SHAPING THE FUTURE OF WORK

ADAPTING TO A NEW WORLD

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Five Defining Trends

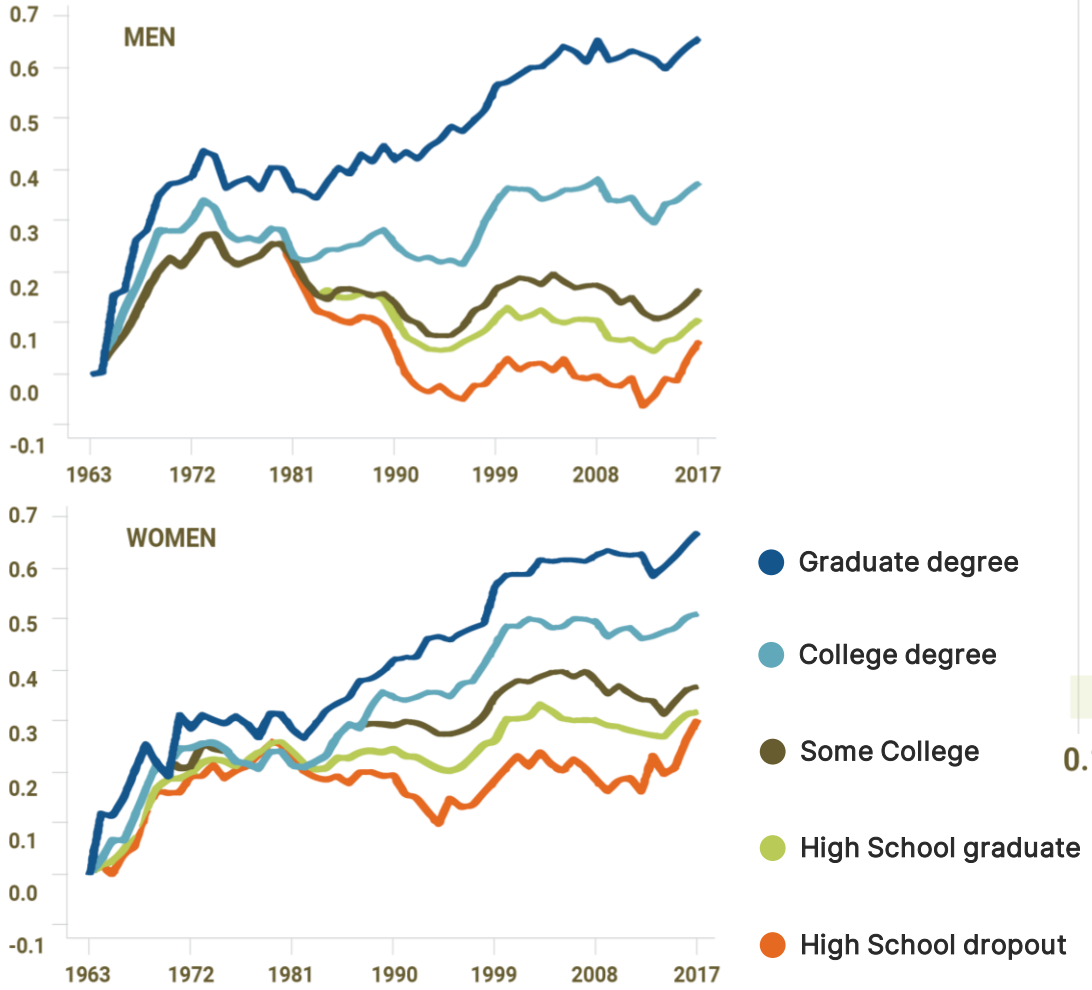
1. AI, inequality and jobs
2. Aging
3. Climate change
4. Crisis of democracy
5. Global reordering

Each one of these trends poses major challenges to the global economy and world stability, but they also present (some) opportunities to companies, civil society and governments for building a better future both in developed and developing countries.

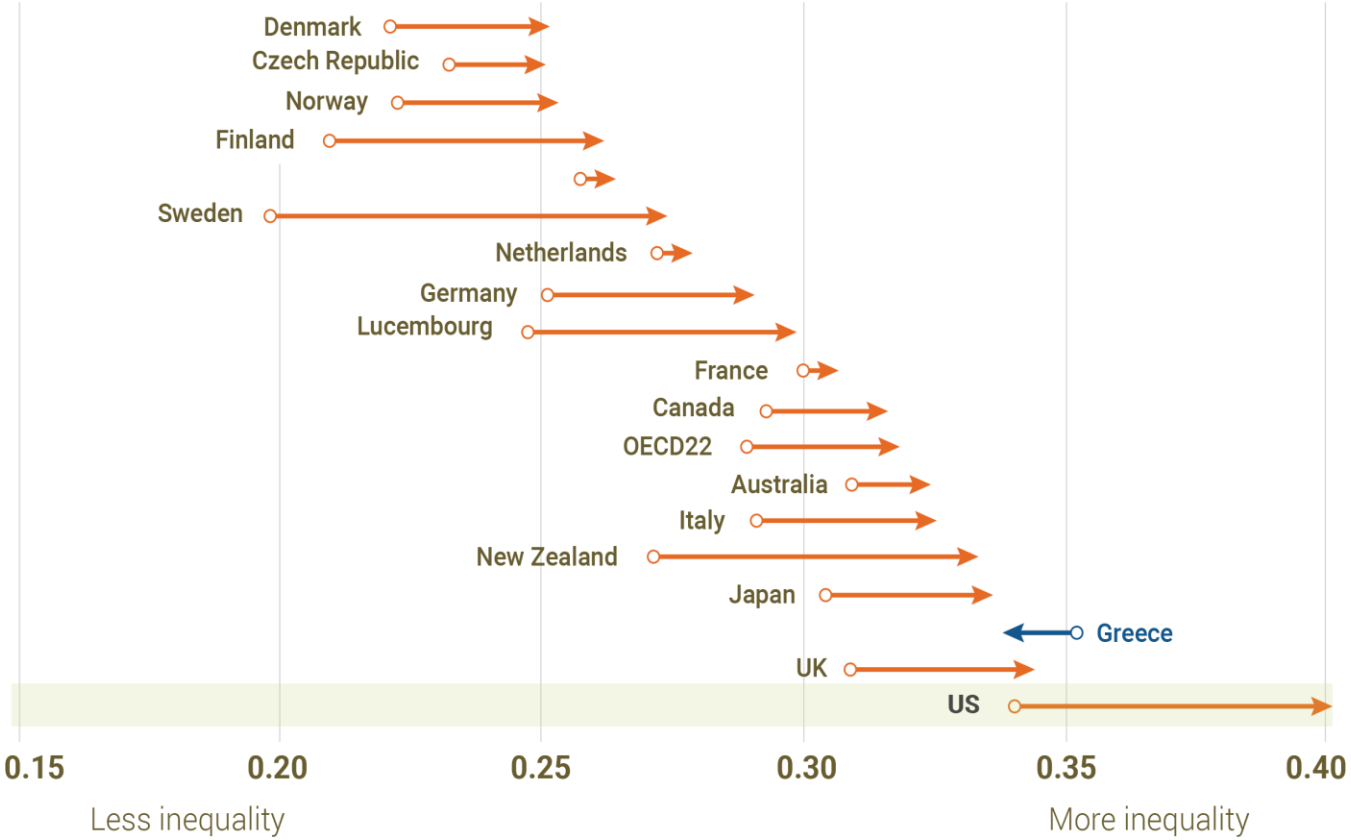
These opportunities are related to how we develop and use technology and are synergistic with rebuilding and strengthening institutions around the world.

US Inequality Trends: Breakdown of shared prosperity during the era of digital technologies

The change in real (log) weekly earnings
Working age adults, ages 18–64, since 1963



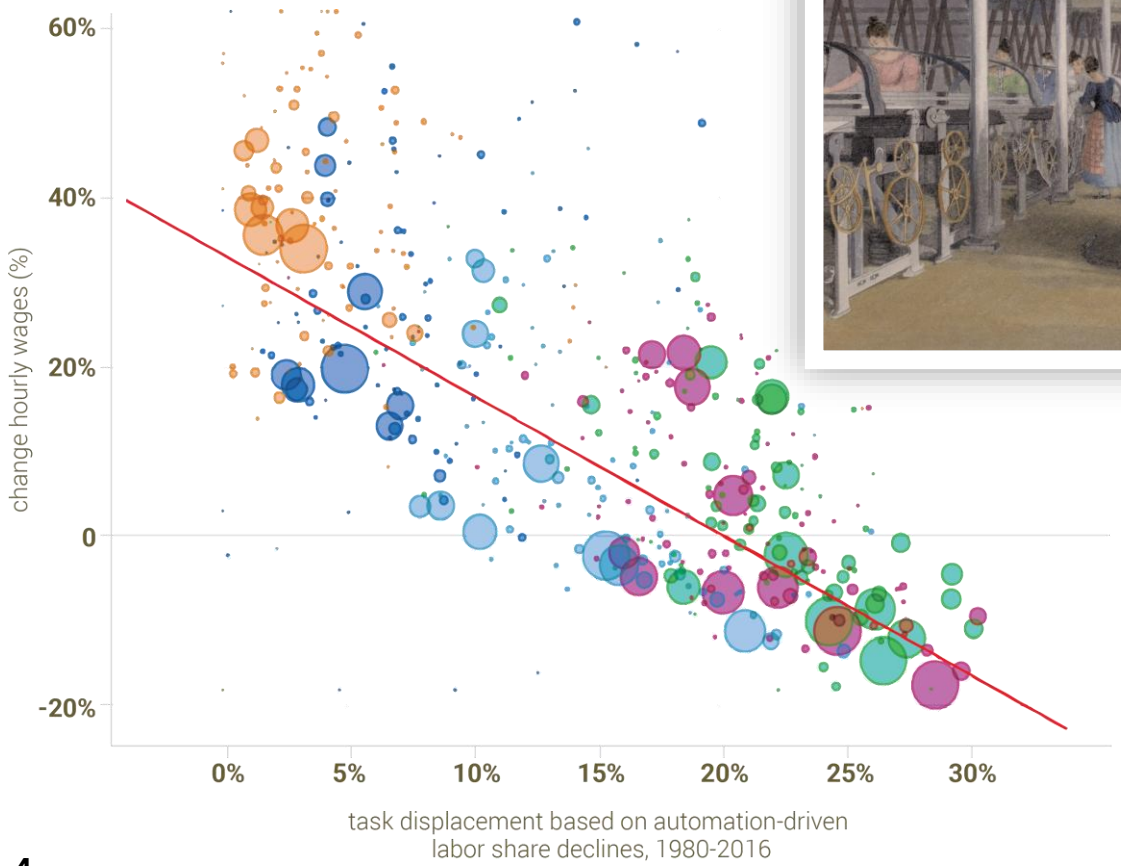
Change in the Gini Coefficient, measure of inequality
1985–2010's



(left) Exhibit from Autor, David. (2019). "Work of the Past, Work of the Future." AEA Papers and Proceedings. 109(2019): 1–32.; (right) Exhibit from OECD. (2015). "In It Together: Why Less Inequality Benefits All."

