Sorting Into Jobs and Labor Supply and Demand at Older Ages

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NBER Workshop on Labor Demand and Older Workers
Cambridge, MA; November 15, 2019

Background

- Aging society: Boomer cohort & longer life spans
- Pressure on Social Security: solvency
- Also worries about deficient preparedness for retirement w/DC plans
- Working longer = potential solution (also some evidence that this may have health/cognition benefits)
- In this context, labor supply studied a lot: wages, SS/pensions, health (+ins), non-monetary job characteristics, worker characteristics
- Less known about labor demand for older workers

Basic idea

Suppose

- Occupation j is an occupation most suitable for older workers
- Number of (all) workers in occupation j has increased

$\Rightarrow$ increased demand for older workers (in occ. j)
$\Rightarrow$ efforts to retain older workers, e.g., higher wages
$\Rightarrow$ lower retirement rates

Preview of findings

- Variation across occupations in fraction of older workers and suitability for older workers
- Differential increases of number of workers by occupation between 1986 and 2016
- Older workers often in declining occupations ⇒ would suggest reduced demand overall, but varies
- Evidence of increased wages in occupations with increased demand for older workers, relative to other occupations
- Retirement related to wages but no evidence for other channels of effect of increased demand

Limitation: No (quasi-) experimental variation ⇒ mostly stories with corroborating (or not) evidence

Related work

- Angrisani et al. (2015, 2017a, 2017b) Non-monetary job characteristics & retirement
- Krueger & Schkade (2008) Sorting into jobs based on match of characteristics
- McFall et al. (2015), Sonnega et al. (2016) What occupations do older individuals work in & how does this affect retirement?
- Currie & Madrian (1999) Health shock & physically demanding job $\Rightarrow$ retirement
- Autor et al. (2003), Acemoglu & Autor (2011) Occ with non-routine tasks that cannot be automated & reduced supply of prime-age workers $\Rightarrow$ higher demand for older workers
- Neumark & Yen (2018) Demographic changes $\Rightarrow$ higher demand for older workers

Also: Autor et al. (2013) Labor demand depends on outsourcing, changes in product demand, import competition (implicitly underlies our main story)

Data sources

Main data source: CPS

- Employment, occupation, age
- All monthly data, 1986 & 2016; treat as single cross-section per year
- Use workers age 18+
- IPUMS version: harmonized vars, esp. occupation codes

Health and Retirement Study (HRS)

- Panel study of older individuals (50+) with rich info
- Study of worker characteristics and retirement
- 2010–2016 waves
- Use workers age 50+
- RAND HRS version: user friendly, harmonized; plus personality data from the leave-behind questionnaire

Occupation Information Network (O*NET)

- Occupational characteristics, worker requirements
- Merge to CPS and HRS by occupation code; take averages across detailed occupations when necessary.

Key variables

Occupation j, year t
Older worker: age 50+

Fraction of older workers by occupation and year $P_j(\text{old} \mid t)$

- Terciles of this, e.g., 330 occupations $\Rightarrow \text{Terc}_{j,t} = 1$ for 110 occupations with lowest fraction and 3 for 110 occupations with highest fraction
- Terciles only computed if ≥ 100 observations in year t

Fraction of all workers in occupation by year $P(j \mid t)$

- Increase: $\text{Incr}_j = 1[P(j \mid 2016) > P(j \mid 1986)]$
  (also growth; conversely decrease, decline)

