

Declining Jobs, Declining Opportunities? Mobility of Workers in Occupations With Job Contraction, 2000–2020

Xi Song

University of Pennsylvania

Jennie Brand

University of California, Los Angeles

Sukie Yang

University of Pennsylvania

Michael Lachanski

University of Pennsylvania

August 13, 2022

Motivation

- ▶ A dramatic **growth of jobs** and **new job types** in high-tech, biomedical, data science, and new energy occupations (Autor,

Salomons, and Seegmiller 2021).

Motivation

- ▶ A dramatic **growth of jobs** and **new job types** in high-tech, biomedical, data science, and new energy occupations (Autor, Salomons, and Seegmiller 2021).
- ▶ **Declining jobs:** Some previously highly desirable and in-demand occupations have been *downgraded*, are *declining*, or have even *disappeared* (Kalleberg and Mouw 2018).

Motivation

- ▶ A dramatic **growth of jobs** and **new job types** in high-tech, biomedical, data science, and new energy occupations (Autor, Salomons, and Seegmiller 2021).
- ▶ **Declining jobs:** Some previously highly desirable and in-demand occupations have been *downgraded*, are *declining*, or have even *disappeared* (Kalleberg and Mouw 2018).
- ▶ **Job mobility:** Increased intragenerational occupational mobility, especially within the clerical, craft, service, and sales occupations (Jarvis and Song 2017; Kambourov and Manovskii 2008).

Research Question

- ▶ Do workers' mobility prospects depend on the rates of job growth in their occupations?

Research Question

- ▶ Do workers' mobility prospects depend on the rates of job growth in their occupations?
 - ▶ **1990s.** Occupations with *lower* rates of job growth had *higher* rates of job mobility (DiPrete et al. 1997; DiPrete and Nonnemaker 1997).
 - ▶ **2000-.** Same trends? Where did they move?

Research Question

- ▶ Do workers' mobility prospects depend on the rates of job growth in their occupations?
 - ▶ **1990s.** Occupations with *lower* rates of job growth had *higher* rates of job mobility (DiPrete et al. 1997; DiPrete and Nonnemaker 1997).
 - ▶ **2000-.** Same trends? Where did they move?
- ▶ We compile a novel dataset of harmonized detailed job codes, titles, sizes, and associated characteristics.

Research Question

- ▶ Do workers' mobility prospects depend on the rates of job growth in their occupations?
 - ▶ **1990s.** Occupations with *lower* rates of job growth had *higher* rates of job mobility (DiPrete et al. 1997; DiPrete and Nonnemaker 1997).
 - ▶ **2000-.** Same trends? Where did they move?
- ▶ We compile a novel dataset of harmonized detailed job codes, titles, sizes, and associated characteristics.
- ▶ We explore the link between macro-level occupational contraction and micro-level intragenerational mobility.

A Hypothetical Two-Way Mobility Table

		Destination, $t + 1$						
		$g1$	$g2$	$s1$	$s2$	$s3$	$d1$	$d2$
Origin, t	$g1$	Dark	Medium	Light	Light	Light	Light	Light
	$g2$	Medium	Dark	Light	Light	Light	Light	Light
	$s1$	Light	Light	Dark	Medium	Medium	Light	Light
	$s2$	Light	Medium	Medium	Dark	Medium	Light	Light
	$s3$	Light	Medium	Medium	Medium	Dark	Light	Light
	$d1$	Light	Light	Light	Light	Light	Dark	Medium
	$d2$	Light	Light	Light	Light	Light	Medium	Dark

Occupational outlook cluster:

g : growing

s : stable

d : declining

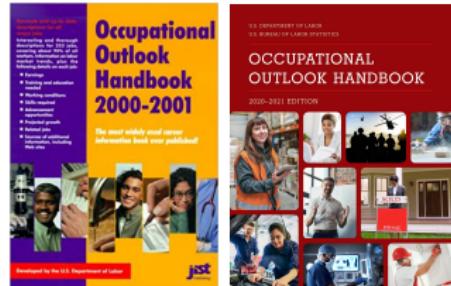
Data

Occupational Outlook Handbook (OOH) 2000–2020

BLS's career resource with detailed job information

- ▶ Updated **biennially**
- ▶ Estimated occupation size
- ▶ Projected occupation change
- ▶ Organized using **O*NET codes**
- ▶ etc.

