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Lessons from Past Productivity Research and Implications for Future Growth

for the
Webinar on Productivity
OECD, November 27, 2023.

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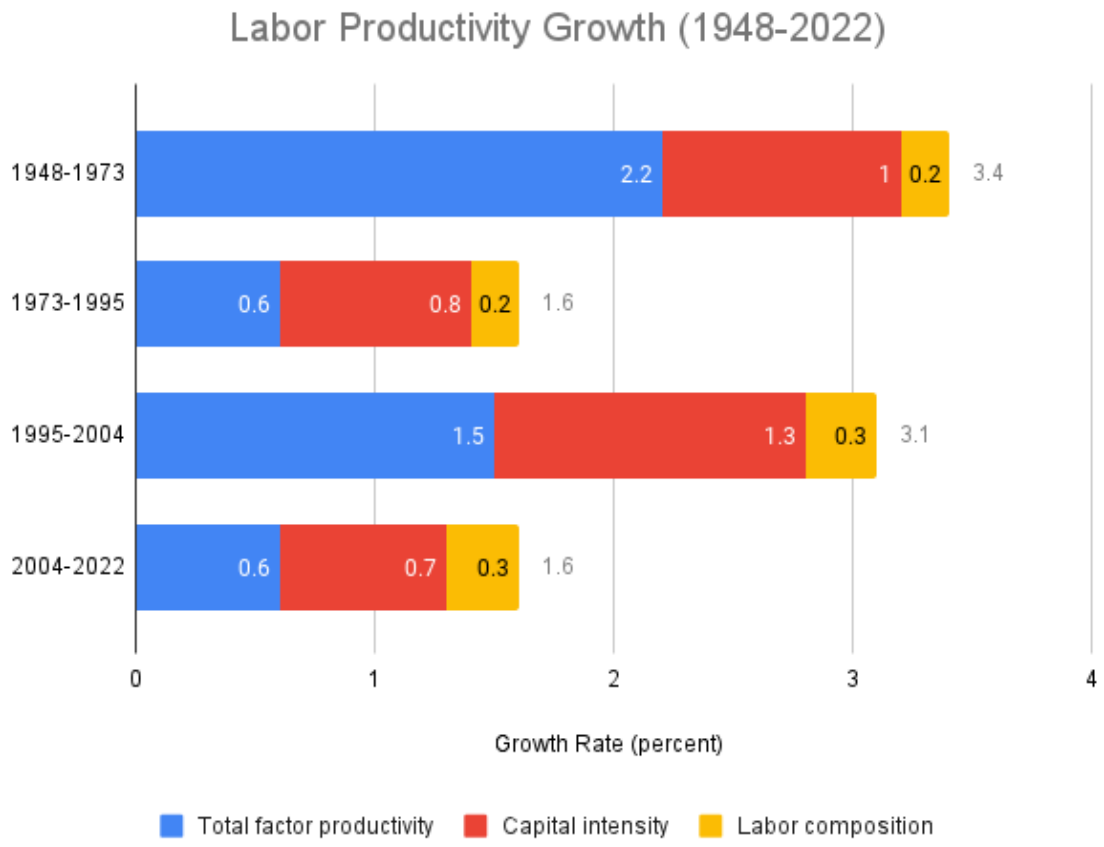
Brookings

Productivity Issues

- **Rapid productivity growth after World War II, slowed in the 1970s. Temporary surge in productivity (esp. the US) 1995-2004. Very slow productivity growth almost everywhere since then.**
- **Slow growth associated with weak capital formation and weak growth in total factor productivity. Two are connected: Weak TFP growth (plus slow labor force growth) causes weak capital formation.**
- **What drives TFP growth? Scientific and engineering advances. New business models. Better design of products and organization of production. Reallocation of capital and labor towards innovation. All of the above.**
- **Large productivity gaps between countries. Why do some lag? The gaps vary substantially by industry.**

1. US Labor Productivity Growth was rapid in the 50s and 60s. Slowed in the 70s. Recovered 95-04, and then slowed again
2. TFP Growth and Capital Contribution Move Somewhat Together.
3. Contribution of Labor Composition Small, Stable.