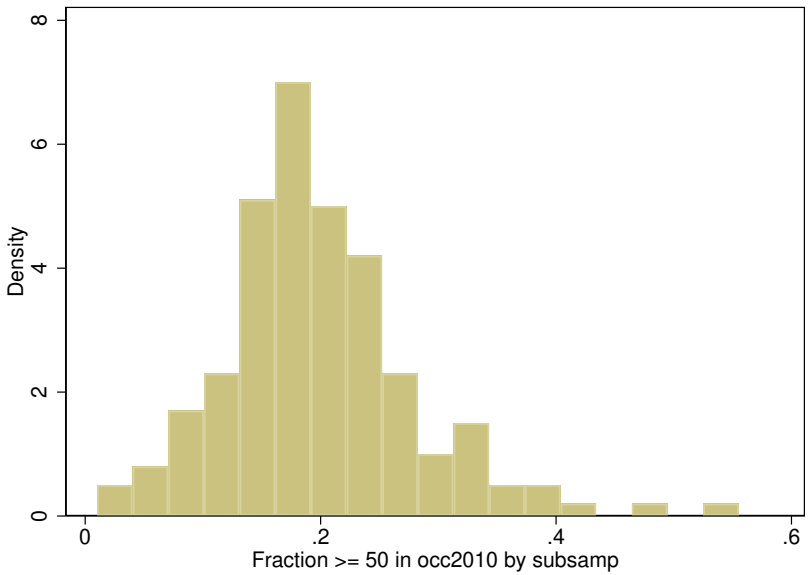
Methods

- Mostly descriptive statistics + some regressions. (You'll see.)
- Mostly use sample weights (exception: some analyses at the occupation level)
- Use robust or clustered s.e.'s as appropriate, except we don't cluster the CPS

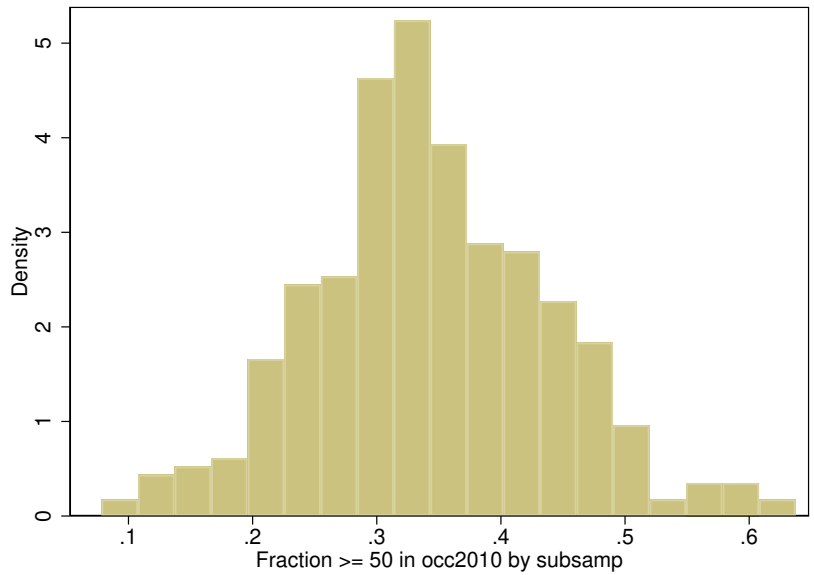
Heterogeneity in age structure by occupation

Distribution of fraction older workers across occupations

1986



2016



- Shift to the right: aging workforce
- Considerable variation in fraction older workers per occupation
- Characterization of occupations by fraction older workers may be meaningful

"Oldest" occupations

1986		2016	
Occupation	Frac	Occupation	Frac
precision instr and equipment repair	0.382	tax preparers	0.550
funeral directors	0.391	tool and die makers	0.562
community and social service spec	0.393	chief executives and legislators/publ	0.568
woodworking machine setters, oper	0.399	clergy	0.572
optometrists	0.405	motor vehicle operators, all other	0.592
tailors, dressmakers, and sewers	0.433	bus and ambulance drivers and attend	0.597
farmers, ranchers, and other agric	0.480	tailors, dressmakers, and sewers	0.600
barbers	0.485	agricultural inspectors	0.600
crossing guards	0.552	postal service clerks	0.611
chief executives and legislators/publ	0.555	farmers, ranchers, and other agric	0.637

- Traditional occupations, crafts; CEOs

"Youngest" occupations

1986		2016	
Occupation	Frac	Occupation	Frac
dancers and choreographers	0.010	host and hostesses, restaurant	0.078
dental hygienists	0.026	waiters and waitresses	0.098
law enforcement workers, nec	0.029	residential advisors	0.120
respiratory therapists	0.033	vehicle and mobile equip mechanics	0.126
dental assistants	0.037	helpers, construction trades	0.126
speech language pathologists	0.047	bartenders	0.129
computer programmers	0.052	fence erectors	0.136
announcers	0.054	new account clerks	0.144
physician assistants	0.055	emergency medical tech and paramed	0.146
therapists, nec	0.063	roofers	0.147

- 1986: lower-level health care
- 1986: computer programmers $\Rightarrow$ new skills
- 2016: serving and assisting customers
- less consistent than "oldest" occupations

Persistence in ranking of occupations across years

Number of occupations by terciles of the distributions of fraction older workers in 1986 and 2016

Tercile in 1986	Tercile in 2016			
	1	2	3	Total
1	**59**	30	12	101
2	26	**49**	30	105
3	13	23	**59**	95
Total	98	102	101	301

