HOW DO *YOU* SEE THE *FUTURE* OF AI ?

- Science Fiction has explored many issues associated with AI

RISE OF ARTIFICIAL INTELLIGENCE

CAN WE (ECONOMISTS) SAY MORE THAN SCIENCE FICTION?

PABLO WINANT

WHAT IS AI?

WHAT IS AI

- AI can be:
  - a field
  - a set of technologies including
    - machine learning
    - deep learning
    - reinforcement learning
  - a philosophical concept
- Usual definition of AI:
  - mimic human intelligence:
    - *problem solving*: achieve goal without being explicitly told how
    - *learning*: gets better over time
  - without emotions

HOW TO MAKE THE DIFFERENCE BETWEEN A ROBOT AND A ?

- Check whether it thinks like a human being
- Turing test:
  - a machine discussing with a human must be recognized as a 7 years old human 50% of the time
  - can machines emulate human behaviour?
- Chinese Room thought experiment:
  - how to differentiate somebody who speaks chinese and somebody who follows rules to speak?
  - turing test cannot determine whether machines think
- What do you think of these tests?

IMPRESS ME?

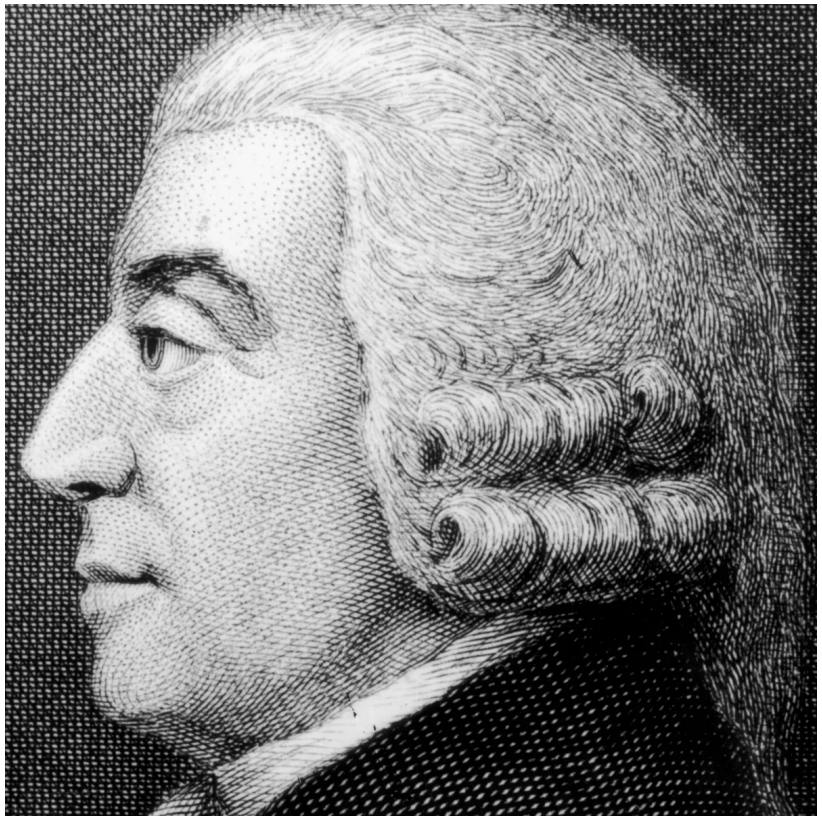
- So, what can machines do that is really intelligent?
  - speech recognition, language translation
  - drive a car
  - play chess better than a human
  - play go, better than a humman, without being a specialist, by learning on its own
  - create, imagine
  - have empathy
  - talk

AI EFFECT

- people have a way to discount achievments of AI as "not AI"
  - because not impressive enough
  - because humans do it in "a different way"
- Larry Tesler theorem: "AI is whatever hasn't been done yet"
- Nick Bostrom: "once something becomes useful enough and common enough it's not labeled AI anymore"
- keep human special
  - interestingly that didn't seem to be a concern before the 70s

THE CLASSICAL VIEW

"THIS TIME IT'S DIFFERENT" OR "SAME OLD, SAME OLD..."?

