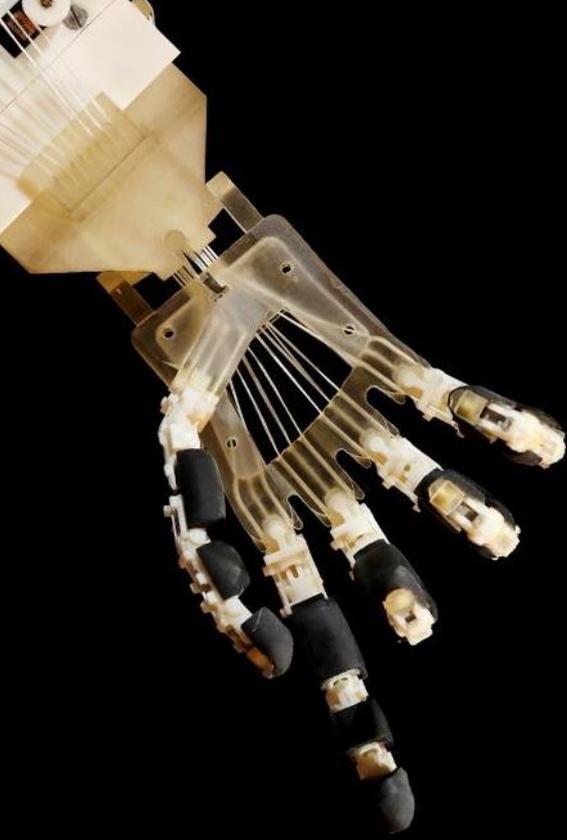


A FUTURE THAT WORKS: AI, AUTOMATION, EMPLOYMENT, AND PRODUCTIVITY

JAMES MANYIKA

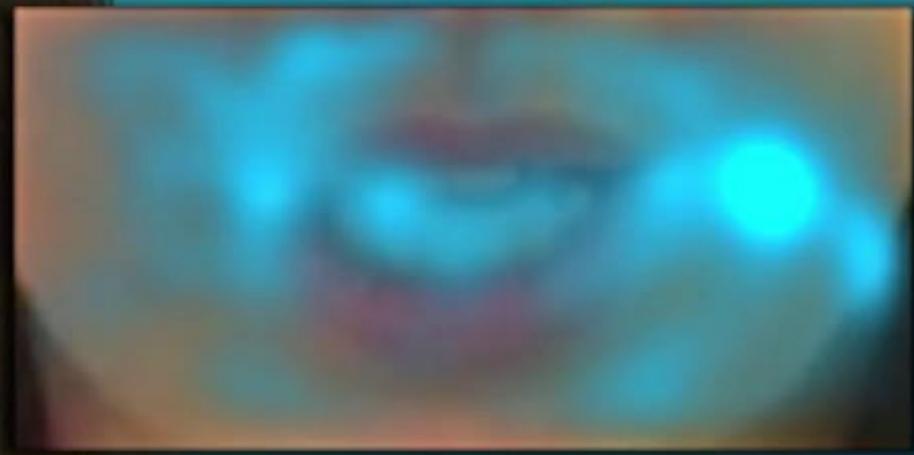
Extracts From McKinsey Global Institute Research, June 2017



Amazing progress in AI and Automation



LipNet



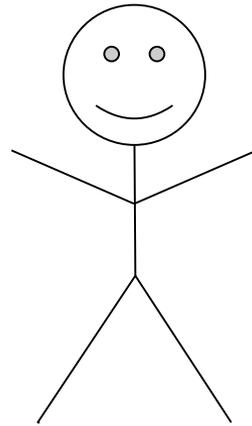
Sentence: Place blue in m 1 soon
LipNet:

2011



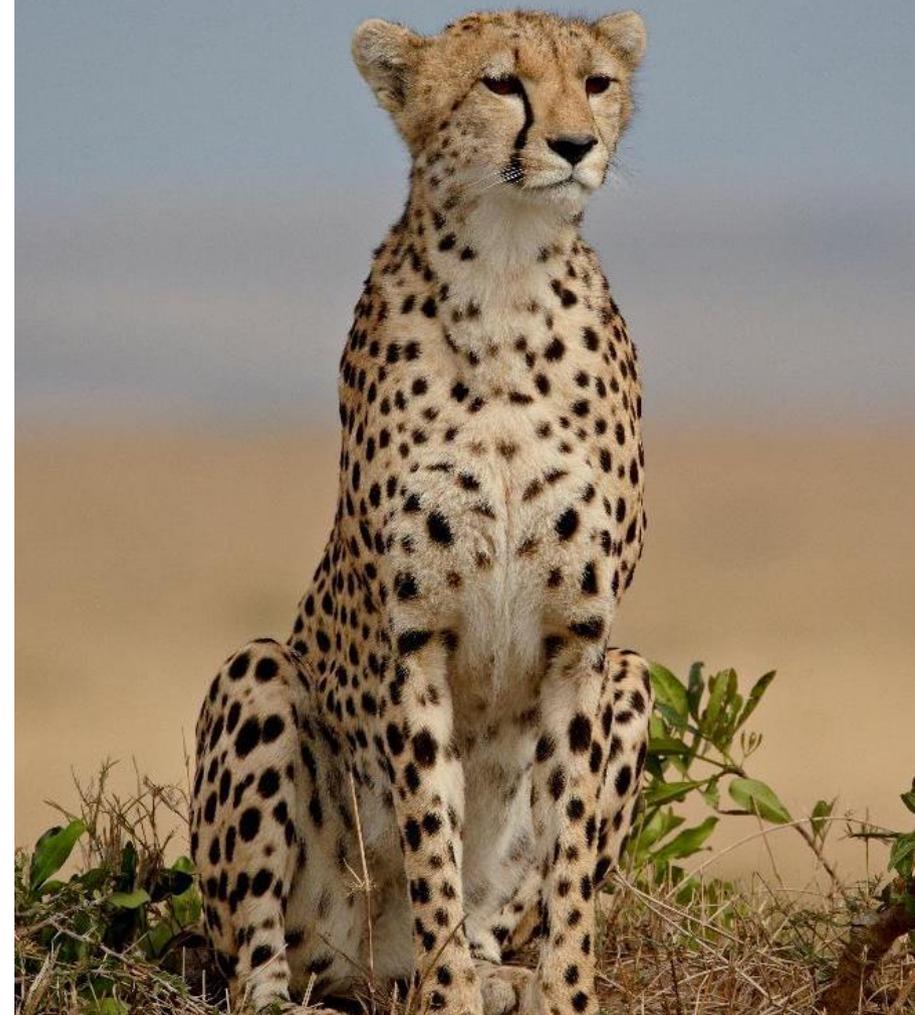
26% errors

Humans



5% errors

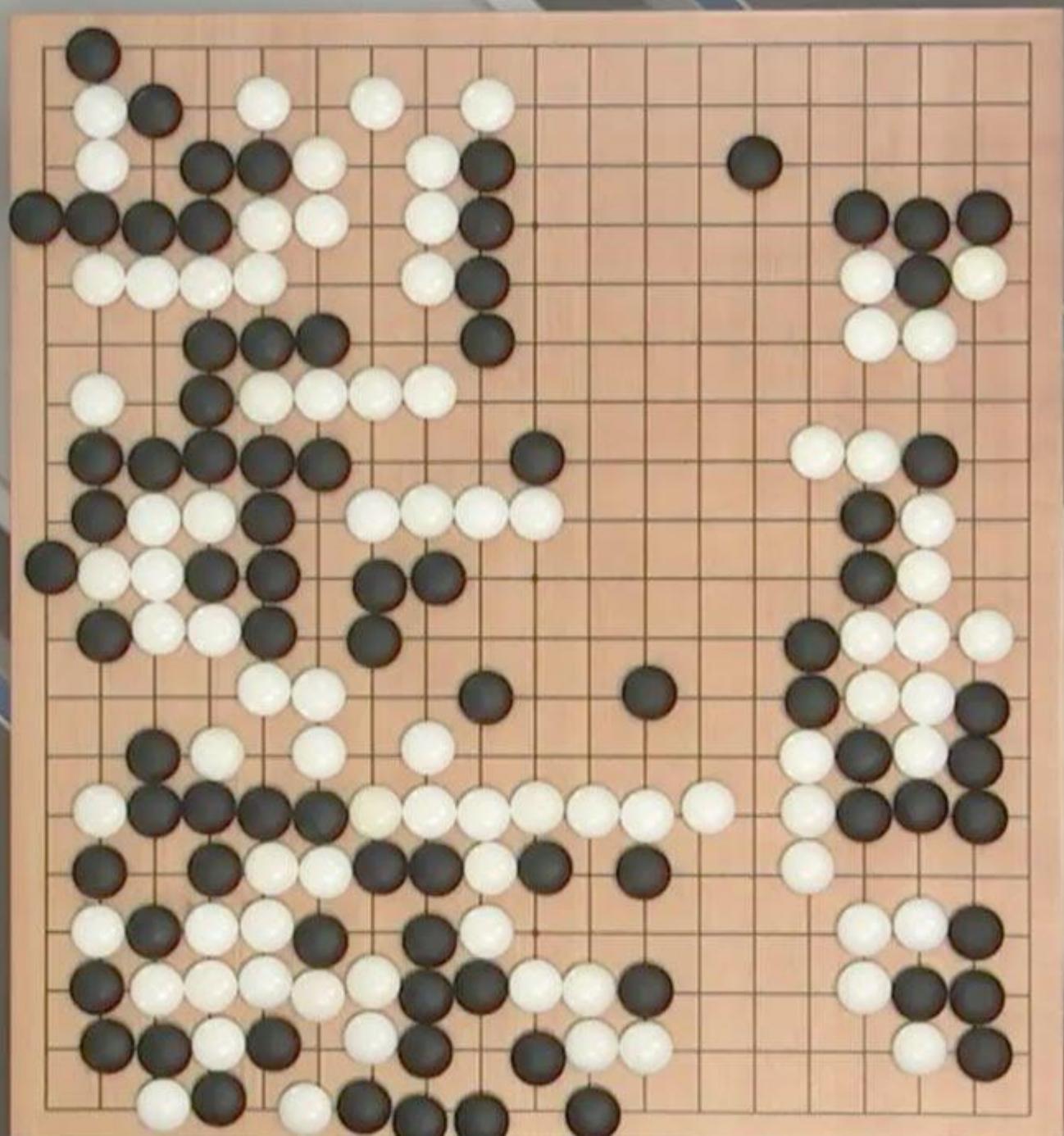
2016



3% errors



● ALPHAGO



● LEE SEDOL





**PROUDLY BREWED.
SELF-DRIVEN.**

Budweiser
OTTO

Why Now?

- 1 Algorithms/techniques** – Neural Networks, CNNs, RNNs, Deep learning, Reinforcement Learning...
- 2 Compute power** – Silicon (CPUs, GPUs, TUs ...); Hyperscale compute capacity, cloud available ...
- 3 Data** – 50 exabytes (2000), 300 exabytes (2007); 4.4 zettabytes (2013), 44 zettabytes (2020) ...