The screenshot shows the official website for the Occupational Outlook Handbook. At the top, there is a navigation bar with links for "HOME", "SUBJECTS", "DATA TOOLS", "PUBLICATIONS", "ECONOMIC RELEASES", "CLASSROOM", and "BETA". Below the navigation is a search bar with the placeholder "Search OOH.gov". The main header reads "U.S. BUREAU OF LABOR STATISTICS" with a star logo. Underneath, it says "BUSINESS OF LABOR STATISTICS | PUBLICATIONS | OCCUPATIONAL OUTLOOK HANDBOOK". A banner at the top of the page says "OCCUPATIONAL OUTLOOK HANDBOOK". On the left, there is a sidebar titled "OCCUPATION GROUPS" listing various industry categories like Architecture and Engineering, Arts and Design, Building and Grounds Cleaning, Business and Financial, Community and Social Service, Computer and Mathematical Technology, Construction and Extraction, Education, Training, and Library, Entertainment and Sports, Farming, Fishing, and Forestry, Food Preparation and Serving, Healthcare, Installation, Maintenance, and Repair. To the right, there is a section titled "SELECT OCCUPATIONS BY" with dropdown menus for "2020 Median Pay", "Entry-Level Education", "On-the-job Training", "Number of New Jobs (Projected)", and "Growth Rate (Projected)". Below this is a "FEATURED OCCUPATION" section for "EMT's and Paramedics" showing a photo of a paramedic in action and a link to "www.bls.gov/ooh".



Natural Language Processing of OOH Data

- ▶ Text digitization and text data preprocessing ([HathiTrust](#), [ABBYY](#))
- ▶ *RegEx* string-search algorithm
- ▶ Hand-coding using MTurk ([1](#) HIT assigned to [2-3](#) MTurk Masters)
- ▶ Validation



Civil Engineer in OOH, 2020

Civil Engineers

Summary

Quick Facts: Civil Engineers

2018 Median Pay	\$86,640 per year \$41.65 per hour
Typical Entry-Level Education	Bachelor's degree
Work Experience in a Related Occupation	None
On-the-job Training	None
Number of Jobs, 2018	326,800
Job Outlook, 2018–28	6% (As fast as average)
Employment Change, 2018–28	20,500

What Civil Engineers Do

Civil engineers design, build, and supervise infrastructure projects and systems.

Work Environment

Civil engineers generally work in a variety of locations and conditions. It is common for them to split their time between working in an office and working outdoors at construction sites so that they can monitor operations or solve problems onsite. Most work full time.

How to Become a Civil Engineer

Civil engineers need a bachelor's degree in civil engineering, in one of its specialties, or in civil engineering technology. They typically need a graduate degree and licensure for promotion to senior positions. Although licensure requirements vary by state, civil engineers usually must be licensed if they provide services directly to the public.

Pay

The median annual wage for civil engineers was \$86,640 in May 2018.



Civil engineers provide cost estimates for materials and labor to determine a project's economic feasibility.

Job Outlook

Employment of civil engineers is projected to grow 6 percent from 2018 to 2028, about as fast as the average for all occupations. As infrastructure continues to age, civil engineers will be needed to manage projects to rebuild, repair, and upgrade bridges, roads, levees, dams, airports, buildings, and structures of all types.

State & Area Data

Explore resources for employment and wages by state and area for civil engineers.

Similar Occupations

Compare the job duties, education, job growth, and pay of civil engineers with similar occupations.

What Civil Engineers Do

Civil engineers conceive, design, build, supervise, operate, construct and maintain infrastructure projects and systems in the public and private sector, including roads, buildings, airports, tunnels, dams, bridges, and systems for water supply and sewage treatment. Many civil engineers work in planning, design, construction, research, and education.



Civil engineers design major transportation projects.