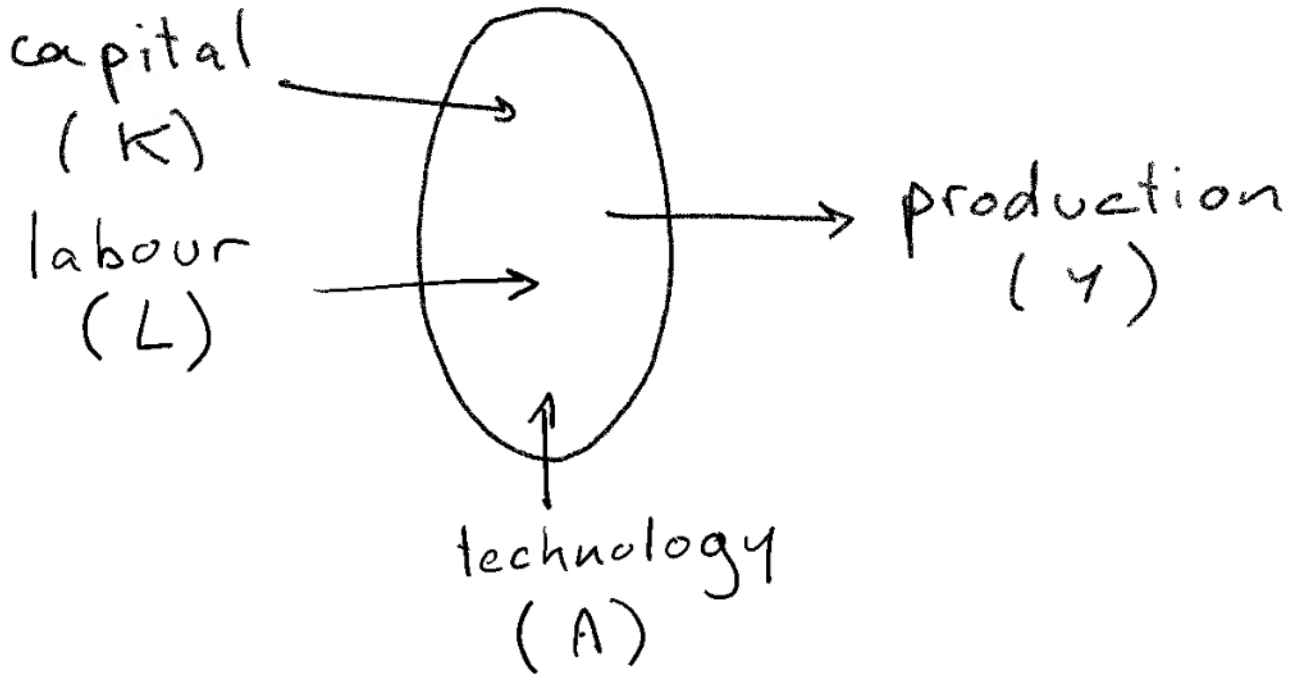


THE (NEO)CLASSICAL PRODUCTION FUNCTION

What are its main properties?

- production takes several **factors** as inputs
  - capital
  - labour
  - ... (natural resources, land, ...)
- each factor has a **market price**
- marginal returns w.r.t. each factor are **decreasing**
- factors are paid according to their **marginal productivity**
- the **technology** is the particular process through which inputs are combined

