GLOBAL DIGITAL TRANSFORMATION

LECTURE 5 – COMPUTING SPREAD

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OUTLINE

1. BOUNTY VERSUS SPREAD
2. INEQUALITY
3. MECHANICS OF INEQUALITY

OUTLINE

1. BOUNTY VERSUS SPREAD
   - CASE STUDY – DIGITAL PHOTOGRAPHY
   - DISTRIBUTION OF INCOME AND WEALTH
2. INEQUALITY
3. MECHANICS OF INEQUALITY

CASE STUDY: DIGITAL PHOTOGRAPHY

The earliest known surviving photo:

- taken by Joseph Nicéphore Niépce in 1826 or 1827
- View from an upstairs window at Niépce's estate, Le Gras, in the Burgundy region of France.

Source: https://www.hrc.utexas.edu/kiosk/firstphotograph/

CASE STUDY: DIGITAL PHOTOGRAPHY

Eastman Kodak Company:

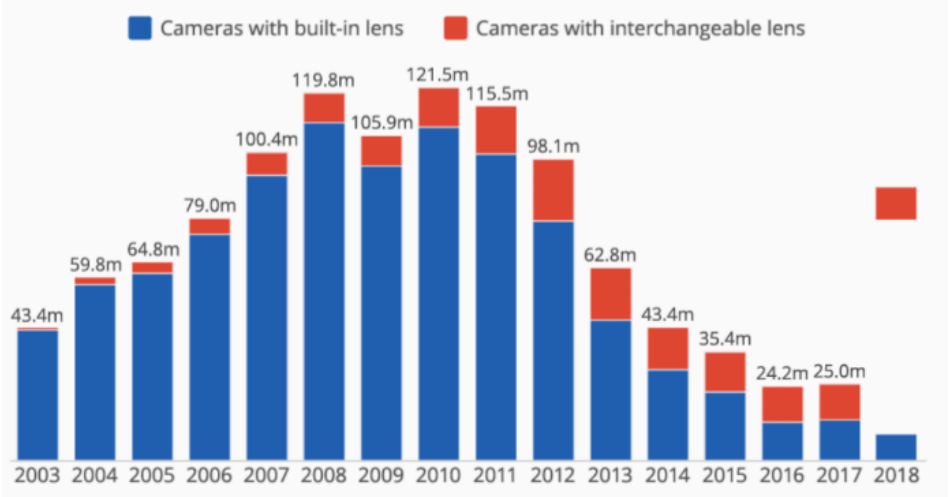
- created in 1880 in the city of Rochester, New York
- employed 145300 people at one point, indirectly thousands via more via supply chain and retail distribution channels required in the first machine age
- one third of employment in Rochester, providing middle-class jobs for generations and creating a substantial share of the wealth in the city
- made its founder George Eastman a billionaire
- Steven Sasson at Eastman Kodak invented the first digital camera in 1975
- filed for bankruptcy in 2012

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

CASE STUDY: DIGITAL PHOTOGRAPHY

Digital photography:

- From the peak of 121 mln digital cameras sold to 19 mln sold thanks to fast improving digital cameras built into smart phones
- More digital photos are taken every two minutes then in all of the 19th century.
- We record the people and events of our lives with unprecedented detail and frequency, and share them more widely than ever before.



Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016
Source: https://www.statista.com/chart/5782/digital-camera-shipments/

CASE STUDY: DIGITAL PHOTOGRAPHY

Digitalization of photography:

- Profound changes in the economics of photography production and distribution.
- A team of 15 people at Instagram created a simple app that over 130 million customers used to share 16 billion photos. Within 15 months of his funding, the company was sold for 1 billion to Facebook.
- Today, 350 million photos are uploaded to Facebook every day, and many times more are shared via other digital services like Flickr at nearly zero cost.
- At the time Kodak filed for bankruptcy, photography has never been more popular.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

CASE STUDY: DIGITAL PHOTOGRAPHY

Result:

- Hundreds of thousands of people who worked making photography chemicals and paper need to find some other ways to support themselves.
- Companies like Instagram or Facebook employ at tiny fraction of the people that were employed at Kodak.
- Nonetheless, Facebook has a market failure several times greater than Kodak and produced 7 billionaires worth 10 times greater than George Eastman did.
- The shift from analog to digital has delivered a bounty of digital photos but also contributed to an income distribution that is far more spread out than before.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

VIDEO – KODAK AND THE RISE OF DIGITAL PHOTOGRAPHY

Source: https://www.youtube.com/watch?v=i_SB_RTQUTc

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BOUNTY BEYOND DIGITAL PHOTOGRAPHY

Photography is not an isolated example of this shift.

Similar stories have been told in:

- music and media,
- finances and publishing, and
- retailing, distribution, services, and manufacturing.

In almost every industry, technological progress will bring unprecedented bounty.

More wealth will be created with less work.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

BOUNTY VERSUS SPREAD

Bounty and spread of the second Machine Age:

- Bounty – great consequence of the exponential, digital, combinatorial progress taking place with digital technology for individuals, society and economy.

