The rise of robots and structural economic change

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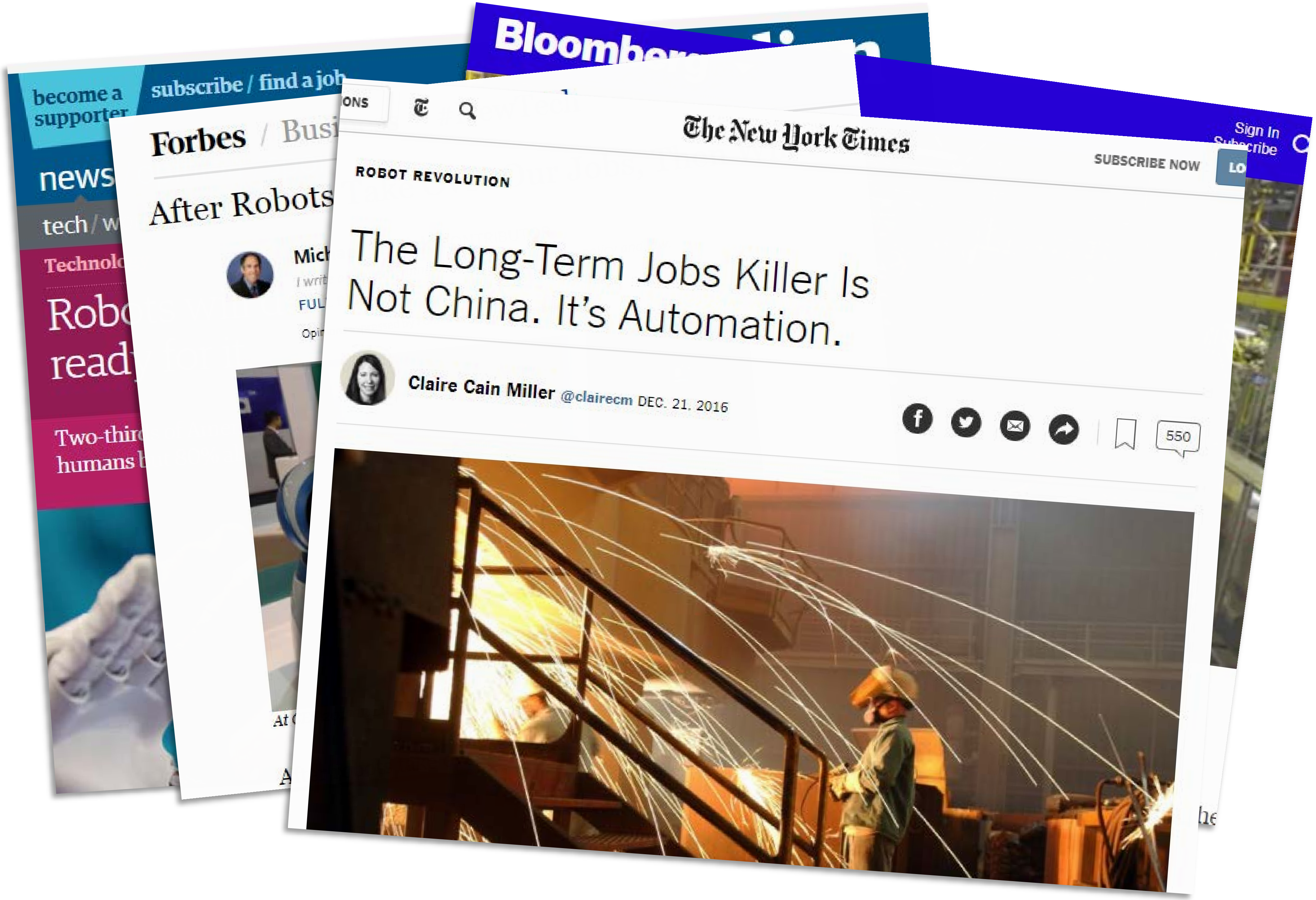
RoboPhilosophy 2018


