How Will AI Affect Our Students' Employability?

Implications for Equity

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APRIL 2024

How is next-generation AI different from prior workforce automation?

What is generative Artificial Intelligence (AI)?
It makes new things by emulating patterns in existing things.

Why is it different from previous types of automation?
AI doesn't just carry out pre-programmed steps. It identifies complicated patterns and generates new material that matches them. As such, it competes with creative and non-routine jobs in ways that previous automation rounds have not.

Why is this possible now?
Generative AI requires large amounts of digitized input and very high computing power, made possible by huge gains in graphics chip processing power (e.g., NVIDIA)

Questions for Today

1. Discussion: What are you *willing to automate?*
   - https://forms.gle/tBHXHxR3YFDko3BS6
2. What fraction of work activities are at risk of automation in the age of AI, and how will this vary by sector?
3. Which levels of education and which skill areas will be most protected from the next automation wave?
4. Will automation widen or exacerbate earnings disparities?
5. How can we prepare students to thrive as automation increases?

Key work on which I build

Techno-optimists: AI can reallocate difficult work away from elites toward novice and lower-skilled workers (Brynjolfsson, Li, & Raymond, 2023; Autor, 2024; Chui et al., 2021)

Techno-worriers: AI may exacerbate inequality trends wrought by the industrialization in the past three decades (Acemoglu & Restrepo, 2020).

Social skills are hard to routinize: "Non-cognitive" social skills have risen in economic importance with the rise of the knowledge economy (Deming, 2017)

Felten, Raj, & Seamans (2021) use **O*NET ability importance and level scores**, combined with *crowd-sourced views on task automatability*, to predict AI Occupational Exposure (AIOE) and Industry Exposure (AIIE)

Limitation: Atheoretical approach yields questionable automatability scores

Frey and Osborne (2017) score job automatability based on known automation bottlenecks: *social intelligence; complex perception and manipulation*; *creative intelligence*

Limitation: Treats jobs as monoliths and doesn't anticipate surge in AI's creative capacity

My Contribution

Following Acemoglu and Autor (2011), I aggregate from 41 O*NET *activities* instead of abilities

I treat activity *importance* and *level* differently

Adapting Frey & Osborne (2017) to consider generative AI and machine learning, *I rate each activity based on vulnerability to three bottlenecks*:

Theory of Mind *(tomi)*

Can you theorize about what other people are thinking and feeling?

Flexible Dexterity *(fdex)*

Can you perform manual tasks that are intricate and unpredictable?

Vision and Strategy *(visi)*

Can you create intrinsic goals and objectives, as well as a plan for achieving them?

Data Sources

May 2022 Occupational employment and wage survey statistics from the Bureau of Labor Statistics

- Job characteristics: median salaries and number of workers for 873 Standard Occupational Codes (SOCs)

O*NET occupational data from the Bureau of Labor Statistics

- 41 general work activities: importance and level scores by job (1 to 5 and 0 to 7, rescaled from 0 to 100)
- RIASEC interest inventory crosswalk to SOCs[1]
  - Realistic, Investigative, Artistic, Social, Entrepreneurial, Conventional
- Job Zone preparation level scores for SOCs

[2] Holland, J. L. (1959). A theory of vocational choice. *Journal of Counseling Psychology, 6*(1), 35–45. https://doi.org/10.1037/h0040767

Putka, D. J., Dahike, J. A., Burke, M. I., Rounds, J., & Lewis, P. (2023). *Using Machine Learning to Develop Occupational Interest Profiles and High-Point Codes for the O*NET System*. https://www.onetcenter.org/dl_files/ML_OIPs.pdf

REALISTIC
Control machines and processes
Draft, lay out, specify technical devices, parts, equipment
Handle & move objects
Inspect equip, structures, materials
Operate vehicles, devices, equipment
Perform general physical activities
Repair/maintain electronics
Repair/maintain mechanical equipment

INVESTIGATIVE
Analyze data or information
Estimate quantifiable characteristics
Identify objects, actions, events
Judge qualities of objects, services, and people
Process information
Update & use relevant knowledge