AI AND THE (NEO)CLASSICAL PRODUCTION FUNCTION

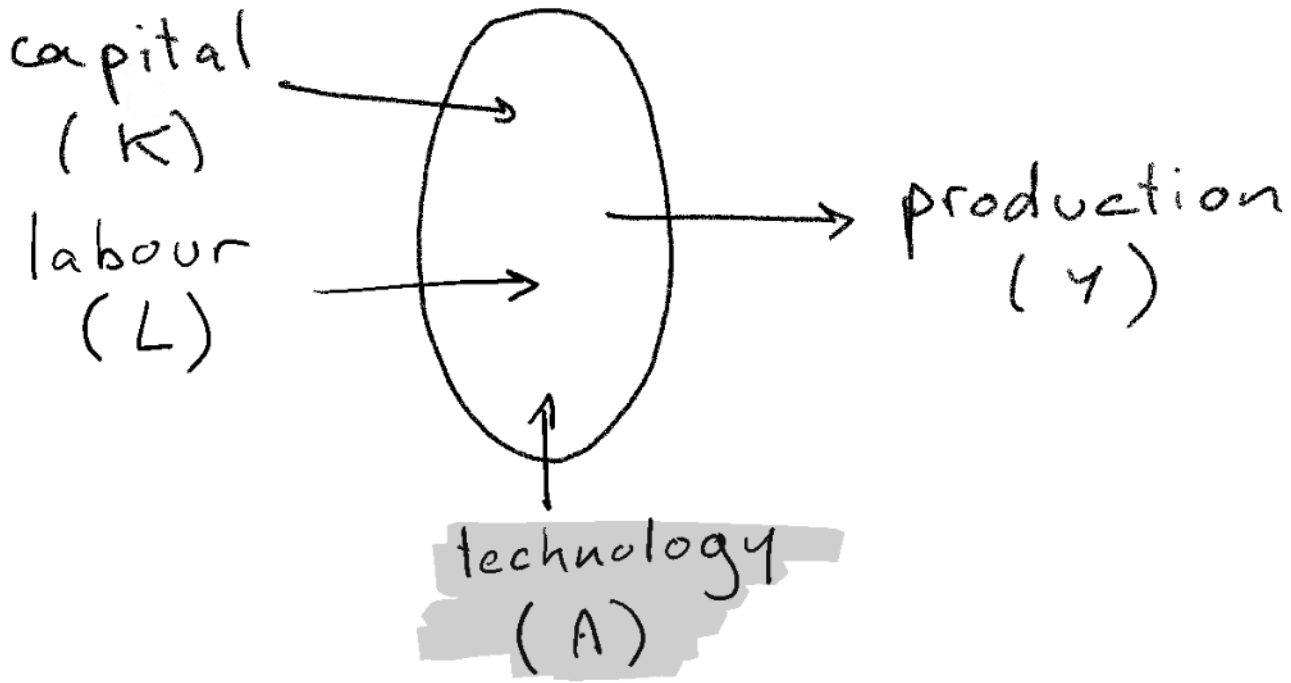


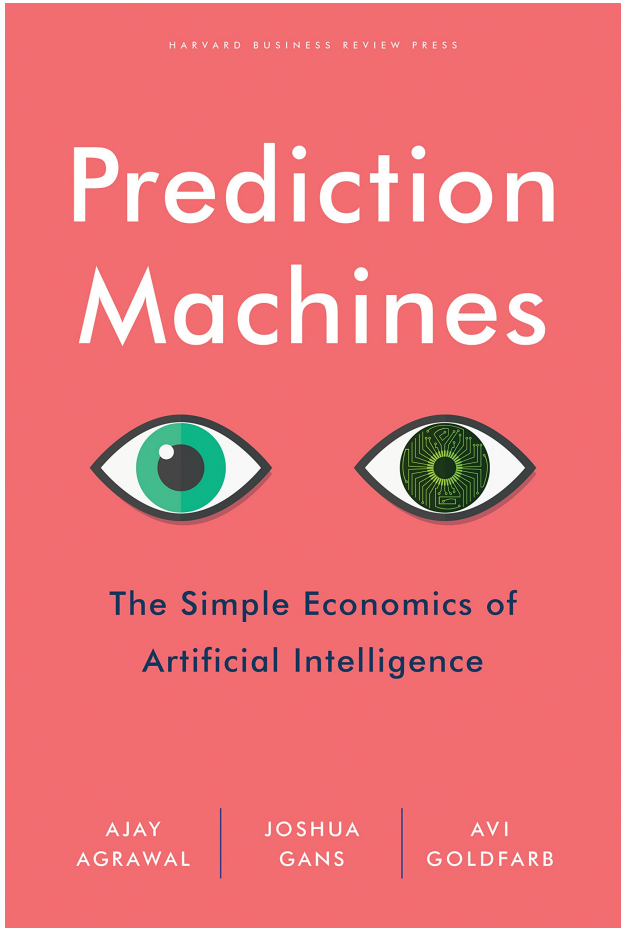
- the precise description depends on the problem under consideration
- what could you change to take into account the effect of AI?
  - data, technological change ?