The Role of automation: Today and in history

Change in real wages due to automation of job tasks 1980–2016



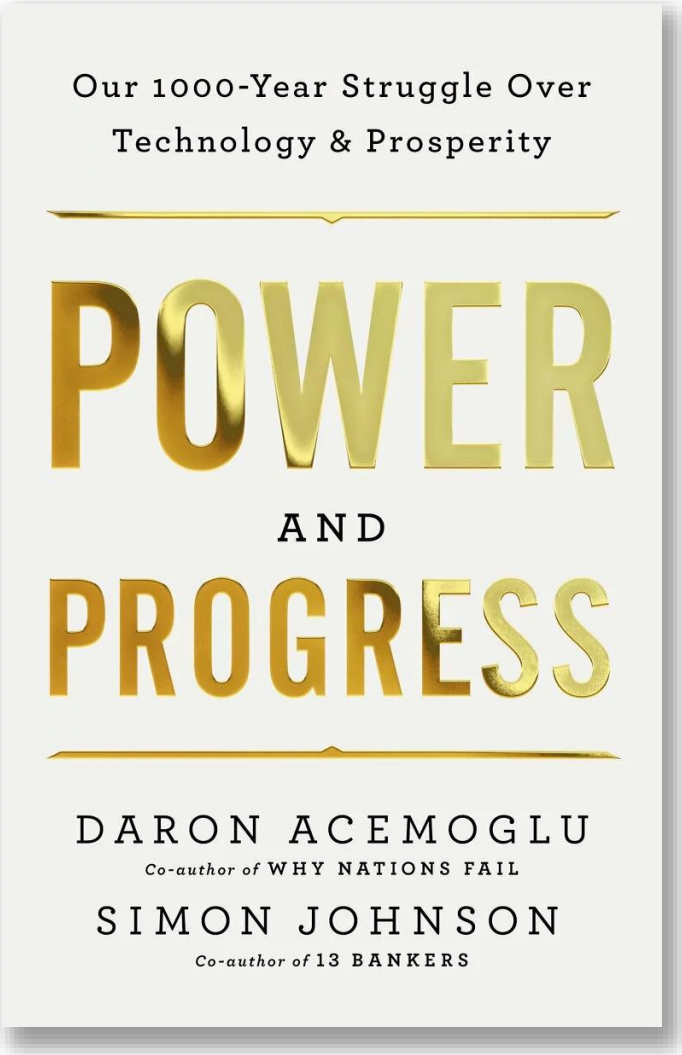
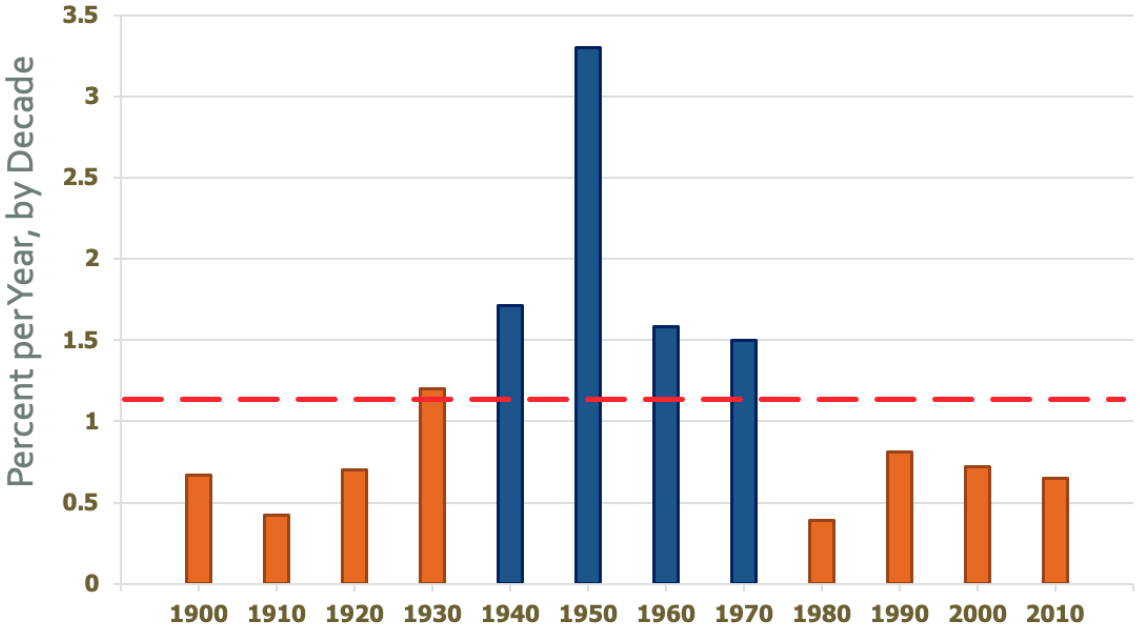


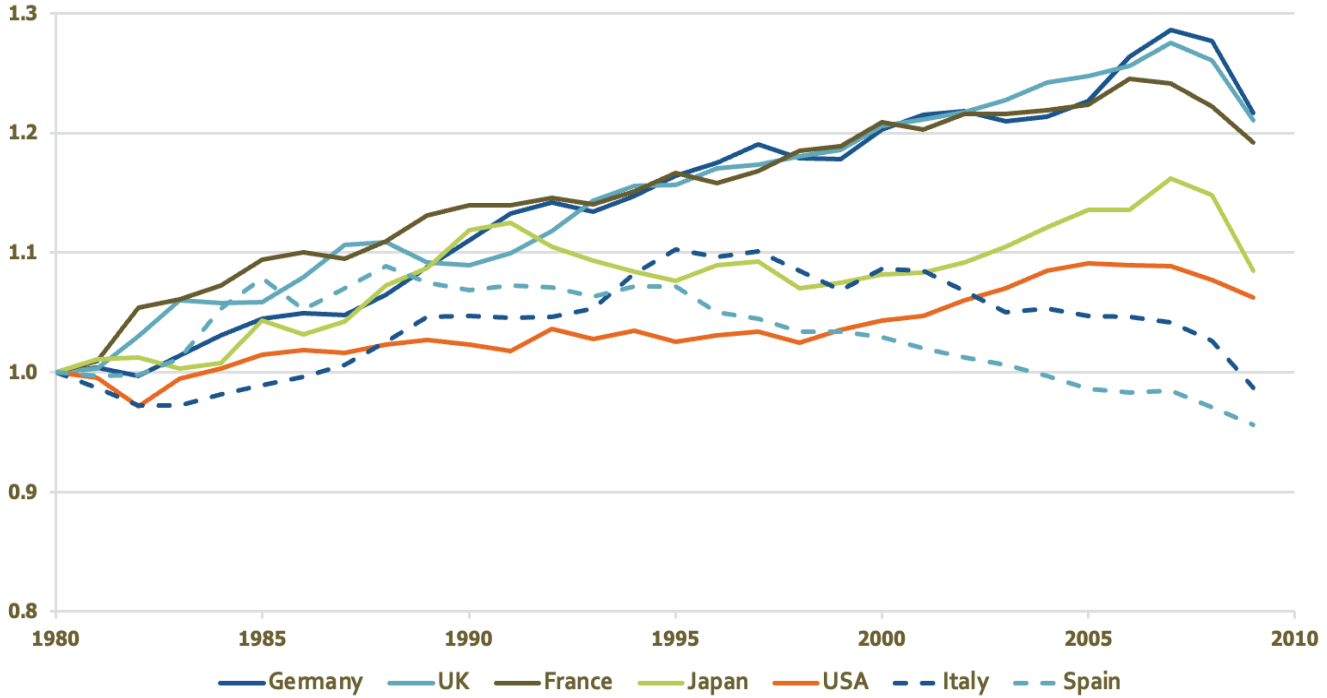
Exhibit from Acemoglu, Daron and Pascual Restrepo. 2022. "Tasks, Automation, and the Rise in U.S. Wage Inequality." Econometrica, 90(5): 1973–2016

But where is productivity?
We need better automation and more than just automation

Annual growth rate of total factor productivity (TFP)
Preceding decadal average, 1900–2010



Total factor productivity growth in OECD countries
Growth over time, 1980–2009



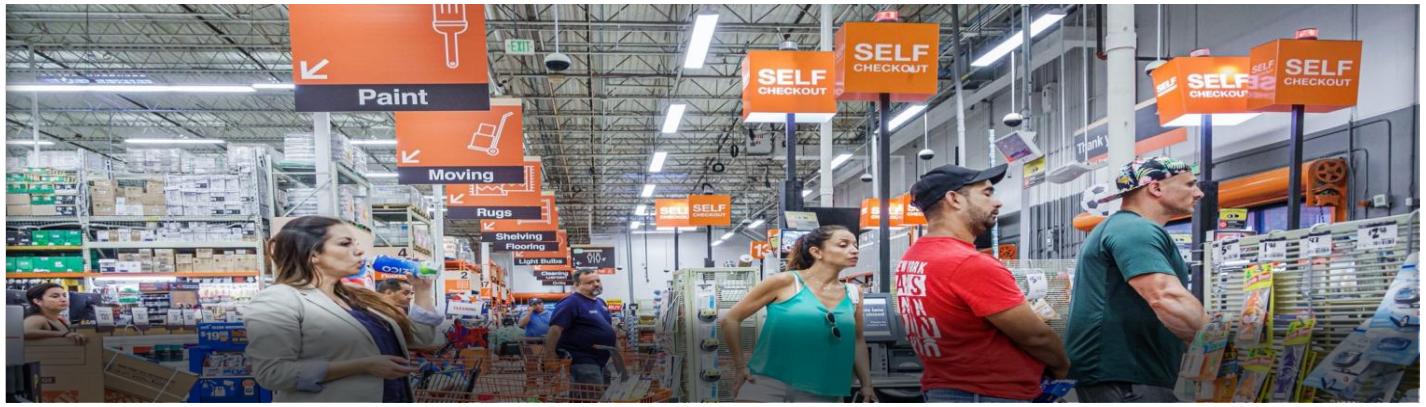
Exhibits from (left) Gordon, Robert. 2016. “US Economic Growth is Over: The Short Run Meets the Long Run.” Think Tank 20, Brookings Institution. (right) EU KLEMS, 2012.