ARTISTIC
Interpret the meaning of information
Think creatively

41 O*NET JOB ACTIVITIES, BY RIASEC INTEREST CATEGORIES

SOCIAL
Assist/care for others
Coach/develop others
Communicate w/ ppl outside the org
Communicate w/ ppl inside the org
Establish/maintain relationships
Provide consulting & advice to others
Perform for or work w/ the public
Resolve conflicts & negotiate with others
Train & teach others

ENTREPRENEURIAL
Coordinate the work & activity of others
Develop objectives and strategies
Develop and build teams
Guide, direct, and motivate subordinates
Make decisions and solve problems
Organize, plan, & prioritize
Sell or influence others
Staff organizational units

CONVENTIONAL
Document/record information
Evaluate information for standards compliance
Get information
Monitor processes, materials, or surroundings
Monitor & control resources
Perform administrative activities
Schedule work and activities
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Jobs that may utilize a theory of mind

tomi=red
fdex=purple
visi=green
Bold=2 factors
Italic Bold=3 factors

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Methodological Approach

For each dimension, I dichotomize 41 work activities in terms of whether they tap each ability. For each activity, *safety from automation,* (ranging from 0 to 1), is given by:

task_safe = sum(tomi, fdex, visi)/3 (1)

The percent (0-100) of a job vulnerable to automation, *job_vul*:

$job\_vul = \Sigma_{1-41}(1\text{-}task\_safe)*rel\_imp$ (2)

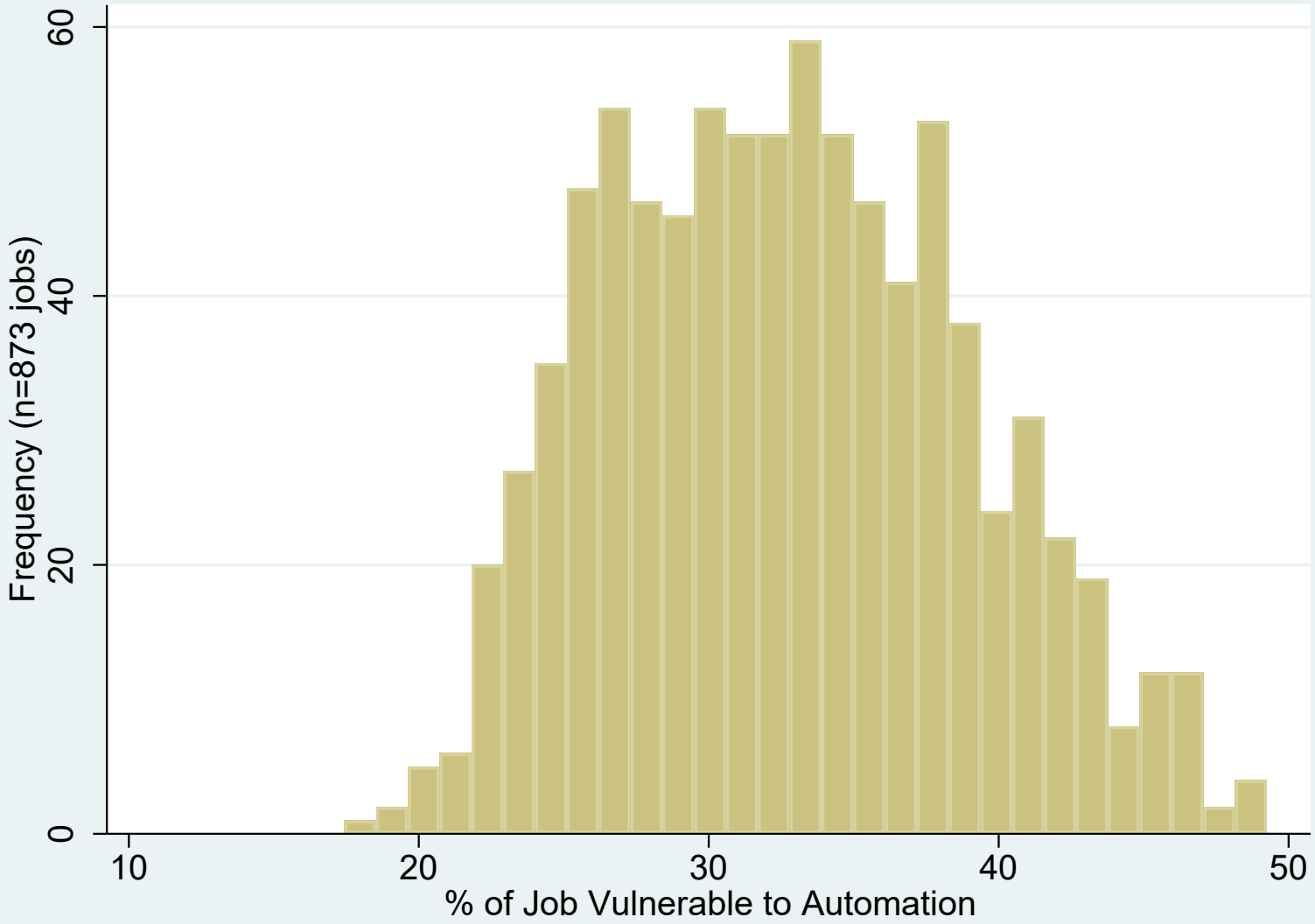
where *rel_imp* = a task's relative importance to the job (sums to 100 within job)

