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Disappearing Routine Jobs:
Who, How, and Why?

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Background

Job Polarization

- Declining share of employment in *routine occupations*

  - Limited in scope, performed by following well-defined instructions

  - Tend to be in the middle of the wage distribution

- Decline argued to be due to technological progress
  (Autor-Levy-Murnane, 2003; Autor-Katz-Kearney, 2006; Goos-Manning, 2007)

This paper

- **Who** the loss of routine job opportunities is affecting most in the US since the 1980s

- **How** these demographic groups have adjusted in terms of employment/occupation

  - Implications of this adjustment for overall labor trends

- **Why**?

  - Quantitative role of automation in the decline of routine employment in neoclassical framework

Preview of Findings

- **Who**?
  - *Routine Manual:* young and prime-aged men with low levels of education
  - *Routine Cognitive:* young and prime-aged women with intermediate levels of education

Preview of Findings

- **Who**?

    - *Routine Manual:* young and prime-aged men with low levels of education

    - *Routine Cognitive:* young and prime-aged women with intermediate levels of education

- **How** have they have adjusted?

    - Increased propensity for **non-employment** and for employment in (low-paying) **non-routine manual** occupations

    - **Accounts for a substantial fraction** of the aggregate growth in these stocks

Preview of Findings

- **Who**?

    - *Routine Manual:* young and prime-aged men with low levels of education

    - *Routine Cognitive:* young and prime-aged women with intermediate levels of education

- **How** have they have adjusted?

    - Increased propensity for **non-employment** and for employment in (low-paying) **non-routine manual** occupations

    - **Accounts for a substantial fraction** of the aggregate growth in these stocks

- **Why**?

    - Basic neoclassical framework **struggles to account for joint decline** in routine employment and associated rise in non-routine manual employment and non-employment

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- Monthly CPS (IPUMS)

- Civilian, non-institutionalized population

- Age 20–64

- Exclude agriculture/resource occupations

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Occupation Groups (e.g. Acemoglu-Autor 2011)

- **Non-Routine Cognitive**: public relations manager, physician, financial analyst, aerospace engineer, computer programmer, economists

- **Routine Cognitive**: secretary, bank teller, travel agent, retail salesperson, mail clerk, office support worker, data entry keyer

- **Routine Manual**: machine operator, machine tender, fabricator/assembler, welder, mechanic, cement mason, dressmaker, butcher

- **Non-Routine Manual**: janitor, bus-boy, gardener, bartender, manicurist, home health aide, personal care aide

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Changes in Routine

	Pre	Post	Total	Difference Group Size	Propensities	Interaction
	(1)	(2)	(3)	(4)	(5)	(6)
1979-2014						
NRC	21.5	28.2	$+6.7$			
RC	17.3	16.1	-1.2			
RM	23.2	15.1	-8.1			
NRM	8.4	12.3	$+3.9$			
Not Working	29.6	28.3	-1.3			
1989-2014						
NRC	24.7	28.2	$+3.5$			
RC	19.6	16.1	-3.5			
RM	21.0	15.1	-5.9			
NRM	9.6	12.3	$+2.7$			
Not Working	25.2	28.3	$+3.1$			

Decomposition

- What accounts for the changes in the probabilities?

    - *Observable*: changes in demographic composition?

    - *Unobservable*: changes in "propensity" to work in Routine...

        - for particular demographic groups?

- Decomposition into 24 groups:

    - **Age**: 20-29 (young), 30-49 (prime-aged), and 50+ years old (old)
    - **Education**: less than HS, HS, some post-secondary, college +
    - **Gender:** male and female

Changes in Routine

	Pre	Post		Difference		
			Total	Group Size	Propensities	Interaction
	(1)	(2)	(3)	(4)	(5)	(6)
1979-2014						
NRC	21.5	28.2	+6.7	+9.7	−2.9	−0.0
RC	17.3	16.1	−1.2	+0.6	−2.0	+0.3
RM	23.2	15.1	−8.1	−5.2	−5.7	+2.7
NRM	8.4	12.3	+3.9	−1.9	+6.6	−0.8
Not Working	29.6	28.3	−1.3	−3.1	+4.0	−2.2
1989-2014						
NRC	24.7	28.2	+3.5	+6.3	−2.7	−0.1
RC	19.6	16.1	−3.5	+0.3	−3.9	+0.2
RM	21.0	15.1	−5.9	−3.5	−4.0	+1.6
NRM	9.6	12.3	+2.7	−1.7	+4.7	−0.3
Not Working	25.2	28.3	+3.1	−1.4	+5.9	−1.3

The Who

- Determine the relative importance of each demographic group:

  - Is total fall disproportionately due to certain groups?