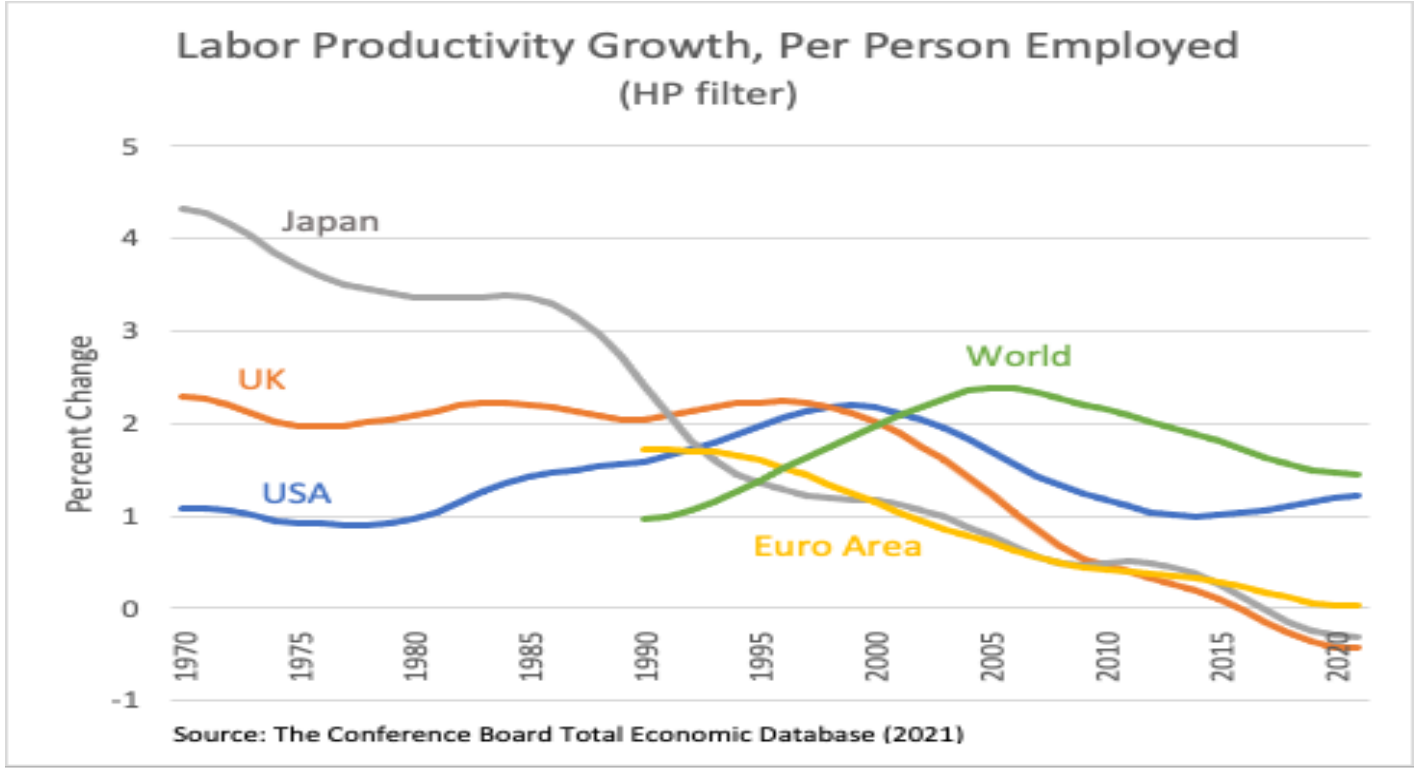
Source: BLS Total Factor Productivity Database