Duties

Civil engineers typically do the following:

- Analyze long-range plans, survey reports, maps, and other data to plan and design projects
- Consider construction costs, government regulations, potential environmental hazards, and other factors during the planning and risk-analysis stages of a project
- Compile and submit permit applications to local, state, and federal agencies, verifying that projects comply with various regulations
- Oversee and analyze the results of soil testing to determine the ability of soil to support loads
- Analyze the results of tests on building materials, such as concrete, wood, asphalt, or steel, for use in particular projects
- Prepare cost estimates for materials, equipment, or labor to determine a project's economic feasibility
- Use design software to plan and design transportation systems, hydraulic systems, and structures in line with industry and government standards
- Perform fieldwork, including operations to establish building locations, site layouts, reference points, grades, and elevations to guide construction
- Manage the repair, maintenance, and replacement of public and private infrastructure

Civil engineers also must present their findings to the public on topics such as bid proposals, environmental impact statements, or property descriptions.

Many civil engineers hold supervisory or administrative positions ranging from supervisor of a construction site to city engineer, public works director, and city manager. As supervisors, they are tasked with ensuring that safe work practices are followed.

Other civil engineers work in design, construction, research, and teaching. Civil engineers work with others on projects and may be assisted by civil engineering technicians.

Civil engineers prepare permit documents for work on projects in renewable energy. They verify that the projects will comply with federal, state, and local requirements. These engineers conduct structural analyses for large-scale photovoltaic, or solar energy, projects. They also evaluate the ability of solar arrays to withstand wind and how much to reduce stresses from wind, seismic activity, and other sources. For large-scale wind projects, civil engineers often prepare roadbeds to handle large trucks that haul in the turbines.

Civil engineers work on complex projects, and they can achieve job satisfaction in seeing the project reach completion. They usually specialize in one of several areas.

Construction engineers manage construction projects, ensuring that they are scheduled and built in accordance with plans and specifications. These engineers typically are responsible for the design and safety of temporary structures used during construction. They may also oversee

budgetary, time-management, and communications aspects of a project.

Geotechnical engineers work to make sure that foundations for built objects, ranging from streets and buildings to runways and dams, are solid. They focus on how structures built by civil engineers, such as buildings and tunnels, interact with the earth (including soil and rock). In addition, they design and plan for slopes, retaining walls, and tunnels.

Structural engineers design and assess major projects, such as buildings, bridges, or dams, to ensure their strength and durability.

Transportation engineers plan, design, operate, and maintain everyday systems, such as streets and highways, but they also plan larger projects, such as airports, ship ports, mass transit systems, and harbors.

The work of civil engineers is closely related to the work of environmental engineers.

Work Environment

Civil engineers held about 326,800 jobs in 2018. The largest employers of civil engineers were as follows:



Though civil engineers must work in an office setting to produce their plans, they must also spend much time on site to oversee construction.

Amazon MTurk Questionnaire

100 Occupational Outlook Handbook
<https://www.bls.gov/ooh/architecture-and-construction/landscape-architects.htm>

Landscape Architects
(D.O.T. 001.06-018)

Significant Points

- Nearly 30 percent—over three times the proportion for all professionals—are self-employed.
- A bachelor's degree in landscape architecture is the minimum requirement for entry-level jobs; many employers prefer to hire landscape architects who have completed at least one year of postgraduate study.
- Because many landscape architects work for small firms or are self-employed, benefits tend to be less generous than those provided to workers in large organizations.

Nature of the Work
Everyone enjoys attractively designed residential areas, public parks and playgrounds, college campuses, shopping centers, golf courses, parks, and other indoor and outdoor areas. Landscape architects design these areas so that they are not only functional but beautiful and compatible with the natural environment as well. They may plan the placement of buildings, roads, paths, walkways, and trees, as well as the planting of flowers, shrubs, and trees. Historic preservation and natural resource conservation and restoration are other important objectives to which landscape architects may apply their knowledge and professional judgment as well as their design and artistic talents.

