STATISTICS

Concepts and Challenges of Measuring Production of Artificial Intelligence in the US Economy

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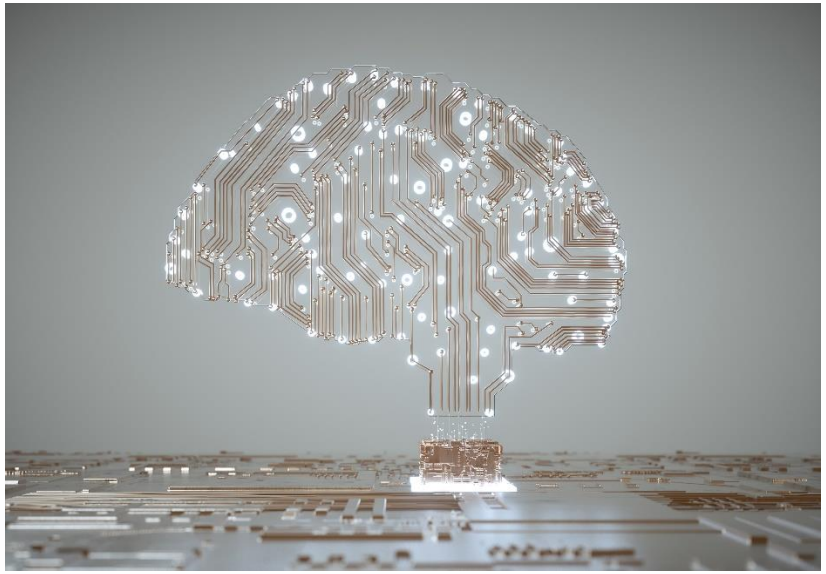
Outline

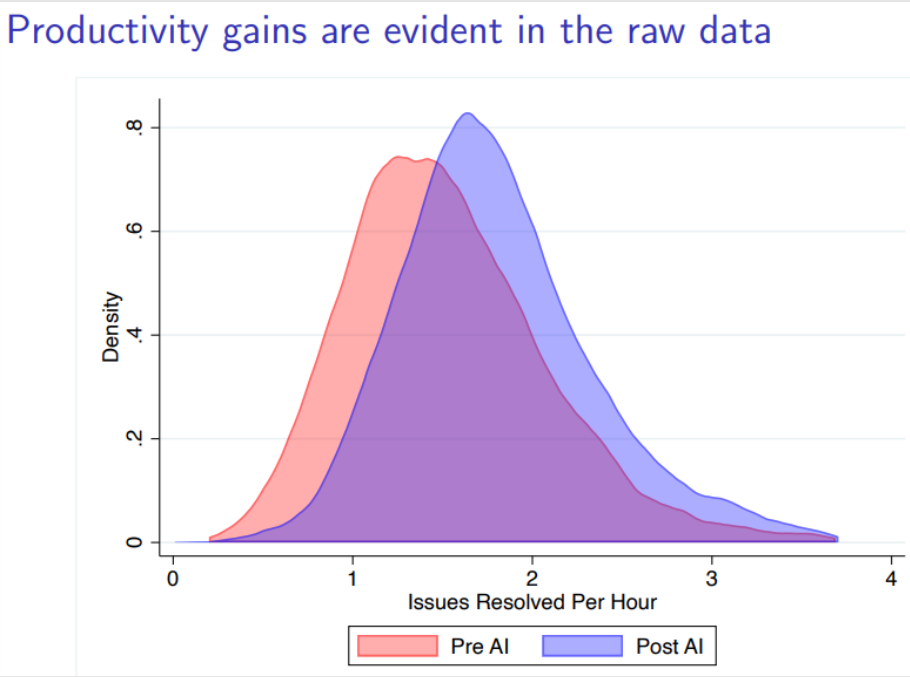
Concepts and challenges of measuring AI production

- How production of AI software is currently reflected in the Supply and Use Tables (SUTs)
- Possibilities for measuring AI production using a thematic satellite account framework



Why Measure Production of AI?

Current AI research mostly focuses on *uses* of AI



"Augmented Intelligence: The Effects of AI on Productivity and Work Practices" (Raymond, Brynjolfsson, and Li 2024)

Why Measure Production of AI?

Current AI research mostly focuses on *uses* of AI

US federal government actions to encourage domestic AI manufacturing and research

- 2022 CHIPS and Science Act (CHIPS = "Creating Helpful Incentives to Produce Semiconductors")
- 2023 Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence

> *"U.S. companies lead the world in driving AI forward, dominating the design of AI chips and the development of Large Language Models. But we don't manufacture or package any of the leading-edge AI chips needed to fuel the innovation ecosystem and power our most critical defense systems….**We need more talent development, R&D, and manufacturing to take place in America**." Gina Raimondo, US Secretary of Commerce (February 2024)*

Production of AI Software in the Supply and Use Tables

Production of For-sale AI Software in the SUTs (simplified example)

A telecommunications company pays a computer systems design company $100 to develop and implement a new AI-enabled customer service software application.