Productivity Growth has Slowed in Almost All Mature Economies

Productivity growth has even slowed recently in emerging economies

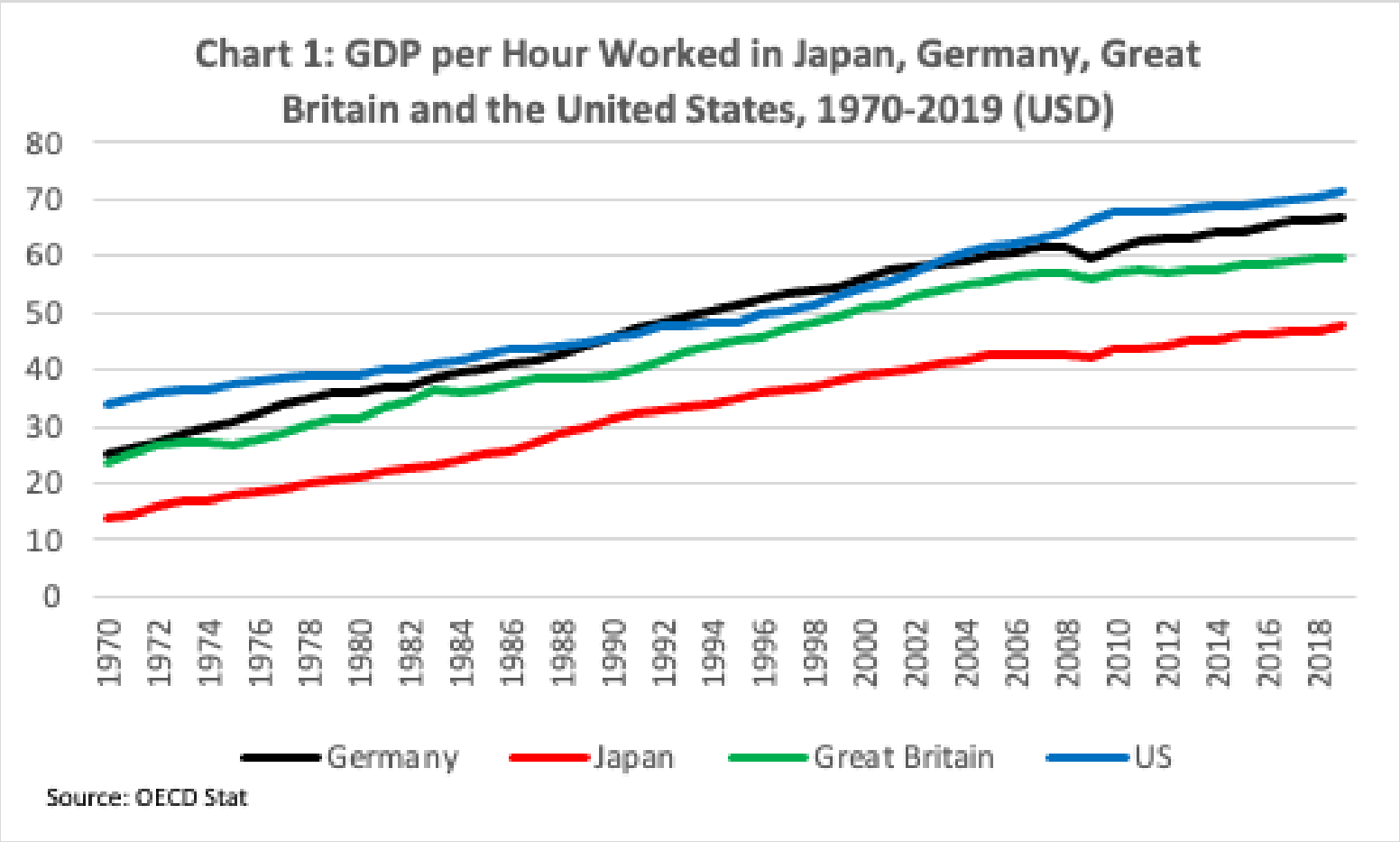
Trend growth of GDP per Person Employed using HP filter, Major Regions, 1970-2019



Source: The Conference Board Total Economy Database (adjusted version) 2021

Incomplete Convergence of Japan and the UK

Many developing economies have failed to converge



First, a look at the productivity gaps across countries.
McKinsey Global Institute looked at levels of labor productivity by industry across countries.
Academic advisors led by Solow

Capital Intensity and Technology

- **For developed economies, capital intensity rarely found to be a *major* driver of productivity differences across economies (within the same operating format).**
  - **Capital goods are available globally, auto factories or supermarkets looked very similar across countries.**
  - **Modest productivity advantage from more recent capital vintages.**
    - **Differences in capital intensity more important for developing economies**
- **The high-tech sector is small in all countries.**
- **Proprietary technology not a significant source of productivity differences across countries *for most industries*. The most productive equipment and software are for sale globally.**
    - **Proprietary technology is very important in high-tech industries**

The Role of Human Capital

- **Studies found the level of human capital *for production and non-supervisory workers* not to be important to cross-country productivity differences.**
- **Companies adapt their business processes to the labor force that is available. US companies are adept at being productive with workforces that have low educational levels and high rates of turnover.**

Can this conclusion be correct?