- Spread – large and growing differences among people in income, wealth, and all the important circumstances of life, amplified by digital technology.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

DISTRIBUTION OF INCOME

In our current economic system, this progress will have enormous effect on the distribution of income and wealth:

- If the work a person produces in one hour can be produced by a machine for $1, then a profit-maximizing employer won't offer a wage for the job of more than $1.

- In a free market system, either that worker must accept a wage of $1 an hour or will have to find some new way to make a living.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

DISTRIBUTION OF WEALTH

Conversely:

- if a person finds new ways to leverage insights, talents, experience or skills across 1 million new customers using digital technologies,

- then she might earn 1 million times as much as would be possible otherwise.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

REALLOCATION OF WEALTH AND INCOME

Theory and data suggest that combination of bounty and spread is not a coincidence.

Digital advances are driving an unprecedented reallocation of wealth and income:

- digital technologies can replicate ideas, insights and innovations at very low costs
- this creates:
  - bounty for society and wealth for innovators, but
  - diminishes the demand for previously important types of labor, which can leave many people with reduced incomes.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

COMBINATION OF BOUNTY AND SPREAD

The combination of bounty and spread challenges two common worldviews:

1. Advances in technology always boost incomes.

2. Automation hurts workers wages as people are replaced by machines.

Both of these are partly true:

- rapid advances in digital tools are creating unprecedented wealth but

- there is no economic law that says that all workers, or even the majority of them, will benefit from these advances.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

VIDEO – 40 YEARS OF AUTOMATION

Source: https://www.youtube.com/watch?v=z-SftQPRk3k

QUESTIONS

1.	What was Kodak's role in digitization of photography?
2.	How did Kodak contribute to digitalization of photography?
3.	Who is better and who is worse off following digitalization of photography?
4.	What is the nature of spread created by the second machine age?
5.	How income and wealth distribute in the information economy?
6.	What are the opposite views on the impact of the second machine age on work?

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   - MEASURES
   - CAUSES
   - ECONOMY
   - WINNERS AND LOOSERS
3. MECHANICS OF INEQUALITY

WAGES VERSUS PRODUCTIVITY

For almost two hundred years, wages increased alongside productivity.

This created a sense of inevitability that technology helped almost everyone.

But more recently, median wages have stopped tracking productivity:

- decoupling is not only a theoretical possibility, but also
- empirical fact in our current economy.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

MEDIUM INCOME

The income of the person at the 50% percentile of the total distribution.

- The year 1999 was the peak year for the real, inflation-adjusted income of the median American household. It reached $54,932 that year.
- Then it started falling. By 2011, it had fallen by 10% to $50,054, even as the overall GDP hit a record high.
- In particular, wages of unskilled workers have trended downward.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

CONCENTRATION OF INCOME

- In 2012, for the first time since before the Great Depression, over 50% of the total income in the United States went to the top 10% of Americans.
- The top 1% earned over 22% of income, more than doubling its share since the early 1980s.
- The share of income going to the top hundreds of 1% of Americans, i.e. those with annual incomes over $11 million, is now at 5.5%.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

LIFE EXPECTANCY

Several other metrics have also been increasingly unequal.

For instance, while overall life expectancy continues to rise, the life expectancies for some groups have started to fall.

For instance:

- The average American white woman without a high-school diploma had a life expectancy of 73.5 years in 2008, compared to 78.5 years in 1990.
- Life expectancy for white men without a high school education fell by three years during the same period.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

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SOCIAL PROTESTS

It's no wonder that protests broke out Across America even as it was beginning to recover from the Great Recession:

- Tea Party Movement on the right emphasized government mismanagement
- Occupy Movement on the left emphasized abuses in the financial services sector.

Each movement channeled the anger of the millions of Americans who felt the economy was not working for them.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

TECHNOLOGICAL DISRUPTION

While both of these problems are important, the more fundamental challenge is structural, it is the result of the diffusion of the second Machine Age technologies.

- Consumers are better off and enormous wealth is created, but a relatively small group of people earns most of the income from the new products or services.
- The rest can be made worse off by advances in technology:
  - not just relative to the winners, but also
  - relative to their income when they were working with the older technologies.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

LIMITED INVESTMENT, UNLIMITED SCALE UP

The crucial reality from the standpoint of economics is:

- it takes only a relatively small number of designers and engineers to create a computer program like, e.g. 15 developers at Instagram in 2012

- when the program is digitized, it can be replicated and delivered to millions of users at almost zero cost, e.g. 130 mln users of Instagram in 2012

As software moves to the core of every industry, these type of production processes and this type of company increasingly populates the economy.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

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WEALTH DISTRIBUTION

- Between 1983 and 2009, Americans became vastly wealthy overall as the total value of their assets increased.
- However, the bottom 80% of the income distribution actually saw a decrease in their wealth. The top 20% got more than 100% of the increase:
  - trillions of dollars of wealth newly-created in the economy but also
  - additional wealth that was shifted in their direction from the bottom 80%.
- The distribution was also highly skewed even among relatively wealthy people:
  - The top 5% got 80% of the nation's wealth increase,
  - the top 1% got over half of that, and
  - so on for ever finer subdivision of the wealth distribution.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

INCOME DISTRIBUTION

Along with wealth, the income distribution has also shifted:

- the top 1% increased their income by 278% between 1979 and 2007
- compared to 35% increase for those in the middle of the income distribution.

