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Economic Impact of AI and Technology: Three case studies

NABE Economic Policy Conference

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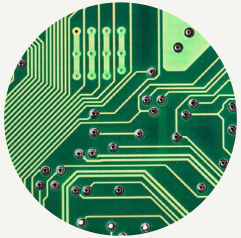
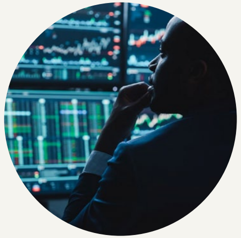
Today’s agenda



Global Productivity Dynamics

Global regulations will have an impact on regional deployment



Productive Use of Agents

A case study on helping customer service representatives

Robotic Enablement

Reducing labor market stress and creating agility in manufacturing

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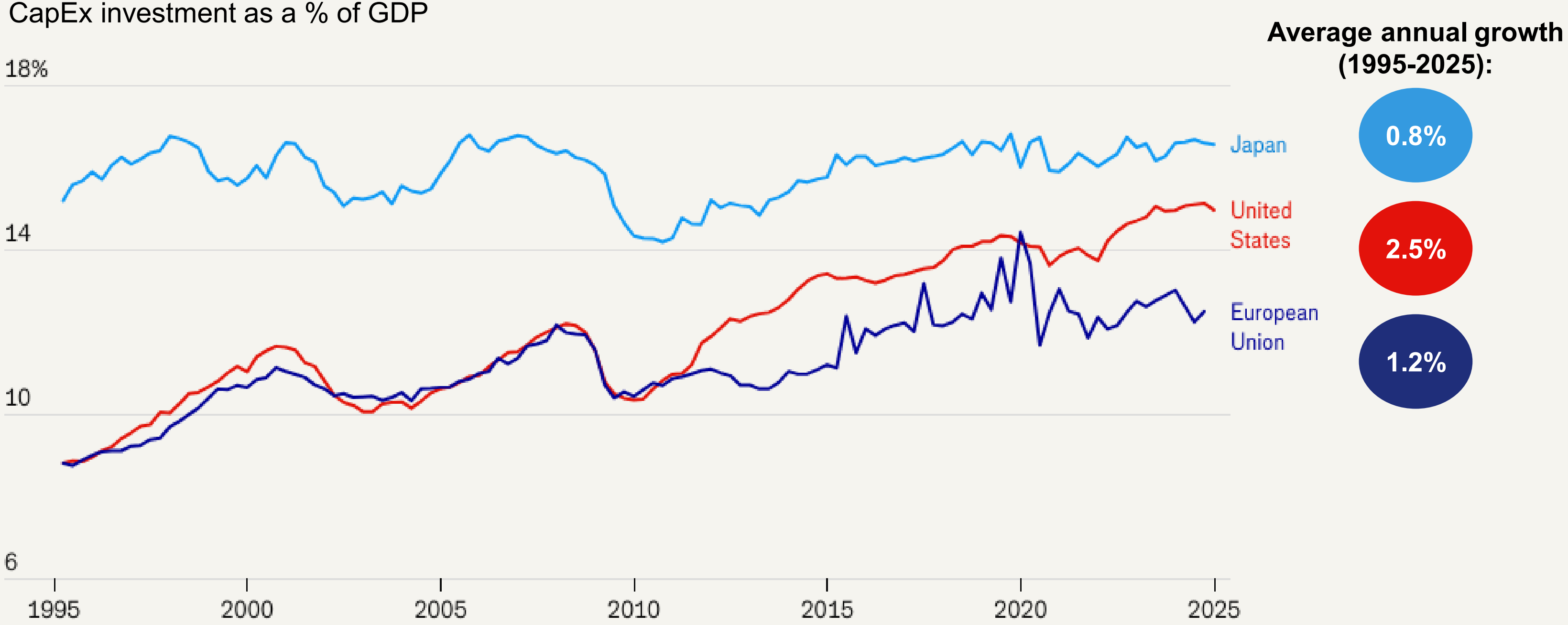
Japan has tried to use fixed asset investment to boost GDP

US businesses are investing more than their European counterparts

CapEx investment as a % of GDP



Note: US: Nonresidential fixed investment; EU: IP, machinery & equipment, transportation equipment, and bio resources; Japan: plants & equipment

Source: Bureau of Economic Analysis, EuroStat, Japan Cabinet Office, EIU.