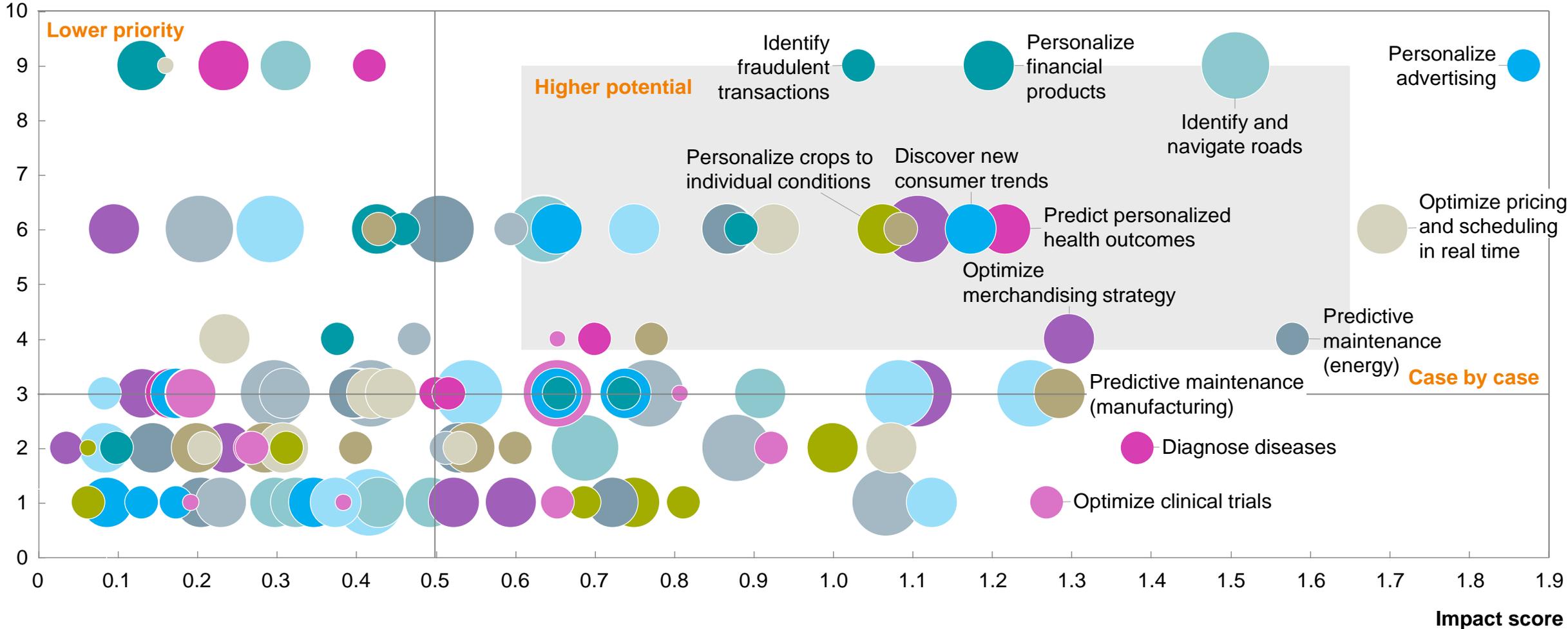
Huge benefits to business,
the economy and society

Machine learning has broad potential across industries and use cases

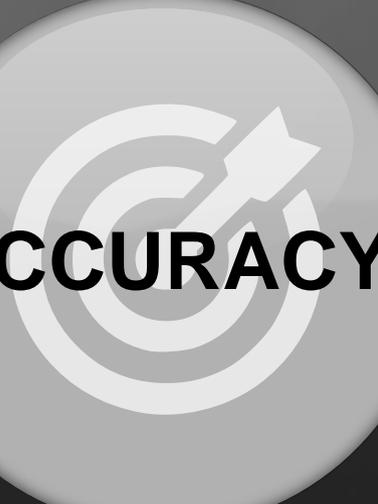
○ Size of bubble indicates variety of data (number of data types)

- Agriculture
- Consumer
- Finance
- Manufacturing
- Pharmaceuticals
- Telecom
- Automotive
- Energy
- Health care
- Media
- Public/social
- Travel, transport, and logistics