Medium income increased little since 1979 and fallen since 1999:

- not because gross of overall income or productivity has stagnated – GDP and productivity have been on impressive trajectories
- the trend reflects a significant reallocation of who is capturing the benefits of this growth, and who isn't

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

AVERAGE VERSUS MEDIAN INCOME

Average versus median income:

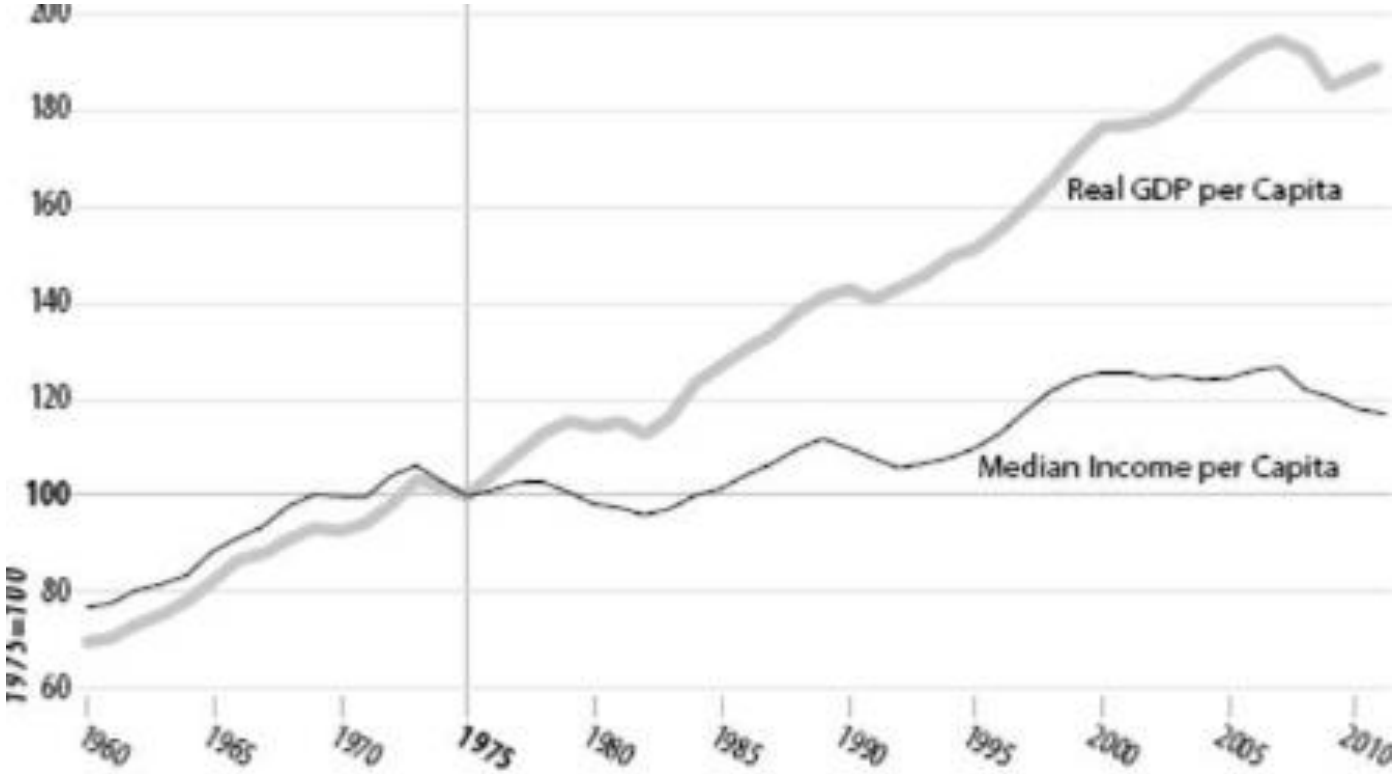
- Average income - total income divided by the total number of people
- Median income - income of the person exactly in the middle of the income distribution – half earning more and half earning less.

Normally, changes in the average income are not very different from the changes in the median income. However, in recent years the trends have diverged significantly.

The primary reason is increases in inequality.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

AVERAGE VERSUS MEDIAN INCOME



Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

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DRIVERS OF INEQUALITY

In the past couple of decades, we've seen changes in tax policy, overseas competition, ongoing government waste, and business dishonesty.

However, none of these primarily drives inequality:

- Western European countries experience income inequality growing more quickly over the past 20 to 30 years than the United States.
- Because they started with less inequality in their income distributions, they continue to be less unequal than United States.
- However, the trends are similar worldwide across different institutions, government policies, and cultures.

The main driver is exponential, digital, and combinatorial change in technology that underpins our economic system.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

WINNERS AND LOSERS

These changes have created three overlapping pairs of winners and losers:

1. Those who have accumulated significant quantities of nonhuman capital assets such as equipment, structures, intellectual property, or financial assets.