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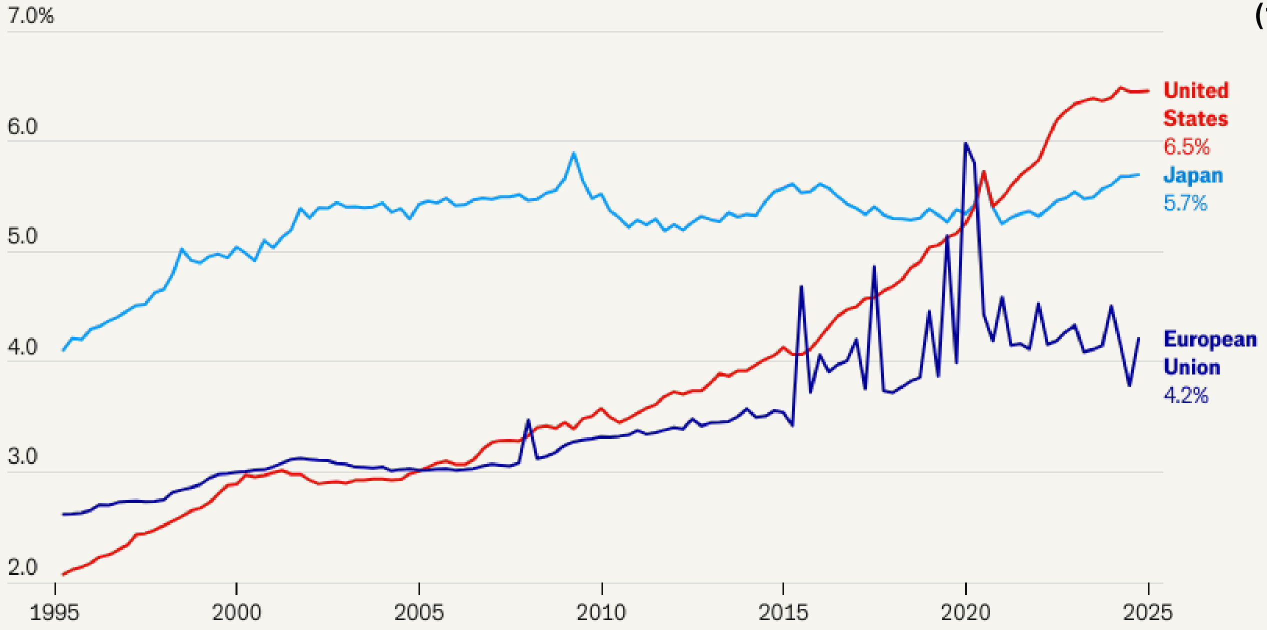
IP investments have a compounding effect on growth

US IP investment has outstripped Europe and Japan

Intellectual property (IP) investment as a % of GDP



Average annual growth (1995-2025):

- United States: **2.5%**
- Japan: **0.8%**
- European Union: **1.2%**

Source: Bureau of Economic Analysis, EuroStat, Japan Cabinet Office, EIU.

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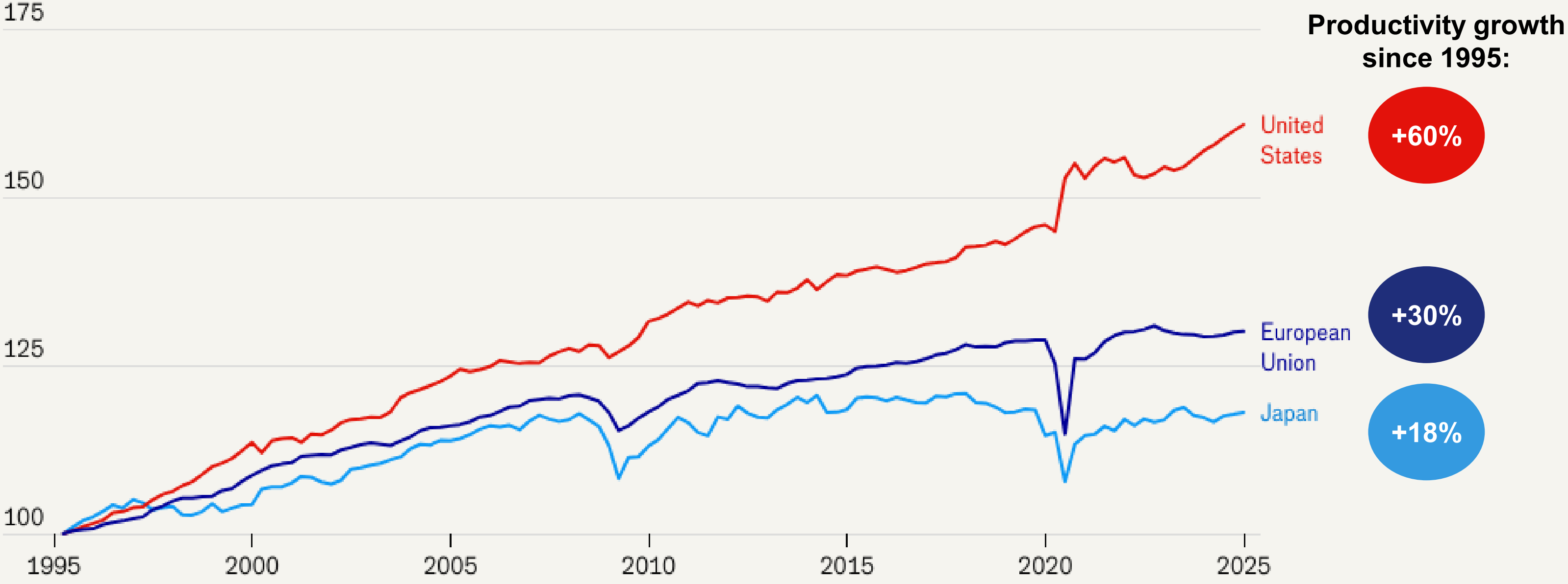
U.S. productivity gains due to multiple factors, including IP in

US productivity has grown twice as fast as the EU and three times as fast as Japan

Output per employed person; indexed to Q1 1995



Source: Bureau of Labor Statistics, EuroStat, Japan Cabinet Office, EIU.

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Technology can impact the capital, labor, productivity mix in differe

- Augment a specific labor type—e.g., increase the productivity of labor in tasks it is already performing
- Augment capital with better software or more efficient production
- Automate work by enabling capital to perform tasks previously allocated to labor
- Create new tasks which both increase productivity and wages

Source: Acemoglu et al (2024), EIU.