Mentimeter

From fear-mongering speculation on the future of employment to historical trends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The Long-Term Jobs Killer Is Not China. It's Automation.
Claire Cain Miller @clairecm DEC. 21, 2016
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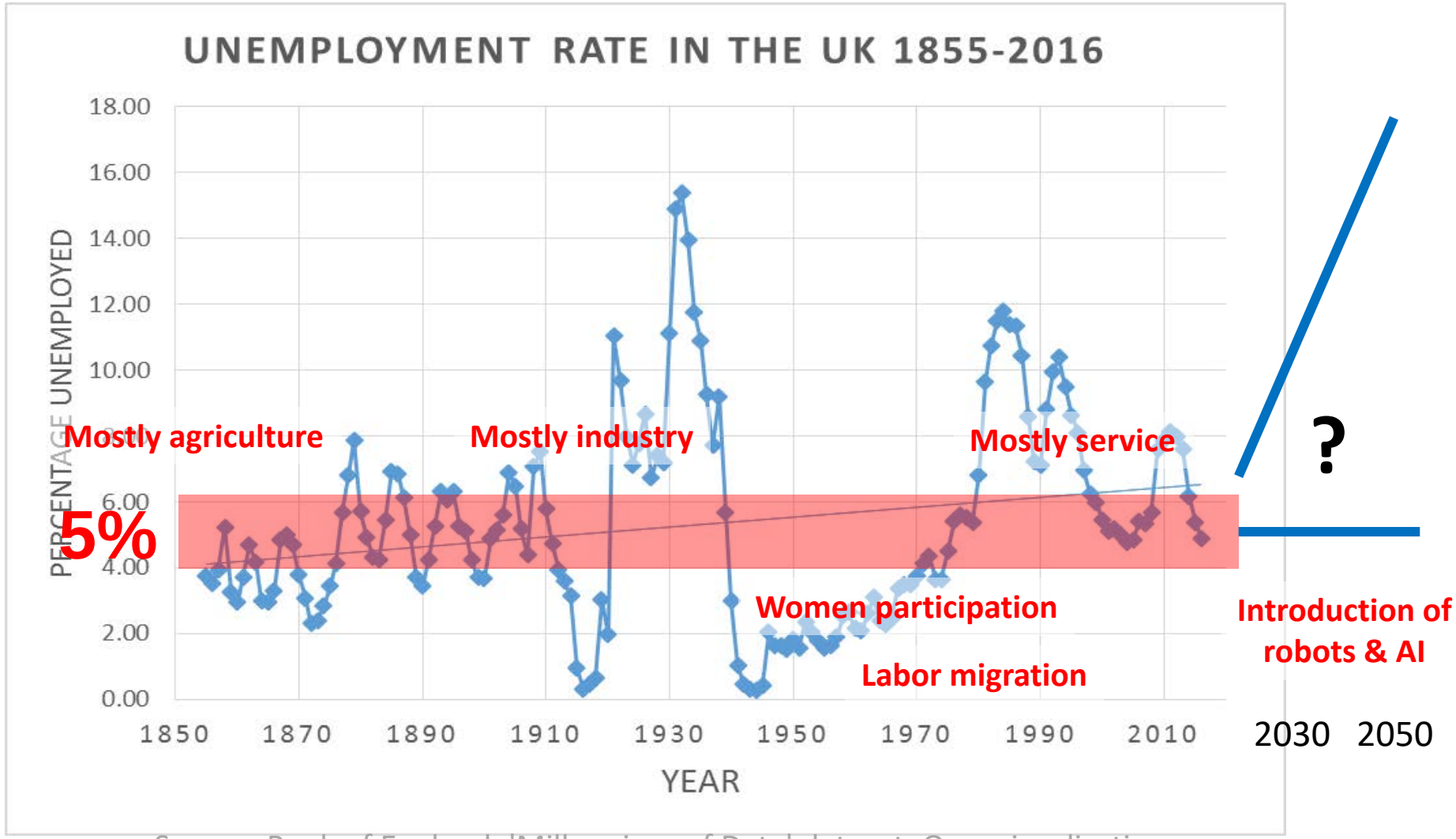
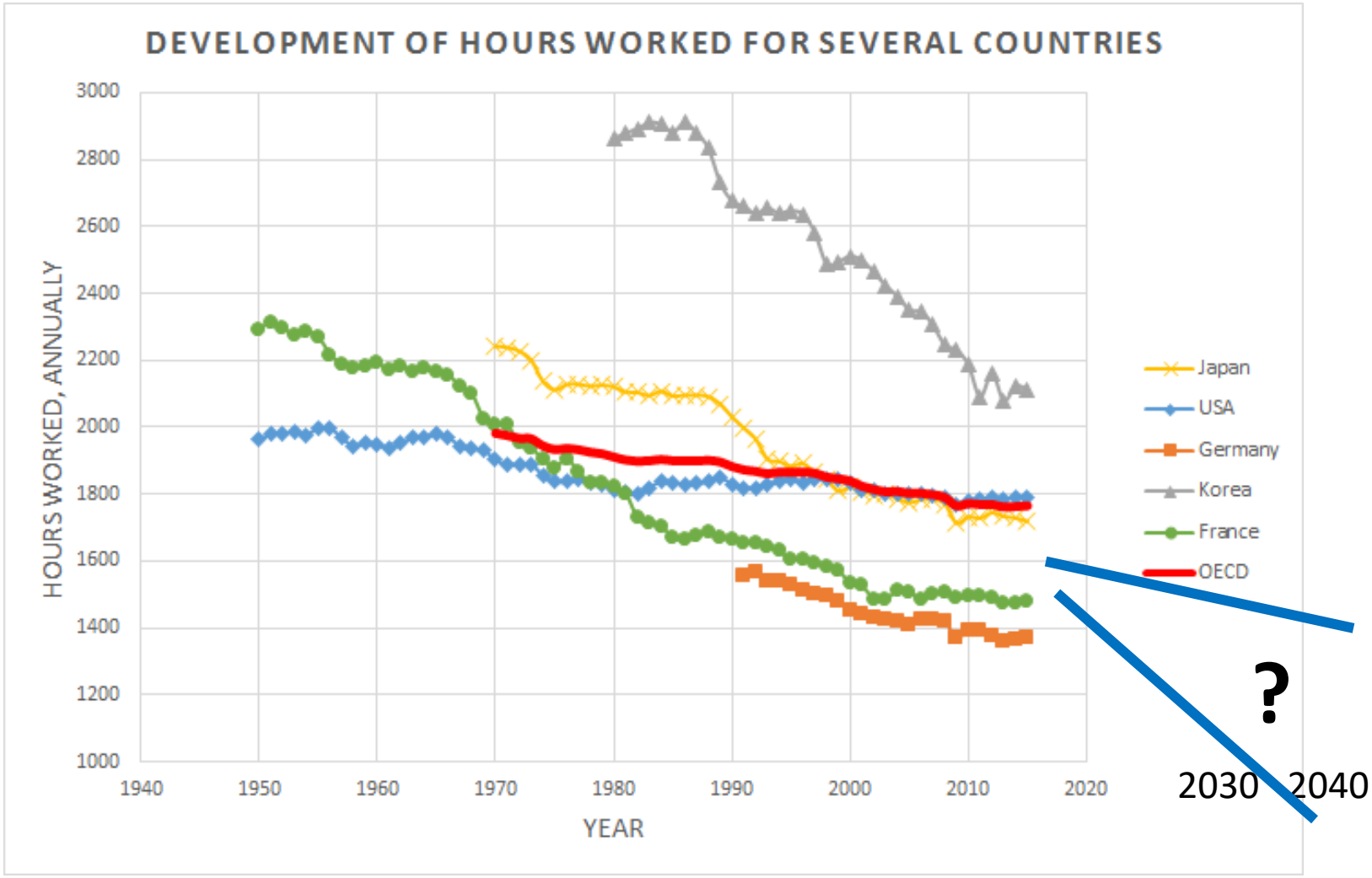