- $(59 + 49 + 59)/301 = 55\%$ of occupations in same tercile
- kappa $= 0.4 \Rightarrow$ moderate agreement
- Some consistency, but age structure by occ not constant

Distribution of occupations by age

(Aggregated occupational categories; subset)

Occupational category	1986		2016	
	Age of worker		Age of worker	
	18–49	50+	18–49	50+
Management	9.07	13.69	10.21	14.56
Computer and math	1.28	0.48	3.46	2.40
Food prep and serving	4.45	3.14	6.65	2.87
Building+grounds clean+maint	3.29	5.66	3.64	4.24
Sales and related	11.78	12.54	10.56	10.00
Office and admin support	16.15	14.81	11.29	12.76
Construction	6.00	4.65	5.51	4.46
Production	10.73	11.17	5.54	5.93
...	...	...	...	...
Total	100.0	100.0	100.0	100.0

- Management stands out: much higher share of older than younger
- Production as a whole declined
- Food prep & serving increased among young, decreased among old

Were older workers in declining occupations in 2016?

Change in fraction of workers in occupation	Tercile of fraction older workers in 2016 ($\text{Terc}_{j,2016}$)				Number of occupations
$\Delta P(j \mid t)$	1	2	3	Total	
Decrease	25.6	37.5	36.9	100.0	176
Increase	42.4	28.8	28.8	100.0	125
Total	32.6	33.9	33.6	100.0	301

Row% of number of occupations

- More likely to be "old" occ in 2016 if decline between 1986 & 2016
- Differences are not huge

Inertia theory

Suppose

- Temporal variation in labor demand per occupation
- When young, enter occupation with high demand
- Stay in occupation throughout career
- Regression to the mean: many high demand occupations become low demand $\Rightarrow$ decline
- Declining occupation: aging of existing workers + less refreshment = older occupation

Inertia theory: illustrative scenario

Occupation j:

Age of workers	1986	2016
Young	A	$C = E - D$
Old	B	$D = A$
Total	$A + B$	E

$\Rightarrow$ predicted frac.old in 2016 given total number of workers in 2016 and number of young in 1986 = $\tilde{P}_j(\text{old} \mid 2016) = A/E$

Evaluating the inertia theory

y = Frac.workers age 50–65 by occ. in 2016, P_j(50–65 | 2016)

	(1)	(2)	(3)
Pred.frac. 50–65 $\tilde{P}_j$(50–65 | 2016)	0.009 (0.009)	0.006 (0.009)	0.007 (0.009)
Frac.50–65 1986 P_j(50–65 | 1986)		0.560*** (0.073)	0.378*** (0.111)
Increase 1[$P(j \mid 2016) > P(j \mid 1986)$]		−0.027*** (0.010)	−0.028*** (0.010)
Frac.20–35 1986 P_j(20–35 | 1986)			−0.138** (0.067)
Constant	0.293*** (0.007)	0.206*** (0.017)	0.304*** (0.049)
R^2	0.009	0.224	0.234

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; $N = 321$ occupations

⇒ Inertia theory explains nothing

Sorting theory

- Different occupations have different tasks that require different skills
- Different individuals have different skills
- Skills systematically evolve over the life course ⇒ older individuals have different skills than younger individuals
- Matching requirements with skills ⇒ sorting by skills ⇒ older workers work in different occupations than younger workers
- Requirements are relatively stable over time ⇒ consistency in which workers are suitable for older workers (We have already seen that this is only partially true.)

Differences in workers' and job chars by occupation

Our (AKM) indexes, used in our other papers

Characteristic	Terc 1	Terc 3	Diff
Worker char: cognition	8.40	9.93	1.53***
Worker char: psycho-motor ability	4.75	3.33	−1.42**
Worker char: physical ability	3.76	1.83	−1.94***
Worker char: eyesight	4.54	4.80	0.26
Worker char: sensory-perception	6.34	6.82	0.48*
Worker reqmt: cognition	8.72	10.83	2.11***
Worker reqmt: social skills	8.33	9.71	1.38*
Worker reqmt: experience	0.97	1.67	0.70***
Job char: cognitive demands	10.89	13.44	2.55***
Job char: physical demands	4.86	3.56	−1.30***
Job char: working with computer	9.48	11.56	2.08
Job char: working with equipment	3.48	2.82	−0.66
Job char: interacting with others	7.27	8.78	1.51**
Job char: responsibility/lot to say	3.00	3.09	0.09
Job char: time pressure	2.47	2.51	0.04