Volume
Breadth and frequency of data



Good for business – Drives innovation, transformation and productivity



ACCURACY



OPTIMIZATION



PREDICTION



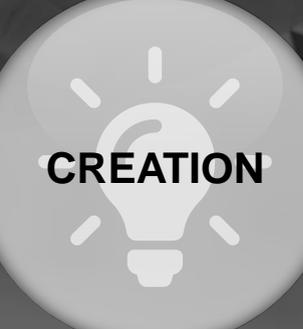
SCALABILITY



THROUGHPUT



DISCOVERY



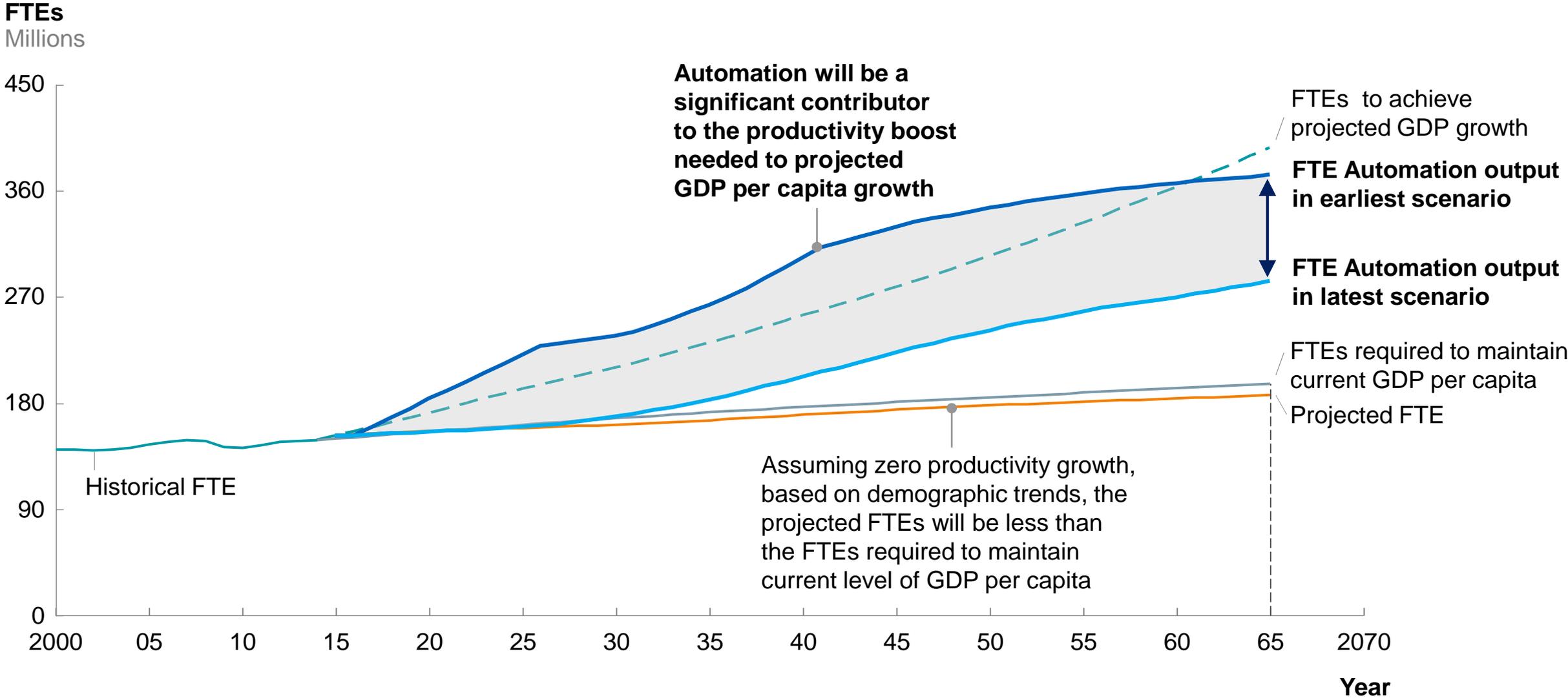
CREATION



DECISIONS

Good for the economy - Automation can contribute to growth in GDP per capita

FTE automation output (United States example, 2000–65)





What about jobs?

Our approach focuses on activities and capabilities of currently demonstrated technologies

Occupations

1		Retail sales-people
2		Food and beverage service workers
3		Teachers
4		Health practitioners
...
...
...

~800 occupations

Activities (retail example)

	Greet customers
	Answer questions about products and services
	Clean and maintain work areas
	Demonstrate product features
	Process sales and transactions
...	...
...	...
...	...

~2,000 activities assessed across all occupations

Capability requirements

Social

- Social and emotional sensing
- Social and emotional reasoning
- Emotional and social output
- etc

Cognitive

- Natural language
- Recognizing known patterns / categories
- Generating novel patterns / categories
- Logical reasoning / problem solving
- Optimizing and planning
- Creativity
- Articulating/display output
- Coordination with multiple agents
- etc

Physical

- Sensory perception
- Fine motor skills/dexterity
- Gross motor skills
- Navigation
- Mobility
- etc

Some activities have higher technical automation potential

BASED ON
DEMONSTRATED
TECHNOLOGY

Time spent on activities that can be automated by adapting currently demonstrated technology