2. Those who have accumulated significant quantities of human capital assets such as training, education, experience, and skills.

3. Superstars who have special talents or luck.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

GAINS VERSUS LOSES

In each group, digital technologies tends to increase the economic payoff to winners while others become less essential, and thus well rewarded.

The overall gains to winners have been larger than the total losses for everyone else:

- productivity and total income have grown in the overall economy, but
- the gains, however large, have been concentrated among a relatively small group of winners, leaving the majority of people worse off than before.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

VIDEO – OBAMA ON WHY INCOME INEQUALITY HAS SKYROCKETED

Source: https://www.youtube.com/watch?v=iY05U7GaU5I

QUESTIONS

1.	How productivity and wages related for the last two hundred years?
2.	What has been the productivity-versus-wage relationship since 1999?
3.	What measures describe growing economic inequality in the society?
4.	Name three main causes of economic inequality.
5.	What is the main mechanism of technology contributing to economic inequality?
6.	What is the relationships between average and median income?
7.	What is the main cause for both measures of income to diverge?
8.	What are three pairs of winners and losers in the new information economy?

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TECHNOLOGY AS A MULTIPLIER

The basic economic model describing the impact of technology:

- Technology acts as a simple multiplayer on everything else, increasing the overall productivity evenly for everyone.
- The model provides a foundation for the intuition that technological progress will make all workers more productive and hence more valuable.
- With technology as a multiplayer, economies are able to produce more output with the same inputs, including labor.
- All labor is affected equally by technology, meaning that every hour worked produces more value than it used to.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

TECHNOLOGY AS A BIASED MULTIPLIER

A slightly more complex model allows technology that is not affecting all inputs equally, but is biased towards some and against others:

- Technologies like:
  - payroll processing software,
  - factory automation,
  - computer-controlled machines,
  - automated inventory control, and
  - word processing

  have been deployed for routine work, substituting for workers in clerical tasks, on the factory floor, and doing information processing.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

TECHNOLOGY AS A BIASED MULTIPLIER

- Technologies like:
  - big data and analytics,
  - high-speed communications,
  - rapid prototyping, etc.

  augmented the contributions made by abstract and data-driven reasoning, increasing the value of people with the engineering, creative, or design skills.

The net effect has been to decrease demand for less skilled labor while increasing the demand for skilled labor.

Skill-based technical change favors people with more human capital.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