THREE HYPOTHESES ABOUT THE ECONOMIC NATURE OF AI

- A technological change
- A new kind of factor: Data
- Yet another kind of factor: Robots
- Something else Completely

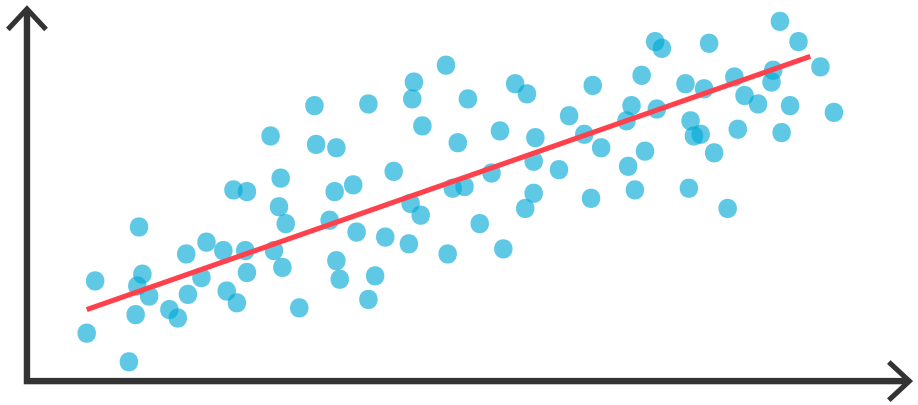
AI IS A CHANGE IN THE COST STRUCTURE





Ajy Agrawal, Joshua Gans and Avi Goldfarb: *Prediction Machines: The Simple Economics of Artificial Intelligence*
2018