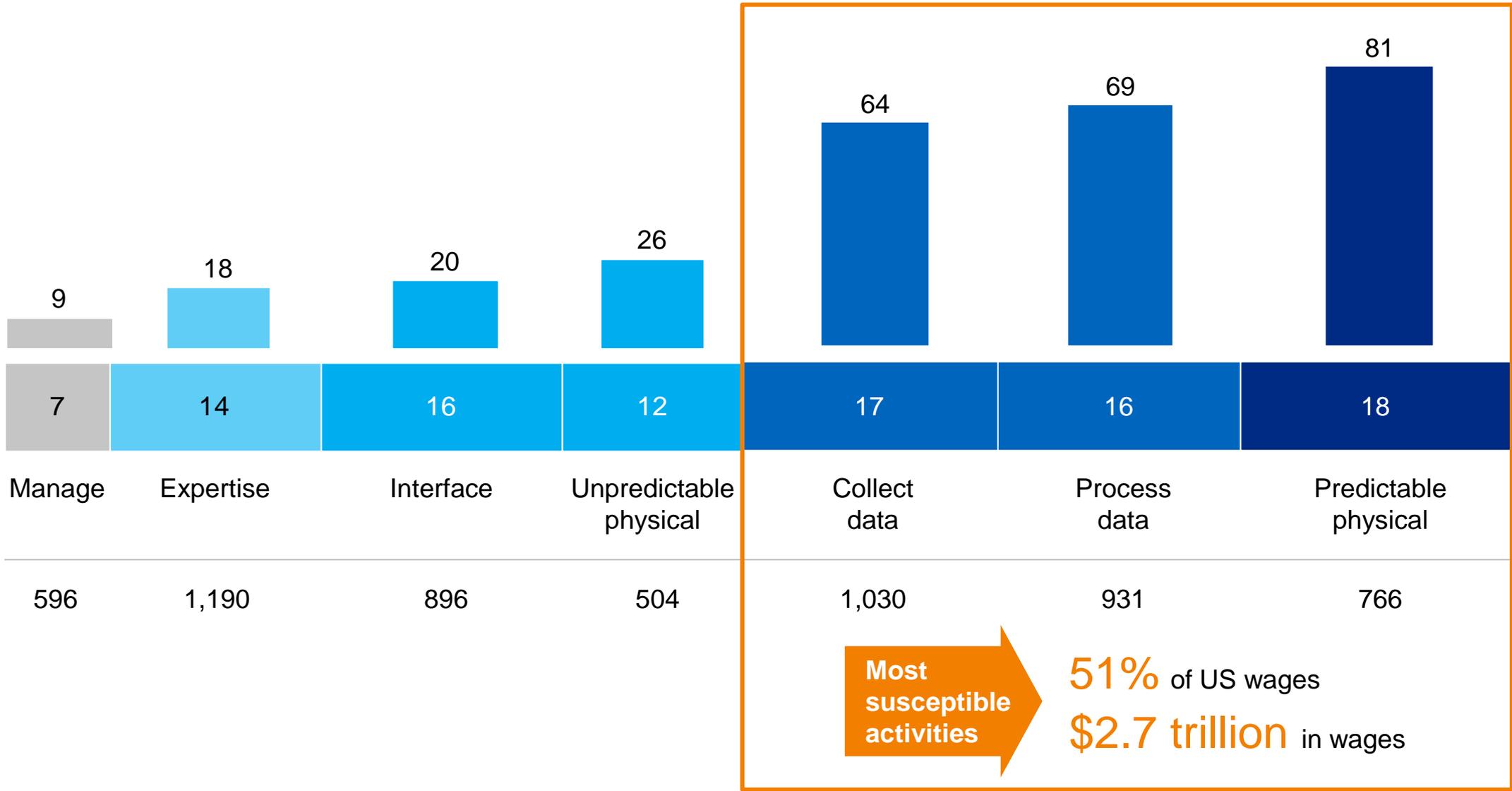
%

Time spent in all US occupations

%

Total wages in United States, 2014

\$ billion



Some sectors have more automatable activities than others

BASED ON DEMONSTRATED TECHNOLOGY

● Size of bubble indicates % of time spent in US occupations

Ability to automate (%)
 0 50 100

Sectors by activity type

Manage Expertise Interface Unpredictable physical Collect data Process data Predictable physical

Automation potential %

Most automatable

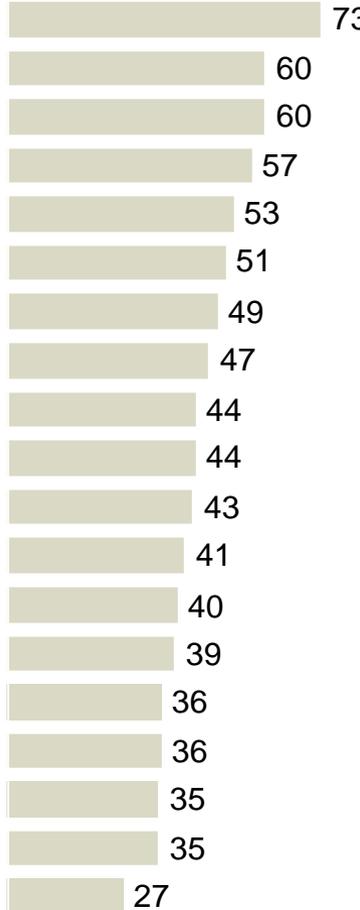
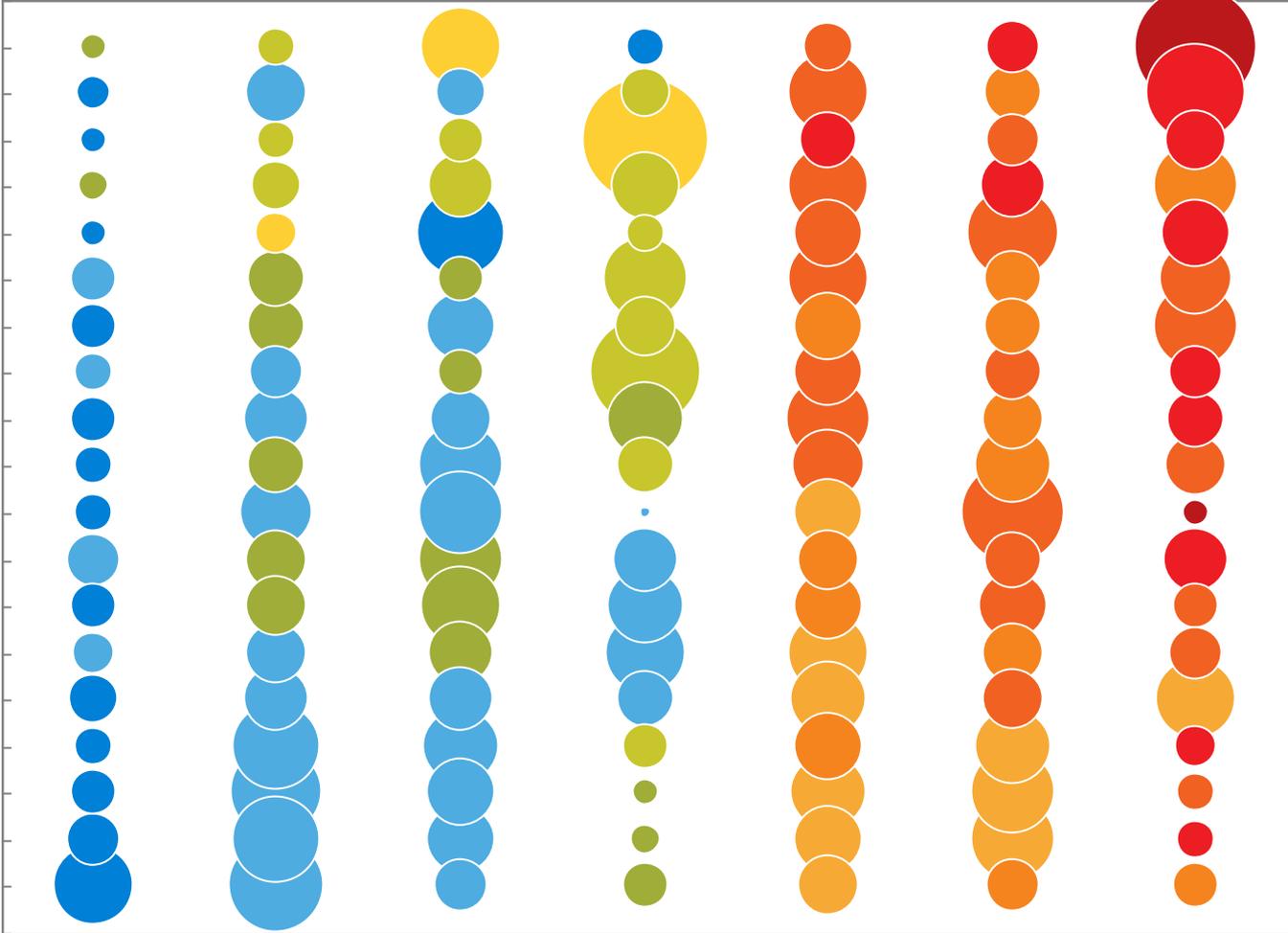
- Accommodation and food services
- Manufacturing
- Transportation and warehousing
- Agriculture
- Retail trade
- Mining