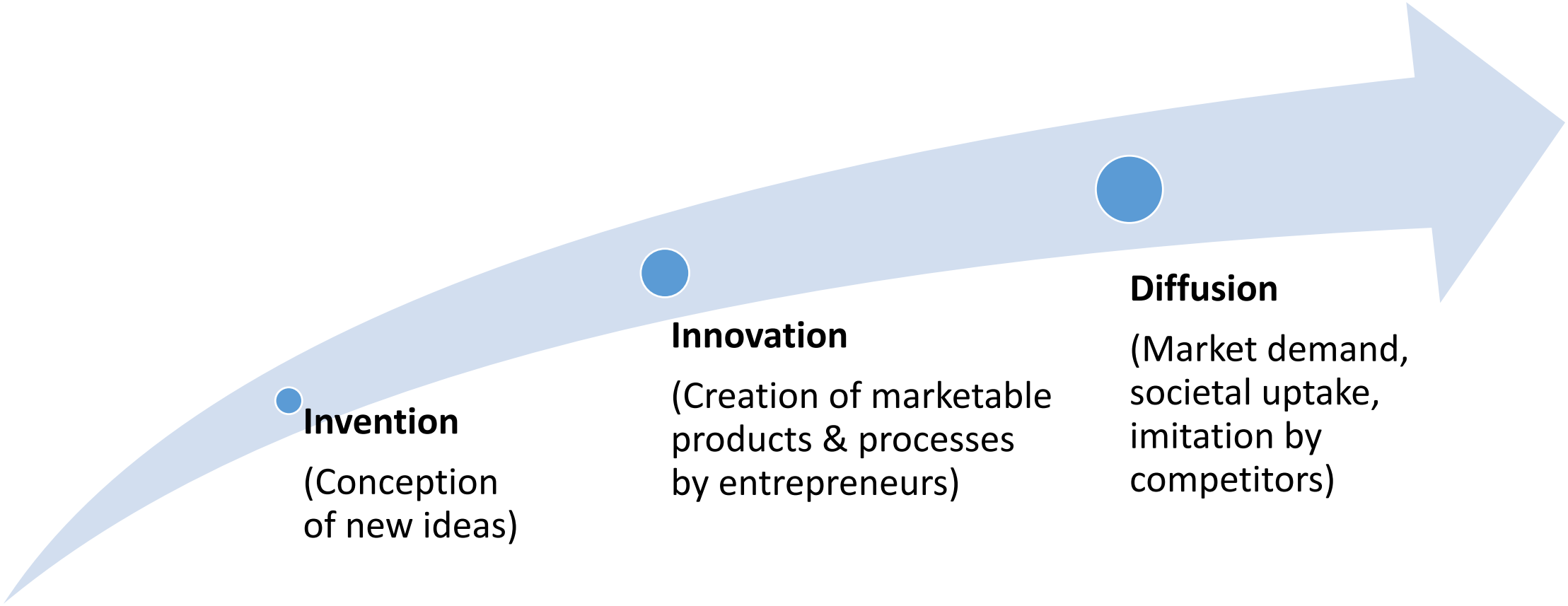
Source: Bank of England, 'Millennium of Data' dataset. Own visualization



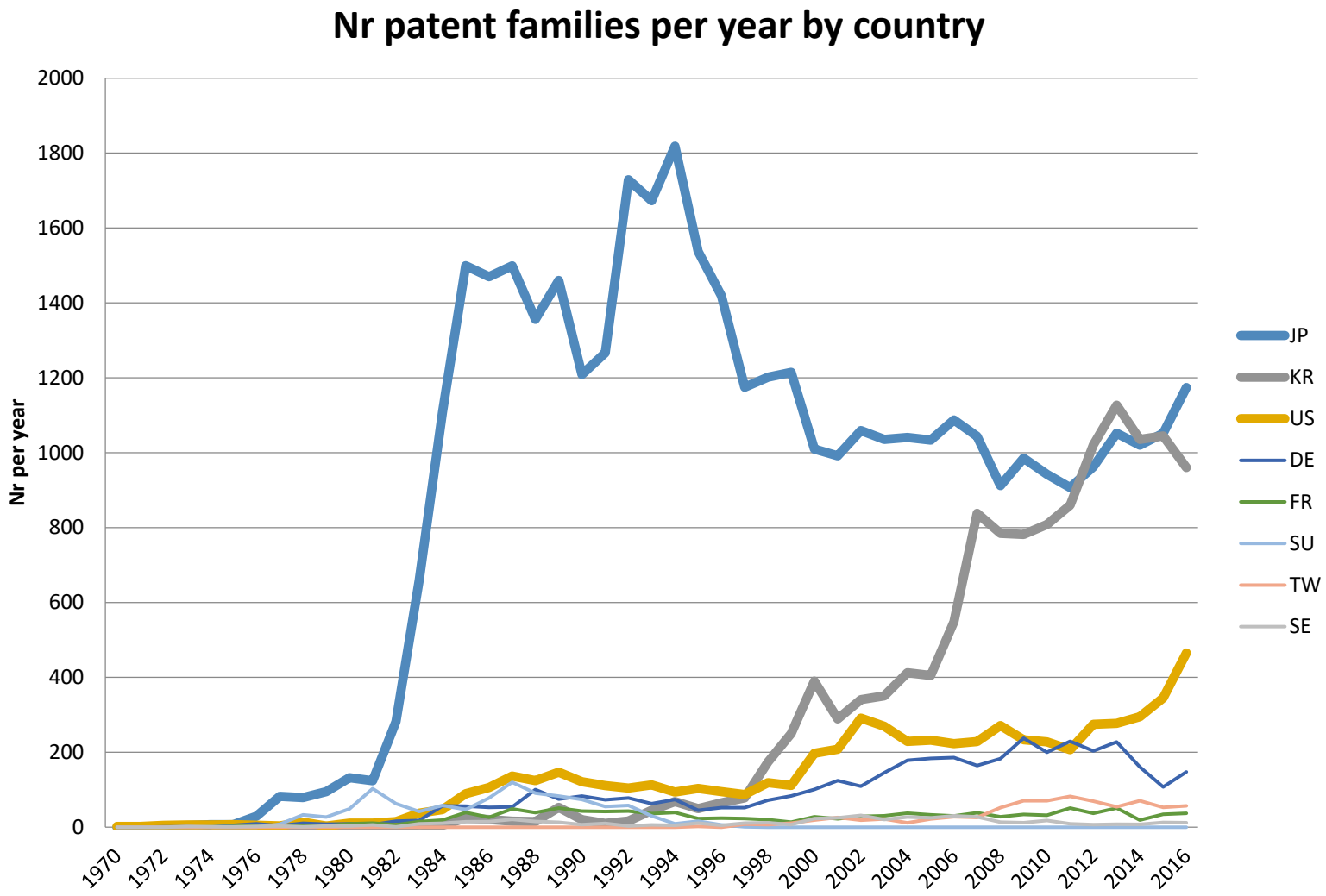
DEVELOPMENT OF HOURS WORKED, ANNUALLY, FOR SEVERAL COUNTRIES (SOURCE: OECD DATA, OWN VISUALIZATION)