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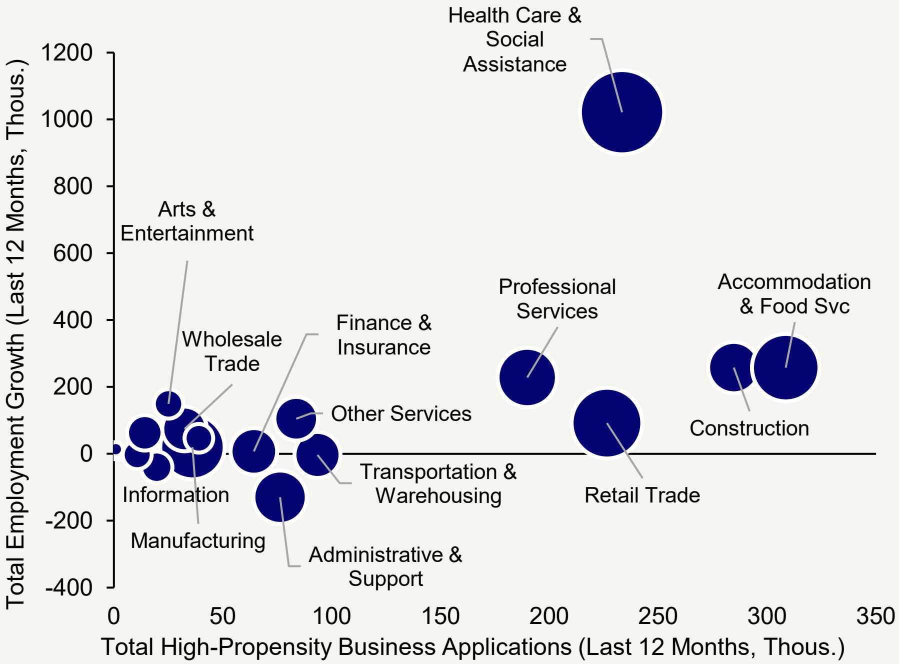
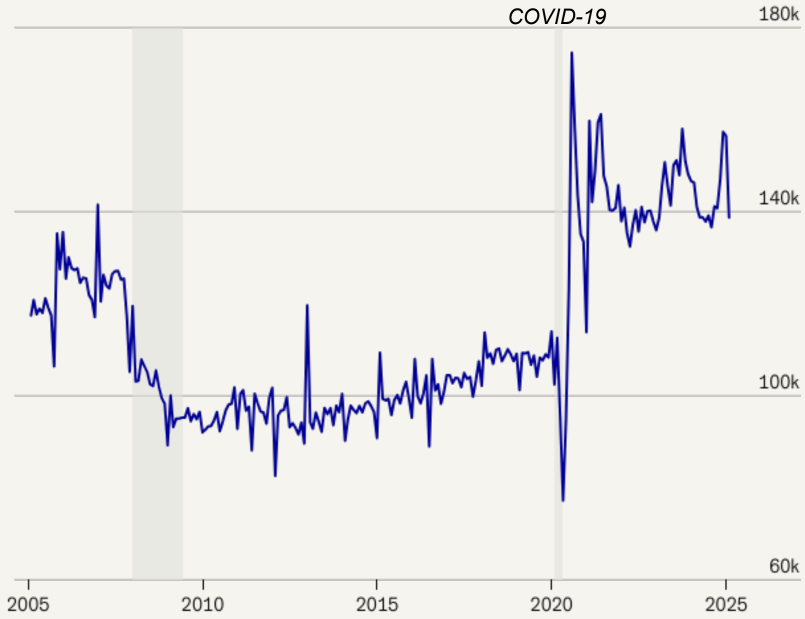
New business formations also driving productivity growth

Jobs Growth Aligns With Business Formation
Employment growth vs. business applications



New businesses use new technology
High-propensity business applications, Thous.



Newer companies tend to be more productive adopting new technology at a faster pace, this helps drive tech diffusion economy-wide

Source: Bureau of Labor Statistics, Census Bureau, EIU.

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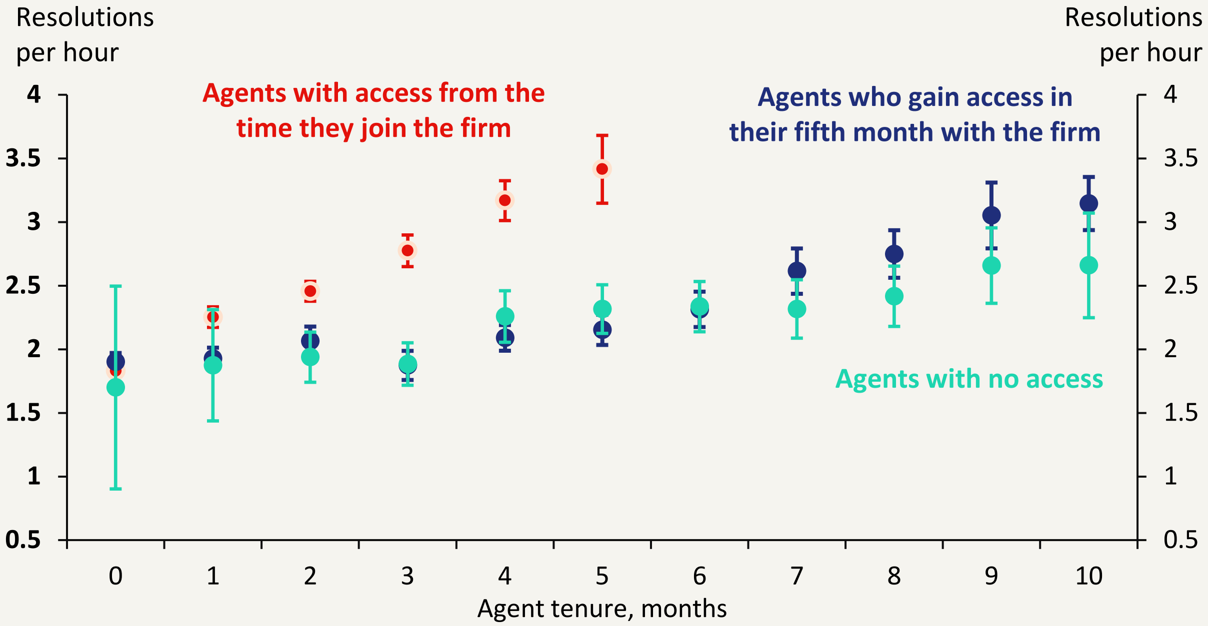
AI augmentation for customer service shows high productivity