In the middle

- Other services
- Construction
- Utilities
- Wholesale trade
- Finance and insurance
- Arts, entertainment, and recreation

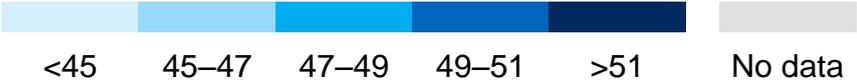
Least automatable

- Administrative
- Health care and social assistances
- Information
- Professionals
- Management
- Educational services



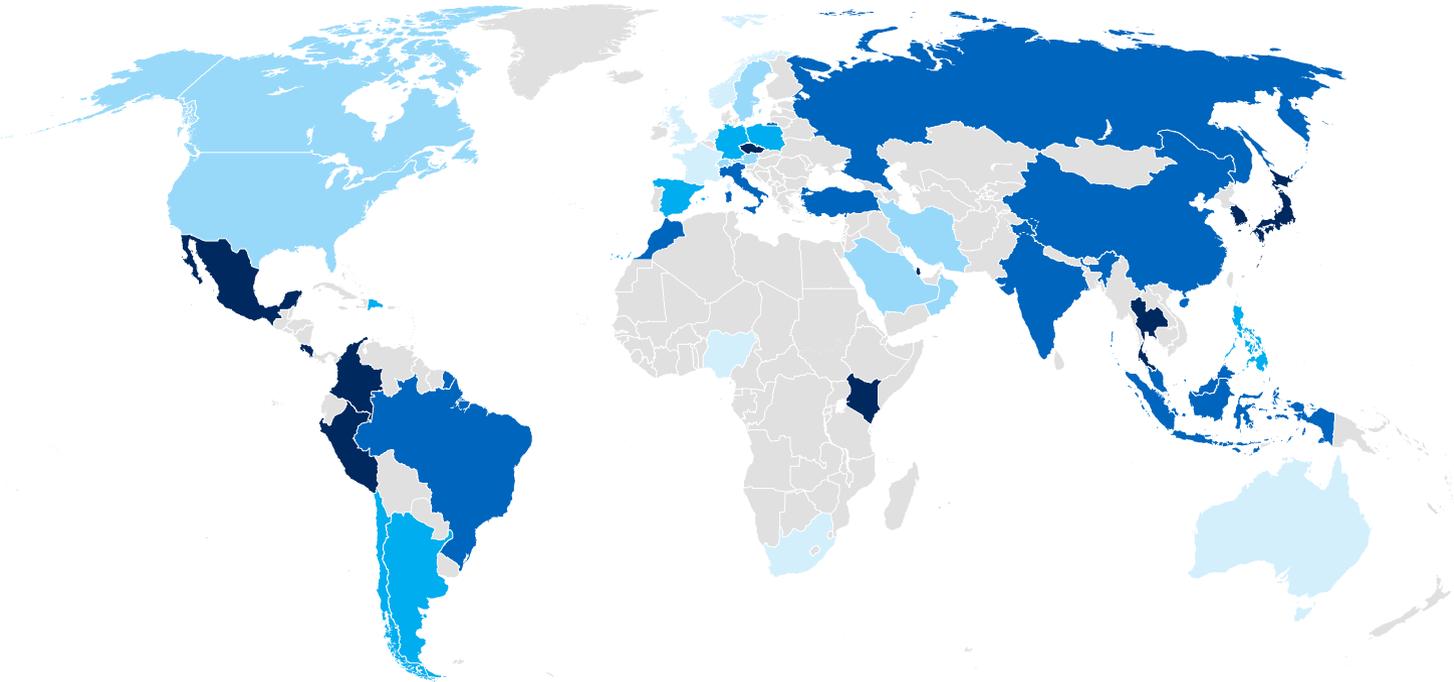
All countries could be impacted by automation

Employee weighted overall % of activities that can be automated by adapting currently demonstrated technologies