	Industries			Final Expenditures		Product Output
	Intermediate Purchases					
Products	Computer system design	All other industries	**Total**	Private fixed investment	**Total (GDP)**	
Software	0	0	0	100	100	100
All other products	20	0	20			20
Total intermediate	20	0	20			
Compensation of employees	50	10	60			
Gross operating surplus	30	10	40			
Value added (GDP)	80	20	100			
Industry output	100	20	120			120

Measuring AI Production Using a Thematic Satellite Account Framework

How Should AI Production be Defined?

Common elements

1. Manufacturing of chips
2. Software publishing (own account and for sale)
3. Computer and data services
4. R&D

Examples of definitions for Artificial Intelligence

US Census Bureau (2024)	"Artificial Intelligence is **computer systems and software** that are able to perform tasks normally requiring human intelligence, such as decision-making, visual perception, speech recognition, and language processing. Types or applications of AI include machine learning, natural language processing, virtual agents, predictive analytics, machine vision, voice recognition, decision making systems, data analytics, text analytics, image processing, etc."
National Institute of Standards and Technology (2019)	AI technologies and systems "comprise **software and/or hardware** that can learn to solve complex problems, make predictions or undertake tasks that require human-like sensing (such as vision, speech, and touch), perception, cognition, planning, learning, communication, or physical action."
OECD (2024)	"An AI system is a **machine-based system** that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments."
US Patent and Trade Office (2020)	"We define AI as comprising one or more of eight component technologies [knowledge processing, speech, AI hardware, evolutionary computation, natural language processing, machine learning, vision, planning/control]. These **components span software, hardware, and applications**, and a single patent document may contain multiple AI component technologies."

What Data Sources are Available to Measure AI Production?

Manufacturing

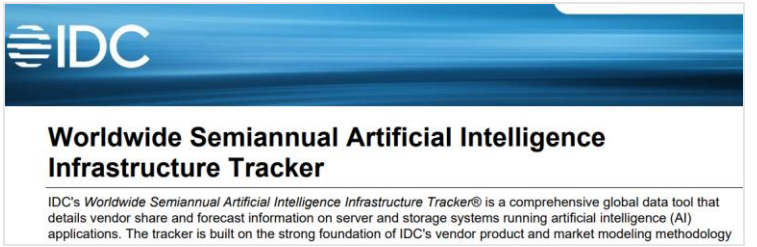
- Sparse government data, potentially private vendor data

Companies that reported selling artificial intelligence or goods and services that included artificial intelligence, by industry: 2016–18

(Number and percent)

Industry	NAICS code	Companies (number)	Yes	No	Don't know
All industries	11, 21–23, 31–33, 42–81	4,805,151	0.4	92.8	6.8
Manufacturing industries	31–33	217,565	0.4	92.4	7.2
Food	311	18,250	0.2 r	90.1	9.7
Beverage and tobacco products	312	7,723	0.0	93.0	7.0
Textile, apparel, and leather products	313–16	10,554	0.1	89.0	10.9
Wood products	321	11,012	0.0	92.6	7.4
Paper	322	2,117	D	95.7	4.2 r

Source: National Center for Science and Engineering Statistics and Census Bureau, 2019 Annual Business Survey: Data Year 2018.



What Data Sources are Available to Measure AI Production?

Software and Computer systems design and related services

- Government occupational data could help inform trend analysis

NAICS 513200 - Software Publishers

Display All records Text search table: data

Occupation code	Occupation title (click on the occupation title to view an occupational profile)	Level	Employment	Employment RSE	Percent of total employment	Median hourly wage	Mean hourly wage	Annual mean wage
15-1240	Database and Network Administrators and Architects	broad	15,360	3.3%	2.35%	$62.31	$62.13	$129,230
15-1242	Database Administrators	detail	1,710	7.8%	0.26%	$62.34	$60.07	$124,940
15-1243	Database Architects	detail	3,470	7.6%	0.53%	$71.73	$70.84	$147,340
15-2051	Data Scientists	detail	8,080	7.7%	1.24%	$68.43	$71.89	$149,530

Source: Occupational Employment and Wage Statistics, Bureau of Labor Statistics (2024)

What Data Sources are Available to Measure AI Production?

R&D

- Government budget documents

Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Defense Advanced Research Projects Agency | **Date:** March 2023

Appropriation/Budget Activity
0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*

R-1 Program Element (Number/Name)
PE 0602303E / *INFORMATION & COMMUNICATIONS TECHNOLOGY*

COST ($ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete
Total Program Element	-	463.806	383.270	333.029	-	333.029	399.233	393.917	399.742	401.742	-
IT-02: *HIGH PRODUCTIVITY, HIGH-PERFORMANCE RESPONSIVE ARCHITECTURES*	-	27.000	11.250	15.000	-	15.000	18.750	15.000	15.000	0.000	-
IT-03: *CYBER SECURITY*	-	242.359	183.786	167.459	-	167.459	222.698	199.752	171.440	175.353	-
IT-04: *ARTIFICIAL INTELLIGENCE AND HUMAN-MACHINE SYMBIOSIS*	-	194.447	188.234	150.570	-	150.570	157.785	179.165	213.302	226.389	-

Source: Department of Defense Fiscal Year 2024 Budget Estimates

Conclusion

Production of AI is currently hidden within the SUTs

There are many challenges to measuring AI production

- Definitions and scope
- Data source availability