Many types of organizations—from real estate development firms starting new subdivisions to companies constructing airports or parks—hire landscape architects, who are often involved with the development and design of a site's overall appearance. In addition to streets, pathways, and buildings, landscape architects help determine the best arrangement of roads and buildings. They also collaborate with environmental scientists, hydrologists, and other professionals to find the best way to conserve or restore natural resources. Once these decisions are made, landscape architects create detailed plans indicating new types of paths, walkways, and other landscaping details, such as fountains and decorative features.

In planning a site, landscape architects first consider the nature and purpose of the project and the funds available. They analyze the natural elements of the site, such as the climate, soil, slope of the land,

Two landscape architects discuss proposed changes to a client's plan.

Although many landscape architects supervise the installation of these designs, some are involved in the construction of the site. However, this usually is done by the developer or landscape contractor. Some landscape architects work on a wide variety of projects.



Part A General information

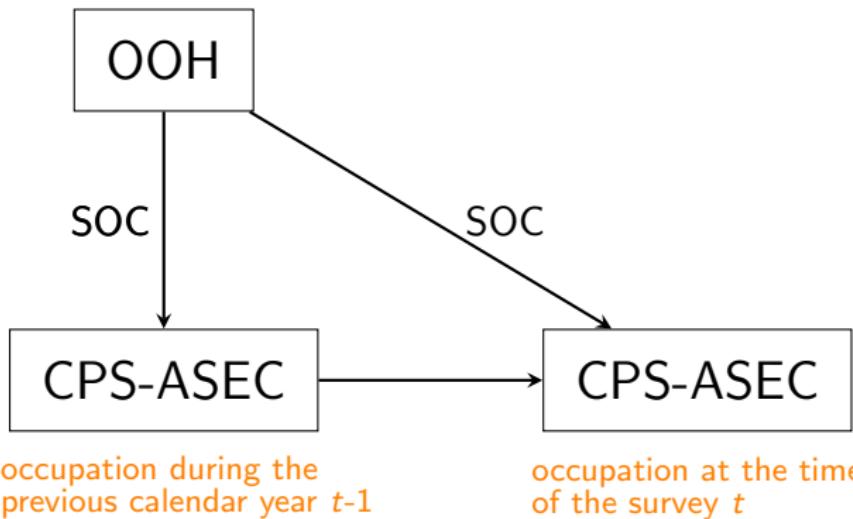
A1. This is the job description for Landscape architects in 1998 Occupational Outlook Handbook (OOH). Is the underlined occupation title the same as what you see on the first page of the PDF file?
Note: If you detect any typo, misspelling, or incompleteness in the occupation title loaded above, choose NO.

- 1) YES -> Go to question A3
- 2) NO -> Go to question A2

A2. Please type in the correct, complete occupation title (e.g., School Teachers – Kindergarten, Elementary and Secondary)

Now read the text below the OOH Occupational Title. In most cases, you will see text above the title, which is from a previous occupation. Skip this text and only focus on the text below the OOH Occupational Title. Note that the order of the questions you receive below may be different from the order of sections you

Merging OOH with the Current Population Survey



- ▶ SOC: Standard Occupational Classification
- ▶ CPS-ASEC: Current Population Survey Annual Social and Economic Supplement

Methods

An Occupational Mobility Model with Opportunity Constraints

- ▶ Denote P_{ij} the probability that worker i chooses alternative occupation j out of J

$$P_{ij} \propto \underbrace{D_{ij}}_{\text{destination (size) constraints}} \cdot \underbrace{O_{ij}}_{\text{origin (size) constraints}} \cdot \underbrace{W_{ij}}_{\text{worker's opportunity}}$$

An Occupational Mobility Model with Opportunity Constraints

- ▶ Denote P_{ij} the probability that worker i chooses alternative occupation j out of J

$$P_{ij} \propto \underbrace{D_{ij}}_{\text{destination size constraints}} \cdot \underbrace{O_{ij}}_{\text{origin size constraints}} \cdot \underbrace{W_{ij}}_{\text{worker's opportunity}}$$

- ▶ We model workers' opportunities W_{ij} using workers' characteristics X_i and occupation choice characteristics Z_{ij} .