Productivity of Customer Support Agents and AI Support

Brynjolfsson, Li, Raymond (2023)



By observing successful conversations, the system can glean the behavior of the most skilled agents and pass on these behaviors as suggestions to novice and less skilled workers.

The **lowest performers improve 35%.** The best stay the same or sometimes lose productivity due to listening to the AI over their superior instincts.

Source: Brynjolfssen and Li (2023), NBER Reporter 1:2024, MacroPolicy Perspectives

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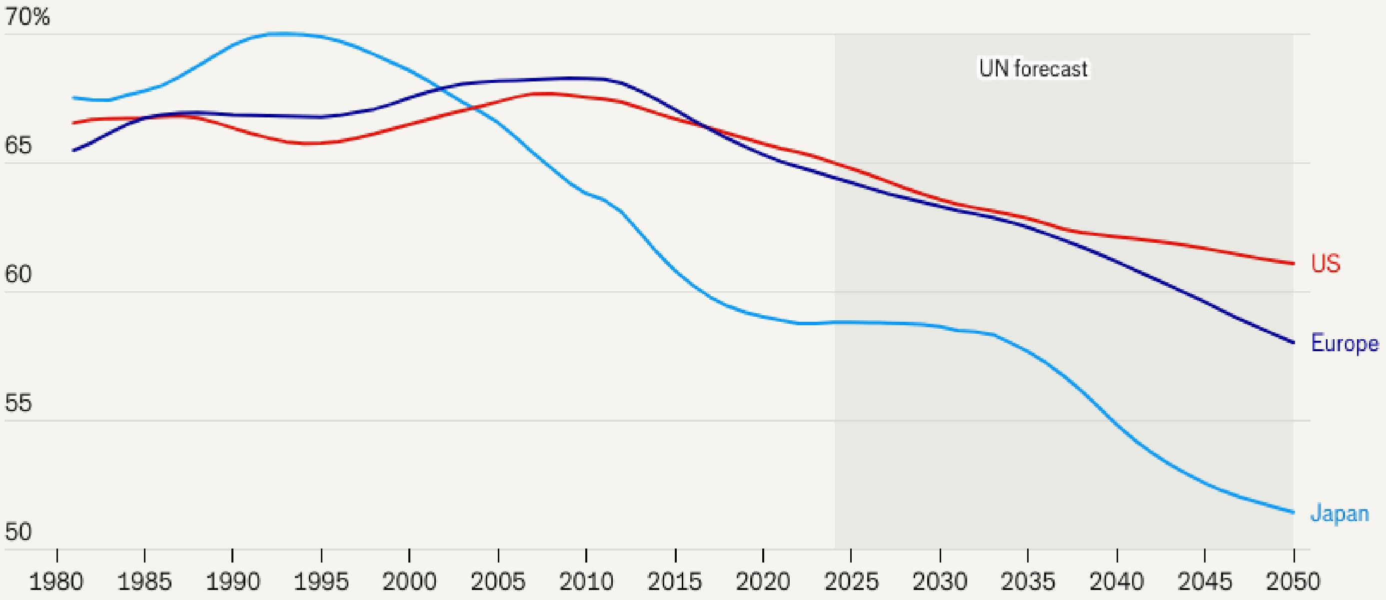
Aging population requires labor saving technology

Working age populations are shrinking in advanced economies

Population ages 16-64 as a % of total population; 1980-2050



Source: UN Population Estimates (medium fertility), EIU.