What is happening, technologically?

Technological change (Joseph Schumpeter)

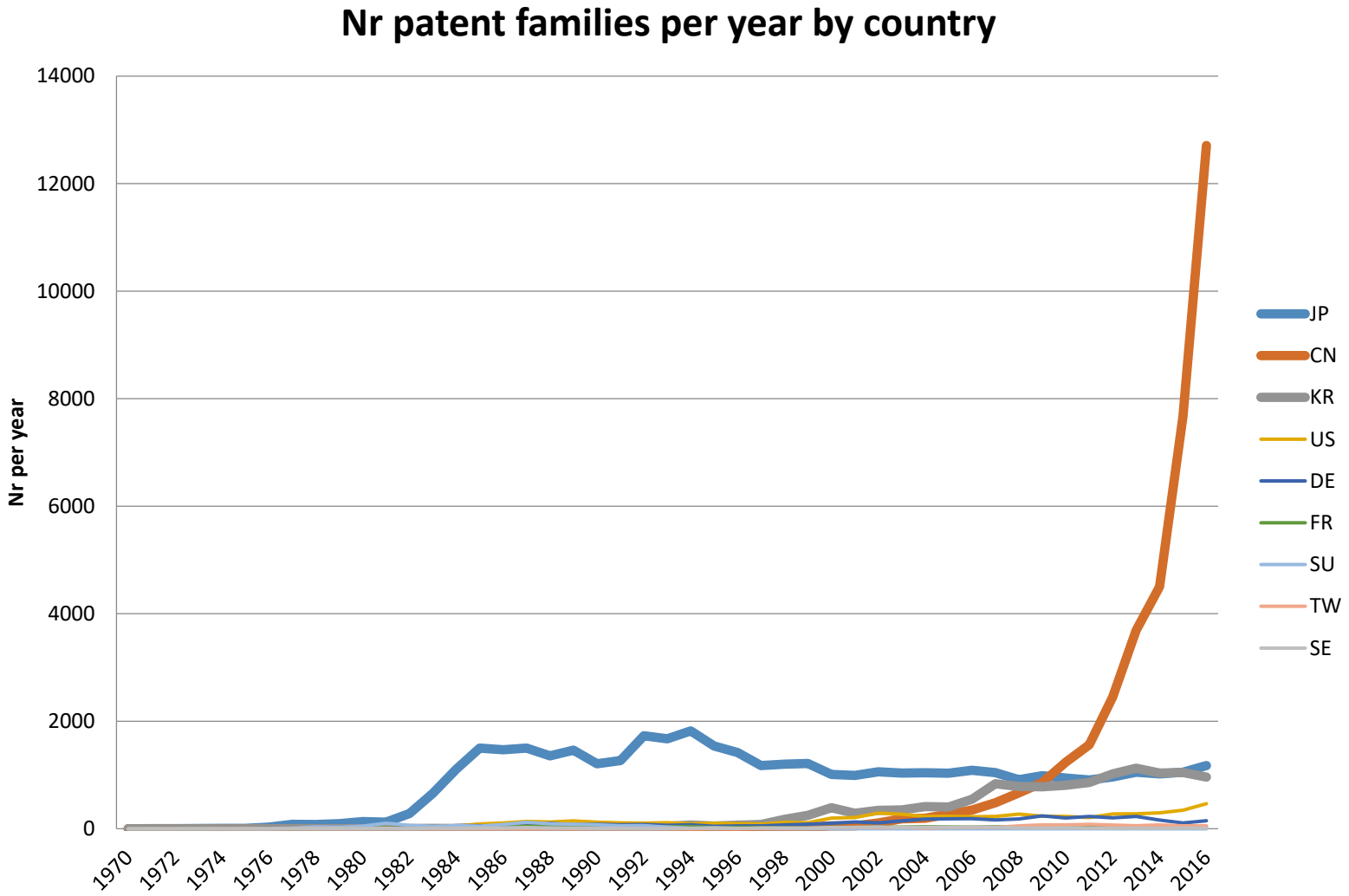


Absolute # of “robot*” patent families / year / country



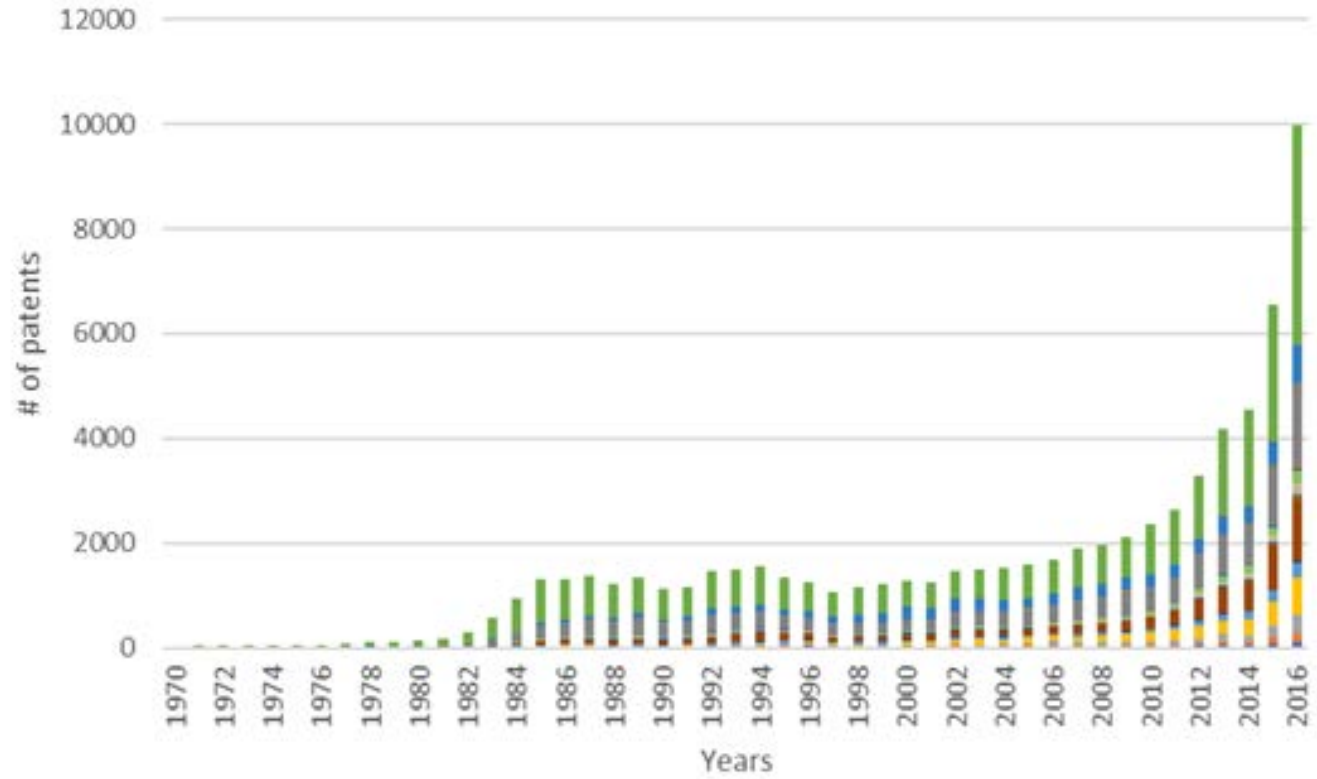
Source: Visualization of extracted and processed EPO data.

Absolute # of “robot*” patent families / year / country



Source: Visualization of extracted and processed EPO data.

patent families by field (~NACE sector)



Source: Visualization of extracted and processed EPO data.

- Agriculture
- Personal or domestic articles
- Separating; Mixing
- Transporting
- Chemistry
- Combinatorial technology
- Paper
- Earth or rock
- Engineering in general
- Weapons; Blasting
- Nucleonics
- Shaping
- Food Stuff; Tobacco
- Health; Life-saving; Amusement
- Printing
- Microstructural Technology; Nanotechnology
- Metallurgy
- Textiles or flexible materials
- Building
- Engines or pumps
- Lighting; Heating
- Instruments
- Electricity