But complex tasks are harder to automate than simple ones. So a job's overall ease of automation, *jobaut*, is given by:

*task_aut = (1-task_safe)*rel_imp*(1-(task_level/100))* (4)

$jobaut = \Sigma_{1-41}\, task\_aut$ (5)

jobaut is the percent of a job that is vulnerable to automation in roughly the next two decades



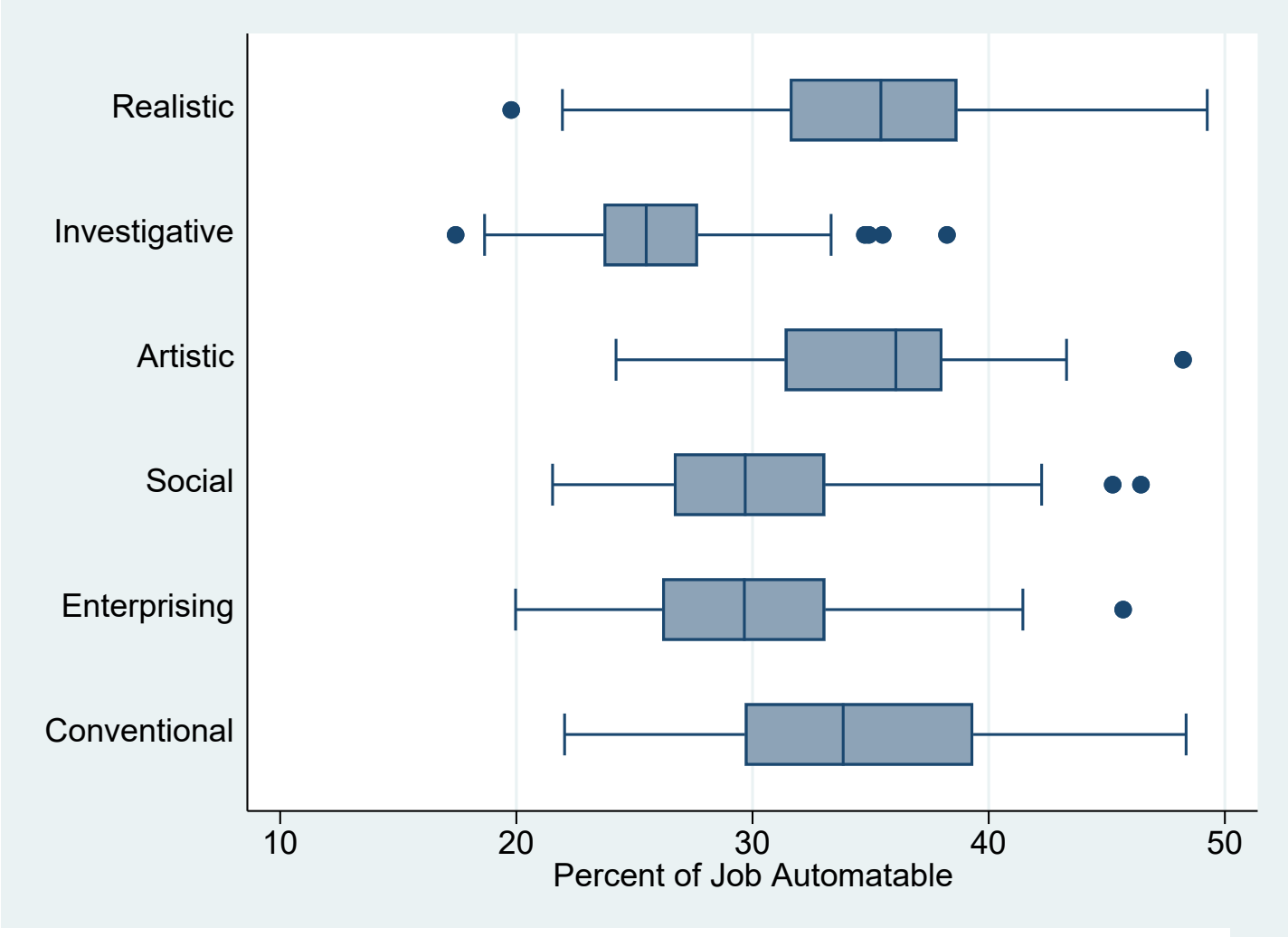
For the average job, about 32% of the tasks are vulnerable to future automation