- **Studies did find organizational and managerial skills to be very important.**
- **A later study by LSE (Bloom and van Reenen) and McKinsey's London office found better managerial skills resulted in superior corporate performance.**
- **Germany uses labor training and skills to achieve close to US productivity.**
- **US relies on immigration of highly skilled workers, such as specialized engineers.**

What Did MGI Conclude were the Main Reasons for Cross-Country Differences?

- In operational terms, productivity differences associated with:
  - the way companies organized production,
  - the design of products and services,
  - skill in development and marketing of new products and services.
- In term of incentives:
  - Many companies and industries operated below the productivity frontier. Comfortable oligopolies, often protected by trade barriers or regulation.
  - The highest productivity manufacturing industries were those most exposed to global best practice companies
  - State-owned companies usually (not always) had lower productivity.

The Industry Pattern of Growth and the Importance of Manufacturing

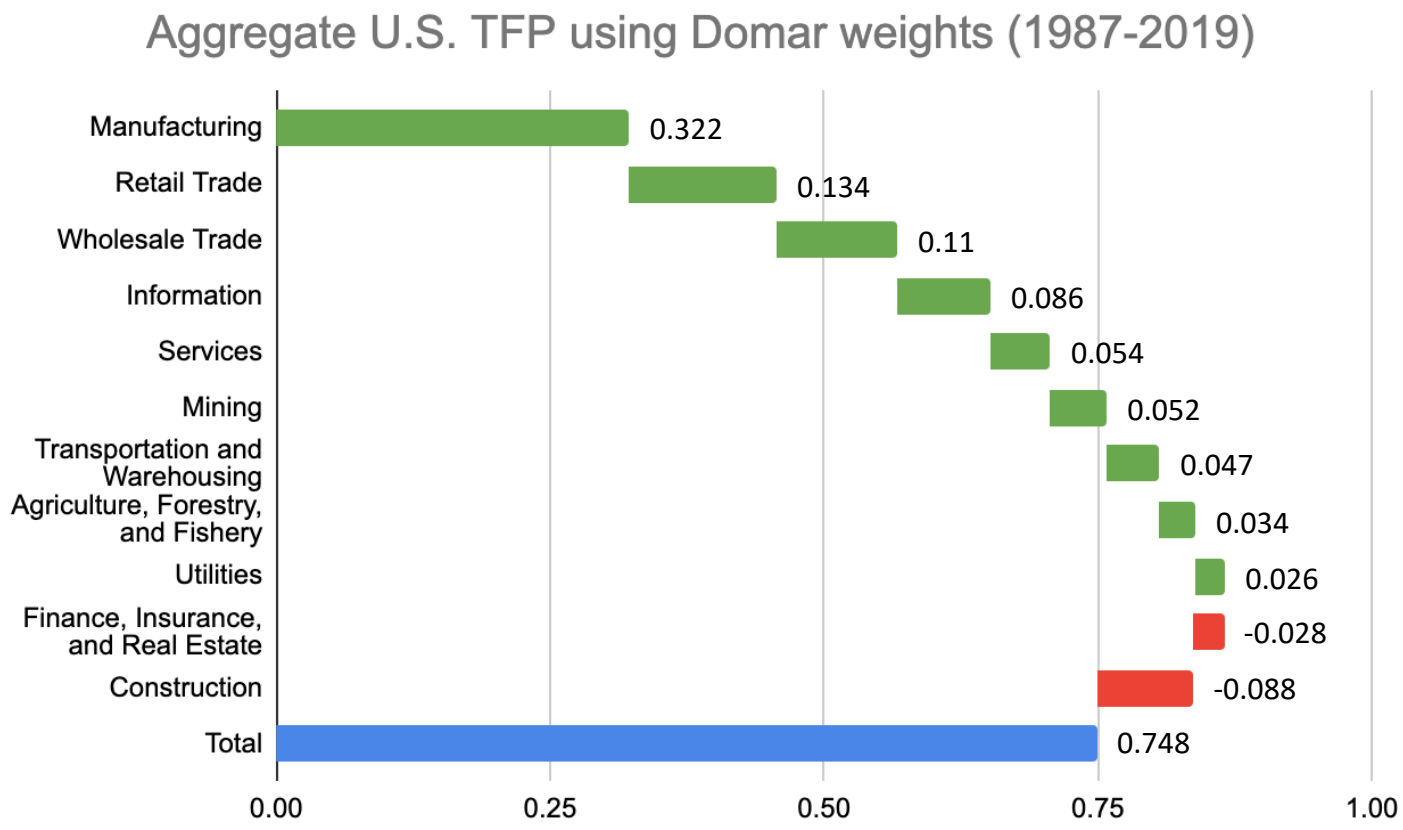
Cross-country studies did not explain *productivity growth at the frontier* or the sources of sustained productivity growth