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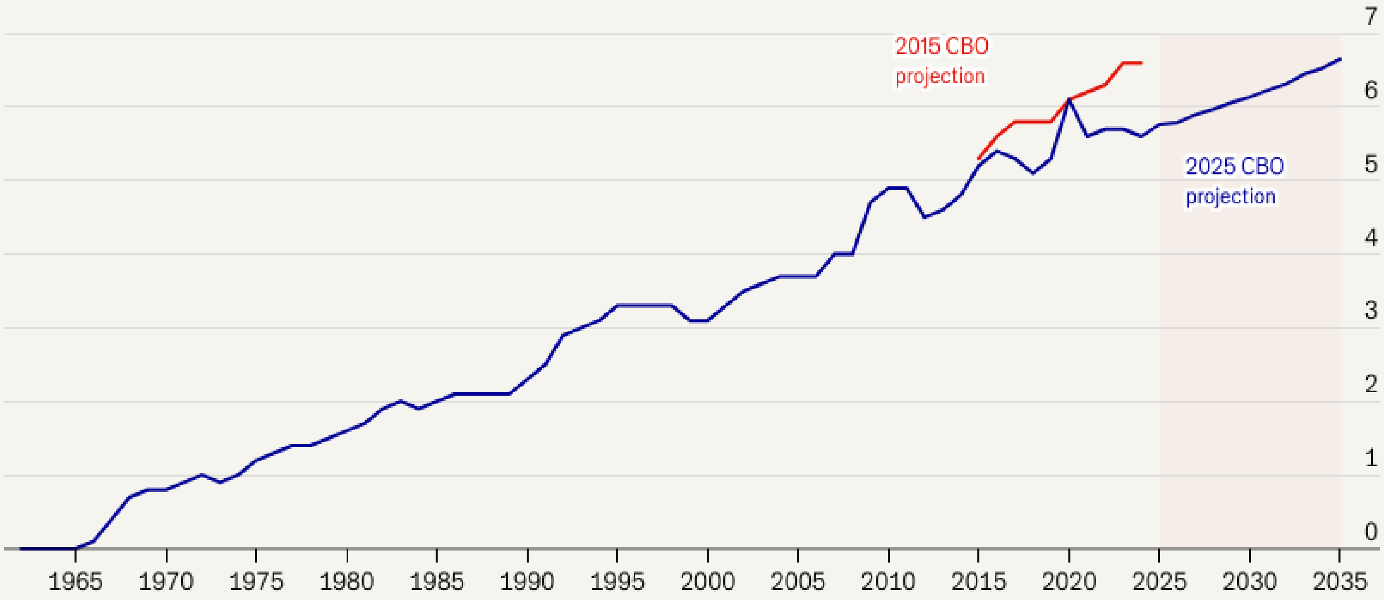
CBO forecasts are absent likely technology cost savings

Technology is crucial to bending the healthcare cost curve

Federal spending on major healthcare programs (% of GDP)



Source: Congressional Budget Office (CBO), EIU.

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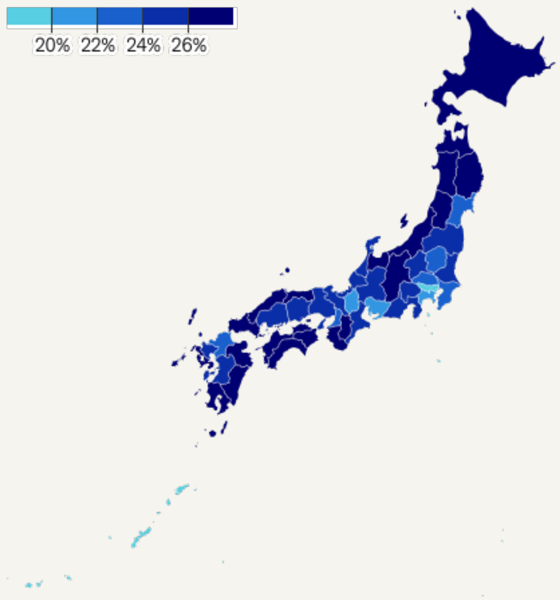
Japanese economy has acute shortage of care workers for el

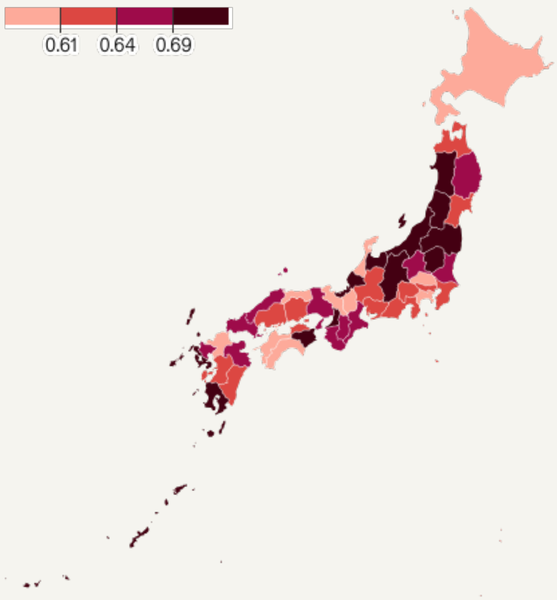
23% of Japan's population is over the age of 70

Proportion of population ages 70+, 2023



Most nursing home residents require constant care

Proportion of nursing home residents requiring level 4/5 care, 2021



Source: Statistical Office of Japan, Eggleston, Lee, Iizuka (2021)

AI enabled robots reduce staff and patient injuries and lower

- Research shows that adoption of robots in nursing homes increased retention, worker-flexibility, care quality, and productivity.
- Complementary care robots were the most adopted, freeing up employees to focus on “human touch” tasks.
- Adoption led to a reduction in wages for full-time staff at nursing homes. Researchers believe this reflects a reduction in caregiver burden during night shifts.
- Robots were more compliments than substitutes and they allowed for easier division and coordination of tasks.