Range across jobs: 17% - 49%

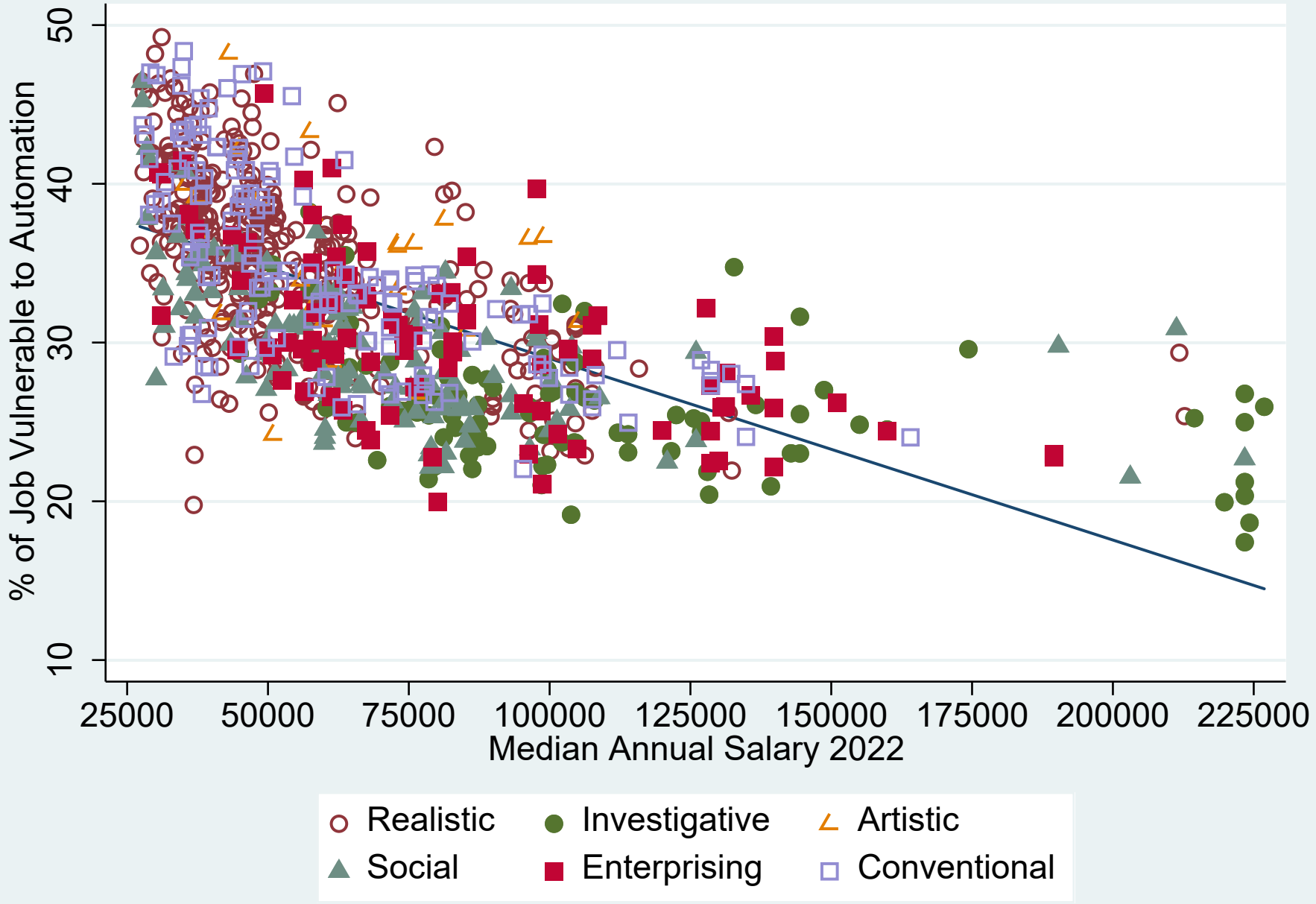
SOC	Risk	SD
Food Preparation	40	4.6
Office and Admin Support	39.3	4.7
Personal Care	38.5	5.4
Production Occupations	37.8	4.3
Farming, Fishing, Forestry	37.7	4.3
Building and Grounds	36.9	5.9
Sales and Related	36.5	5
Transportation/Materials Moving	35.6	5.4
Construction and Maintenance	34.9	4.4
Installation, Maintain, Repair	34.7	4.4
Arts, Design, Entertain, Media	34.1	4.6
Healthcare Support	33	4.4
Legal Occupations	30.9	3.1
Business and Finance	30.3	4.2
Protective Services	29.8	5.4
Educational/Library	29.2	4.5
Community/Social Services	29	2.9
Architecture and Design	28.5	4.1
Healthcare Practioners	28.2	4.5
Computer and Math	27.6	3.3
Life, Physical, Social Scie	27.4	4.7
Management Occupations	27.4	3.6
Total	32.7	6.2

By SOC sector, automation risk ranges from 27% to 40% of the tasks in a given job

interest	mean	sd	n Jobs
Realistic	35.2	5.4	379
Investigative	25.9	3.7	103
Artistic	35.1	5.2	27
Social	30.0	4.8	125
Enterprising	30.2	5.3	90
Conventional	34.6	6.2	149
Total	*32.75*	*6.2*	*873*