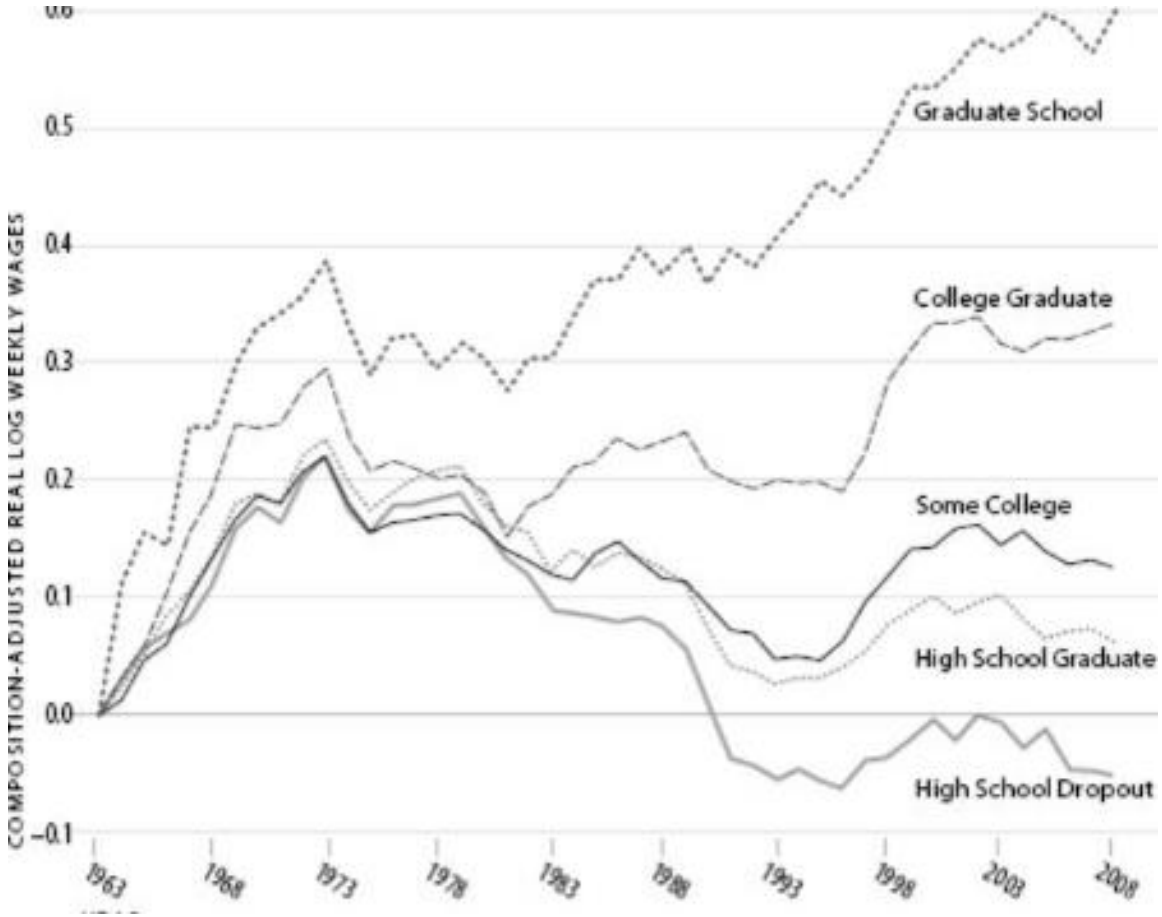
SKILL-BASED TECHNICAL CHANGE

Diverging paths of millions of workers over recent generations:

- Before 1973, American workers all enjoyed brisk wage growth. Rising productivity increased everyone's incomes, regardless of the educational levels.
- Massive oil shock and recession of the 1970s reversed the gains for all groups.
- After that, we began to see a growing spread of incomes:
  - By early 1980s, those with college degrees, particularly graduate degrees, started to see their wages growing.
  - Workers without college degrees where confronted with less attractive labor market, their wages stagnating for even falling for high school dropouts.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

SKILL-BASED TECHNICAL CHANGE



Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

SUPPLY AND DEMAND FOR EDUCATED LABOR

The number of college graduates grew very rapidly during this period, doubling between 1960 and 1980 from 758000 to 1589000.

A large increase in the supply of labor graduating from colleges and universities did not push down the relative wages.

The combination of higher pay despite growing supply mean that the relative demand for skilled labor increased even faster than supply.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

SUPPLY AND DEMAND FOR UNEDUCATED LABOR

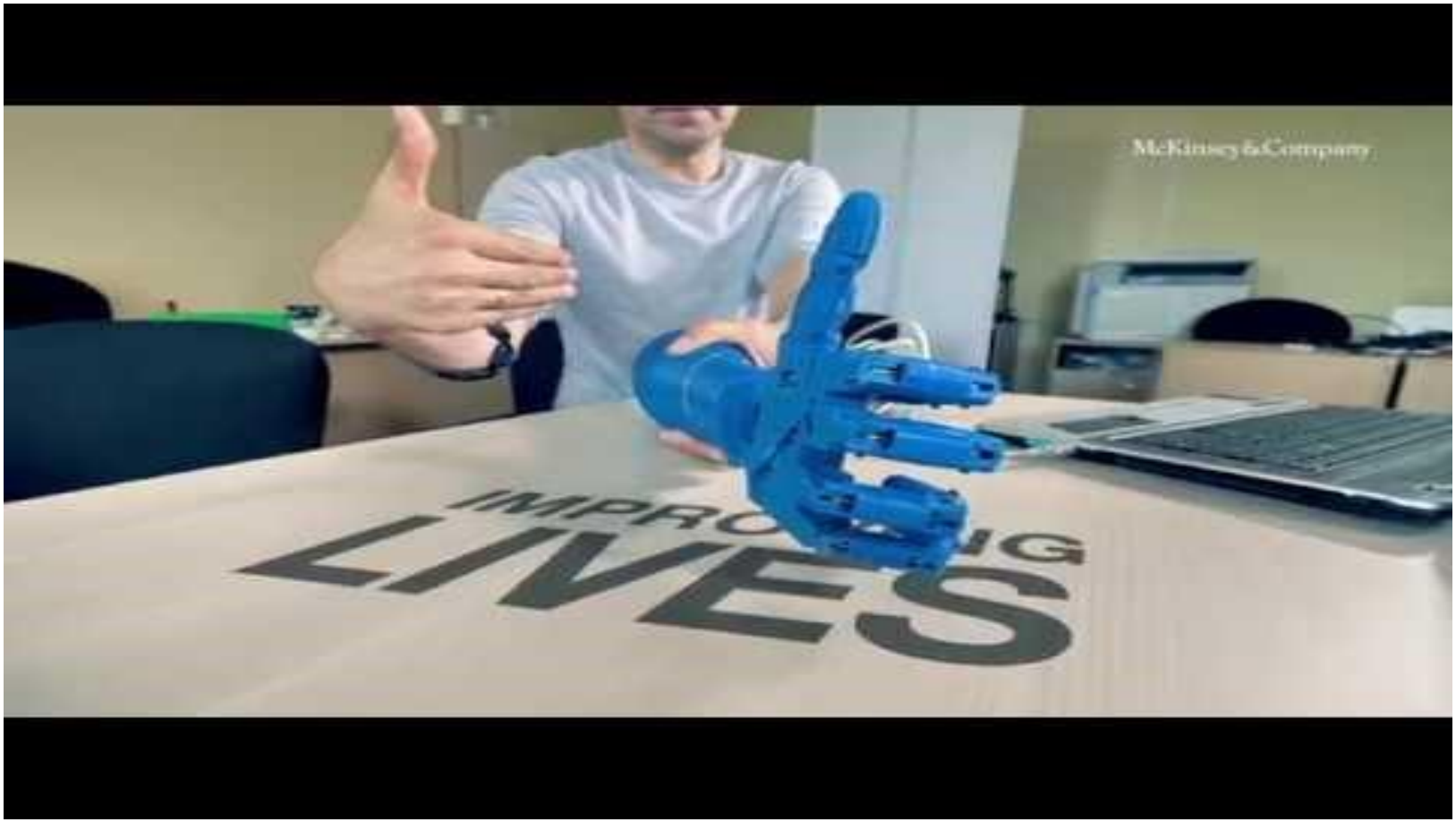
At the same time, the demand for tasks that could be completed by high school dropouts fell rapidly, even though their ranks were thinning.