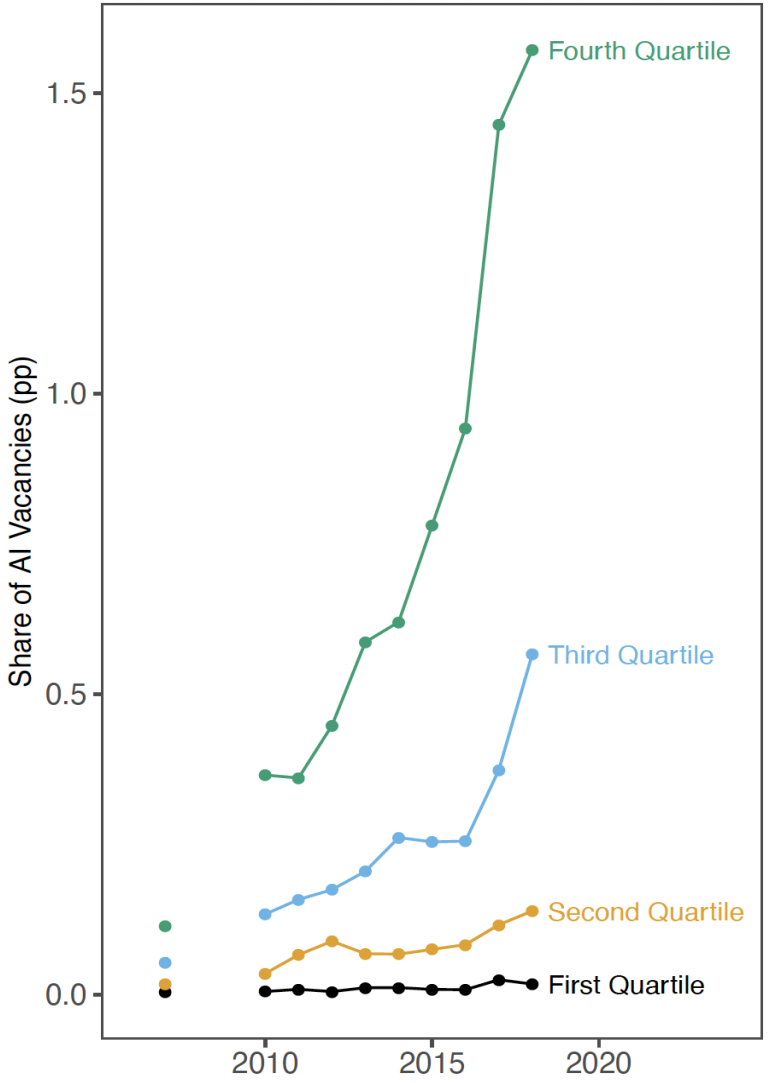
The same direction for AI

AI Adoption by Quartile of AI Task Exposure

There is already evidence that AI is being used mainly for automation

- Establishments investing most in AI are those that used to perform tasks that were replaceable by basic AI (Acemoglu et al., 2022).
- And these same establishments slowed down their hiring after AI adoption.
- LLMs seem to be going the same way — simple writing and analytical tasks are being automated in companies such as Buzzfeed and Bloomberg.



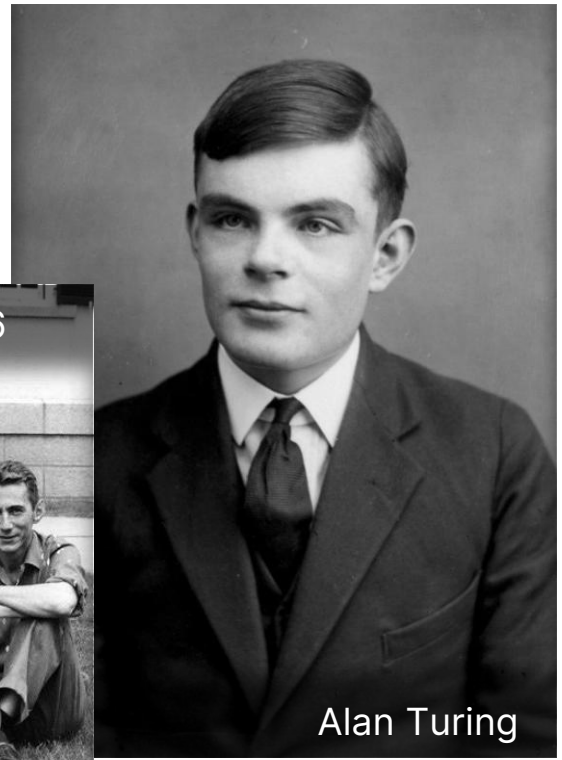


Dominant vision for AI

The dominant vision of AI: Autonomous machine intelligence

Machines designed to be smarter and more powerful than (most) humans.

- Machine intelligence refers to Alan Turing's conceptualization of how the mind works and how computers could imitate.
- This vision often leads to automation and also supports AGI.
- Why is this a problem?
  - Excessive automation.
  - Inequality.
  - Disappointing productivity growth.
  - Disempowerment of people.

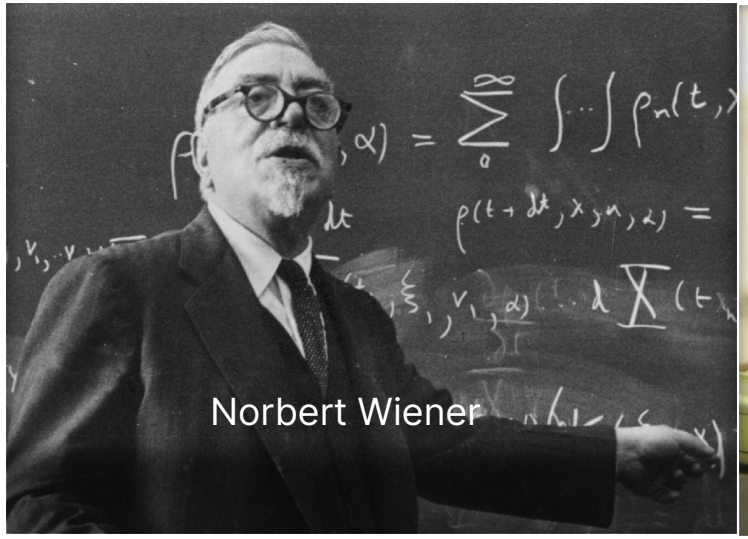


Source: American Academy of Achievement

How to do better AI?

Prioritize machine usefulness and pro-human agency

- Machine usefulness or "pro-human AI" starts with Norbert Wiener.
- Articulated and put into practice by computer scientists, such as Douglas Engelbart and JCR Licklider: "human-machine symbiosis".
- Additional history, motivation, and discussion in *Power and Progress*.


Norbert Wiener


Engelbart's mouse, 1968

JCR Licklider

Source: Ben Shneiderman

Pro-Human Generative AI

Generative AI could provide the tools for humans to get better in knowledge work

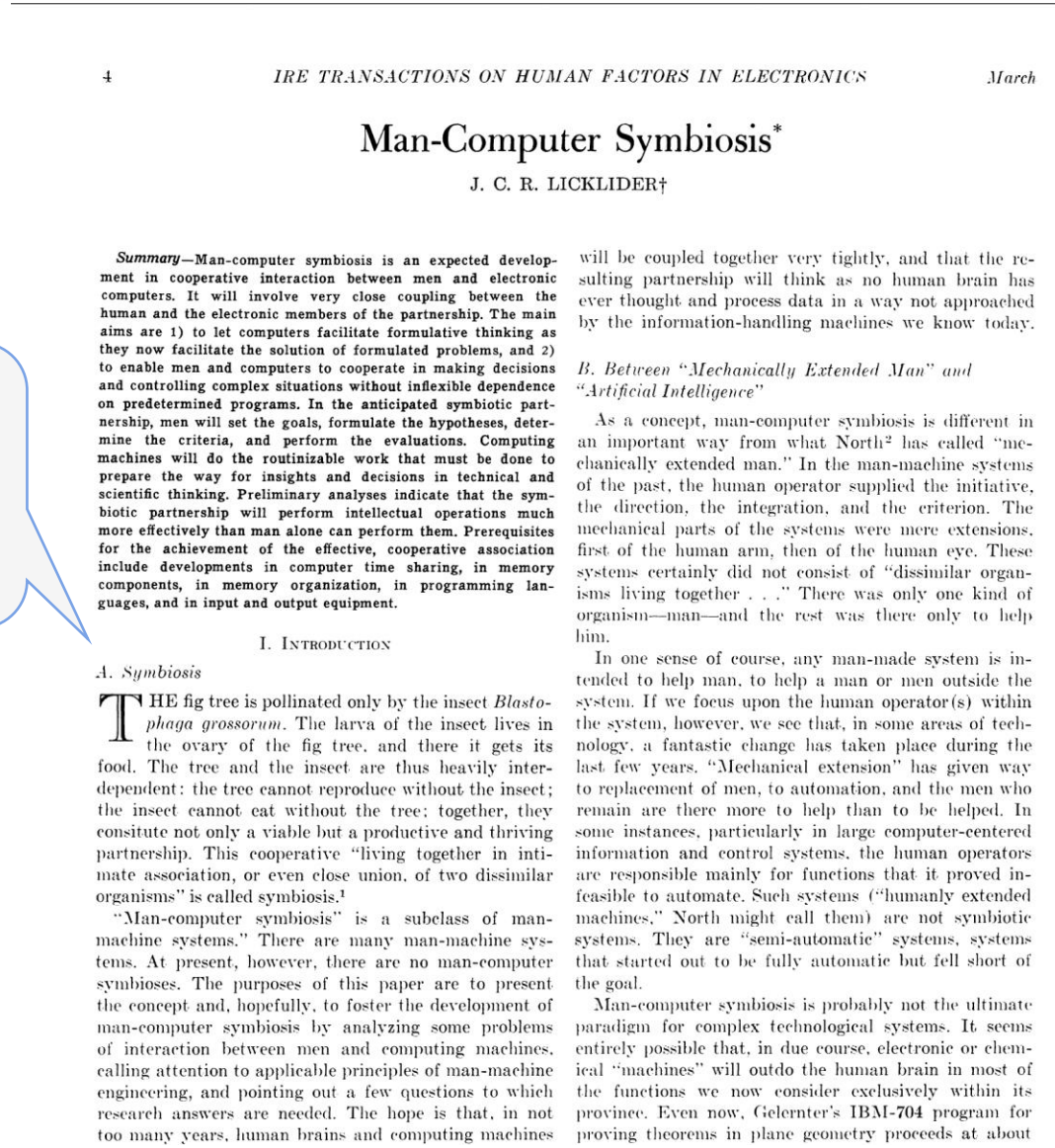
This is JCR Licklider's vision from 60 years ago:

> The hope is that, in not too many years, human brains and computing machines will be coupled together very tightly, and that the resulting partnership will think as no human brain has ever thought and process data in a way not approached by the information-handling machines we know today.

It requires generative AI tools to be useful to humans in better decision-making, problem identification, and information retrieval, filtering, and curation.

Example: helping electricians and manual workers.

Critical not just for workers in the industrialized world but also for the global economy.



4 IRE TRANSACTIONS ON HUMAN FACTORS IN ELECTRONICS March

Man-Computer Symbiosis*

J. C. R. LICKLIDER†

Summary—Man-computer symbiosis is an expected development in cooperative interaction between men and electronic computers. It will involve very close coupling between the human and the electronic members of the partnership. The main aims are 1) to let computers facilitate formulative thinking as they now facilitate the solution of formulated problems, and 2) to enable men and computers to cooperate in making decisions and controlling complex situations without inflexible dependence on predetermined programs. In the anticipated symbiotic partnership, men will set the goals, formulate the hypotheses, determine the criteria, and perform the evaluations. Computing machines will do the routinizable work that must be done to prepare the way for insights and decisions in technical and scientific thinking. Preliminary analyses indicate that the symbiotic partnership will perform intellectual operations much more effectively than man alone can perform them. Prerequisites for the achievement of the effective, cooperative association include developments in computer time sharing, in memory components, in memory organization, in programming languages, and in input and output equipment.

I. Introduction

A. Symbiosis

THE fig tree is pollinated only by the insect *Blastophaga grossorum*. The larva of the insect lives in the ovary of the fig tree, and there it gets its food. The tree and the insect are thus heavily interdependent: the tree cannot reproduce without the insect; the insect cannot eat without the tree; together, they consitute not only a viable but a productive and thriving partnership. This cooperative "living together in intimate association, or even close union, of two dissimilar organisms" is called symbiosis.[1]

"Man-computer symbiosis" is a subclass of man-machine systems." There are many man-machine systems. At present, however, there are no man-computer symbioses. The purposes of this paper are to present the concept and, hopefully, to foster the development of man-computer symbiosis by analyzing some problems of interaction between men and computing machines, calling attention to applicable principles of man-machine engineering, and pointing out a few questions to which research answers are needed. The hope is that, in not too many years, human brains and computing machines will be coupled together very tightly, and that the resulting partnership will think as no human brain has ever thought and process data in a way not approached by the information-handling machines we know today.