$$W_{ij} = \exp\left(\underbrace{Z_{ij}}_{\text{destination occ outlook, etc.}} \gamma + \underbrace{X_i}_{\text{origin occ outlook, edu, age, etc.}} \beta_j\right)$$



An Occupational Mobility Model with Opportunity Constraints

- ▶ Denote P_{ij} the probability that worker i chooses alternative occupation j out of J

$$P_{ij} \propto \underbrace{D_{ij}}_{\text{destination (size) constraints}} \cdot \underbrace{O_{ij}}_{\text{origin (size) constraints}} \cdot \underbrace{W_{ij}}_{\text{worker's opportunity}}$$

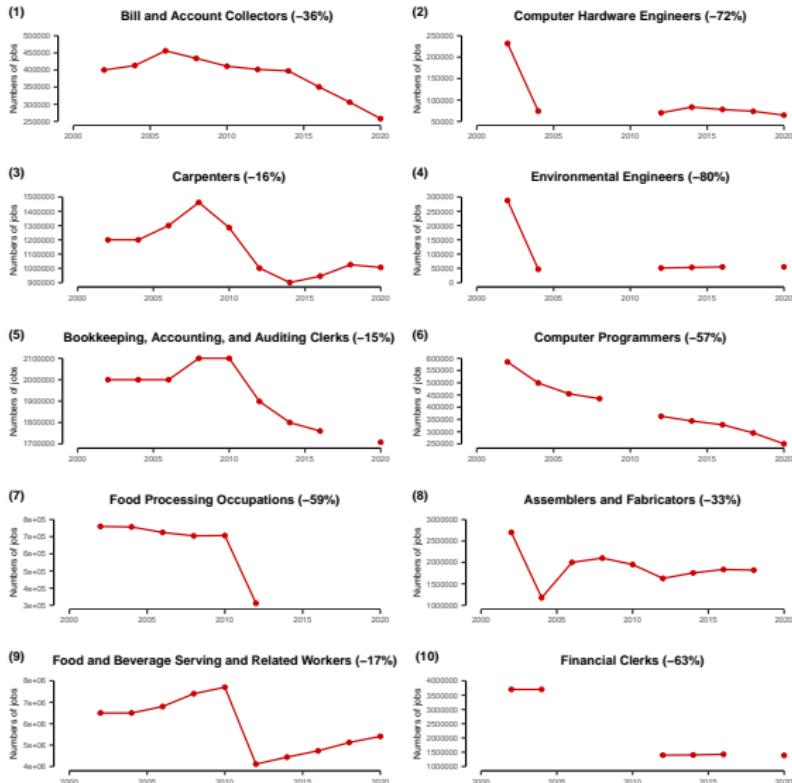
- ▶ We model workers' opportunities W_{ij} using workers' characteristics X_i and occupation choice characteristics Z_{ij} .

$$W_{ij} = \exp\left(\underbrace{Z_{ij}}_{\text{destination occ outlook, etc.}} \gamma + \underbrace{X_i}_{\text{origin occ outlook, edu, age, etc.}} \beta_j\right)$$