The lack of demand for unskilled workers meant ever-lower wages for those who continued to compete for low-skill jobs.

Because most people with the least education already had the lowest wages, this change further increased the overall income inequality.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

VIDEO – AUTOMATION AND THE NEW WORLD OF WORK



Source: https://www.youtube.com/watch?v=3uueWd_WgOE

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WHICH TASKS GET AUTOMATED

Looking at the jobs eliminated as companies reorganize, the term skill-based technical change can be a bit misleading.

In particular, it would be a mistake to assume that all “college-level tasks” are hard to automate while the “kindergarten tasks” are easy to automate.

Low-skill tasks haven't always been the ones being automated, more often it has been the tasks which machines can do better than humans:

- repetitive assembly line tasks are easier to automate then the work of a janitor – machines are currently not very good at picking paper from the floor
- routine clerical work is easier to automate than handling customers questions – machines are not good at reading emotional cues of a frustrated customer.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

ROUTINE VERSUS NON-ROUTINE JOBS

To capture these distinctions, work can be divided into a 2x2 matrix

- cognitive versus manual
- routine versus non-routine

The demand for work has been falling dramatically for routine tasks, regardless of whether they are cognitive or manual.

These leads to job polarization:

- collapse in demand for middle-income routine jobs
- holding up of non-routine cognitive jobs such as financial analyst and non-routine manual jobs like hairdressing

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

JOB POLARIZATION AND JOBLESS RECOVERY

- For most of the 19th and 20th centuries, employment rebounded strongly after each recession.
- Since 1990s, however, employment didn't recover. As the computerization of the economy advanced, post-recession hiring patterns changed.
- Comparing 1980s, 1990s and 2000s, the demand for:
  - routine cognitive tasks - cashiers, mail clerks, and bank tellers and
  - routine manual tasks - machine operators, cement masons and dressmakers

  was falling at an accelerated rate: by 5.6% between 1981 and 1991, by 6.6% between 1991 and 2001, and by 11% between 2001 and 2011.
- In contrast, non-routine cognitive tasks and manual work grew in all three periods.

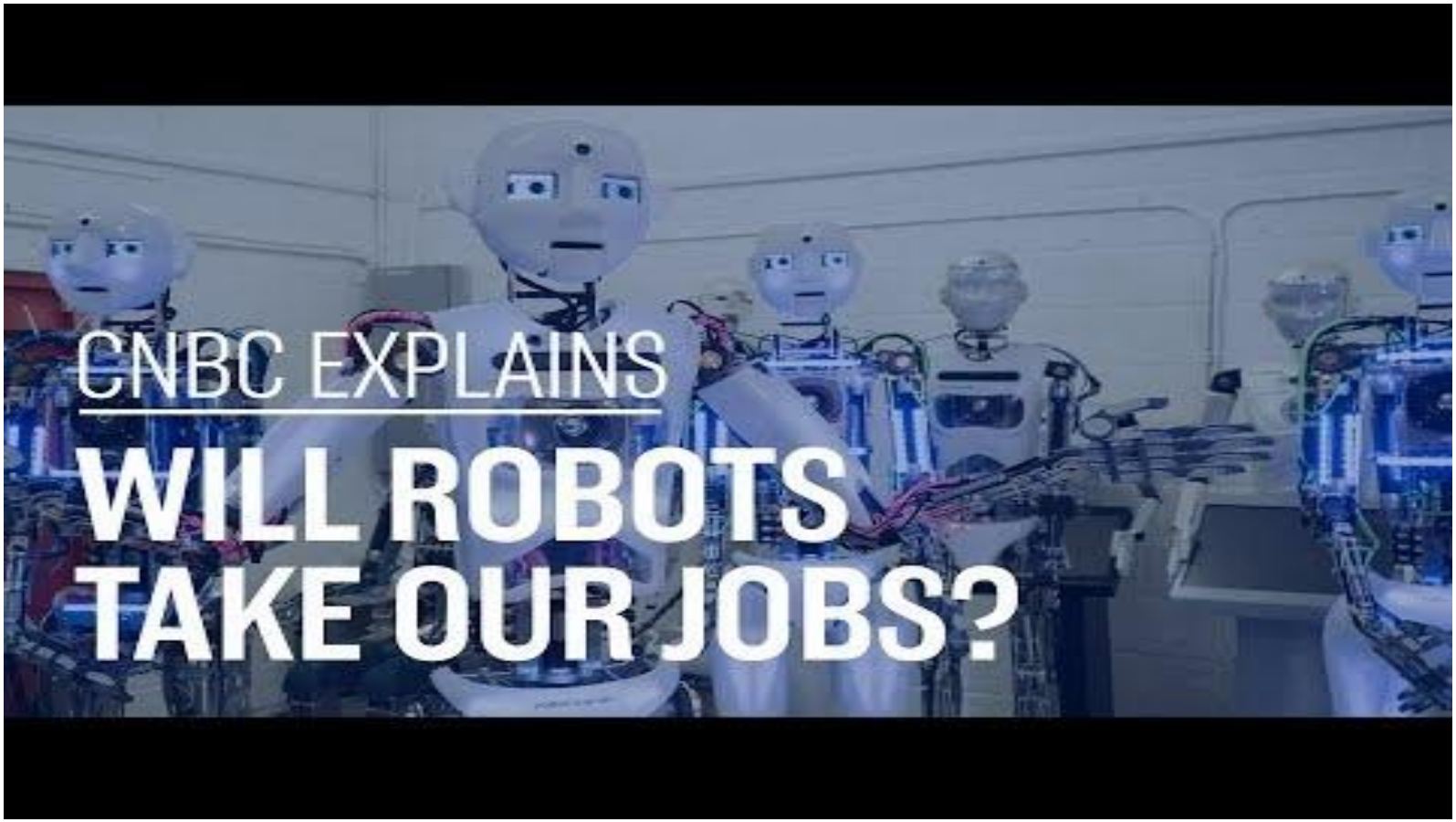
Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