B. Between "Mechanically Extended Man" and "Artificial Intelligence"

As a concept, man-computer symbiosis is different in an important way from what North[2] has called "mechanically extended man." In the man-machine systems of the past, the human operator supplied the initiative, the direction, the integration, and the criterion. The mechanical parts of the systems were mere extensions, first of the human arm, then of the human eye. These systems certainly did not consist of "dissimilar organisms living together . . ." There was only one kind of organism—man—and the rest was there only to help him.

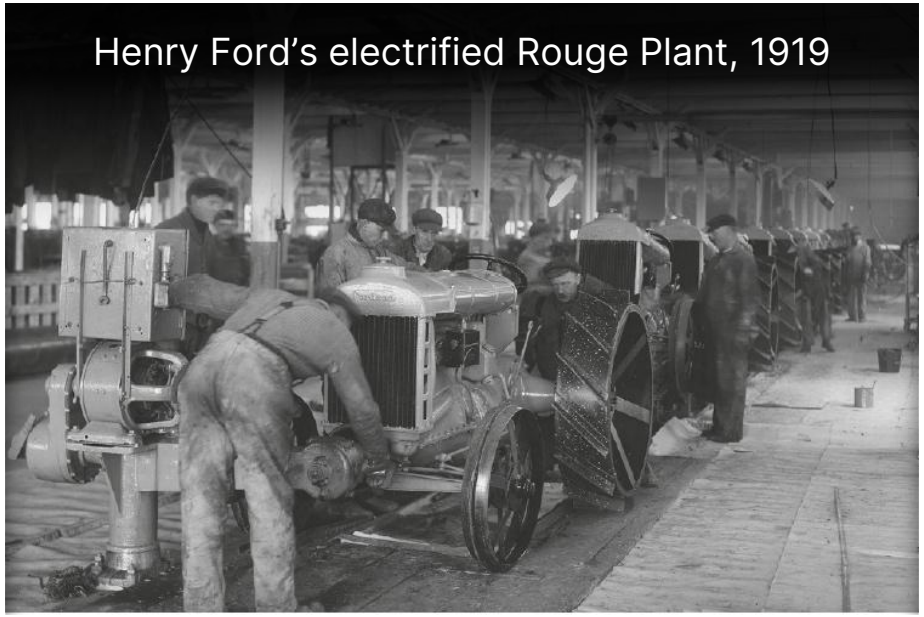
In one sense of course, any man-made system is intended to help man, to help a man or men outside the system. If we focus upon the human operator(s) within the system, however, we see that, in some areas of technology, a fantastic change has taken place during the last few years. "Mechanical extension" has given way to replacement of men, to automation, and the men who remain are there more to help than to be helped. In some instances, particularly in large computer-centered information and control systems, the human operators are responsible mainly for functions that it proved infeasible to automate. Such systems ("humanly extended machines," North might call them) are not symbiotic systems. They are "semi-automatic" systems, systems that started out to be fully automatic but fell short of the goal.

Man-computer symbiosis is probably not the ultimate paradigm for complex technological systems. It seems entirely possible that, in due course, electronic or chemical "machines" will outdo the human brain in most of the functions we now consider exclusively within its province. Even now, Gelernter's IBM-704 program for proving theorems in plane geometry proceeds at about

Better AI can enable new tasks for humans

The alternative path for AI is to create new human tasks

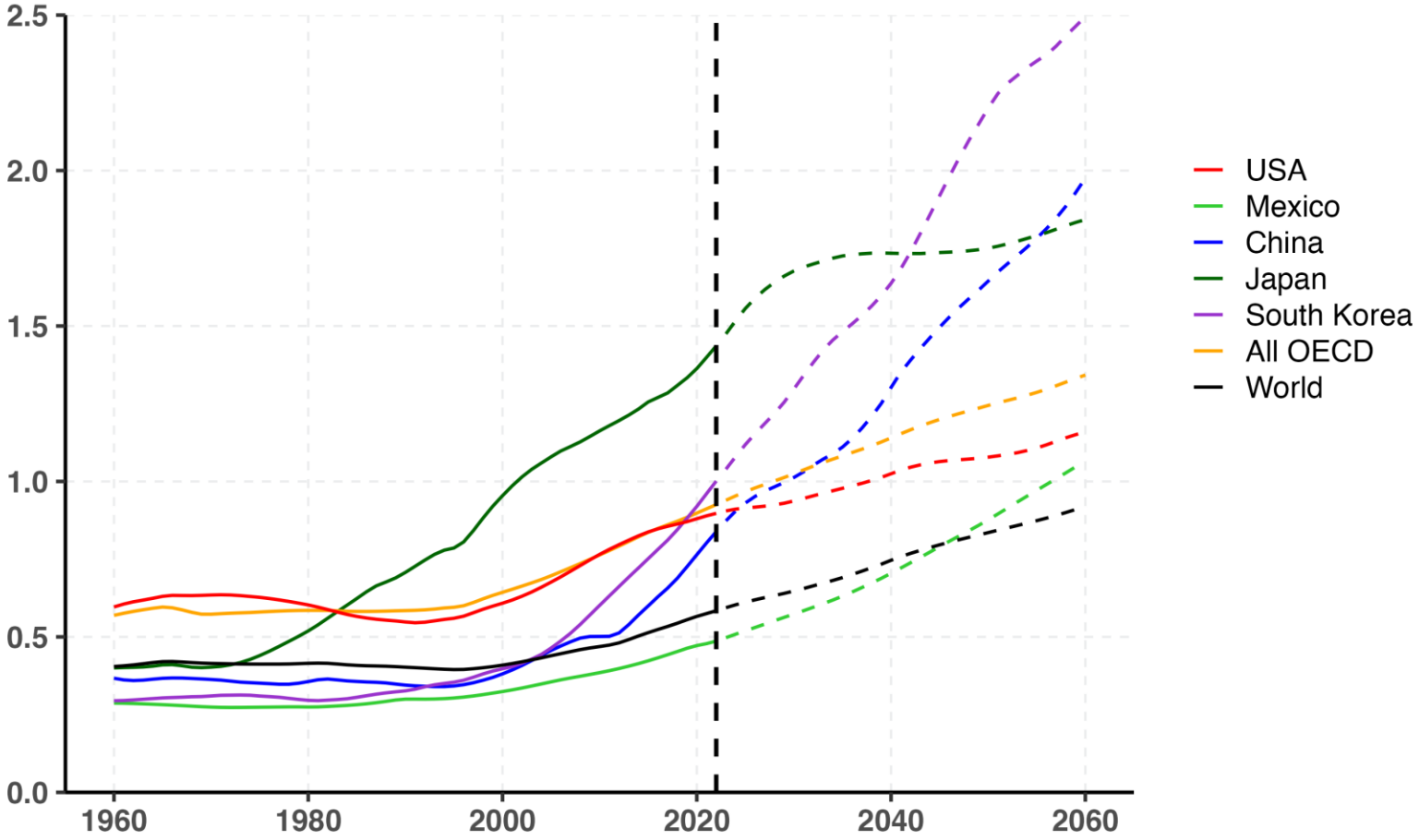
- Even using generative AI in existing human tasks to help workers is not enough.
- If this happens, it will likely devalue specific human skills (better AI-assisted writing would mean lower prices for writing skills and knowledge).
- This conundrum is solved with new tasks. These reinstate workers into the production process, increase worker contribution to productivity and boost earnings (Acemoglu and Restrepo, 2018).
- The promise of LLMs (and generative AI, more broadly) should be in this type of new-task creation.
- But this is not the focus of current AI research.
- **Can we get there?**



Source: 3D World's Advanced Saving Project, TECLA

Demographic Change: The Challenge

Ratio of 50+ years-old population to 20–49 years-old population
1960–2060 (projections after 2022)



Data from United Nations World Population Prospects 2022 Database.

Demographic Change: The Reality

Correlation between Aging and Growth in GDP per Capita (In Constant Dollars)