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; $N = 251$ occupations; 2016

Differences in job chars by occupation (2)

Acemoglu-Autor (2011) indexes

Characteristic	Terc 1	Terc 3	Diff
Non-routine analytical skills	9.02	9.83	0.80*
Non-routine interpersonal skills	9.14	9.69	0.55
Routine cognitive skills	9.47	9.20	−0.27
Routine manual skills	7.78	6.74	−1.04***
Non-routine physical adaptability	10.10	8.54	−1.57**
Non-routine interpersonal adaptability	3.18	3.33	0.14

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$; $N = 251$ occupations; 2016

Taking stock about job chars

- Different jobs do have different demands/requirements
- Evidence that this is related to fraction older workers:
  "old" occupations have higher cognitive demand and lower physical demand, require less routine manual skills, and less non-routine physical adaptability

Does this mean there is a tight match between (older) workers' characteristics and their jobs' demands?

- If mismatch between skills and requirements happens because of skill changes without changing jobs $\Rightarrow$ could lead to retirement
- (Note that there is also likely sorting by preferences and this may be correlated with retirement)

Heterogeneity of individual characteristics within occupational category

Regression of individual characteristics on full set of occupation dummies (HRS)

Variable	R^2	N
Total word recall	0.0808	15,141
Self-reported health	0.0466	23,355
Extraversion	0.0216	17,597
Job tenure	0.0403	23,061

$\Rightarrow$ Occupation explains only a small part of the variation in individual characteristics.

Caveat: HRS has highly aggregated occupation codes $\Rightarrow$ more detailed occupation codes would explain more variation

Correlations at the occupational cat level

Averages of individual-level variables (HRS; 2010–2016) vs. O*NET

O*NET Variable	HRS variable			
	Word recall	Self-rep. health	Extra-version	Job tenure
Worker char: cognition	0.78			
Worker reqmt: cognition	0.83			
Job char: cognitive demands	0.67			
Worker char: physical ability		0.72		
Job char: physical demands		0.69		
Worker reqmt: social skills			0.51	
Job char: interacting with others			0.35	
Worker reqmt: experience				0.86

$N = 22$ occupational categories

$\Rightarrow$ Strong relation between average individual characteristics by occupation for older workers and O*NET measures of requirements

Assessment of sorting and mismatch

Glass half full/half empty:

- Considerable within-occupation heterogeneity of individual characteristics $\Rightarrow$ scope for substantial fraction with mismatch
- Strong relations at the aggregate level $\Rightarrow$ there is clear sorting by skills, even among older workers

Differential changes in the labor market by fraction older workers

Overall change in occupation by tercile of fraction older workers in 1986

Tercile frac.older workers in 1986	Overall change of occupation			Number of occupations
	Decrease	Increase	Total	
1	60.0	40.0	100.0	110
2	62.7	37.3	100.0	110
3	63.6	36.4	100.0	110
Not def. (< 100 obs)	5.8	94.2	100.0	121
Total	47.0	53.0	100.0	451

- Most occupations that had substantial number of workers in 1986 declined between 1986 and 2016
- Weak relation between fraction older workers in 1986 and decline
- The vast majority of occupations that had few or zero observations in the CPS in 1986 grew $\Rightarrow$ emerging occupations

Sorting and labor demand

Suppose:

- Differences between occupations in suitability for older workers (reflected in terciles of fraction older workers)
- Differential growth in labor demand by occupation (reflected in "Increase" dummy)
- $\Rightarrow$ There will be increased demand for older workers in some occupations and decreased demand in others.
- $\Rightarrow$ We construct "Increased demand for older workers" dummy for an occupation as

$$\text{IncrDem}_j = \text{Increase}_j \times (\text{Terc}_{j,1986} = 3)$$

- We also construct the predicted fraction older workers as

$$\hat{P}_j(\text{old} \mid 2016) = P_j(\text{old} \mid 1986) \frac{P(\text{old} \mid 2016)}{P(\text{old} \mid 1986)}$$

Diff-in-diff for wages

- If there is an increased labor demand in occupation j, one would expect wages in occupation j to go up (more than in occupations with decreased demand), to attract or retain workers.
- If j is an "old" occupation, we'd expect the relation to hold for older workers
- If j is an "old" occupation, we may expect wages for older workers to go up more than for younger workers
- We investigate these hypotheses through a diff-in-diff for older workers where the "treatment group" dummy is the "increased demand" dummy and through a triple difference in which young workers are also included and the third diff is older vs younger workers.