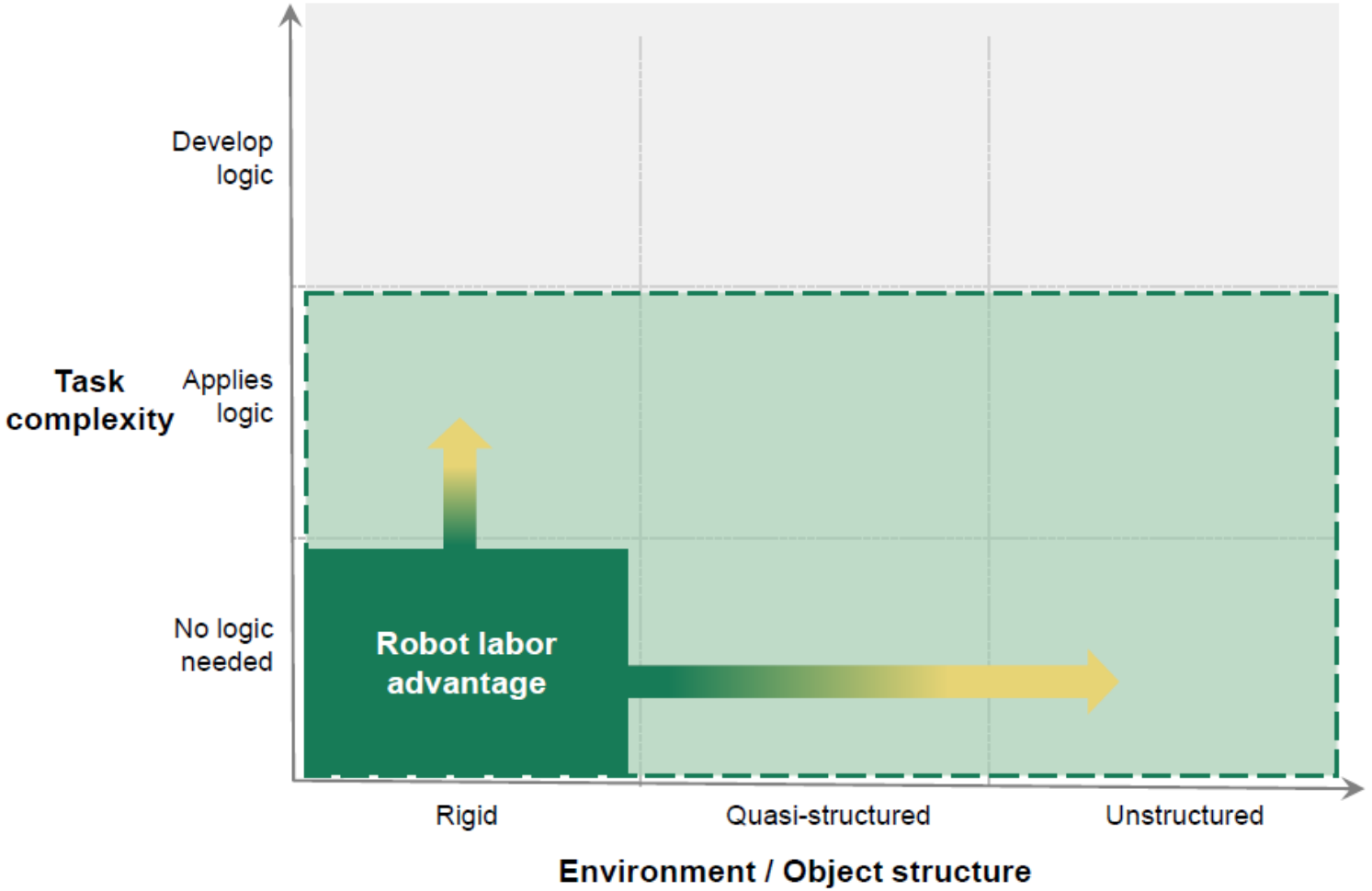
However, it is not just manufacturing…

“Technological profile” of countries

Country	Second specialization	Third specialization	Fourth specialization
China	Health; Life-saving; Amusement	Personal or domestic articles	Engineering in general
	39,32%	16,90%	14,45%
Japan	Health; Life-saving; Amusement	Engineering in general	Building
	30,12%	18,59%	8,27%
Germany (+ DDR)	Health; Life-saving; Amusement	Engineering in general	Building
	27,19%	23,50%	11,80%
Republic of Korea	Personal or domestic articles	Health; Life-saving; Amusement	Engineering in general
	41,73%	32,03%	6,61%
US	Health; Life-saving; Amusement	Metallurgy	Personal or domestic articles
	47,54%	10,58%	8,61%
Sweden	Agriculture	Engineering in general	Weapons; Blasting
	52,77%	15,63%	7,56%
Great Britain	Health; Life-saving; Amusement	Engineering in general	Personal or domestic articles
	38,51%	22,24%	13,26%
Switzerland	Agriculture	Textile or flexible materials	Engineering in general
	32,94%	27,99%	15,84%
Netherlands	Agriculture	Health; Life-saving; Amusement	Building
	80,17%	8,86%	2,72%

Source: Extracted and processed EPO data.