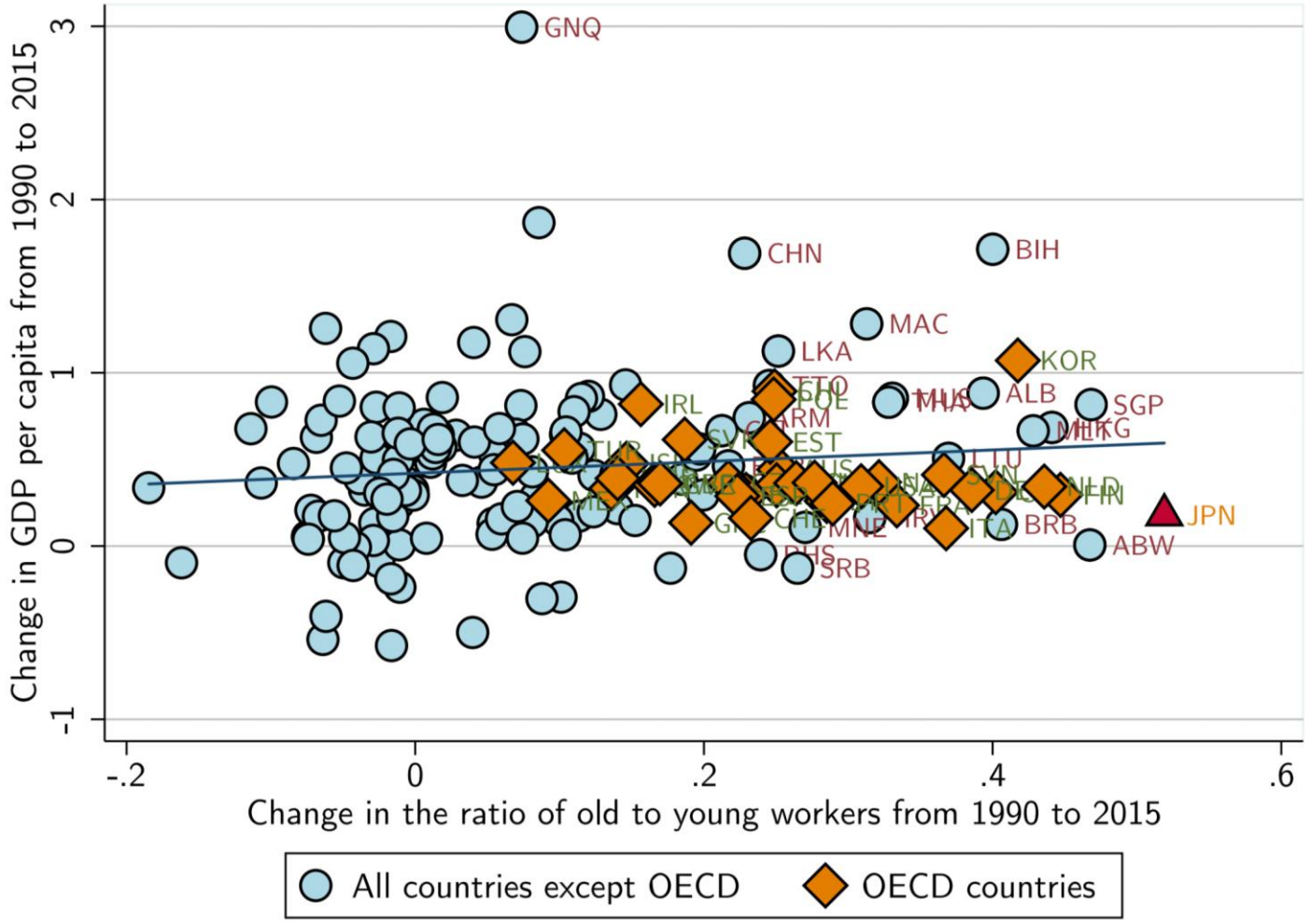
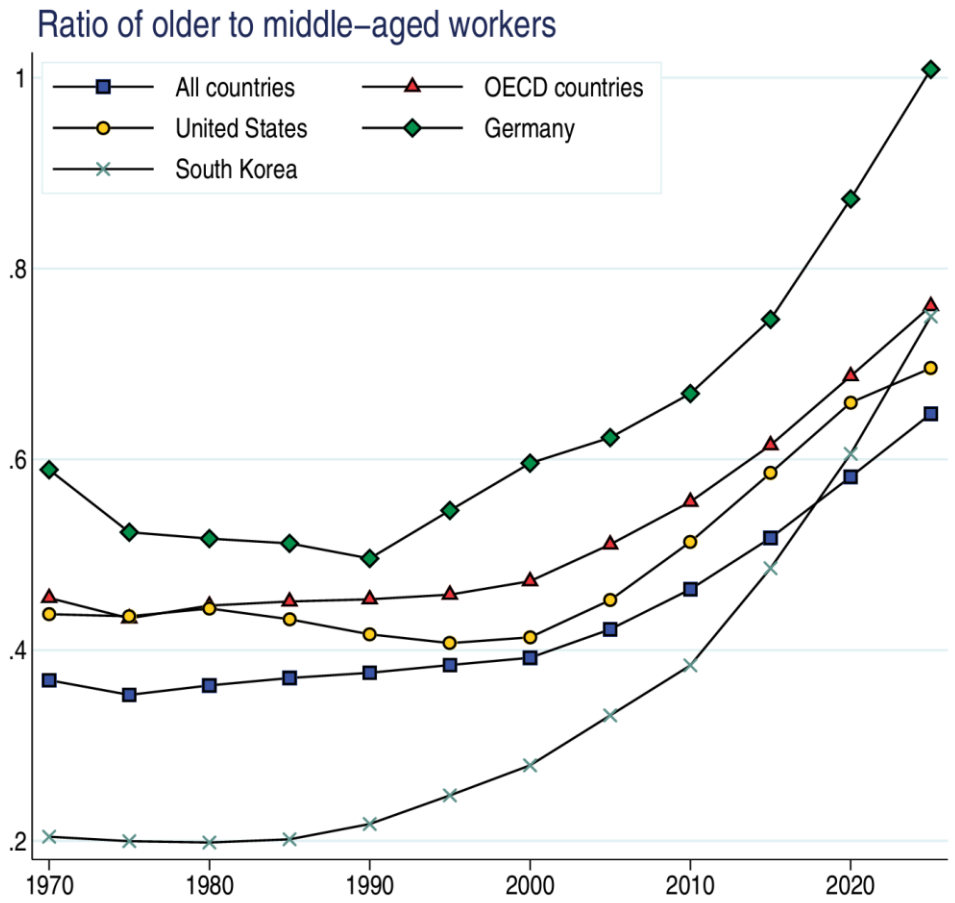


Exhibit from Acemoglu, Daron and Pascual Restrepo (2017). Secular Stagnation? The Effect of Aging on Economic Growth in the Age of Automation. American Economic Review: Papers & Proceedings, 107(5): 174–179

Demographic Change: Aging → Automation?

Trends in demographic shifts; Trends in robot adoption per worker



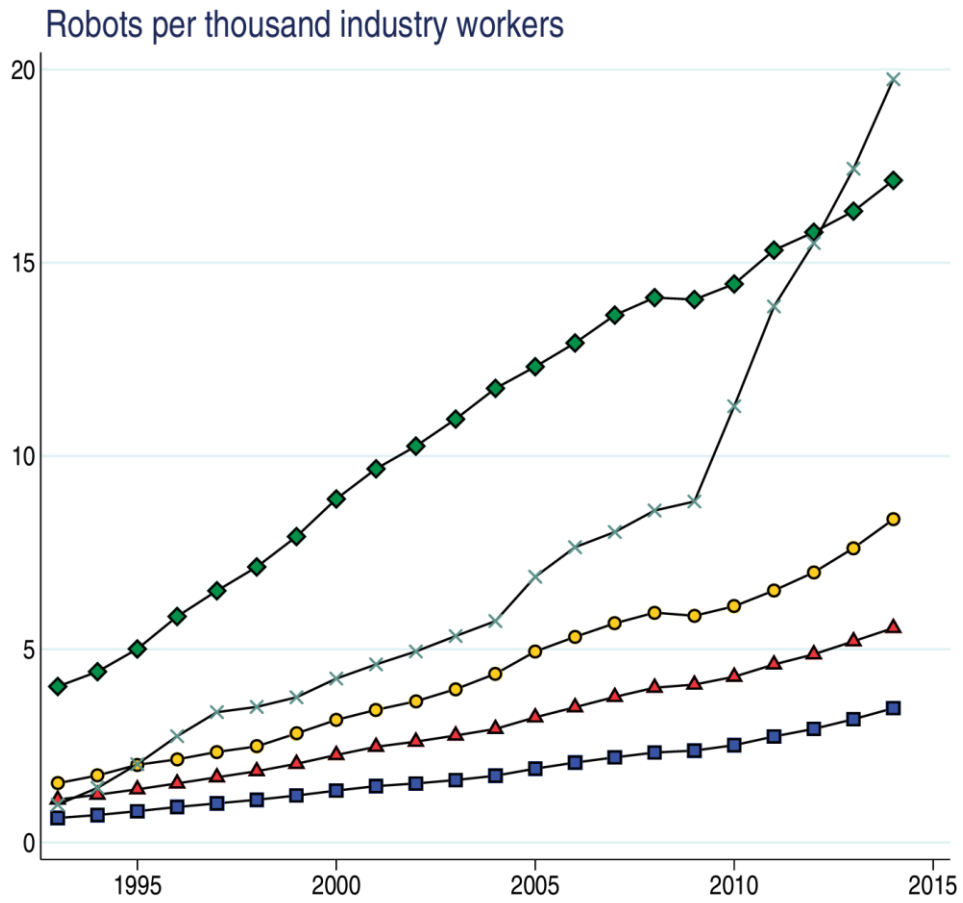
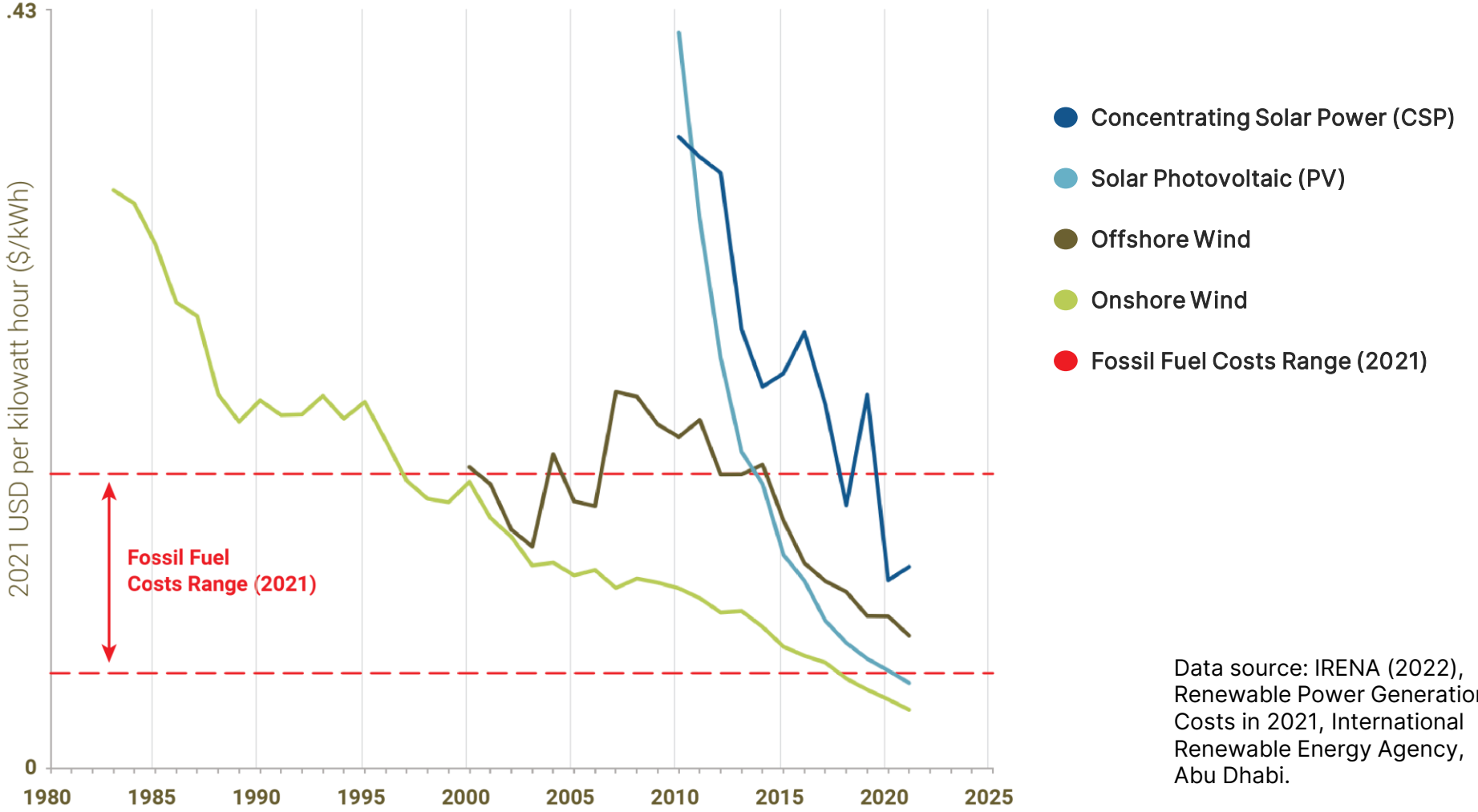


Exhibit from Acemoglu, Daron and Pascual Restrepo (2021). Demographics and Automation. Review of Economic Studies, 2021(0): 1–44.

