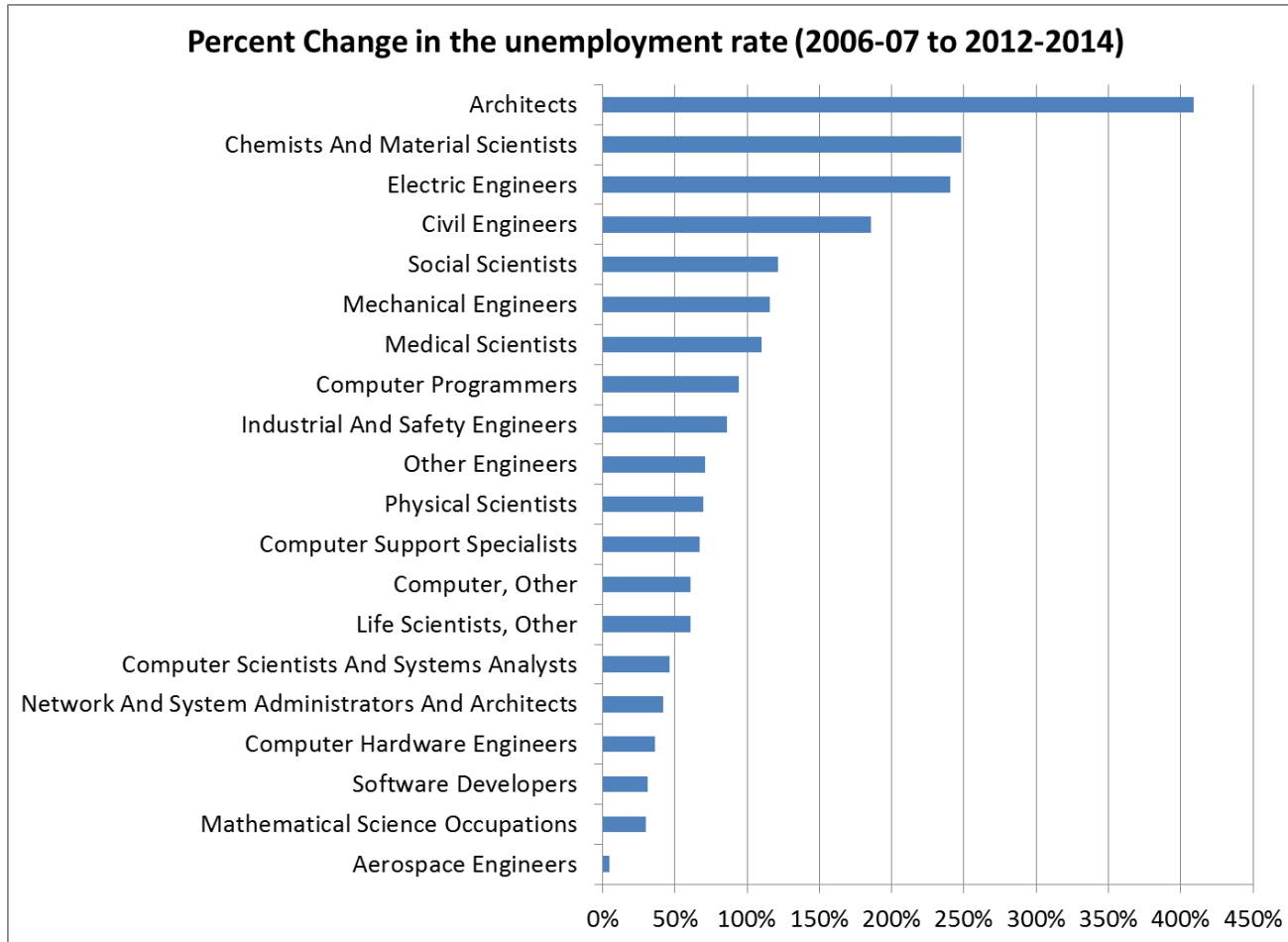
- Often heard: “teaching people how to learn”, “learning to learn” ... what does it mean? Important to prepare people for the idea that they will have to continually reinvent themselves, their skills and their jobs: great flexibility and life-long learning are the new job realities
- Lessons learnt from an expert Round Table organized by TCB in cooperation with the European Commission and Cornell University: ‘*Information Technology and Labour Market Disruptions: A Cross-Atlantic Discussion*’. A web site and resources will be made available soon.
- See also, for example, Lauren Weber, WSJ: <http://blogs.wsj.com/atwork/2014/03/24/to-keep-your-job-learn-something-new/?mod=e2tw>





Are we likely to experience labor shortages in
STEM occupations?