What may change in your job, your tasks?



DOMAIN OF APPLICATION OF ROBOTS IN TERMS OF ENVIRONMENT STRUCTURE AND TASK COMPLEXITY. SOURCE: WOLFGANG, M. (2016). BOSTON CONSULTING GROUP.

What may change?

- Jobs are vanishing: virtually all tasks are taken over by robots / AI
- Jobs are created:
  - Researching, developing & building robots, components, services
  - New fields of application
  - Training people using robots, AI, etc
- Jobs are affected indirectly: disposable income changes (concentrates?) so people spend more/ less on particular discretionary goods like entertainment, leisure, traveling..

- Task content changes: same work but new tools (with higher productivity/ efficiency/ success rate)
- Task set is shifting: some tasks are taken over by robots, allowing emphasis on others (e.g. creative intelligence, social interaction), but also calls for new complementary tasks (e.g. programming, maintaining robot)

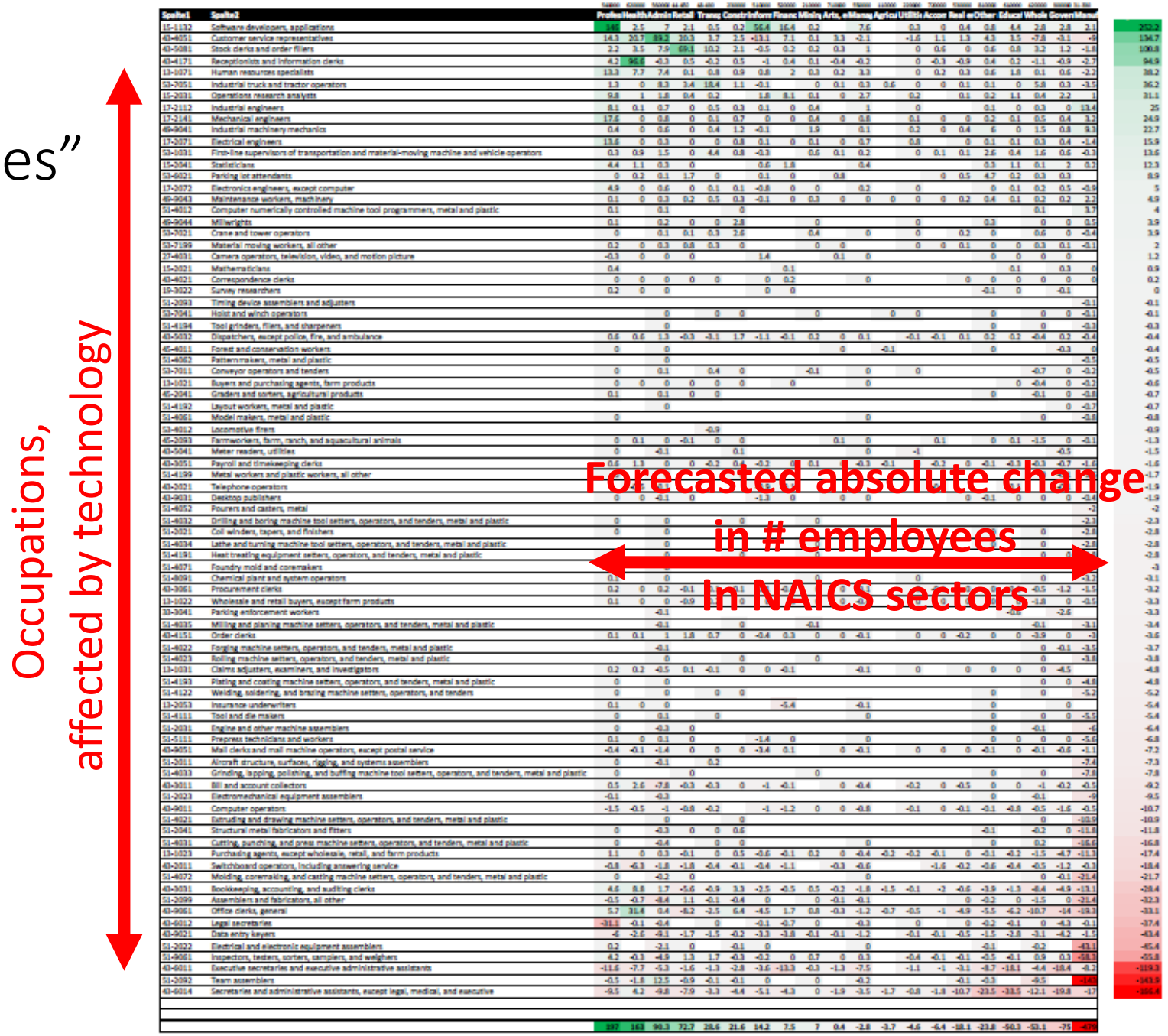
- New sectors/ jobs:
  - “Free hands” start providing new services, make new products
  - New technology calls for new skills (yielding even more new technology)