Climate Change: Innovation has driven down the cost of renewable electricity generation

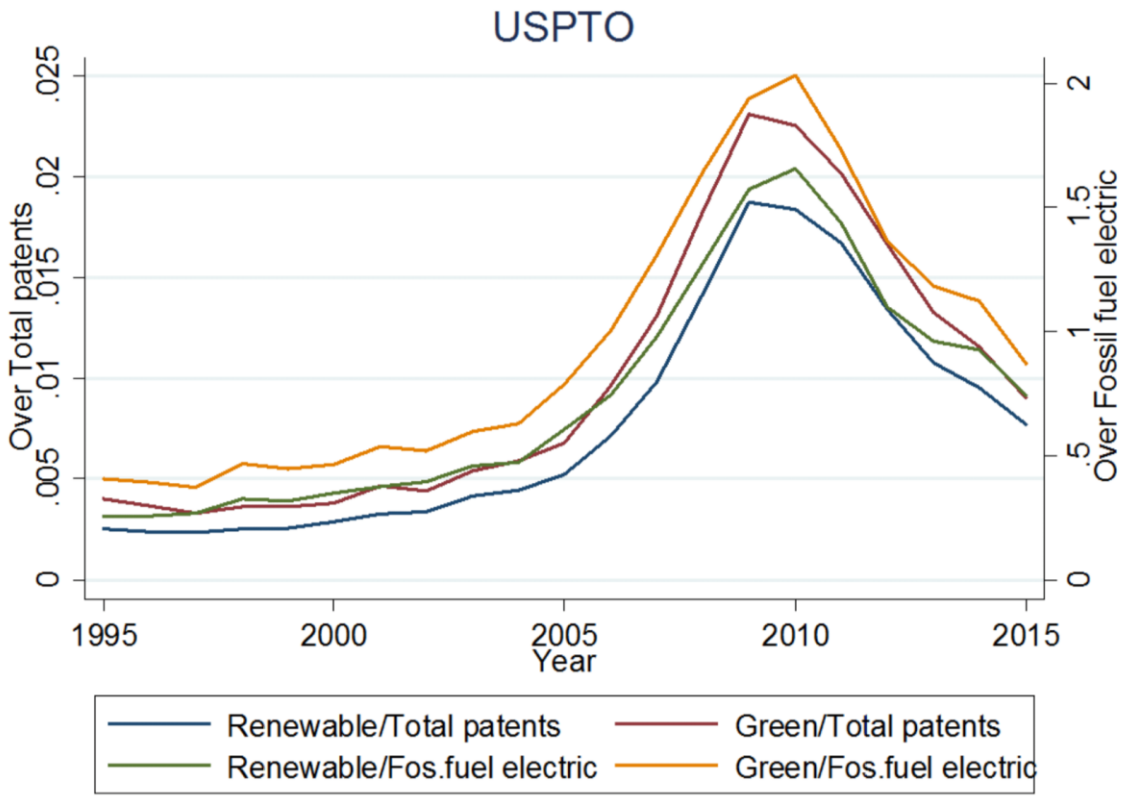
Cost of Generating Renewable Electricity 1980's–2021, various utility-scale sources



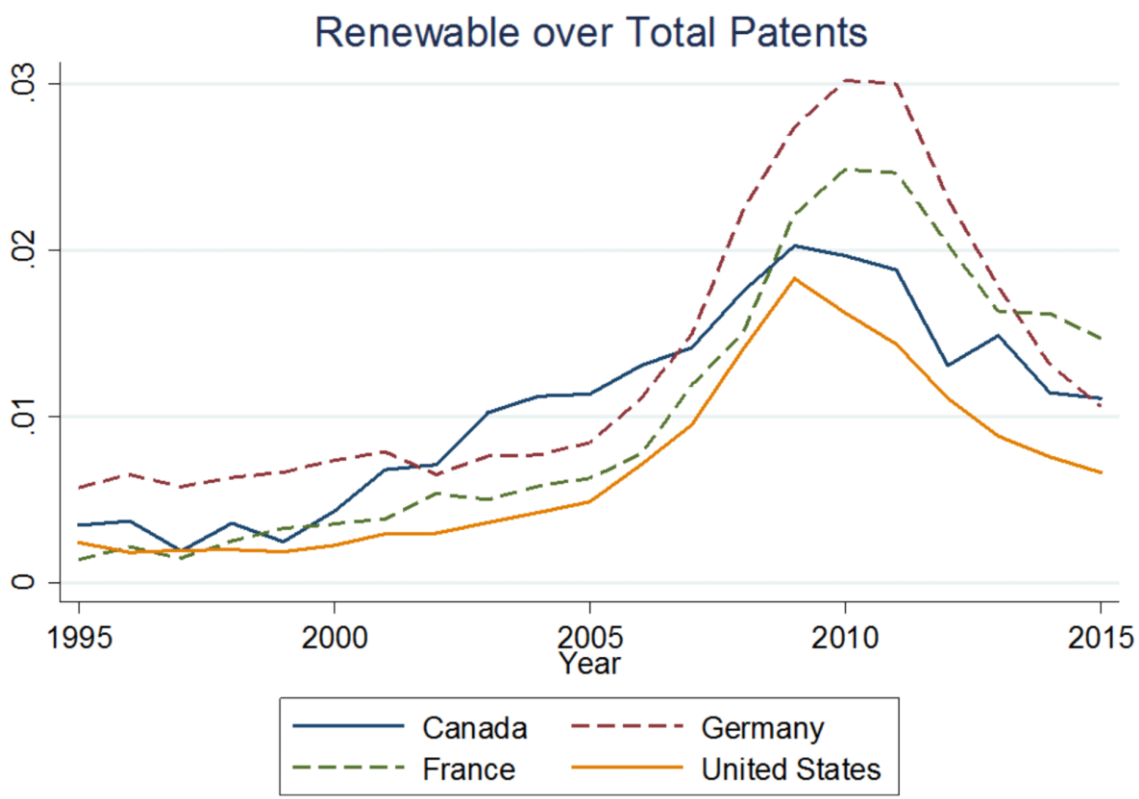
Data source: IRENA (2022), Renewable Power Generation Costs in 2021, International Renewable Energy Agency, Abu Dhabi.

Climate Change: Innovation in renewables is trending down

Ratio of Renewable or Green Patents to Total Patents or Fossil Fuel Electricity; US, 1995–2015



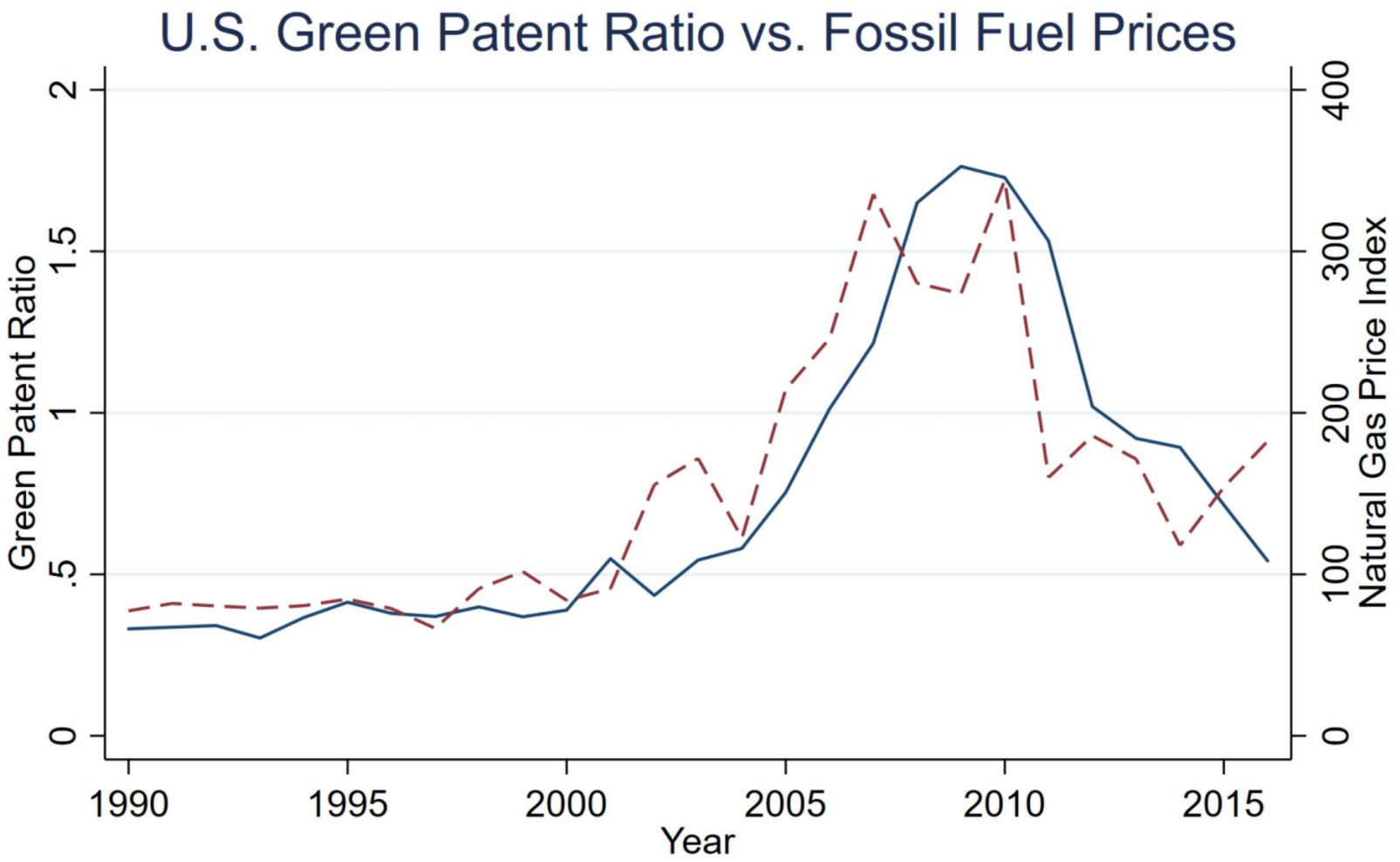
Ratio of Renewable Patents to Total Patents, various countries, 1995–2015



Exhibits from Acemoglu, Daron et al. (2020). Climate Change, Directed Innovation, and Energy Transition: The Long-run Consequences of the Shale Gas Revolution. Richmond Federal Reserve Bank, Climate Economics Workshop.

Climate Change: Shale gas expansion → reversal in green patent trends

U.S. Green Patent Ratio versus 2-year Lagged Fossil Fuel Prices



Exhibits from Acemoglu, Daron et al. (2020). Climate Change, Directed Innovation, and Energy Transition: The Long-run Consequences of the Shale Gas Revolution. Richmond Federal Reserve Bank, Climate Economics Workshop.