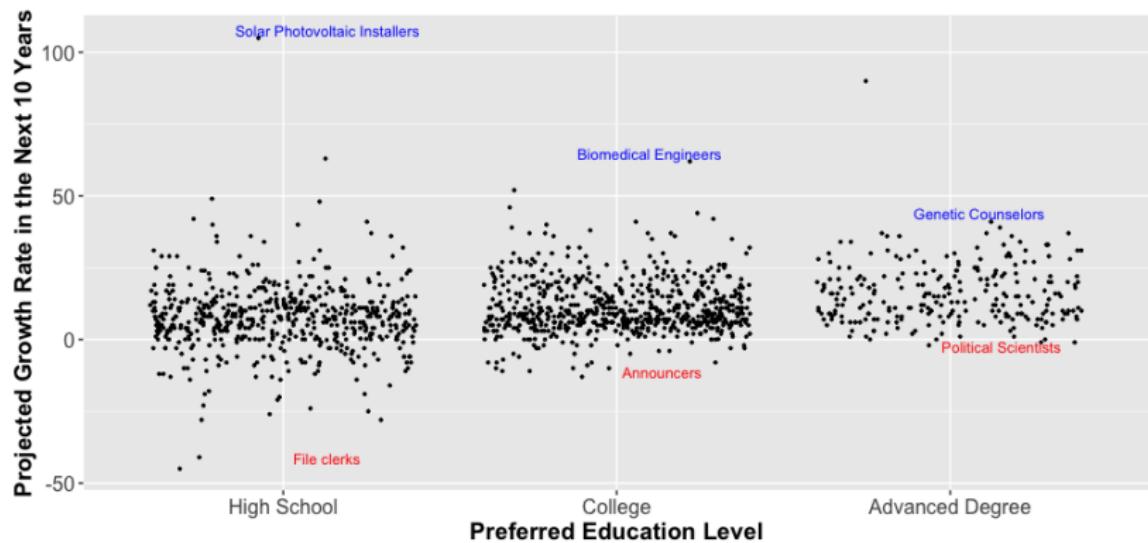
- ▶ This yields a **weighted** form of the standard mixed logit model, where utility is weighted by opportunity structure O and D .

Results

Top 10 Occupations with Most Employment Contraction



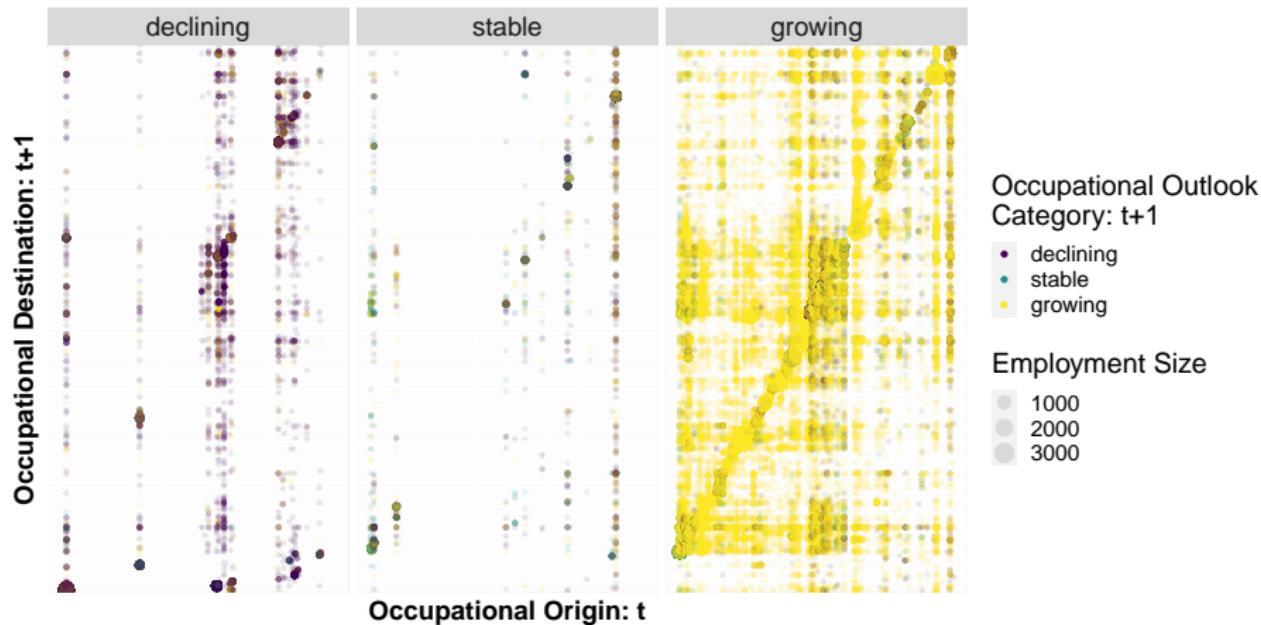
Predicted Occupational Growth Rates by Preferred Education Level of Occupations