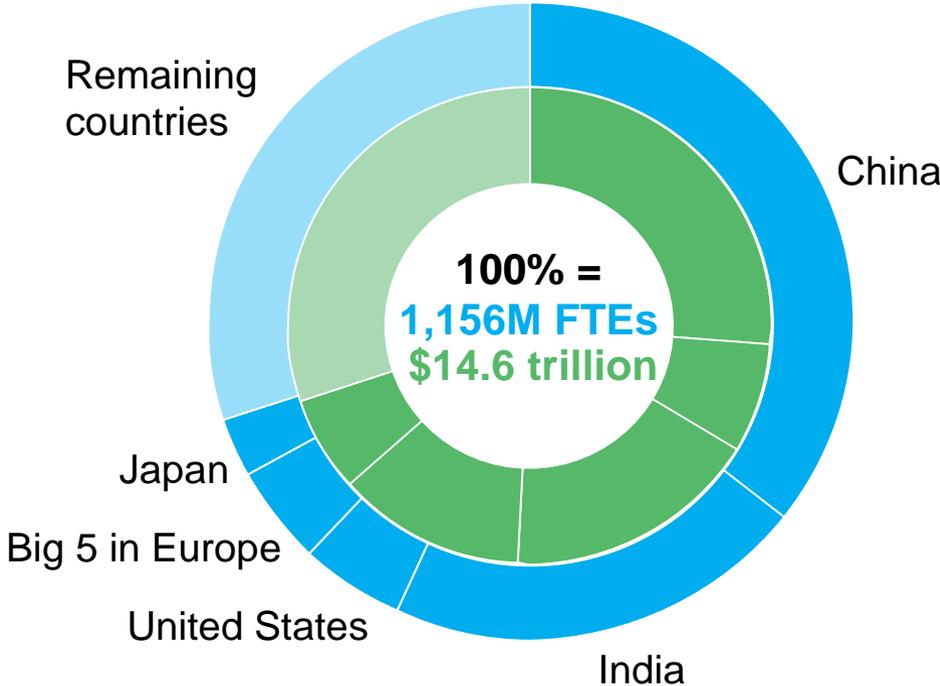


Automatability across economies

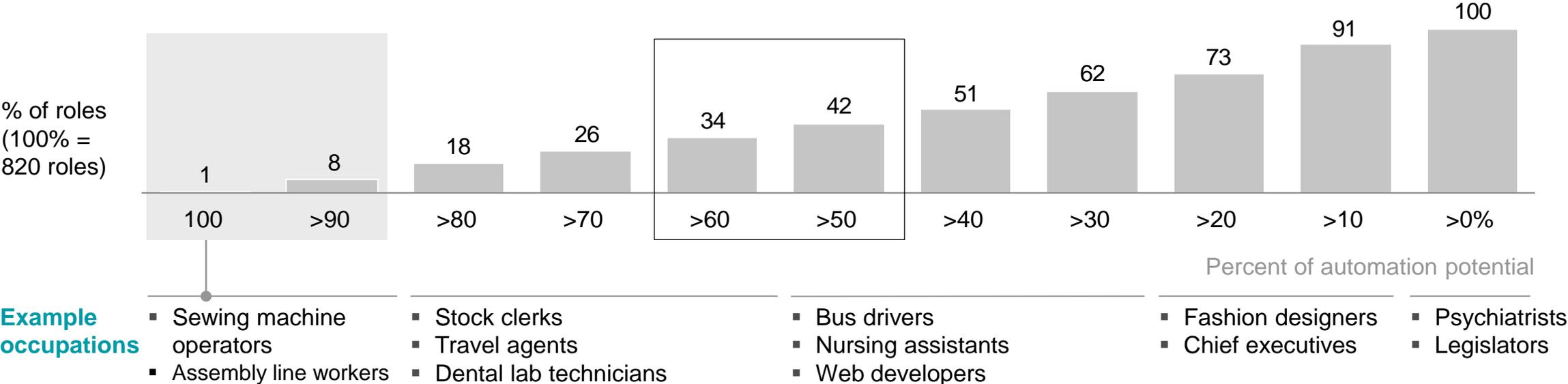
Employee weighted overall % of activities that can be automated



Million FTE
\$ trillion



A small percentage of occupations can be fully automated by adapting current technologies, but almost all occupations have some activities that could be automated



While about **5%** of occupations could have close to **100%** of tasks automated,

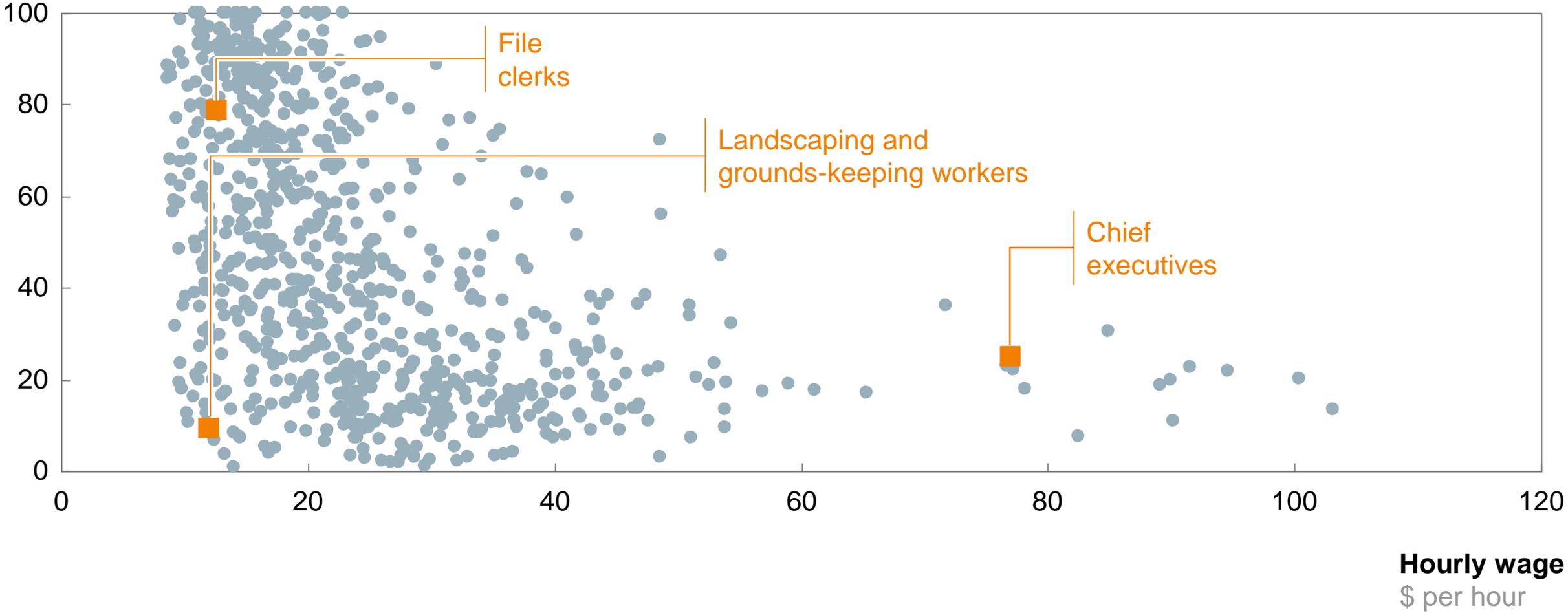
More occupations will have portions of their tasks automated e.g. **60%** of occupations could have **30%** of tasks automated

