# The Evolving U.S. Occupational Structure

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#### Motivation

Labor income inequality has increased over the last several decades.

- ▶ 90-10 ratio of real earnings  $\uparrow$  27 log points between 1960 and 2000.
- ▶ The task approach to labor market:
  - Better, cheaper computers
  - Easier offshoring
  - ➤ Changes in the demand for particular (routine, offshorable) tasks
- ► To assess the task-based model, past work combines:
  - occupations' task content, measured at given point in time (e.g., O\*NET)
  - shifts in employment shares across occupations
- Occupations rich in routine tasks have shrunk, those centered on non-routine interactive tasks have grown.

### Research Questions

- Are there within-occupations trends in the tasks which workers perform?
- Can within-occupation changes in task content help explain increasing earnings inequality?

#### New Measurements

- Construct a new data set drawing from the text of newspaper vacancy postings:
  - ▶ 4.2 million ads
  - **1**960-2000
  - ▶ New York Times, Wall Street Journal, Boston Globe.

#### Main Results

#### Consistent with previous research:

► Routine tasks have declined markedly while nonroutine tasks have become increasingly more important

#### New, compared to previous research:

- ► Large share of aggregate changes in task content occurred within occupations, rather than between.
- Use changes in the task composition of occupations to account for inequality between 1960 and 2000
  - Using equilibrium methods: account for 20 log point increase in 90-10 earnings inequality
  - Using statistical decomposition: account for changes of a similar magnitude

#### Literature

**Task approach**: Autor, Levy, Murnane (2003), Autor and Dorn (2013), Acemoglu and Autor (2011), Goos, Manning, Salomons (2014), Spitz-Oener (2006), Firpo, Fortin, Lemieux (2014), Becker and Muendler (2015), and many other recent studies.

► Contribution: Time-varying task measurements

On-line vacancy postings: Deming and Kahn (2016), Hershbein and Kahn (2016), Marinescu and Wolthoff (2016), Modestino, Shoag, Ballance (2016).

Contribution: Long-run measurements (pre-internet era)

Comparative advantage and occupational choice: Heckman and Sedlaceck (1985), Heckman and Scheinkman (1987), Burstein, Morales, Vogel (2015), and Hsieh, Hurst, Jones, Klenow (2016)

 Contribution: embed task bundling in a quantitative, GE model of sorting

## Roadmap

- 1. Turning job ads into data
- 2. Trends in task-related words
- 3. Wrap up:
  - ▶ Rest of the paper: Tasks and the earnings distribution
  - Other work.

# Processing newspaper text files

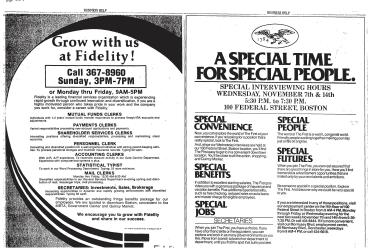
ProQuest processes images of newspaper pages into text files (OCR)

- ▶ Job ads from New York Times (1960-2000), Wall Street Journal (1960-1998), and Boston Globe (1960-1983)
- Steps to construct the data set:
- 1. Distinguish vacancy postings from other advertisements
- 2. Find the boundaries between vacancy postings
- 3. Identify the ad's job title  $\Rightarrow$ SOC code
- 4. Extract task-related information

## Processing newspaper text files - Unprocessed

Display Ad 133 -- No Title

Boston Globe (1960-1985); Nov 4, 1979; ProQuest Historical Newspapers: The Boston Globe pg. E51



## Processing newspaper text files - Unprocessed

rapid growth through continued innovation and diversification If you are highly motivated person who takes pride in your work and the company you work for consider career with Fidelity \n MUTUAL FUNDS CLERKS \n Individuals with 1-2 years funds transfer experience to process Keogh IRA accounts and adjustments \n PAYMENTS CLERKS \n Varied les processing new account applications and payments \n StI nt flt ner fr nlr ct tfl \n Mnirk \n and maintaining client \n strong record-keeping 50 wpm \n Data Control Department \n sorting and \n Brokerage \n environments with \n benefits package for our Boston convenient to the Market \n gr WilnliE lU5lty \n success \n -l 1?Q1.al ol P-1Sl1v MPloV \n Fidelit \n Group \n 82 DEVONSHIRE STREET BOSTON MA 02109 \n 111 \n -1 \n TERMINAL OPERATOR \n Position involves typing policy related information Into computer terminal No previous computer experience required Typing 5055 wpm Excellent benefits plus work Incentive program in addition to starting salary of S150-165.