RECESSION AND POST-RECESSION PERSONNEL DECISIONS

- Many executives realize that advances in information technology may rendered many routine information processing jobs superfluous.
- At the same time, when profits and revenues are on the rise, it can be hard to eliminate jobs.
- When the recession comes, business-as-usual is not sustainable, making it easier to implement painful streamlining and layoffs.
- However, as the recession ends and the profits and demand return, the jobs doing routine work are not being restored.
- In the end, executives found that their organizations could use technology to operate and scale-up business without these workers.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

VIDEO – WILL ROBOTS TAKE OUR JOBS?



Source: https://www.youtube.com/watch?v=a-7Azih0D98

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REORGANIZATION OF BUSINESS CULTURE

A one-for-one substitution of machines for people sometimes happens.

However, the reorganization in business culture may have been an even more important path for skill-based change.

Companies use digital technologies to reorganize:

- decision-making,
- incentives systems,
- information flows,
- hiring systems, and
- other organizational processes.

The co-invention of organization and technology not only increases productivity but also requires more educated workers and reduces demand for less skilled workers.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

REORGANIZATION OF BUSINESS CULTURE

Reorganization of production affects those who work directly with computers as well as those who, at first, seemed to be far from technology:

- A fashion designer might find herself in demand at a company with flexible equipment in distant factories, able to quickly adapt to the latest fashions.
- An airport ticket agent might find himself replaced by an internet website he never he never knew existed, let alone worked with.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

COMPLEMENTARY INVESTMENTS

1$ of computer capital is often the catalyst for more than $10 of complementary investment in organizational capital or investments in:

- training,
- hiring, and
- business process redesign.

Reorganization eliminates a lot of routine work, such as repetitive order entry, leaving behind residual tasks that require more judgment, skills, and training.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

TECHNOLOGY-INTENSIVE COMPANIES

Companies with the biggest technology investments typically:

- make the biggest organizational changes
- have the biggest demand increase for skilled work relative to unskilled work
- wait 5 to 7 years before seeing the full performance benefits
- the lag reflects the time that it takes for managers and workers to figure out new ways to use the technology

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

CO-INVENTION VERSUS AUTOMATION

The best way to use new technologies is not to make a literal substitution of a machine for a human worker, but to restructure the process.

Businesses are rarely able to get performance gains from digital technology without rethinking how they can be redesigned to take advantage of such technologies.

Creativity and organizational redesign are key to investments in digital technologies.

Still:

- some workers (usually the less skilled ones) are eliminated from the process
- others (usually those with more education and training) are augmented.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

CO-INVENTION VERSUS AUTOMATION

Compared to simply automating existing tasks, organizational co-invention:

- requires more creativity on the part of entrepreneurs, managers, and workers,
- and for that reason tends to take time to implement the changes after the initial invention and introduction of new technologies.

But once the changes are in place, they generate most productivity improvements.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

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TWO CLASSICAL INPUTS TO PRODUCTION

Technology is:

- not only creating winners and losers among those with different amounts of human capital,
- it is also changing the way national income is divided between:
  - the owners of physical capital, e.g. factory owners
  - labor, i.e. workers

  as two classical inputs to production.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

SUBSTITUTING CAPITAL FOR LABOR

Substituting capital for labor:

- Foxconn purchasing 30,000 robots to work in the company's factories in China.
- An automated voice response system is used to take over some of the functions of the human call center operators.