Multisectoral perspective on effects of robotics & AI on employment

		Developing & producing, Supplying & supporting	**Applying**	**Facilitating**	**Spillover**
Existing	**Substitution**	Increasing employment (higher demand)	Decreasing employment for jobs due to substitution; Increasing employment for jobs with complementarities; Possibly increasing employment due to possibly increasing demand	Increasing employment (higher demand)	Employment depends on dispensable income
Transforming	**Exploitation of complementarities & new tools**				
Emerging	**Exploitation of new skill sets**				

Source: Own conceptual model

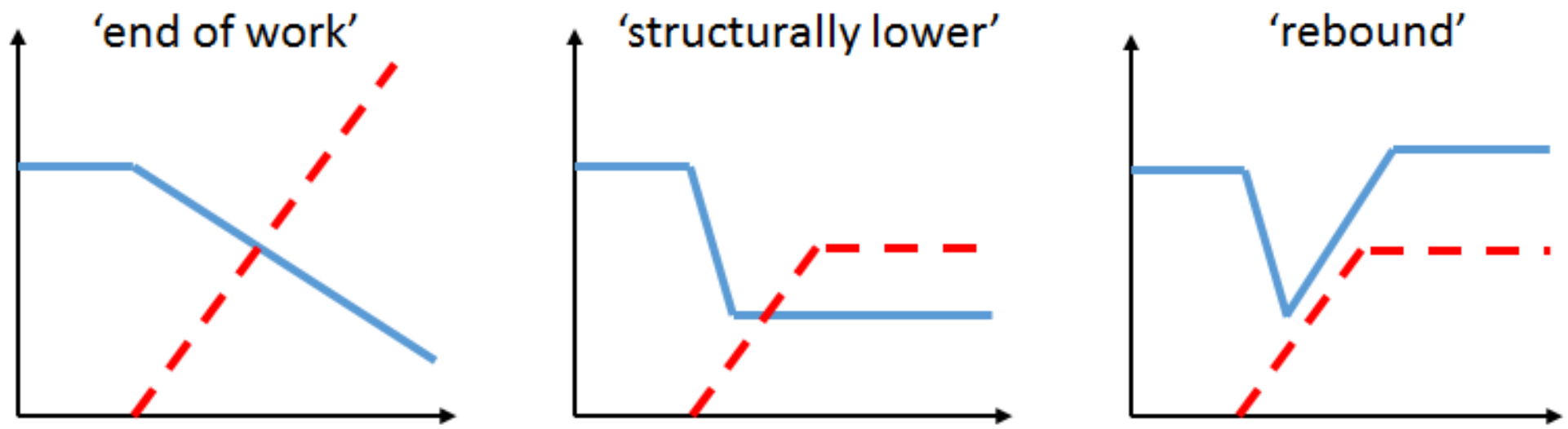
Impact “Industry 4.0 technologies” on (NAICS) sectors 2016 – 2026 (BLS outlook)



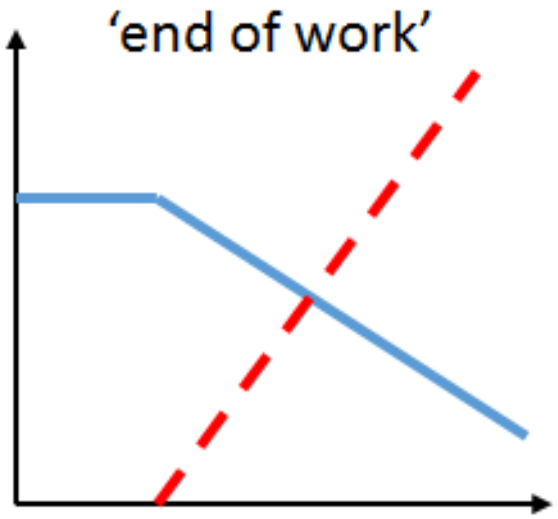
Source: Own visualization of extracted & processed BLS OO data