PREDICTION MACHINES

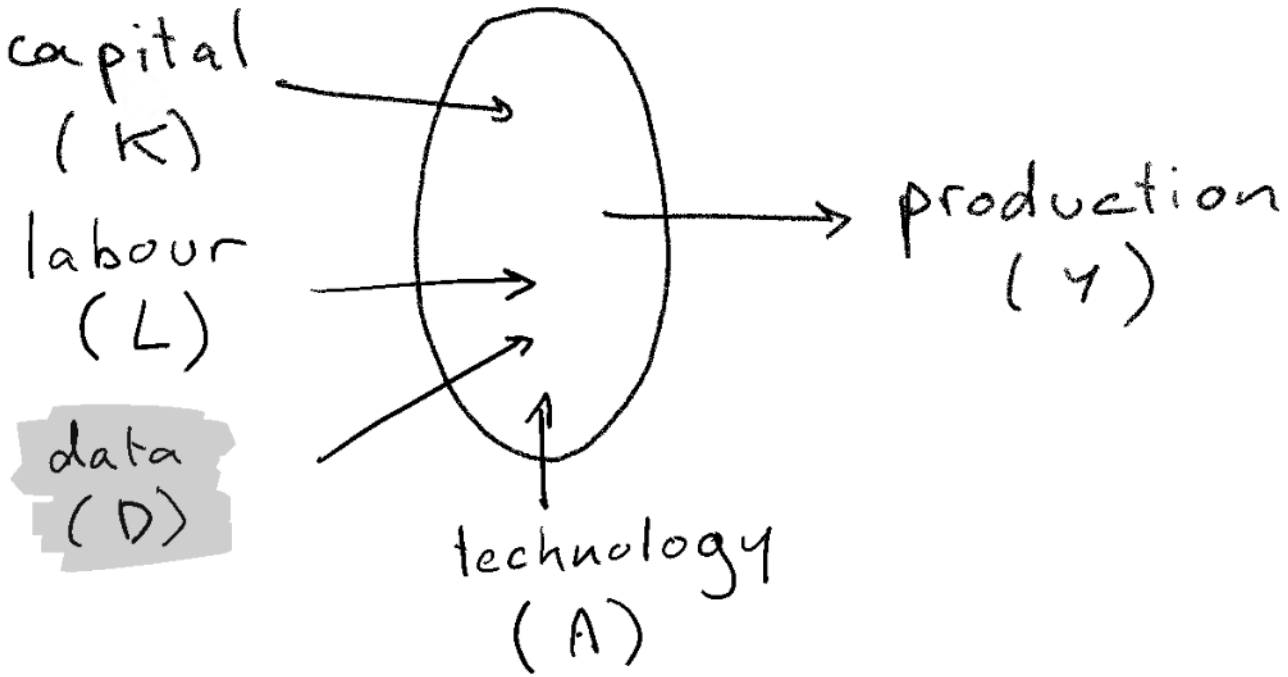


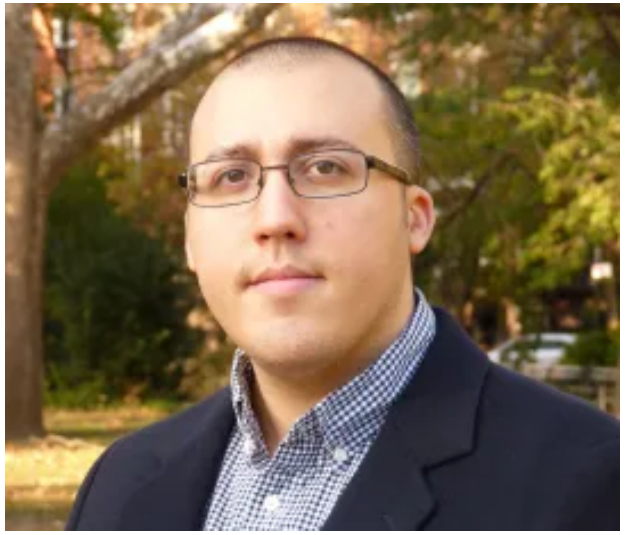
- many production tasks can be formulated as **prediction problems**

WILL I LOOSE MY JOB ?

- AI is a decrease in the **cost** of predictions
- The demand for all prediction-intensive tasks will rise (**law of demand**)
- The salary of workers with prediction-intensive tasks will rise (**market price**)
- Value of other tasks will fall (**general equilibrium effect**)
- More precisely:
  - demand for tasks that are **substitute** to predictions will be low
  - demand for tasks that are **complement** to predictions will be high

AI IS DATA





Chad Jones and Christopher Tonetti (Stanford) *Nonrivalry and the Economics of Data* (Sep 2020, American Economic Review)

DATA IS A FACTOR NOT A TECHNOLOGY

- Data is a **factor**, not a **technology**
  - Can you explain it ?
- The difference between an idea and a factor? Exemples:
  - idea: use machine learning to build self driving cars
  - factor: each car-maker gathering his own data to train cars
- Data (even anonymous) improves quality of existing products

WHAT KIND OF GOOD IS DATA ?

- Remember the **classification of goods**?
  - **nonrival**: can be used with leftovers
  - **excludable**: use can be limited to paying customers
  - data is a: **club good**
- Nonrivality implies **increasing returns to scale**
  - marginal value of new data increases more than proportionnally