Large variation in labor market tightness across STEM occupations



Source: BLS and The Conference Board



Methodology for projecting supply-demand gaps

- Employment growth
- Replacement rate
- Current labor market tightness
- New Entrants



STEM occupations are not at high risk of shortages, but the occupational level hides skills and tasks changes

Selected groups of occupations ranked by supply-demand gap

| | |
|----|--|
| 1 | Water transportation workers |
| 2 | Plant and system operators |
| 3 | Librarians, curators, and archivists |
| 4 | Mathematical science occupations |
| 5 | Rail transportation workers |
| 6 | Counselors, social workers, and other community and social service specialists |
| 7 | Health diagnosing and treating practitioners |
| 8 | Health technologists and technicians |
| 9 | Law enforcement workers |
| 10 | Extraction workers |
| 11 | Architects, surveyors, and cartographers |
| 12 | Social scientists and related workers |
| 13 | Life, physical, and social science technicians |
| 14 | Financial specialists |
| 15 | Engineers |
| 16 | Postsecondary teachers |
| 17 | Preschool, primary, secondary, and special education school teachers |
| 18 | Business operations specialists |
| 19 | Computer occupations |
| 20 | Physical scientists |
| 21 | Media and communication workers |
| 22 | Life scientists |
| 23 | Entertainers and performers, sports and related workers |
| 24 | Art and design workers |
| 25 | Drafters, engineering technicians, and mapping technicians |
| 26 | Lawyers, judges, and related workers |
| 27 | Forest, conservation, and logging workers |
| 28 | Electrical and electronic equipment mechanics, installers, and repairers |
| 29 | Communications equipment operators |
| 30 | Media and communication equipment workers |

There may be shortages of certain types of skills and tasks within occupations

‘STEM’ type skills and tasks may also increasingly become part of non-STEM occupations.

And, these skills and tasks needs may change very rapidly.

Source: The Conference Board



... Why?

- Computer occupations – Low replacement rate and high new-entrants rate
- Life and Physical Science – moderate employment growth and very high new-entrants rate
- Most STEM occupations – high share of immigrants



STEM occupations are not at high risk of shortages, but this may hide rapidly evolving skills and tasks changes within occupations, including outside of STEM

Selected STEM occupations ranked by supply-demand gap

| | |
|----|---|
| 1 | Biomedical Engineers |
| 2 | Environmental Engineers |
| 3 | Environmental Scientists and Geoscientists |
| 4 | Agricultural and Food Scientists |
| 5 | Petroleum Engineers |
| 6 | Marine Engineers and Naval Architects |
| 7 | Civil Engineers |
| 8 | Mechanical Engineers |
| 9 | Database Administrators |
| 10 | Industrial Engineers, including Health and Safety |
| 11 | Computer Programmers |
| 12 | Astronomers and Physicists |
| 13 | Computer Scientists and Systems Analysts |
| 14 | Aerospace Engineers |
| 15 | Materials Engineers |
| 16 | Conservation Scientists and Foresters |
| 17 | Computer Hardware Engineers |
| 18 | Electrical and Electronics Engineers |
| 19 | Computer Software Engineers |
| 20 | Chemical Engineers |
| 21 | Chemists and Materials Scientists |
| 22 | Network and Computer Systems Administrators |
| 23 | Biological Scientists |
| 24 | Medical Scientists |
| 25 | Atmospheric and Space Scientists |
| 26 | Physical Scientists, All Other |

Source: The Conference Board



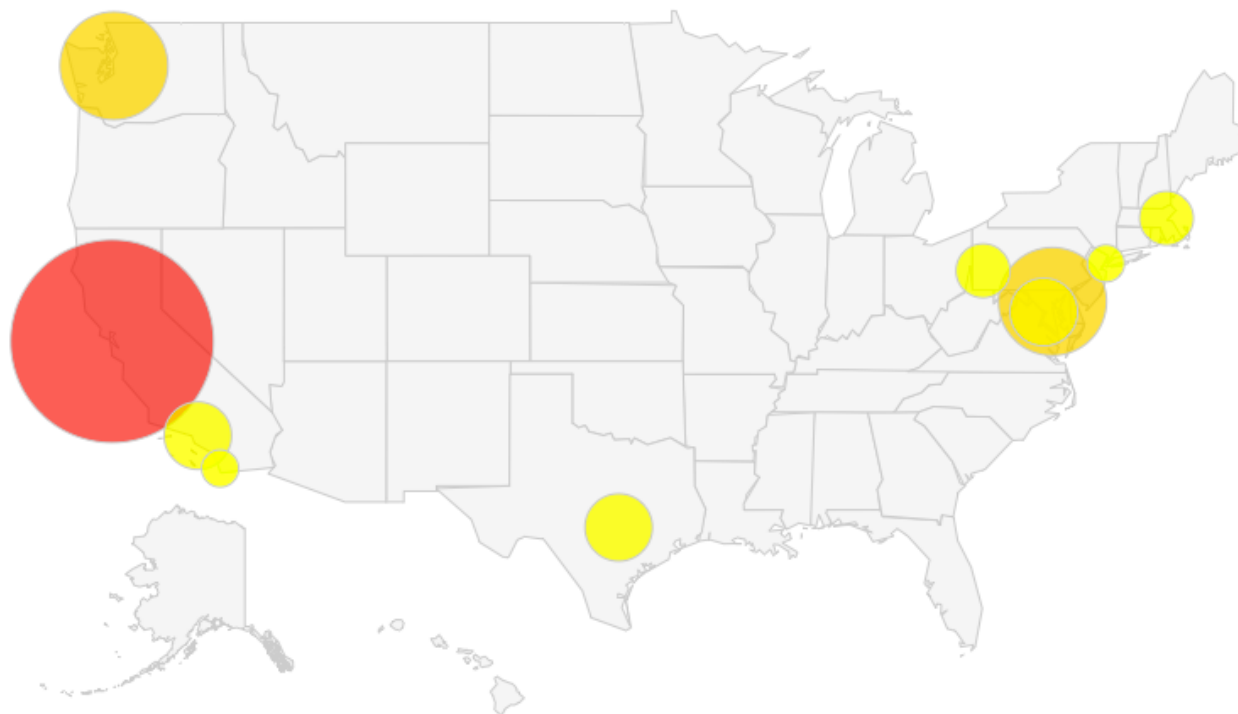
STEM occupations have a high share of immigrants