Democracy is good for growth

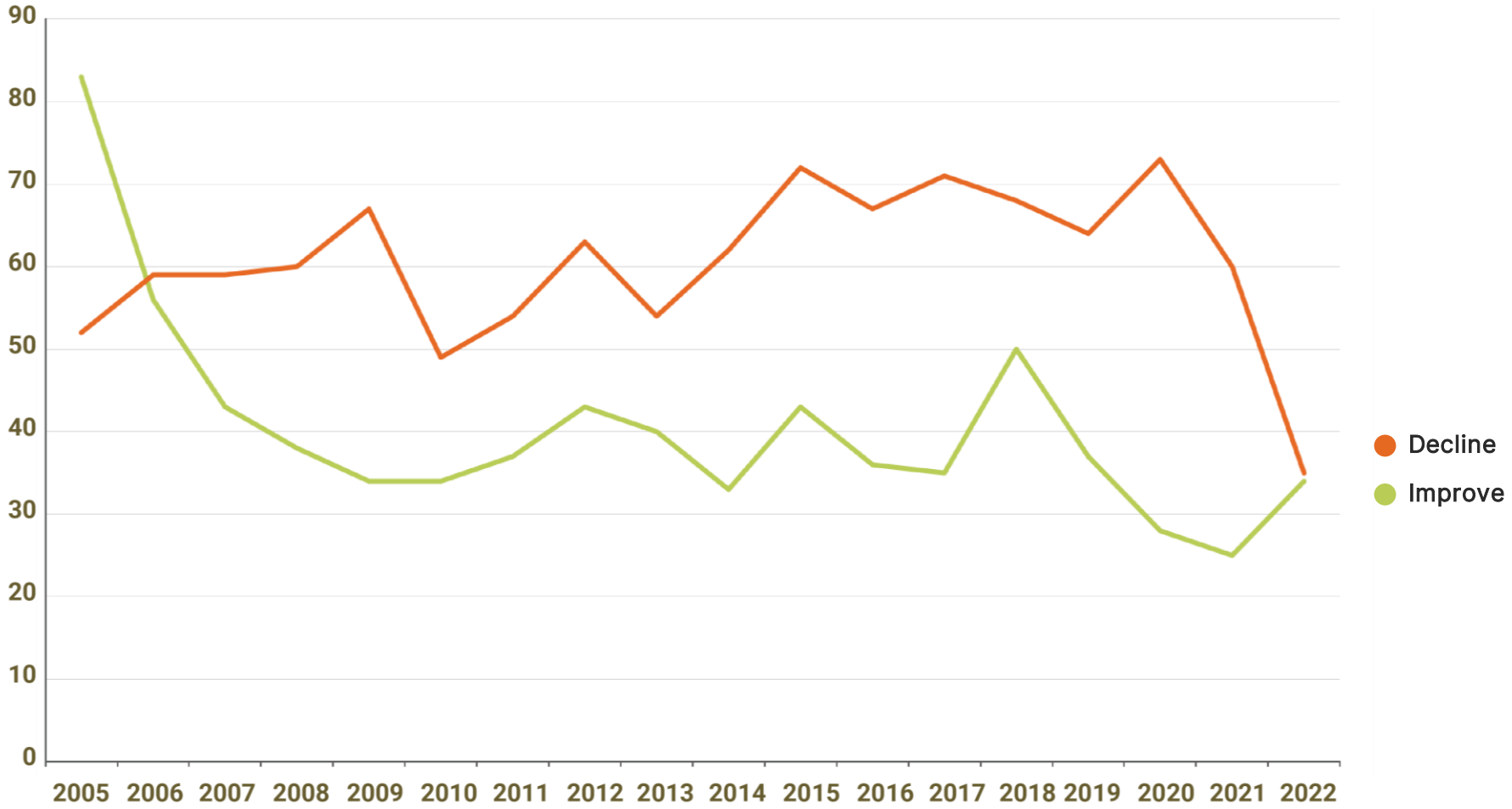
What happens to GDP after democratization?

Year 0 is the year of democratization of a previously non-democratic country

The figure plots the evolution of democratizing countries GDP per capita relative to GDP per capita of non-democracies

But democracy is in decline

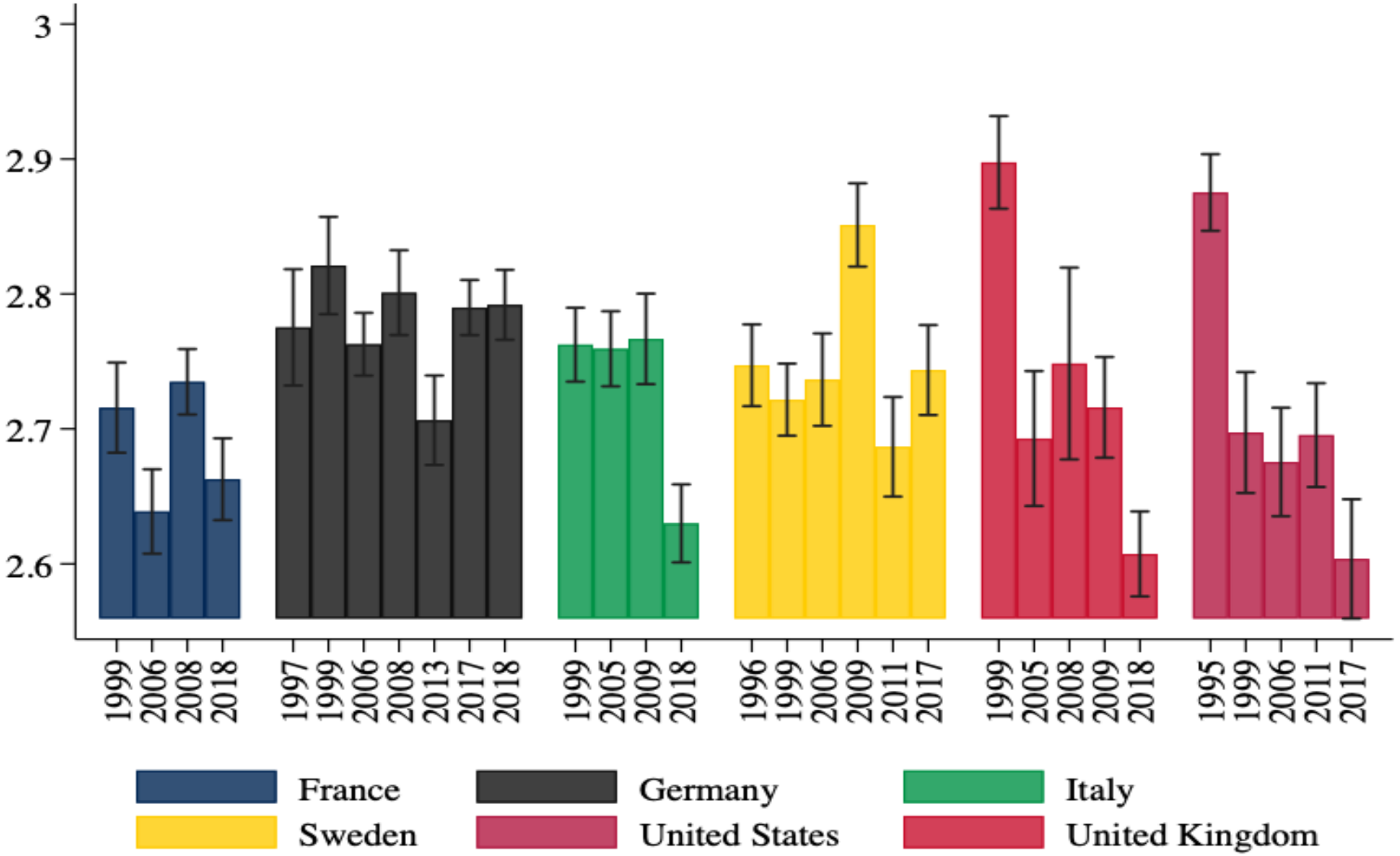
Number of countries with improving or declining democratic institutions, by year, 2005–2022



Data source: Gorokhovskaia, Shahbaz, and Slipowitz (2023), Freedom in the World 2023, Freedom House, Washington D.C.