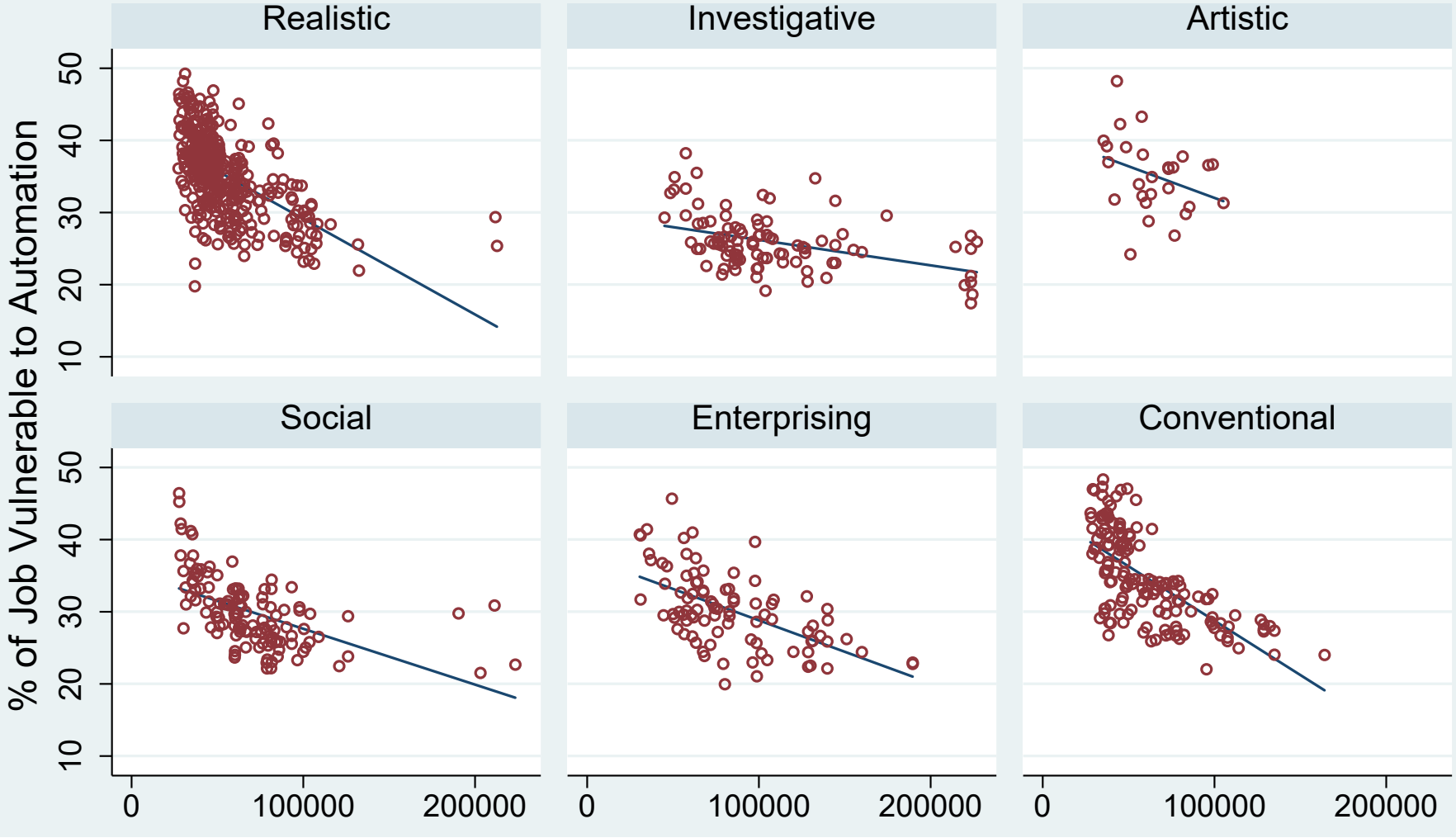


Automation Risk Is Highest in Realistic, Artistic, and Conventional-Interest Jobs