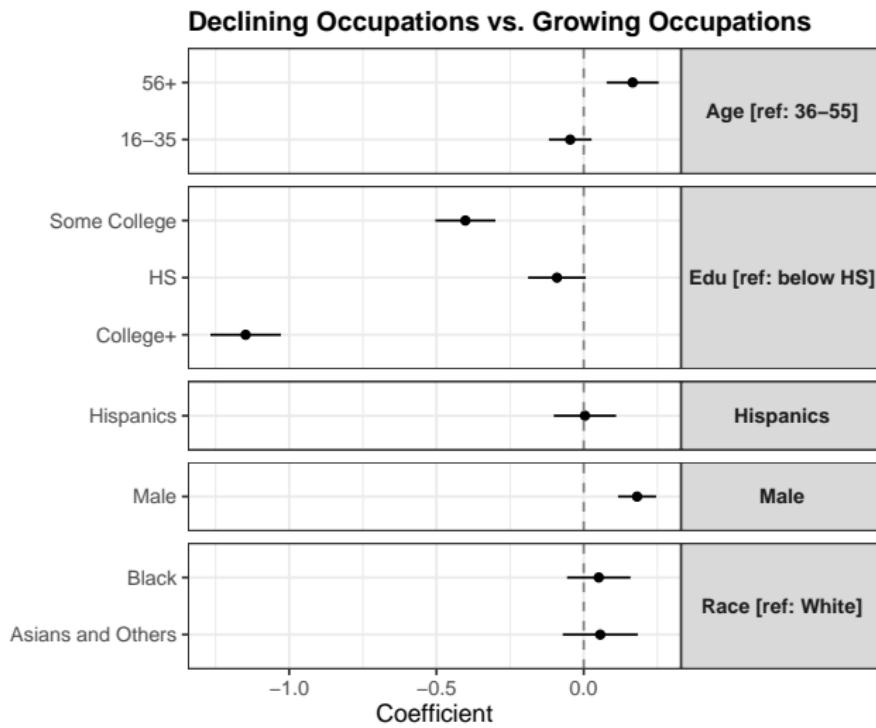
Finding 1: Workers in declining occupations are *less* likely to change occupations than workers in growing or stable occupations.

	Within-Group		Between-Group Mobility To			Total	N
	Immobility	Mobility	Declining	Stable	Growing		
Declining	56.96	33.28	-	1.70	8.07	100	7,707
Stable	53.22	11.76	16.60	-	18.42	100	2,804
Growing	50.42	46.36	1.82	1.40	-	100	124,670

Finding 2: If workers in declining occupations change occupations, they are *likely* to move from one declining occupation to another *rather than* entering growing occupations with expanding opportunities.



Finding 3: Education, sex, and age are associated with the likelihood of mobility, but race is not.



Conclusion

- ▶ Workers in occupations with job contraction face the **double disadvantage** of occupational mobility.
 - ▶ Lower mobility rates
 - ▶ Fewer upward mobility opportunities

Conclusion

- ▶ Workers in occupations with job contraction face the **double disadvantage** of occupational mobility.
 - ▶ Lower mobility rates
 - ▶ Fewer upward mobility opportunities
- ▶ Growing and declining occupations require **different sets of skills**
 - ▶ Higher within cluster mobility
 - ▶ Lower mobility between these clusters

Conclusion

- ▶ Workers in occupations with job contraction face the **double disadvantage** of occupational mobility.
 - ▶ Lower mobility rates
 - ▶ Fewer upward mobility opportunities
- ▶ Growing and declining occupations require **different sets of skills**
 - ▶ Higher within cluster mobility
 - ▶ Lower mobility between these clusters
- ▶ Future work is needed on how to offset the negative mobility consequences of occupational restructuring.

Acknowledgement

We would like to thank support from

- ▶ Penn Population Studies Center
- ▶ California Center for Population Research at UCLA (CCPR)
- ▶ Eunice Shriver Kennedy National Institute of Child Health and Human Development Population Research Infrastructure Program ([NIH P2C-HD044964](#); [NIH P2C-HD041022](#); [NIH T32 HD007242](#))



Extra Slides

The Distribution of Occupations by Employment Size and Projected Growth Rate, 2020