Automation potential spans from high to low wage occupations

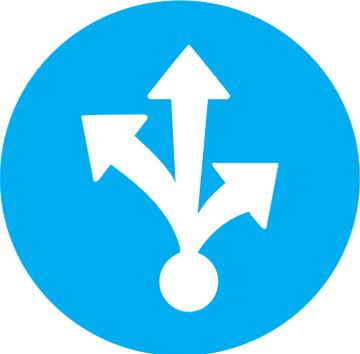
BASED ON DEMONSTRATED TECHNOLOGY

Ability to technically automate

Percentage of time on activities that can be automated by adapting currently demonstrated technology



Several factors affect the pace and extent of AI and automation



**Technical
feasibility and
pace of
breakthroughs**



**Cost of
developing
and
deploying
technologies**



**Cost of labor
and related
supply-
demand
dynamics**



**Benefits
including
and beyond
labor
substitution**



**Regulatory
and social
factors**

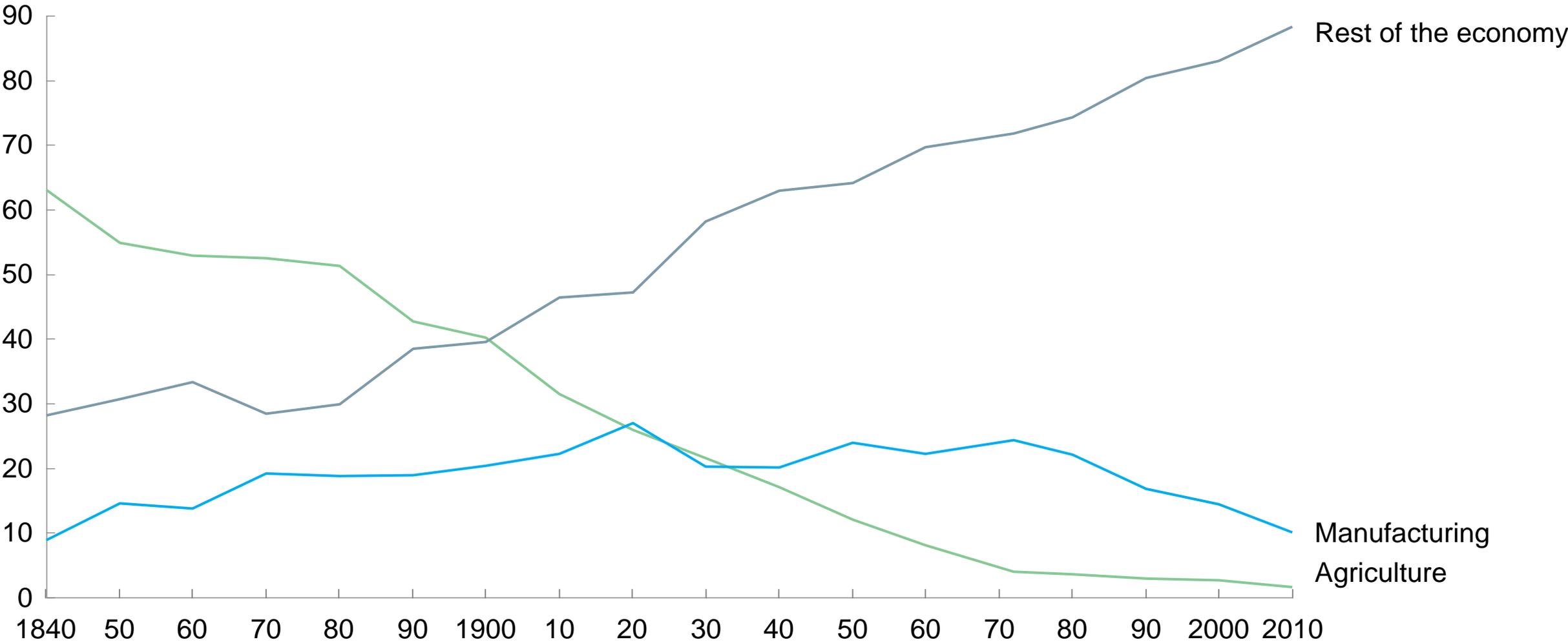


In summary...

We've seen this before—but is this time different?

Distribution of labor share by sector in the United States, 1840–2010

%



So with huge benefits, some real challenges to address

For
businesses
and users

Benefits

- Faster innovation and business transformation
- Better performance, outcomes, quality, speed
- Overcome human limits; Solve new problems, create new opportunities and innovations
- Safety, utility, quality of life

For
economies
and society

- Boost productivity growth, GDP growth and prosperity
- Counter aging or shrinking workforce
- Solve “moonshot” problems (e.g., climate)

Challenges

Social and
economic

- Jobs and wages
- Skills and training
- Dislocation and transitions
- Distributional issues
- Acceptance

Other issues

- Transparency, openness and competition
- Biases
- Safety, Cybersecurity
- Ethics