Source: Eggleston, Lee, Iizuka (2021)

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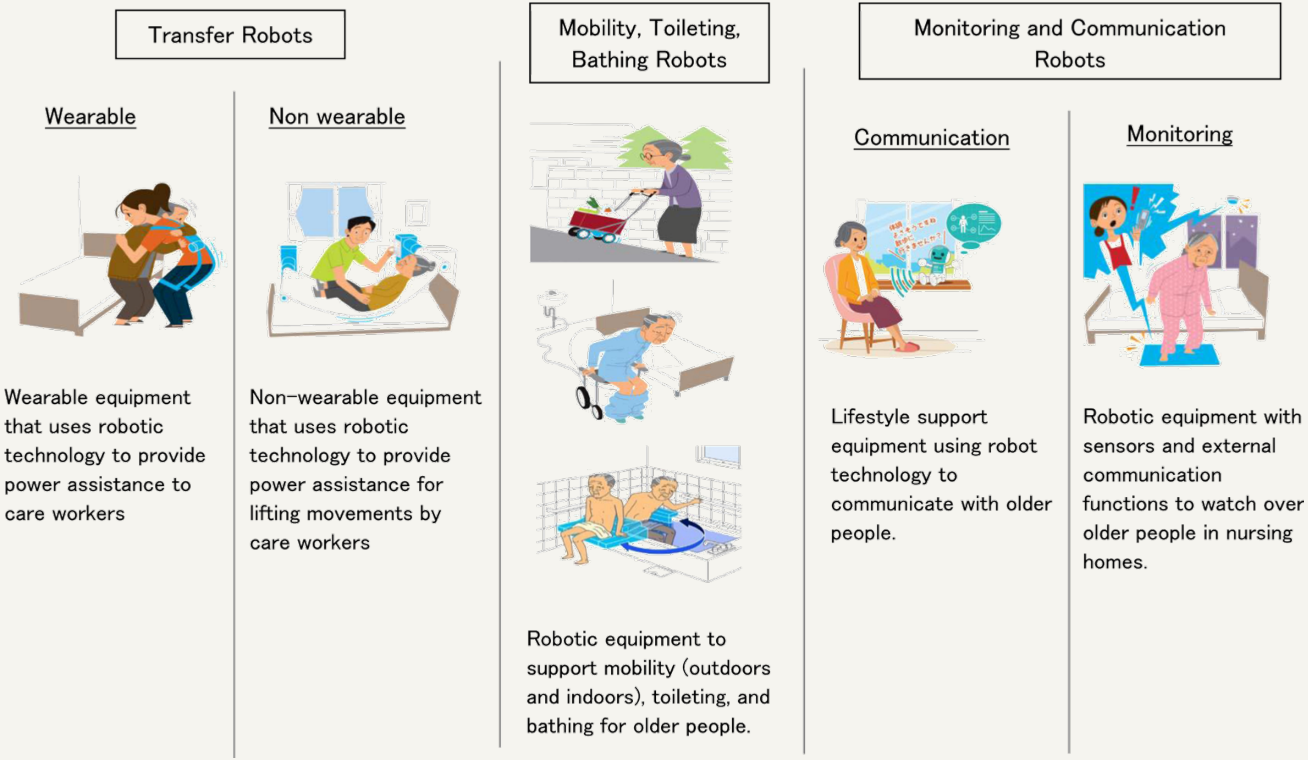
AI enabled robots can reduce the burden of care on health ai



Source: Eggleston, Lee, Iizuka (2025)

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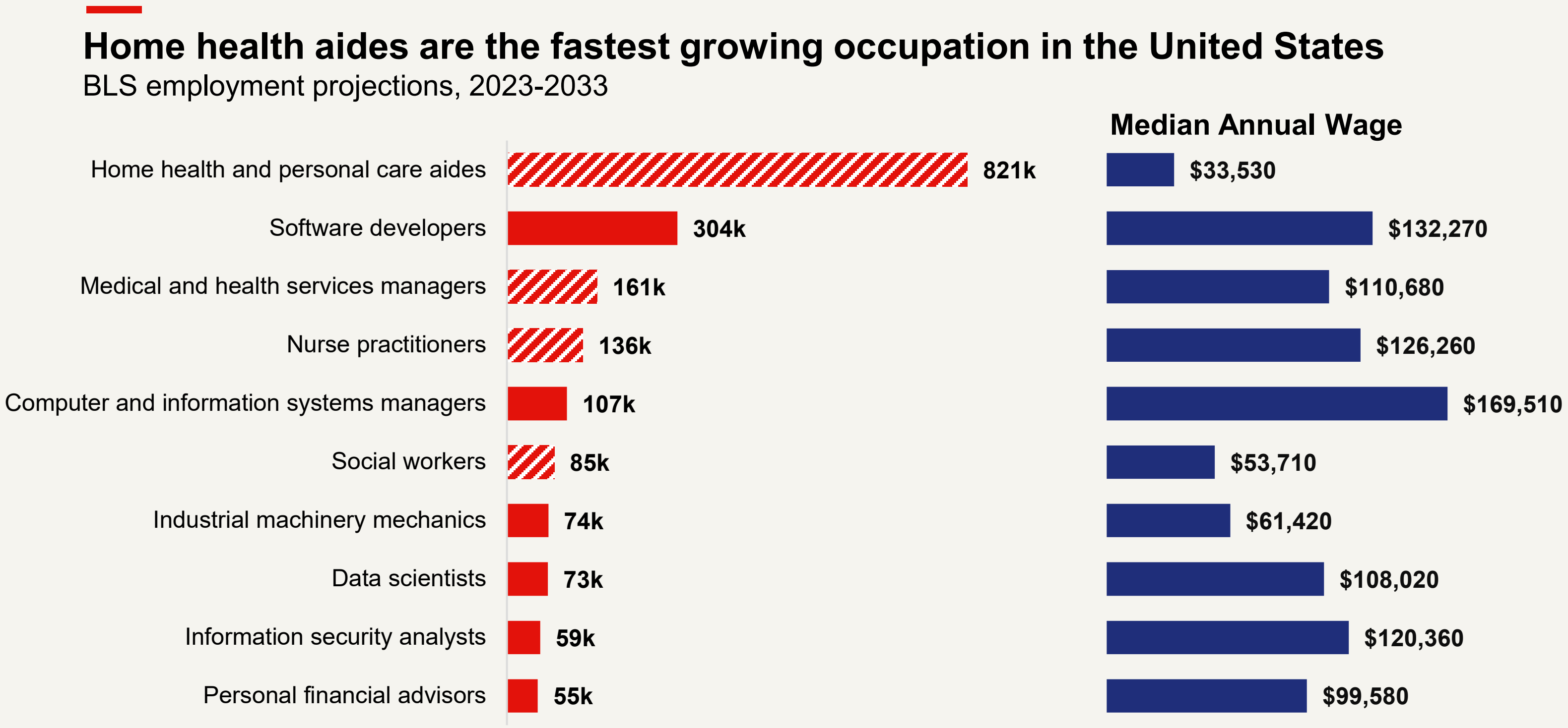
Home health worker and personal care worker shortage is in