Diff-in-diff results (y = log hourly wage)

Regressor	Ages 50–79		Ages 18–79	
	(1)	(2)	(3)	(4)
Year 2016	0.870***	0.879***	0.778***	0.755***
	(0.006)	(0.006)	(0.003)	(0.003)
Increased demand	−0.002	0.020	0.081***	0.059***
	(0.019)	(0.019)	(0.010)	(0.010)
2016 × incr.dem	0.092***	0.083***	0.040***	0.039***
	(0.023)	(0.023)	(0.014)	(0.013)
Age 50+			0.089***	0.399***
			(0.005)	(0.052)
Age 50+ × 2016			0.092***	0.123***
			(0.007)	(0.006)
Age 50+ × Incr.dem			−0.083***	−0.039*
			(0.022)	(0.021)
Age 50+ × 2016 × Incr.dem			0.051*	0.044*
			(0.027)	(0.026)
Age dummies		Y		Y
R^2	0.399	0.410	0.419	0.489
N	41,443		175,395	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

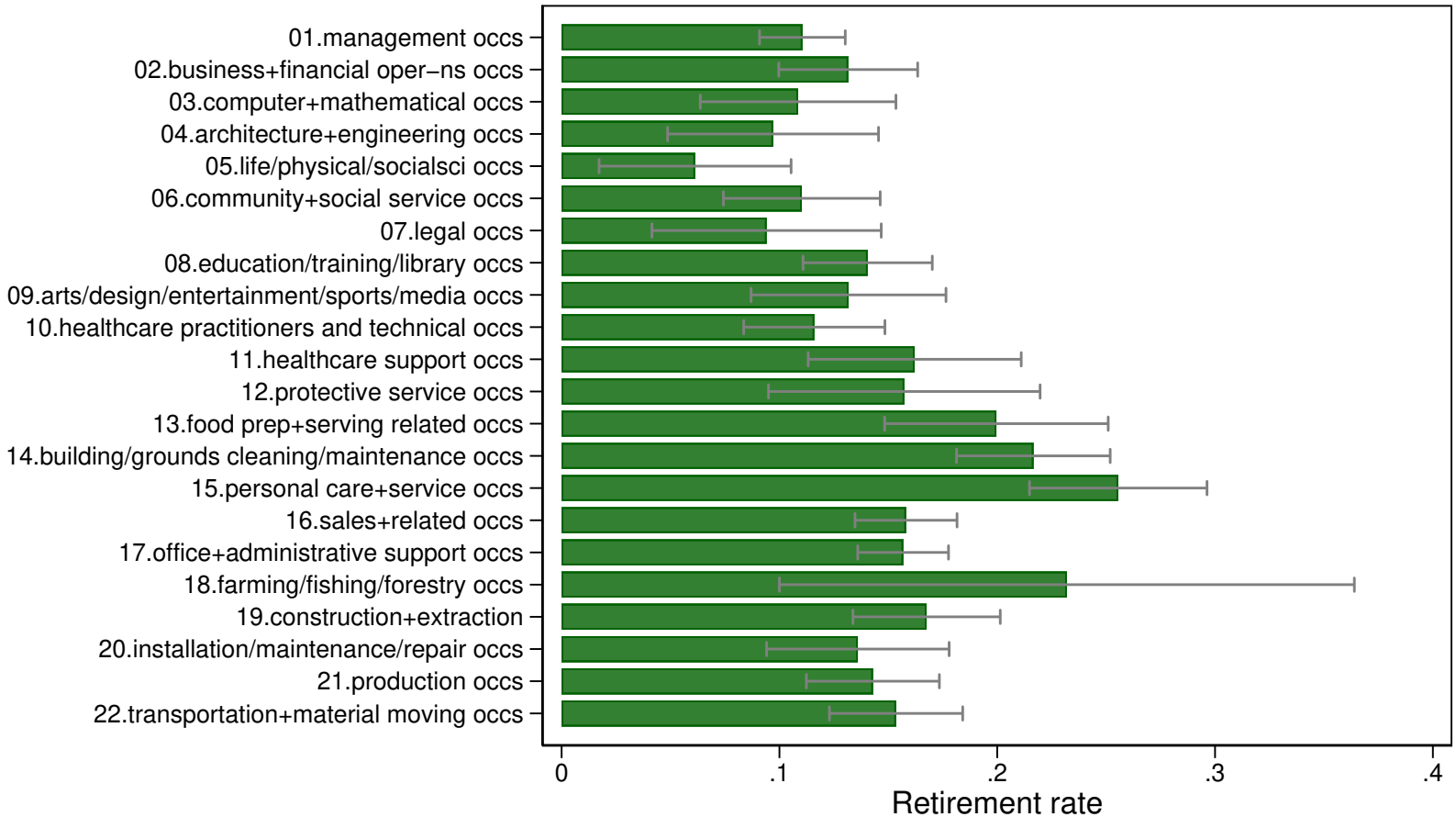
Effects on retirement

- We expect increased demand for older workers in occupation j to lead to decreased retirement rates, through higher wages and/or other channels that employers can use to attract or retain workers.
- We analyze retirement in the HRS $\Rightarrow$ need to use aggregate occupational codes

HRS occ coding applied to IPUMS-CPS data

Occupational category	Percent in occ		Percent older workers		
	1986	2016	1986	2016	Pred.2016
Management	10.0	11.7	27.8	42.2	46.3
Business oper.+fin	3.4	5.0	18.5	35.8	30.8
Computer+math	1.1	3.1	8.8	26.2	14.6
Archit;engineer;techn.	2.4	2.1	21.6	35.8	35.9
Life/phys/soc.sci	1.4	0.9	16.3	33.1	27.2
Comm.+social serv	1.0	1.7	24.8	36.8	41.3
Legal	0.8	1.2	18.3	39.7	30.6
Educ/train/libr	4.1	5.6	20.3	33.7	33.8
Arts/design/entert/sport/media	1.7	2.0	17.5	31.3	29.2
Healthcare pract+tech	3.6	5.9	17.2	33.5	28.7
Healthcare supp	1.7	2.4	18.7	27.1	31.2
Protective	1.6	2.0	20.8	28.9	34.8
Food prep+serv	4.2	5.4	15.2	18.1	25.4
Building/grounds clean+maint	3.8	3.8	30.5	37.3	50.8
Personal care+serv	2.2	3.8	18.7	32.0	31.1
Sales and related	11.9	10.4	21.3	32.6	35.5
Office and admin.supp	15.9	11.8	18.9	36.6	31.6
Farm/fish/forestry	1.1	0.7	20.3	29.2	33.9
Construct/extract	5.9	5.3	16.4	29.2	27.4
Install/maint/repair	4.2	3.3	18.8	33.3	31.3