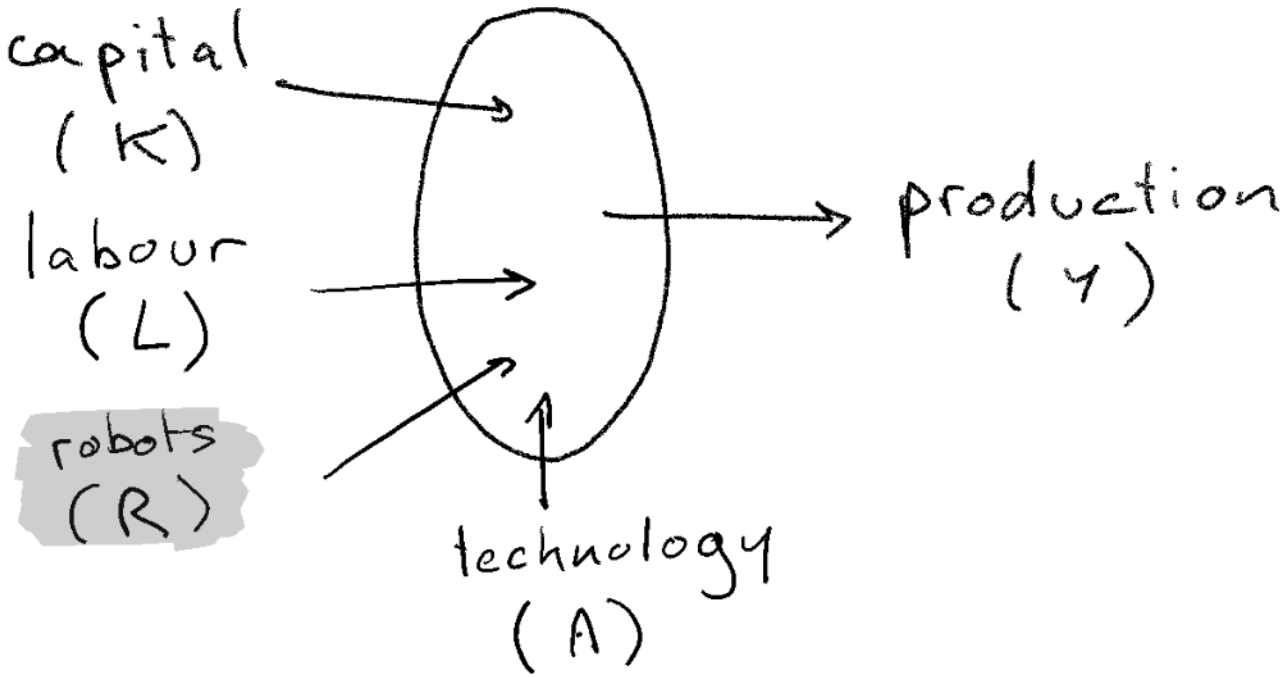
AI: ADDS DATA TO THE PRODUCTION FUNCTION (CONSEQUENCES)

- increasing returns to scale implies **natural monopoly**
  - ->GAFAMs
  - increasing suboptimal **monopoly rents** (already a problem before existence of AI...)
  - should you regulate a monopoly?
    - it depends what is the barrier to entry: data-gathering or data-processing
- other relevant questions
  - where are the markets? (empirically it seems "undertraded")
  - who owns the data ? Consumer, producer.

HOW DO YOU REGULATE A DATA-MONOPOLY ?

- solutions:
  - split the monopolies (if deadweight loss is too big)
  - outlaw data gathering (big productivity loss)
  - force data-sharing: make it a public good
  - let the consumer be free to decide whether to rent his data (remove externalitiess)

AI: COMPETITION BETWEEN HUMANS AND ROBOTS



ECONOMIC SINGULARITY

- In the very long run, could technology be **bad**?
- Recall the neoclassical world
  - market economy
  - technological progress reduces production cost
  - always good for consumers. Increase (real) total income.
  - becomes an inequality problem
- But
  - whether technology reduces salaries depends on whether growth is **labour augmenting** or **capital augmenting**
  - if AI is a close enough substitute, salaries of "humans" as a whole are at risk
  - the is an economic *singularity* when salary of humans arrives below the **subsistance level**