Source: Bureau of Labor Statistics, EIU.

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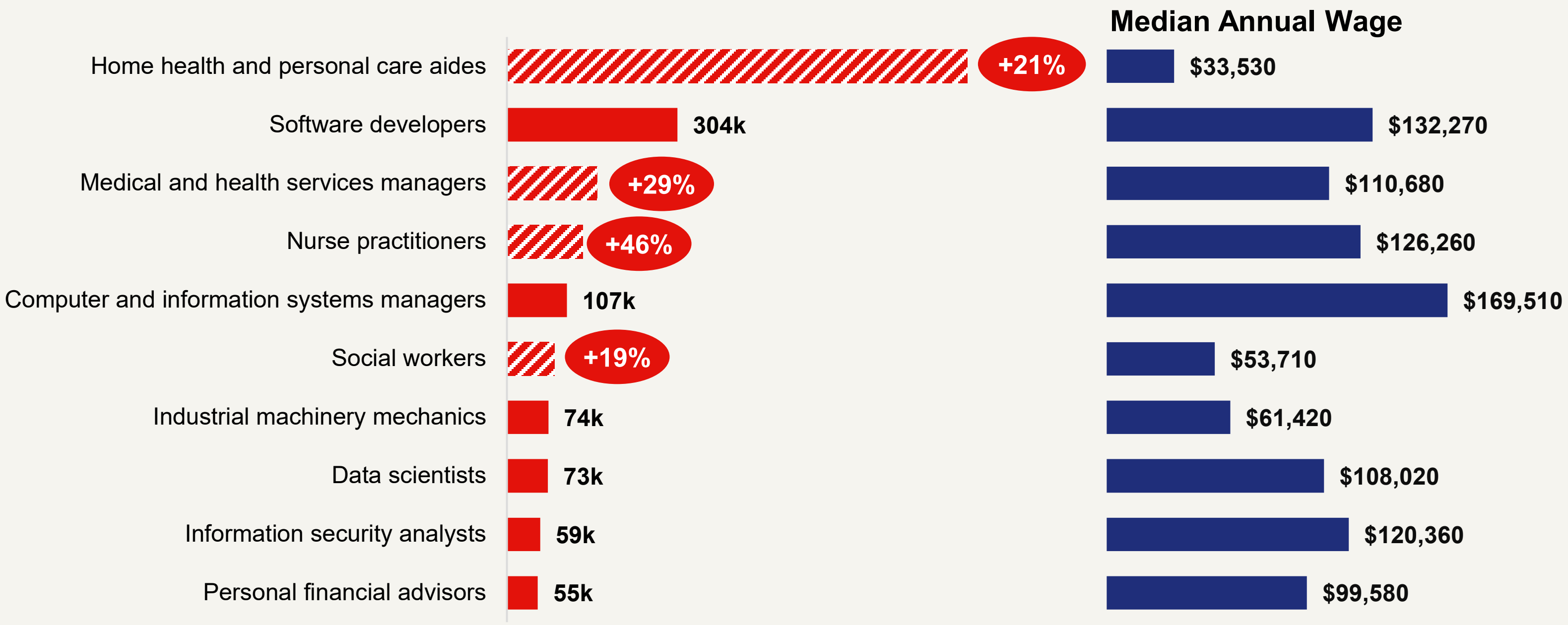
Median annual income is double what home health aides are

Home health aides are the fastest growing occupation in the United States

BLS employment projections, 2023-2033



Source: Bureau of Labor Statistics, EIU.

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Digital twins are becoming more sophisticated and productive

Definition: A digital twin is a virtual model of a physical object, system, or process, enabling real-time simulation and decision-making.