Production	10.8	5.7	21.0	35.4	34.9
Transportation	7.2	6.1	17.5	36.0	29.1

Retirement rates by occupation



- Relation with "old" job (less retirement) and associated job chars (less physically demanding, more non-routine analytical skills)
- Not an obvious relation with "increase" of the occupation as a whole: some low retirement occupations are declining

Regressions of retirement

Logit coefficients

Regressor	(1)	(2)	(3)	(4)	(5)
Increased demand for older workers	−0.101 (0.074)	−0.141∗ (0.075)	0.005 (0.114)	−0.008 (0.123)	−0.009 (0.160)
Log wage			−0.113∗∗∗ (0.039)	−0.112∗∗∗ (0.039)	−0.116∗∗∗ (0.039)
Job chars (AKM)			Y		Y
Job chars (AA)				Y	Y
Age dummies		Y			
Other indiv			Y	Y	Y
Pseudo-R^2	0.000	0.050	0.079	0.077	0.079
Obs (indiv-wave)	14,238	14,238	9,617	9,617	9,617
Individuals	6,573	6,573	4,754	4,754	4,754

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

No direct effects, but possibly indirect through wages

Discussion

- Considerable heterogeneity in fraction older workers by occupation
- Older workers tend to work in declining occupations
- Inertia theory does not (empirically) explain the data
- Clear evidence for sorting: "old" occupations have different characteristics from "young" occupations, and on average these match with (older) workers characteristics.
- However, lots of room for mismatch due to within-occupation variation
- We constructed an "increased demand" indicator that is 1 for "old" occupations whose share of the labor market increased between 1986 and 2016 and 0 otherwise
- Evidence for effect of increased demand on increased wages, but weaker evidence for a differential effect for older vs. younger workers
- No direct effect of increased demand on retirement, but possibly an indirect effect through wages.
- Limitation: no (quasi-)experimental variation

Further research

- Data improvements: more years in the CPS, restricted detailed occupations in the HRS
- Robustness to alternative occupation coding (1990 instead of 2010) in the IPUMS-CPS
- Study industry