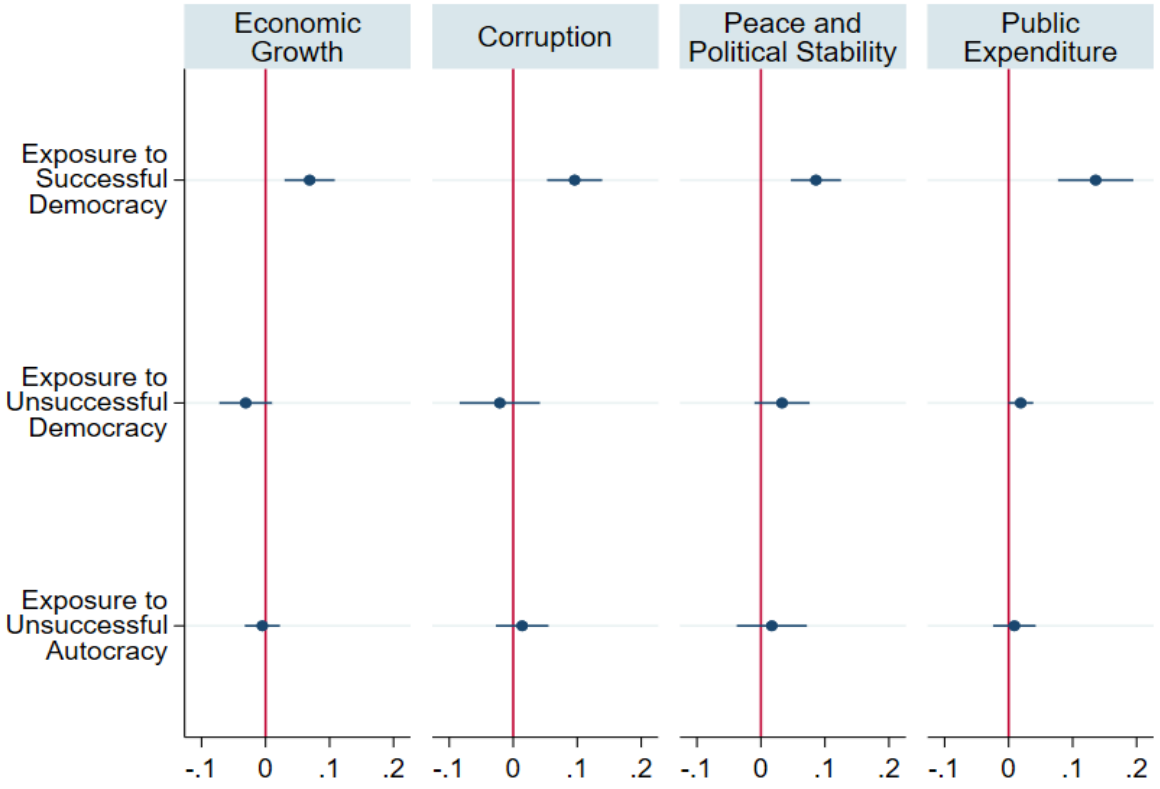
A Latin American problem of democracy

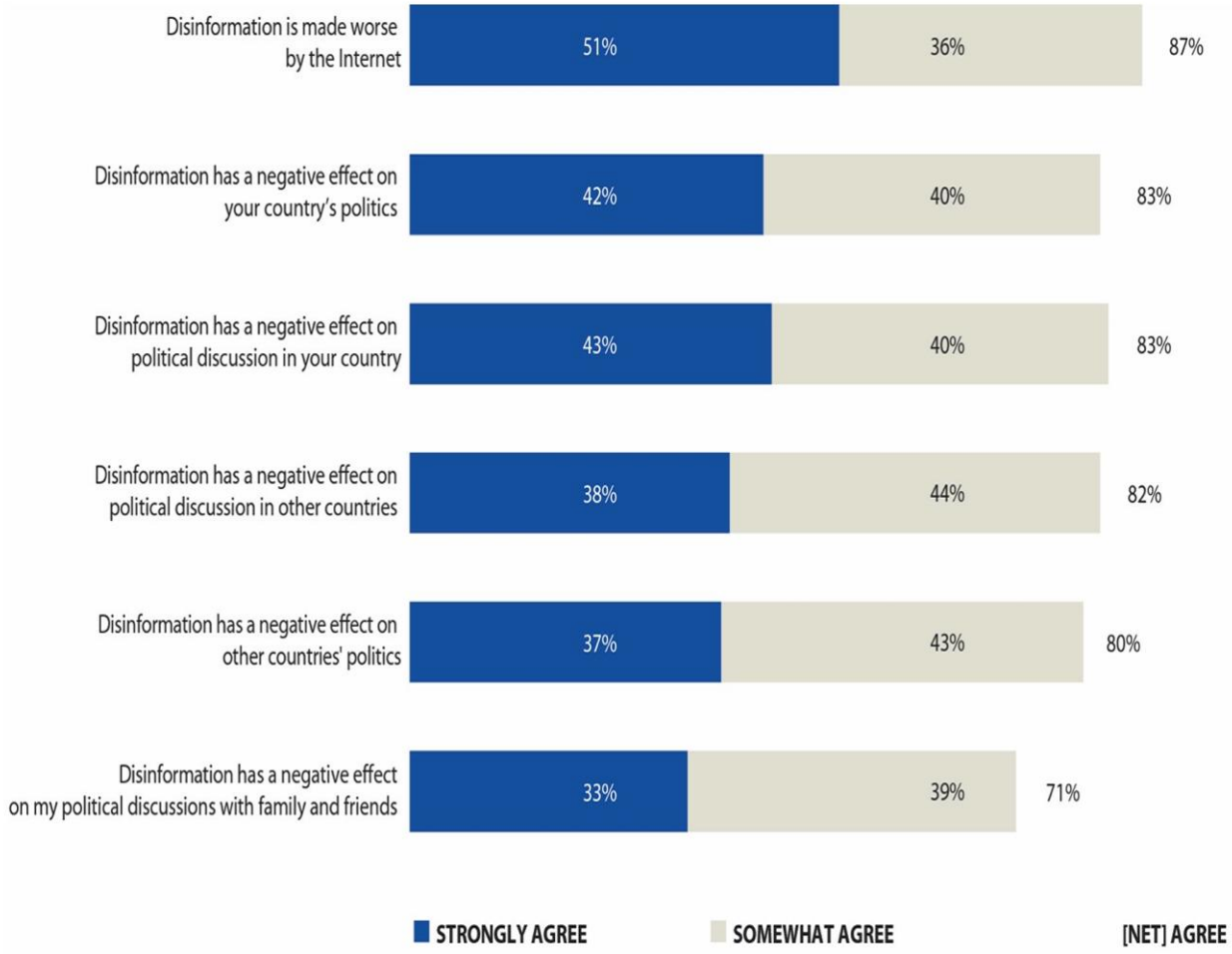
Democracy: support declining



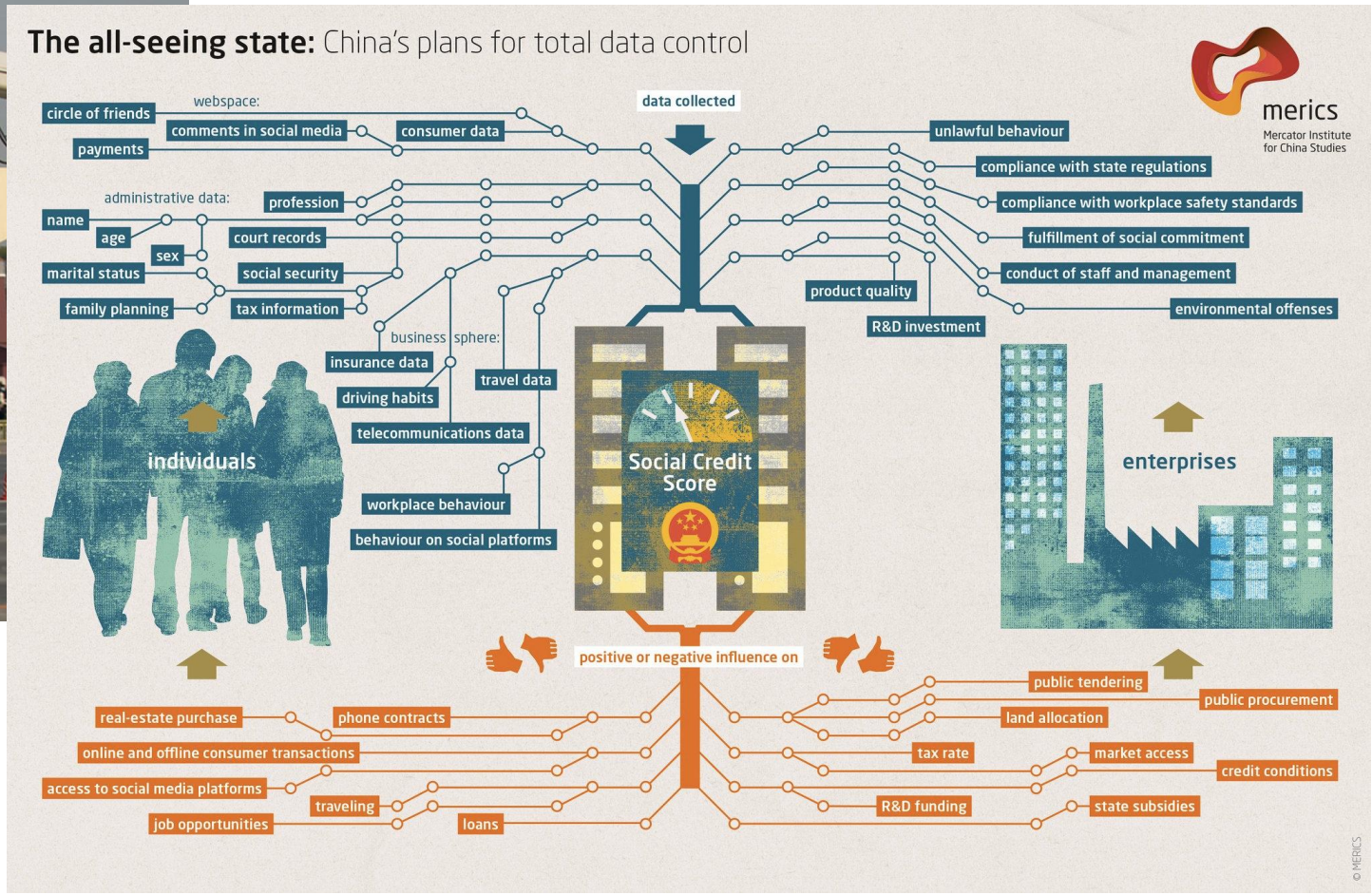
Democracy: Successful democracies breed their own support but social media may get in the way

Exposure to Successful Democracy and Support for Democracy





Technology, surveillance and democracy



AI and democracy around the world

Chinese AI/surveillance tech deployed around the world

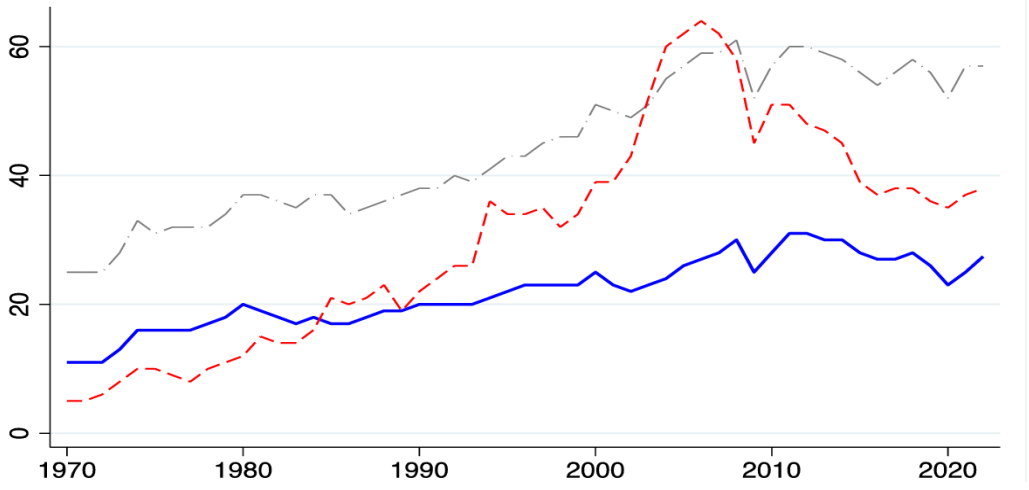
Partnerships, projects, and relationships with Chinese AI and surveillance tech companies

- Acceleration of Chinese AI surveillance tech deployment around the world, especially in Asia but increasingly in Africa and South America.
- Part of China's larger "Belt and Road Initiative" to drive global investment. Around 150 countries signed-on as of 2023.
- E.g., "smart city" projects, facial recognition and surveillance equipment, industry and academic partnerships.

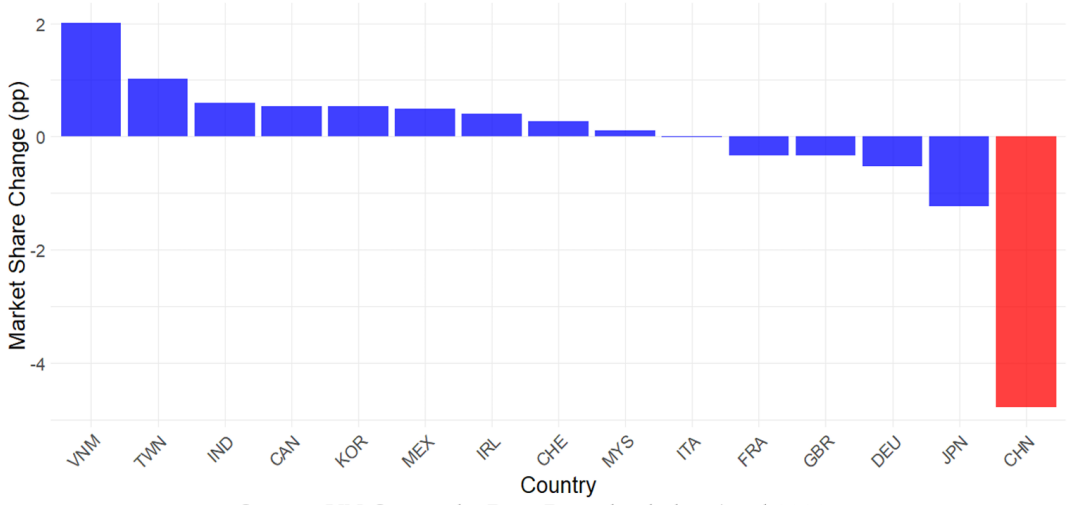
Exhibit source: Australian Strategic Policy Institute. (2021). "Mapping China's Tech Giants." International Cyber Policy Centre, ASPI.

Global order changing

Trade share of GDP: China, USA, World



Change in US Import Market Share, 2017–2022



The nature of globalization is changing.

Together with this, greater geopolitical risks.

In addition, the return of great power politics could destabilize the world.

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Conclusion

Five trends will shape the world of tomorrow.

- In each case, huge and dangerous challenges for the economy and politics of all nations around the world — but also opportunities.
- Innovation, the path of technology and investment in the right human skills will be essential in each case (for jobs, adapting to aging, combating climate change and better democratic discourse and information).
- **But innovation is not a panacea.** The direction of technology will be more critical than the overall amount of innovation (when it comes to inequality and jobs and when it comes to the impact of new technologies and AI on democracy).
- Many of these developments may also threaten existing institutional balances, so institutional adaptability will be critical as well. But strong institutions and democracy are more crucial than ever.
- Solutions will be synergistic: democratic governance will help with other challenges.