		Producing & developing, Supplying & supporting	Applying	Inhibiting or Facilitating	Spillover
Vanishing occupations	Most tasks substituted for.	Robot designer; Robotic system engineer; Robotic system designer; Software engineers; Electrical & electronical engineers	**Examiners, investigators, readers, data keyers:** Buyers and purchasing agents; Claims adjusters, appraisers, examiners, and investigators; Insurance underwriters; Survey researchers; Parking enforcement workers; Communications equipment operators; Bill and account collectors; Dispatchers, except emergency; Meter readers, utilities; Computer operators; Parking lot attendants; Data entry keyers; Desktop publishers; Camera operators, television, video, and motion picture; **Assemblers, laborers & farm workers:** Electrical, electronics, and electromechanical assemblers; Aircraft structure, surfaces, rigging, and systems assemblers; Engine and other machine assemblers; Farmworkers and laborers, crop, nursery, and greenhouse; Inspectors, testers, sorters, samplers, and weighers; Graders and sorters; Forest Conversation Workers; Miscellaneous assemblers and fabricators; **Transportation & material movers:** Locomotive firers; Material moving workers; Hoist and winch operators; Industrial truck and tractor operators; **Clerks, accountants and secretaries:** Bookkeeping, accounting, and auditing clerks; Payroll and timekeeping clerks; Procurement Clerks; Correspondence Clerks, Order Clerks; Mail Clerks and mail machines operators; Office clerks; Executive secretaries; Legal secretaries; **Machine setters, operators, tenders (Metal, plastics and chemical):** Forming machine setters, operators, and tenders; Machine tool cutting setters, operators, and tenders; Metal furnace operators, tenders, pourers, and casters; Chemical plant and system operator; **Model, die and pattern makers:** Molders and molding machine setters, operators, and tenders; Welding, soldering, and brazing workers; Miscellaneous metal and plastics workers; Structural metal fabricators and fitters; Tool and die makers; Prepress technicians and workers;	Teachers, lecturers, Lawyers, legal secretary work Incubators *[Losing in the vanishing, gaining in the emerging occupations]*	**Recreation:** Recreation Workers; **Sports:** Fitness Trainers and Instructors; Massage Therapists; Athletes; **Arts, culture, entertainment:** Musicians and singers; Producers and directors; Multimedia artists and animators; Actors; Art directors; Music directors and composers; Craft artists; Dancers; **Traveling:** Flight attendants; Water transportation workers; Lodging Managers; Airline & commercial pilots;
	Few tasks substituted for, several complementary tasks added to exploit substituted tasks. Same occupation but alternative tools, technologies *[Higher productivity, higher efficiency, lower failure rate, etc.]*	Electrical and Electronics Engineers; Industrial engineers, including health and safety; Mechanical Engineers; Industrial machinery installation, repair, and maintenance workers;	Computer numerically controlled machine tool programmers, metal and plastic Stock clerks and order fillers; Human resource specialists; Customer service representative; First-line supervisors of transportation and material-moving; Receptionists and information clerks Mathematicians; Statisticians; Operations research analyst		
Transforming occupations					
Emerging occupations	New skills, new technology, new specializations *[Creation and exploitation of new technologies creating new demand]*	**Employm in big-data driven model & system:** Big data model designer; Information Systems architects;; Composite Engineer; Smart Management Systems Architect; **Employm in robotics & AI in health care:** Bioinformatician; Ergonomic designer Medical Equipment designer; **Employm in robotics & AI in agriculture:** Agricultural Informatics and Engineering Expert;	**In big-data model & system:** Telemetric data interpretation engineer; Operating Data Analyst; **In health care:** Medical Data Manager; Medical Robot Operator Remote Security Coordinator; **In agriculture:** Automated farming equipment operator; Robot attendant **Miscellaneous:** 3D printing designer in construction; Smart Travel System Designer; Clothes 3D model programmer;	Robotics Lawyer Robotics teacher	Media Software Designer; Game designer Virtual & augmented reality engineer

Implications for employment at the macro-level?


'end of work'
'structurally lower'
'rebound'
Capital share
Labor share

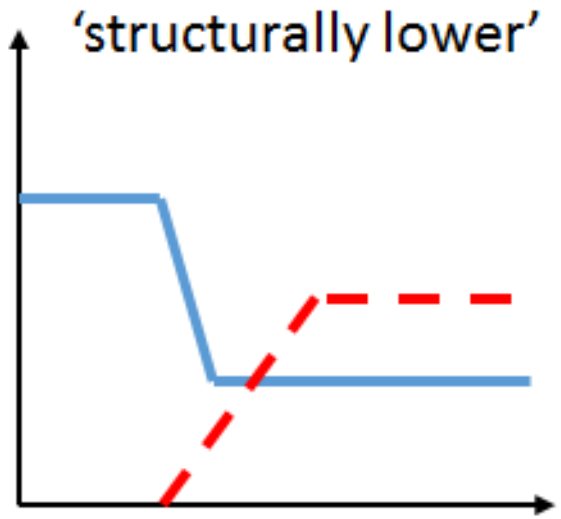
Effect over time: ‘end of work’ (race against the technology)



Conditions:

1. Rate at which humans create new opportunities and can be reeducated and retrained for employment is lower than the rate of technological advancement
2. Job *destroying* potential of technology through substitution outpaces the job *creating* potential of technology through complementarities (cf. MacCrory *et al.*, 2014) and creation of new sectors.

Effect over time: ‘structurally lower’

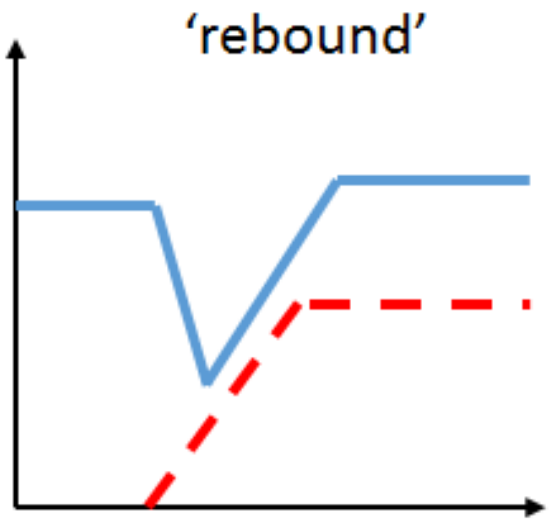


Conditions:

1. Rate at which humans can create new opportunities and be reeducated and retrained for employment is equal to the rate of displacement

2. Which is the case, if education moderates the pace of technological progress (stronger condition)

Effect over time: ‘rebound’



Conditions:

1. Education and creation of new sectors moderates the pace of technological progress, but people can catch up faster than technology can progress
2. Unemployment returns to a 'regular' rate of frictional unemployment

Measures to direct the effects of robots & AI on employment

- Get ‘displaced’ people to update skills into new occupations
  - Particularly those predispositioned, low prior educations, geographically immobile.
- How to stimulate people to engage in ‘entrepreneurial activities’, exploiting new technological opportunities?
- Which policies to stimulate inventiveness, innovativeness & diffusion (“dynamic efficiency”)? How to facilitate the creation of new sectors?

- In response to Guy Standing: The measures above seem to curb ‘precariatization’ of labor. Admittedly, we ignore the “existential stress”.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