Next two figures look at the contributions of each industry's TFP growth to the total for the private economy.
Which industries have accounted for overall private sector TFP growth?

Calculate using Domar weighting, estimates from 1987-2019.

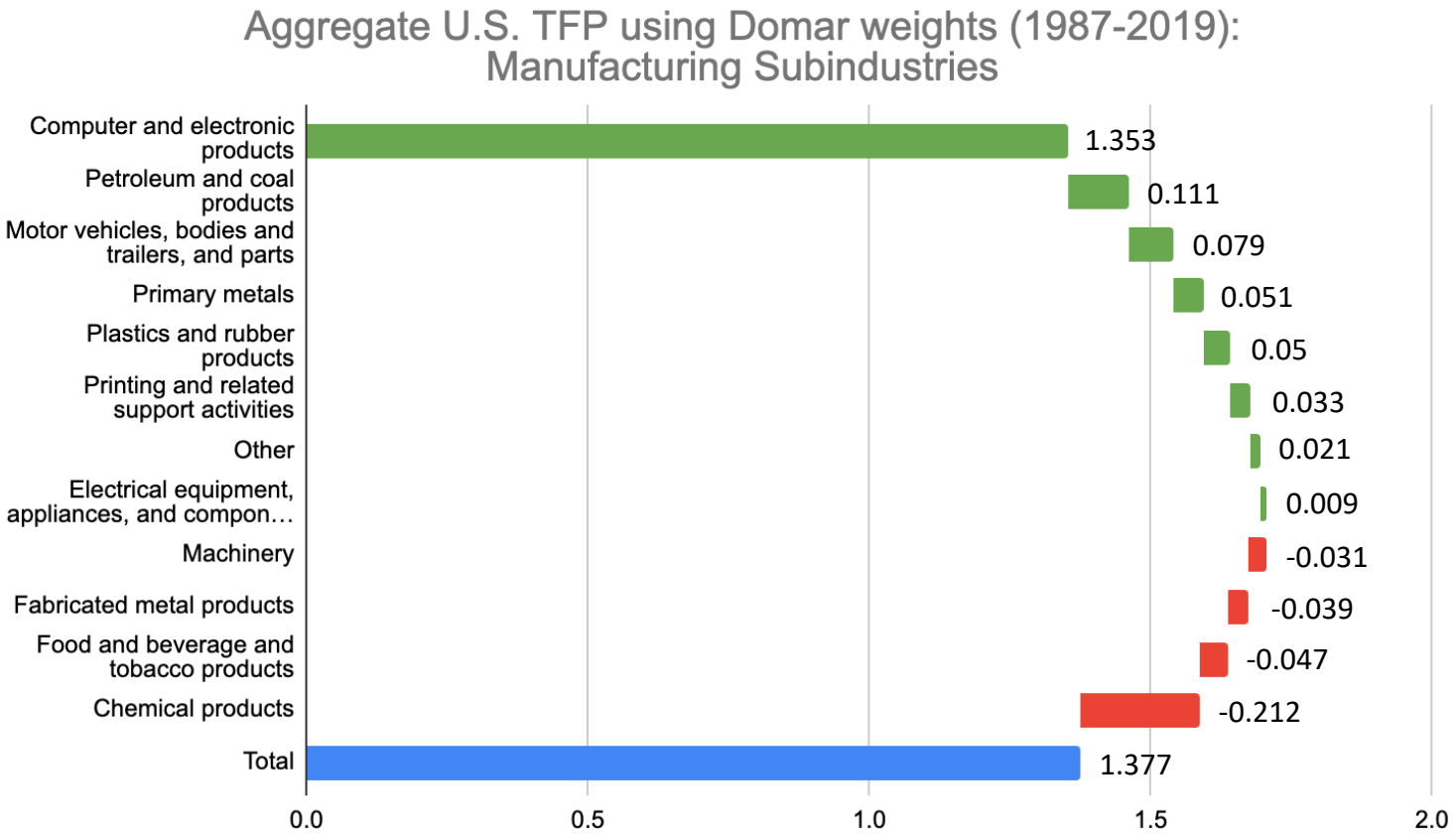
Which Industries Generated US TFP Growth? Manufacturing, Trade and Information account for over 85 percent of US TFP Growth 1987-2019