Managers are constantly making such decisions:

- weighting the relative costs of each type of input, as well as
- the effects on the quality, reliability and variety of output that can be produced.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

SUBSTITUTING CAPITAL FOR LABOR

The Baxter robot works for the equivalent of about $4 per hour.

To the extent that the factory owner previously employed human to do the same task that Baxter could do, the economic incentive would be to:

- substitute capital (Baxter) for labor
- as long as the human was paid more than $4 per hour.

If output stays the same, and no new hires are made in engineering, management or sales, this would increase the ratio of the capital-to-labor input.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

COMPENSATION OF THE REMAINING WORKERS

The compensation could go up or down:

- If their work is a close substitute for the machines, then there will be downward pressure on human wages.
- That could grow worse if future versions of machines could work for $2 per hour, $1 per hour, etc. while handing tasks of larger variety and complexity.
- The remaining workers could also see an increase in pay, particularly if their work complements the technology, and demand for their services increases.
- In addition, as technical advances increase labor productivity, employers can afford to offer higher wages and benefits, or lower product and service costs.

As productivity improves, output per person would increase, the amount earned by human workers would raise or fall, with the remainder going to the capital owners.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

RELATIVE SHARE OF CAPITAL AND LABOR – HISTORICALLY

Until recently, despite changes in the technology of production, the share of GDP going into labor has been surprisingly stable.

As a result, wages and living standards have grown dramatically, in line with a dramatic increases in productivity.

As a result, labor compensation has grown along with payments to owners of physical capital via profits, dividends, and capital gains.

This is partly reflected in the increase in human capital that have paralleled visible increases in equipment and buildings in the economy.

The overall magnitude of the human capital in the US economy, as measured by its economic value, is as much as 10 times the value of the physical capital.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

RELATIVE SHARE OF CAPITAL AND LABOR – CURRENTLY

In the past decade, the relatively consistent division between the share of income going into labor versus physical capital seems to be coming to an end:

- Labor share of the GDP averaged 64.3% between 1947 to 2000.
- It fell subsequently, in 2010 to 57.8%.

This is a global phenomenon, a significant decline happening since the early 1980s within the large majority of countries and industries.

The decline is due to the technologies of the information age.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

RELATIVE SHARE OF CAPITAL AND LABOR OVER TIME

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

CAUSES OF THE FALL IN THE RELATIVE SHARE OF LABOR

The fall in labor's share is partly the consequence of two trends:

- fewer people are working, and
- wages for those who are working are lower than before.

As a result, while in the past labor compensation and productivity rose in tandem, in recently years and growing gap has opened.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

CAPTURE OF PRODUCTIVITY INCREASES

If productivity is growing and labor isn't capturing this value, who is?

Owners of physical capital, to a large extent.

Profits are reaching historic highs:

- both in absolute terms - $1.6 trillion in 2010 and
- as a share of GDP – 26.2% in 2010 from 20.5% between 1960 and 2007.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

FURTHER DETERIORATION OF TYPICAL WAGES

The share of GDP going into typical worker wages is further suppressed due to:

- soaring wages of a small number of superstars in media, finance, sports and corporate positions

It is also debatable whether all compensation going to CEOs and other top executives is really labor income.

It may reflect the CEO's bargaining power, partly due to control of capital, not labor

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

THREATS TO CAPITAL SHARE

While the share of national income to capital has been growing at the expense of labor, this need not continue, even if machines take over more human work.

The threats to capital shares comes from:

- the bargaining power of various types of human labor, CEOs, unions, etc. and
- other capital.

The biggest premiums go to the scariest inputs needed for production.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

THREATS TO CAPITAL SHARE

The rewards earned by capital owners may not automatically grow relative to labor:

- In the world where capital can be replicated at a relatively low cost (e.g. software), the marginal value of capital which will tend to fall, even if more is used overall.
- The value of existing capital would be driven down as new cheap capital is added.
- Capital shares will depend on the exact details of the production, distribution, and governance systems.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

THE SCARCEST RESOURCE

Most of all, the payoff will depend on which inputs to production are scariest.

- If digital technologies create cheap substitutes for labor, then it is not a good time to be a laborer.

- If digital technologies can also increasingly substitute for capital, then capital owners shouldn't expect high returns either.

What is the scariest, the most valuable, resourcing in the second machine age?

Superstars versus everyone else.

Source: E. Brynjolfsson and A. McAfee, The Second Machine Age, 2016

VIDEO – JACK MA CAREER ADVICE

Source: https://www.youtube.com/watch?v=MwixREUJOI0

QUESTIONS

1.	How technological impact is created with technology as a (biased) multiplier?
2.	What skill-based technical change is all about?
3.	Describe trends in supply and demand of educated versus uneducated labor.
4.	What kinds of tasks get automated in the new information economy?
5.	What trends are observed in post-recession hiring decisions?
6.	What are complementary organizational investments to investments in technology?
7.	What is the difference between organizational co-invention and automation?
8.	Describe trends in income distribution between capital owners and workers.
9.	What are the causes for diverging shares of capital and labor?
10.	What are the main threats to gains by capital owners?

THANK YOU FOR YOUR ATTENTION

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