- Two sets of authors reach very similar conclusions

SOME VERY LONG RUN SCENARIOS

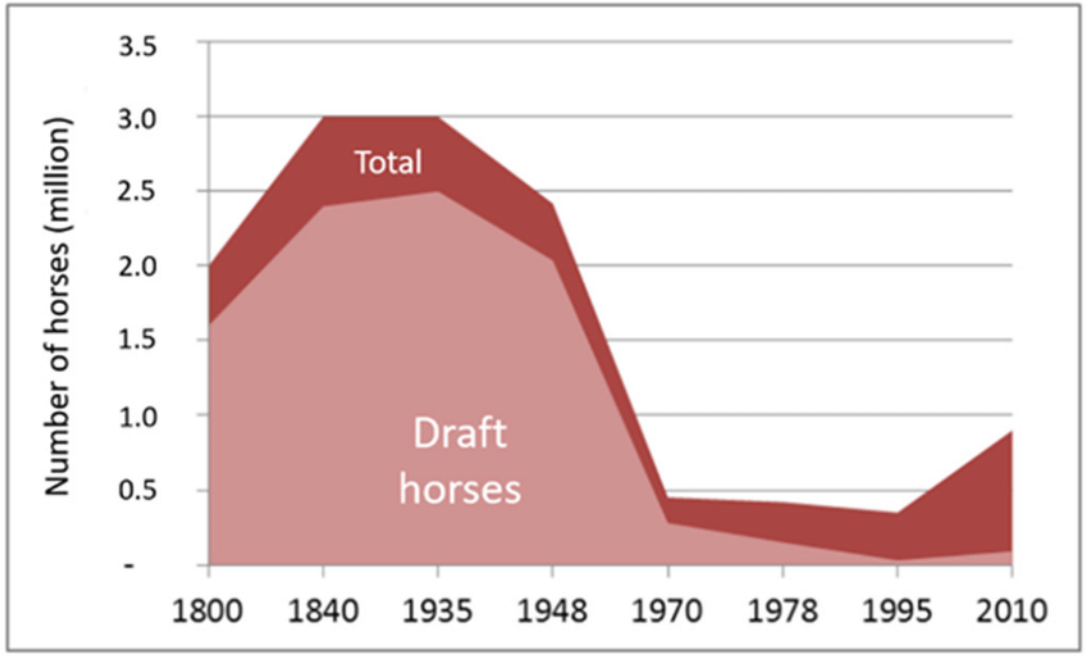
- Analysis taken from Gilles Saint Paul
- *Main hypothesis*: all humans can be replaced by more productive robots
- **Comparative advantage** logic:
  - humans specialize in work where their comparative disadvantage is lowest (services, art, crafting...)

SCENARIO 1: SOCIETY REDISTRIBUTES INCOME FROM ROBOTS

Four political subscenarios

- welfare state
  - robot-owners are taxed, income is redistributed
  - for instance as universal income
  - some productivity losses
  - what about international competitivity?
- rentiers society
  - robot owners invest the rent over many generations
  - capital concentration increases
- neo fordism
  - Firms pay huge salaries for essentially useless jobs (powerpoint presentations, 😉 ...)
  - Useful to sustain demand
- new roman empire
  - robot owners: *patricians* (top 2%)
  - rest of population: *plebeians*
    - survive thanks to clientelism
  - robots: slaves

SCENARIO 2: WARS, STARVATION, EPIDEMIC



- human income (marginal productivity) falls below subsistance levels

SCENARIO 3: THE MATRIX

- human wage decrease

SOMETHING ELSE COMPLETELY?

- Right now AI is a technology (or a factor)
- What if it becomes another intelligent agent?
  - has its own goals
  - its own preferences
  - with superhuman thinking abilities...
- Response in the literature (if curious):
  - Anton Korinek: *if* market economy survives
    - malthusian and non-malthusian scenarios
  - At that stage humans might be something different completely
    - transhumanism

CONCLUSION

- Research on AI is very speculative: especially about the long run
- But concepts from classical economics still help
- For next time:
  - make sure you understand all concepts in bold

MORE READINGS

- Chad Jones and Christopher Tonetti: *Nonrivalry and the Economics of Data*, American Economic Review
- Avi GoldFarb: *Prediction Machines: The Simple Economics of Artificial Intelligence* 2018
- Gilles Saint Paul: *Robots Vers la fin du travail ?*
- Anton Korinek, Joseph E. Stiglitz: *Artificial Intelligence and Its Implications for Income Distribution and Unemployment*, chapter in *Artificial Intelligence and Its Implications ..., NBER*
  - also on coursera