| | % Naturalized or not a citizen | | % Naturalized or not a citizen |
|---|--------------------------------|---|--------------------------------|
| Medical Scientists | 43.3% | Financial Managers | 12.7% |
| Computer Software Engineers | 35.7% | Chief Executives | 11.8% |
| Computer Hardware Engineers | 31.3% | Human Resources Managers | 11.4% |
| Physicians and Surgeons | 27.7% | Medical and Health Services Managers | 10.7% |
| Astronomers and Physicists | 27.1% | Construction Managers | 10.5% |
| Chemists and Materials Scientists | 26.0% | Social Workers | 9.5% |
| Electrical and Electronics Engineers | 24.8% | Advertising and Promotions Managers | 8.7% |
| Computer Programmers | 23.8% | Psychologists | 8.4% |
| Postsecondary Teachers | 21.2% | Editors | 8.4% |
| Biomedical Engineers | 20.7% | Librarians | 7.4% |
| Computer Scientists and Systems Analysts | 20.2% | Technical Writers | 6.8% |
| Natural Sciences Managers | 19.9% | Lawyers | 6.4% |
| Chemical Engineers | 18.9% | Elementary and Middle School Teachers | 6.0% |
| Petroleum Engineers | 18.1% | Audiologists | 5.8% |
| Civil Engineers | 17.9% | Air Traffic Controllers and Airfield Operations Specialists | 5.4% |
| Biological Scientists | 17.4% | Ship and Boat Captains and Operators | 4.9% |
| Computer and Information Systems Managers | 16.9% | Police and Sheriff's Patrol Officers | 4.7% |
| Engineering Managers | 16.5% | Speech-Language Pathologists | 4.1% |
| Accountants and Auditors | 16.4% | First-Line Supervisors/Managers of Correctional Officers | 3.8% |
| Actuaries | 15.7% | Power Plant Operators, Distributors, and Dispatchers | 3.0% |
| Registered Nurses | 14.1% | First-Line Supervisors/Managers of Police and Detectives | 2.9% |
| Network and Computer Systems Administrators | 14.1% | First-Line Supervisors/Managers of Fire Fighting and Prevention | 2.1% |

Source: American Community Survey



Where to find skills? Geographical distribution of one particular 'big data skill': Hadoop



The size of each circle represents the number of technical workers with Hadoop skills in each region normalized by total IT labor force size for each region.

From: Prasanna Tambe (2014): Big data investment, skills and firm value, forthcoming in Management Science



Conclusions

1. As technology evolves, and with the spread of AI and robots, the scope of jobs that could potentially be displaced increases, including for more highly skilled (“intellectual”) types of jobs traditionally seen as unaffected
2. However, in recent years, no evidence of unusual job destruction rates as a result of technological improvements... yet
3. In the next 15-20 years we are more likely to experience too few workers than too few jobs, though changes in migration policy will also matter (and at the same time, technology might expand the scope for moving work across geographic locations)
4. STEM occupations are likely to grow faster than average
5. While STEM occupations will benefit from favorable demographics and immigration, there may be shortages in certain types of skills and task
6. Skills and tasks needs may change rapidly, while the burden for (re)skilling seems to shift to the worker





Evolving talent shortages in the US

- One day seminar on May 20th that will discuss:
 - The macro trends that are causing the evolving talent shortages
 - The specific occupations and industries in which talent shortages are especially likely to occur
 - How strategic workforce planning, recruiting, training, compensation, and reallocation of workers across geographies are likely to be impacted by the growing shortages
 - How human capital professionals could prepare themselves for the coming shortages
 - What human capital professionals that are already experiencing talent shortages are doing to reduce the damage
 - For more information and to register go to: <https://www.conference-board.org/conferences/conferencedetail.cfm?conferenceid=2681>