Contributions to US TFP Growth by Industry. Author's calculations: BLS total factor productivity database, Domar weights



Within manufacturing, the computer & electronics subsector is responsible for the vast majority of TFP growth.

Contributions to US TFP Growth by Manufacturing Subindustry. Author's calculations: BLS total factor productivity database, Domar weights



Manufacturing No Longer Driving US Productivity Growth Post 2004.

Total Factor Productivity Growth, CAGR, by Period			
Sector	1987-1995	1995-2004	2004-2021
Nonfarm Business	0.474%	1.517%	0.583%
Manufacturing	0.795%	1.953%	0.240%
Nondurable Manufacturing	0.228%	0.577%	-0.181%
Durable Manufacturing	1.149%	2.769%	0.683%
Comp., Electron. Prod.	7.318%	9.935%	3.244%
Utilities	2.177%	-0.203%	0.035%
Construction	-0.330%	-0.609%	-0.909%
Trade	1.568%	2.566%	0.032%
Information	-0.133%	0.859%	1.402%
Fin., Ins., Real Estate, and Leasing	-0.462%	-0.169%	0.313%
Services	-0.766%	0.293%	0.371%

Source: Author's calculations, BLS Total Factor Productivity Database. Data is expressed in percent change per year

Labor Productivity Growth Figures Show the Contribution of Capital Deepening also Declined Post-2004

Labor Productivity Growth, CAGR, by Period			
Sector	1987-1995	1995-2004	2004-2022
Nonfarm Business	1.519%	3.478%	1.537%
Manufacturing	2.627%	5.347%	0.744%
Nondurable Manufacturing	3.495%	6.106%	0.872%
Durable Manufacturing	1.538%	3.962%	0.559%

Source: Author's calculations, BLS Labor Productivity Database. Data is expressed in percent change per year

Turning to the Future: Will Artificial Intelligence Revive Growth? One view is that there will be too much growth—a Singularity!

- "The idea here [of a singularity] is that rapid growth in information technology and artificial intelligence will cross some boundary, after which economic growth will rise rapidly as an ever-increasing pace of improvements cascade through the economy." Nordhaus definition.
- Some computer scientists are pushing this idea of a fast-approaching singularity. See for example, Ray Kurzweil, 2022, "Superintelligence and Singularity", in *Machine Learning and the City: Applications in Architecture and Urban Design,* Ed. Silvio Carta, John Wiley & Sons Ltd.
- William Nordhaus is more cautious. See "Are We Approaching an Economic Singularity? Information Technology and the Future of Economic Growth", American Economic Journal: Macroeconomics 2021, 13(1): 299–332.
- Anton Korinek sees very rapid changes, posing significant dangers for workers and democracy. www.brookings.edu/wp-content/uploads/2023/12/Korinek_Senate_Statement_11.01.2023.pdf
- **I am very skeptical that there will be accelerating increases in productivity causing a singularity any time soon. Problem is too little productivity growth not too much.**