Note: Snippet of the raw text from Boston Globe, 11/4/79, Display Ad #133

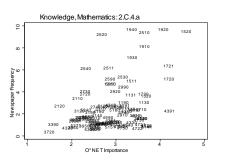
### Processing newspaper text files - Processed

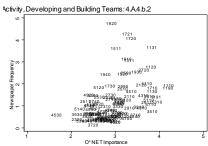
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## Mappings of words to task classifications

- ➤ Spitz-Oener (2006): 1) nonroutine analytic, 2) nonroutine interactive, 3) nonroutine manual, 4) routine cognitive and 5) routine manual
- O\*NET: 16 Work Styles, 35 Skills, 33 Knowledge Requirements, 41 Activities





# Mappings to Spitz-Oener (2006) classification

nonroutine	analyze, analyzing, design, designing, devising rule,
analytic	evaluate, evaluating, interpreting rule, plan,
	planning, research, researching, sketch, sketching
nonroutine	advertise, advertising, advise, advising, buying,
interactive	coordinate, coordinating, entertain, entertaining,
	lobby, lobbying, managing, negotiate, negotiating,
	organize, organizing, presentation, presentations,
	presenting, purchase, sell, selling, teaching
nonroutine	accommodate, accommodating, accommodation,
manual	renovate, renovating, repair, repairing, restore,
	restoring, serving
routine	bookkeeping, calculate, calculating, correcting,
cognitive	corrections, measurement, measuring
routine	control, controlling, equip, equipment, equipping,
manual	operate, operating

<sup>\*</sup>we include for each of these words, synonyms based on machine-learning text similarity

# Relative importance of within versus between occupations

Question: What fraction of changes in aggregate use of task h are driven by changes in tasks within occupations?

- lacktriangle Aggregate use of task h at time t is  $ar{\mathcal{T}}_{ht} = \sum_j heta_{jt} ilde{\mathcal{T}}_{hj}$
- We decompose aggregate changes:

$$\bar{T}_{ht} = \bar{T}_{h,1960} + \underbrace{\sum_{j} \theta_{j,1960} \cdot \left(\tilde{T}_{hjt} - \tilde{T}_{hj,1960}\right)}_{\text{"within"}} + \underbrace{\sum_{j} \left(\theta_{jt} - \theta_{j,1960}\right)\tilde{T}_{hjt}}_{\text{"between"}}$$

#### where:

- $\tilde{T}_{hjt}$  is mentions of task h per thousand ad words for occupation j in year t.
- $\theta_{jt}$  is the share of employment in occupation j at time t (Census data)

Nonroutine Analytic	Total	Between	Within	Within Share
1960 Level	3.43			
1960-2000 Growth	2.61	0.20	2.41	0.92
1900-2000 Growth	(0.14)	(0.15)	(0.23)	(0.06)
Nonroutine Interactive				
1960 Level	4.95			
1060 2000 Committee	2.61	0.37	2.24	0.86
1960-2000 Growth	(0.15)	(0.16)	(0.27)	(0.06)
Routine Cognitive				
1960 Level	1.23			
1960-2000 Growth	-0.47	-0.14	-0.33	0.70
1900-2000 Growth	(0.06)	(0.15)	(0.20)	(0.41)
Routine Manual				
1960 Level	0.78			
1960-2000 Growth	-0.72	-0.02	-0.70	0.97
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# The relation between task changes and inequality

- 1. Quantitative GE model of sorting and comparative advantage
  - Workers of different skill types have different comparative advantages in producing nonroutine vs. routine tasks.
  - ► Changes in the demand for nonroutine vs. routine tasks alter
    - the occupations which workers sort into, their earnings, overall earnings inequality.
  - Counterfactual exercise: Use within-occupation changes in tasks as a measure for changes in the demand for tasks ⇒ 23 p.p. increase in 90-10 earnings inequality.
- 2. Decompositions via recentered influence function regressions
  - Analogue of Oaxaca-Blinder decomposition for distributional statistics other then the mean
  - ► Our measures of tasks account for a 22 p.p. increase in 90-10 inequality between 1960 and 2000...
    - ... and a more modest 5 p.p. increase when using measures which are fixed within occupations throughout the sample.

#### Conclusion

#### This paper

- New measurements of changes in task content of jobs over time; publicly available
- "Within-occupation" changes are at least as important as "between-occupation" changes in accounting for aggregate changes in job content
- Reduced-form and model-based decompositions suggest our task measures account for about a 20 percentage point increase in the 90-10 ratio

#### Related work

- adoption of technology ("New Technologies and the Labor Market")
- gender targeting in vacancy postings