Higher-Paying Jobs are Less at Risk

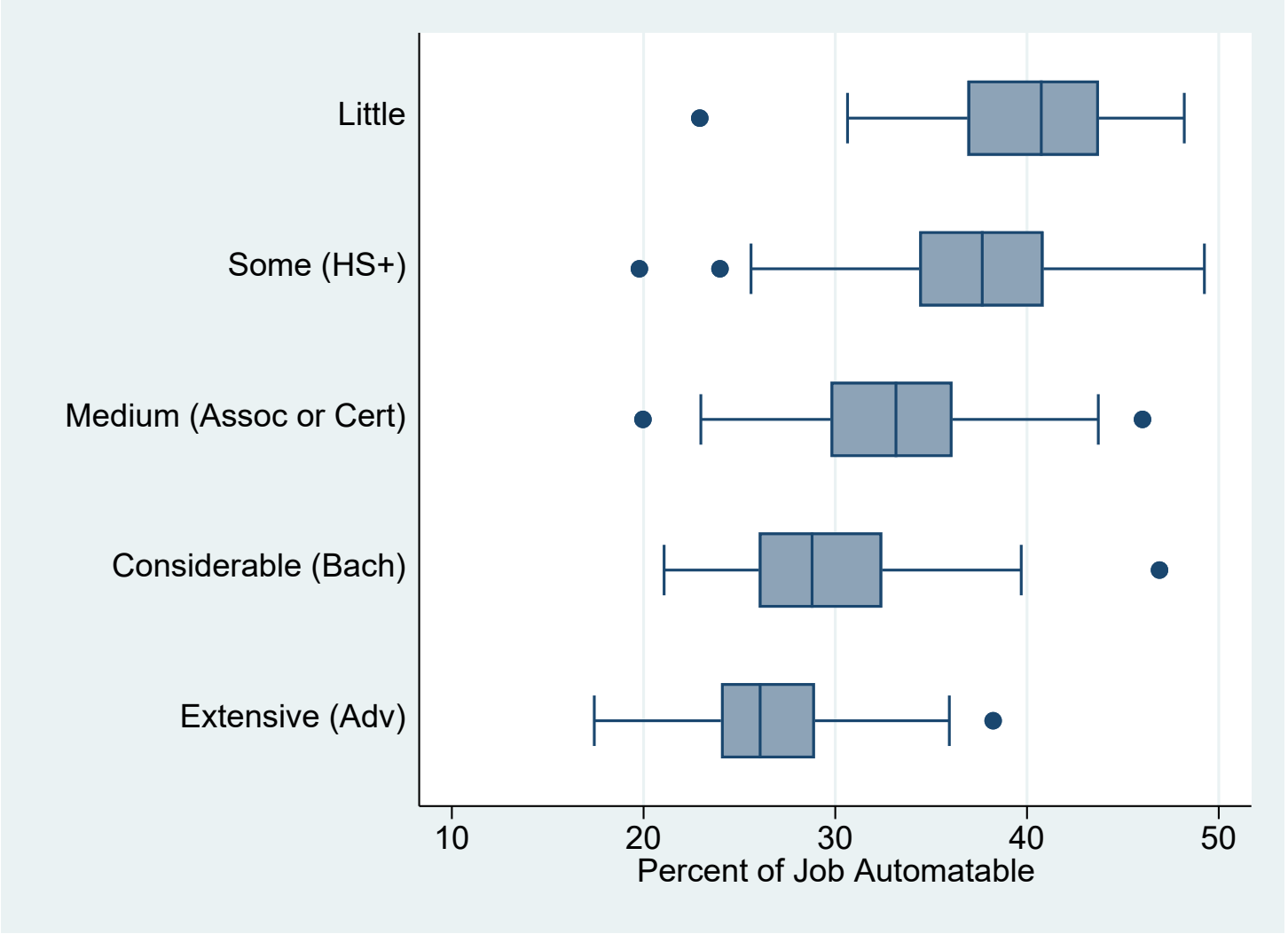
Complexity is protective under current assumptions