- **Types of Digital Twins**:

- **Product Twins**: Represent products at different lifecycle stages, providing real-time performance insights.
- **Data Twins**: Digital representations of data environments, like Google Maps for real-time navigation.
- **Systems Twins**: Model interactions in processes like manufacturing and supply chain management.
- **Infrastructure Twins**: Virtual models of physical structures like roads, buildings, and stadiums for monitoring and maintenance

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McKinsey research shows significant adoption in the tech ind

- **Applications & Benefits**:
  - Enhances **efficiency, agility, and resilience** in industries.
  - Helps organizations anticipate disruptions in **supply chain management**.
  - **70% of enterprise tech executives** are investing in digital twins.
  - **Projected market growth** of 60% annually, reaching **$73.5 billion by 2027**.
- **Key Value Proposition**:
  - Enables **scenario simulation, predictive analytics, and real-time decision-making**.
  - Drives **innovation, operational optimization, and cost reduction**.

Source: McKinsey & Company (2024), EIU.

Case study from the auto industry examines digital twins

- Shift from ICE to Hybrid to EVs required factories to change assembly lines and materials within a short time window.
- The development and utilization of a modular, affordable, safe human–robot interaction and highly performant intelligent robot is critical to enable the changes in production lines.
- This study explores the implementation of automation and the initial strides toward transitioning from Industry 4.0 to 5.0, focusing on three recognized, large, and automotive companies operating in the north of Portugal.
- By examining the interconnected domains of digital transformation (DTR) and digital twins (DTWs), exploring their important roles in shaping the factory of the future (FoF).
- At the heart of this transformation lie the Internet of things (IoT) and the industrial Internet of things (IIoT), offering a conduit to usher in the circular economy (CE).
- The concept of the DTW emerges as a bridge between virtual simulations and real-world operations. This seamless exchange of data between digital and physical twins (PTWs) in real time empowers operational efficiency, smart manufacturing (SM), and informed decision-making.

Source: Rahmani, Jesus, and Lopez (2024), EIU

Manufacturing likely to see productivity agility and boost

Industry 3.0
Digital Revolution

Computerization and automation, integration of electronic systems for manufacturing in industrial processes

Industry 4.0
Smart Factory

Customization of products with the use of smart technology, internet of things, artificial intelligence and cyber-physical systems

Industry 5.0
Human-Robot Interface

Collaboration between humans and machines, emphasizing complex decision-making by humans and strengths of robots for enhanced productivity

Industry 6.0
Cognitive Manufacturing

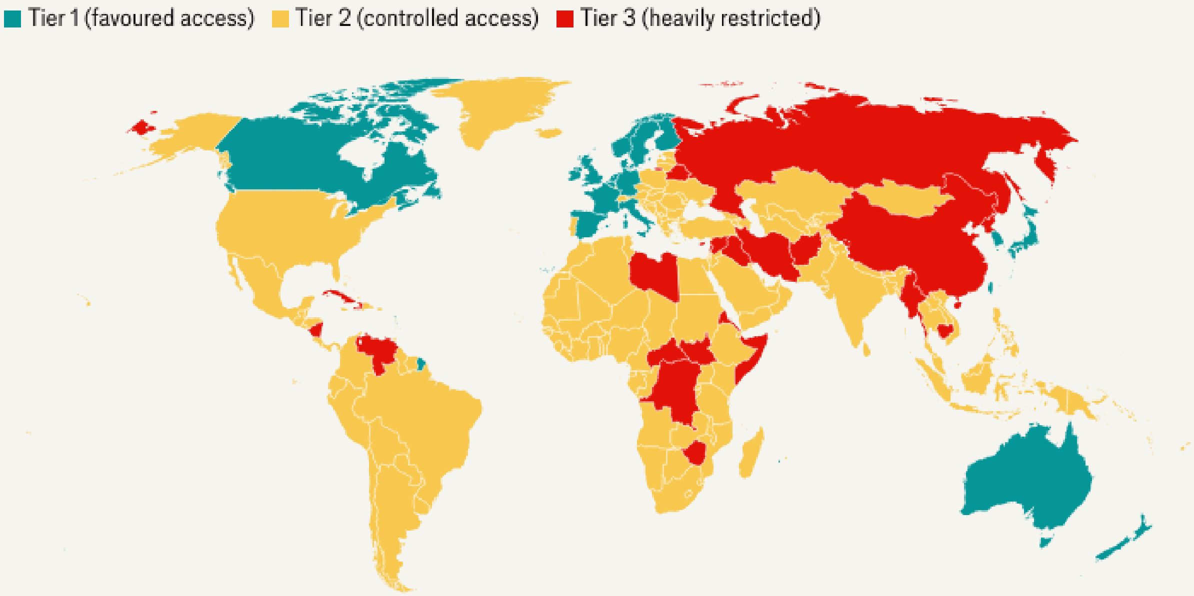
Advanced AI and cognitive technologies leverage to create self-learning and adaptive manufacturing systems

Source: Rahmani, Jesus, and Lopez (2024), EIU

Technology and security overlap increases scrutiny and risks

New US export controls carve up the world by security

Countries subject to US AI export controls unveiled in January 2025



Source: US Federal Register, EIU.

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Concluding Thoughts

- IP and AI investment increases useful data and its non-rivalry gives it a multiplier effect
- AI has been shown to augment service worker skills for call-center workers
- AI is dramatically increasing the viability and use of robots in a variety of applications
- AI enabled robots in healthcare, a notable source of government fiscal burdens, can reduce costs, ease the burden of care for workers, and reduce accidents
- AI enabled factory twinning combines robotics, the internet of things, data and information processing and 3D printing which together are increasing the productivity and nimbleness of manufacturing