An Optimistic View of Productivity Growth from AI

- **In joint work with Erik Brynjolfsson and Anton Korinek, we suggested US labor productivity growth could double from 1.5% to 3% in nonfarm business. Will take some time before faster growth materializes (J-curve effect).**
- **Comparable to the computer and internet driven surge in the 90s, which resulted in over 3% a year productivity growth.**
- **Reasons for optimism:**
  - **Huge investments by multiple entities, rapid improvements in AI**
  - **Large language models (LLMs) could impact 80% of workforce (Elandrou et al. 2023)**
  - **Software engineers can code twice as fast using Codex (Kalliamvakou 2022).**
  - **Many writing tasks can be completed twice as fast (Noy and Zhang 2023)**
  - **Economists can be much more productivity using AI (Korinek 2023)**
  - **Call center operators 14% more productive, greatest gains to least experienced workers (Brynjolfsson, Li, and Raymond 2023)**
- **https://www.brookings.edu/articles/machines-of-mind-the-case-for-an-ai-powered-productivity-boom/**

Further Exploration of the Contribution of AI to Future Growth.

Is AI a General-Purpose Technology? If so, will it Drive Faster Growth?

Joint work with David Byrne

- **There is a view that General-Purpose technologies (GPTs) are the drivers of long run productivity growth.** (Bresnahan and Trajtenberg (1995), Lipsey et al. (2005))
  - **examples: steam power, railways, steamships, internal combustion engines, electricity, automobiles, airplanes, mass production, computers.**
- **Characteristics of GPTs: 1. Widely used across sectors. 2. Continue to improve over a long period. 3. Raise the productivity of R&D/technology development/complementary technologies.**
  - **We will explore whether a cluster of AI technologies meets these criteria and, if so, whether they will generate sustained economic growth.** (Goldfarb, Taska, Teodoridis (2023))
- **Look at whether the emphasis on GPTs as drivers of long run growth is correct.** Field (2009) asks if concept of GPTs is required to understand/explain periods of rapid productivity growth.

Conclusion

- Lesson from the cross-country studies is that countries that want to catch up to the frontier should encourage competition and bring best-practice technologies from around the world.
- Manufacturing has contributed disproportionately to US TFP growth. 1987-2019, most of this has came from computers and electronics (esp. 95-04). That is now fading, contributing to slower growth overall. Production has migrated overseas.
- Can AI provide a new growth stimulus? I am cautiously optimistic.

A Small Sample of Publications

- Martin Neil Baily, Competition, Regulation and Efficiency in Service Industries, Brookings Papers: Microeconomics 2, 1993.
- Martin Neil Baily and Hans Gersbach, "Efficiency in Manufacturing and the Nature of Competition," Brookings Papers on Economic Activity, Microeconomics, 1995.
- Martin Neil Baily and Alan Garber, “Health Care Productivity” Brookings Papers on Economic Activity, Microeconomics; 1997.
- Martin Neil Baily and Eric Zitzewitz, “Extending the East Asian Miracle: Microeconomic Evidence From Korea,” Brookings Papers on Economic Activity, Microeconomics, 1998.
- Martin Neil Baily and Robert M. Solow, “International Productivity Comparisons Built from the Firm Level,” Journal of Economic Perspectives, 15 (3), Summer 2001.
- William W. Lewis, The Power of Productivity: Wealth, Poverty, and the Threat to Global Stability, University of Chicago Press, 2005.
- Increasing Global Competition and Labor Productivity: Lessons from the US Automotive Industry, McKinsey Global Institute, McKinsey & Company, November 2005.
- Martin Neil Baily, 2023, Lessons from a Career in Productivity Research: Some Answers, A Glimpse of the Future, and Much Left to Learn, International Productivity Monitor, Spring.
- Martin Neil Baily, 2023, Machines of the Mind: The Case for an AI-Powered Productivity Boom, Brookings, May 10, 2023, https://www.brookings.edu/articles/machines-of-mind-the-case-for-an-ai-powered-productivity-boom/