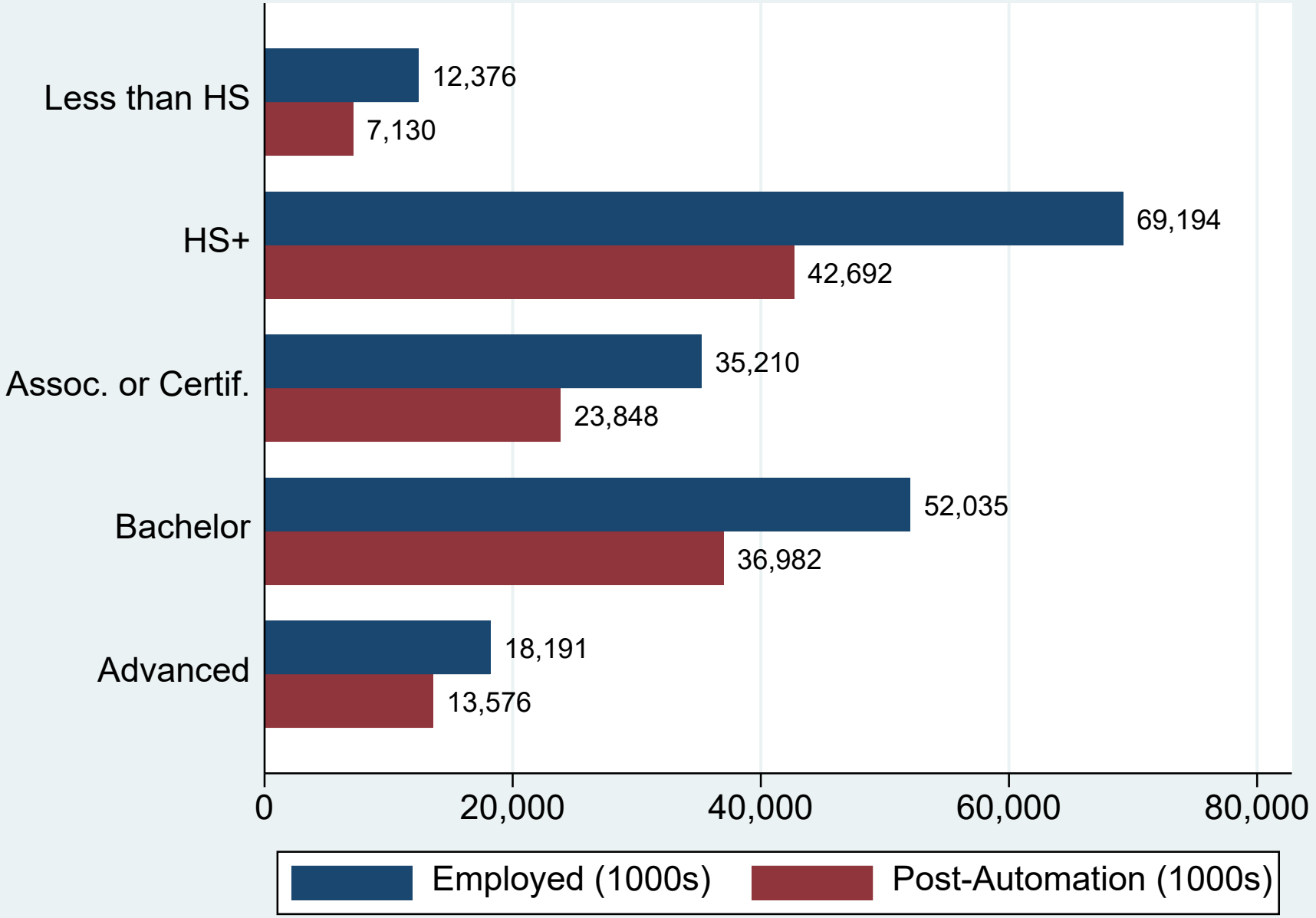
Investigative social, and enterprising jobs are least vulnerable

Flatter slopes will see more equitable automation patterns by salary level

Job Zone	mean	sd	n Jobs
Little	39.7	5.4	32
Some (HS+)	37.5	5.0	279
Medium (Assoc)	33.3	4.5	207
Considerable (Bach)	29.3	4.2	203
Extensive (Adv)	26.5	3.7	152
Total	*32.7*	*6.2*	*873*



Automation Risk Is Inversely Correlated with Job Zone Because Complexity Is Hard to Automate



Automation may exacerbate earnings inequities

New jobs will arise too, but likely entailing higher levels of complexity

Implications and Next Steps

Implications

Next-gen automation may exacerbate income inequality by education and income

Investments in investigative (scientific), social, and vision/leadership skills hold promise

Teaching novices to leverage AI productivity tools may help preserve pathways to advanced expertise

Next Steps

Test sensitivity to construction of the automatability index by (1) how bottlenecks are weighted, and (2) crowd-sourcing task-based willingness to automate

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