  - How much is it fall in their share or change in propensity?

The Who

- Determine the relative importance of each demographic group:

    - Is total fall disproportionately due to certain groups?

    - How much is it fall in their share or change in propensity?

- **Approach:** Compute, for each group g and labor market state j,

$$\frac{w_{g1}\pi_{g1}^{j} - w_{g0}\pi_{g0}^{j}}{\overline{\pi}_{1}^{j} - \overline{\pi}_{0}^{j}}$$

The Who: RM

Table: Fraction of Δ in RM accounted for by demographic groups, 1979-2014

	Males			Females		
	20-29	*30-49*	*50-64*	*20-29*	*30-49*	*50-64*
Less Than High School	10.26	19.60	18.66	3.60	8.41	5.60
High School Diploma	30.86	14.88	-4.03	7.39	6.62	0.30
	All Ages			*All Ages*		
Some College	-13.55			-2.88		
At Least College	-4.41			-1.33		

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RM: The changes

Table: Key demographic groups: Routine Manual

	Population Share (%)			Fraction in RM (%)		
	1979	2014	Change	1979	2014	Change
Male High School Dropouts						
Age 20-29	1.90	0.89	-1.01	61.58	37.87	-23.70
Age 30-49	4.12	2.06	-2.06	63.19	48.94	-14.25
Age 50-64	4.68	1.51	-3.17	43.09	32.92	-10.17
Male High School Graduates						
Age 20-29	6.27	3.82	-2.45	61.36	34.99	-26.36
Age 30-49	7.51	6.60	-0.91	55.11	44.39	-10.72

- Overall share went down: From 25% to 15%

RM: The changes

Table: Key demographic groups: Routine Manual

	Population Share (%)			Fraction in RM (%)		
	1979	2014	Change	1979	2014	Change
Male High School Dropouts						
Age 20-29	1.90	0.89	-1.01	61.58	37.87	-23.70
Age 30-49	4.12	2.06	-2.06	63.19	48.94	-14.25
Age 50-64	4.68	1.51	-3.17	43.09	32.92	-10.17
Male High School Graduates						
Age 20-29	6.27	3.82	-2.45	61.36	34.99	-26.36
Age 30-49	7.51	6.60	-0.91	55.11	44.39	-10.72

- Composition: Compounded by a fall in propensity to work in RM.

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RM: Where to?

Table: Δ in the Fraction of Workers in each Group, 1979-2014 (p.p.)

	NRC	RC	RM	NRM	Not Working
Male High School Dropouts					
Age 20-29	-1.10	2.16	-23.70	7.47	15.17
Age 30-49	-4.95	0.62	-14.25	9.02	9.55
Age 50-64	-6.31	-0.12	-10.17	2.66	13.95
Male High School Graduates					
Age 20-29	-3.81	5.22	-26.36	7.79	17.16
Age 30-49	-8.37	0.64	-10.72	5.32	13.13

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The Who: RC

Table: Fraction of Δ in RC accounted for by demographic groups, 1989-2014

	Males			Females		
	20-29	*30-49*	*50-64*	*20-29*	*30-49*	*50-64*
High School Diploma	-2.35	3.16	3.13	14.80	24.13	3.54
Some College	2.15	5.43	2.38	12.27	10.62	1.50
	All Ages			*All Ages*		
Less Than High School	0.65			3.37		
At Least College	8.75			6.46		

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RC: The changes

Table: Key demographic groups: Routine Cognitive

	Population Share (%)			Fraction in RC (%)		
	1989	2014	Change	1989	2014	Change
Female High School Graduates						
Age 20-29	5.82	3.05	-2.77	32.61	22.73	-9.89
Age 30-49	10.58	5.57	-5.01	32.68	23.81	-8.87
Females with Some College						
Age 20-29	3.88	4.70	0.82	36.77	24.46	-12.31
Age 30-49	5.48	6.32	0.84	33.04	25.50	-7.54

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RC: Where to?

Table: Δ in the Fraction of Workers in each Group, 1989-2014 (p.p.)

	NRC	RC	RM	NRM	Not Working
Female High School Graduates					
Age 20-29	-2.58	-9.89	-4.39	7.06	9.79
Age 30-49	-2.05	-8.87	-3.34	6.28	7.99
Females with Some College					
Age 20-29	-4.42	-12.31	-1.16	9.94	7.96
Age 30-49	-3.78	-7.54	-0.24	7.44	4.11

Notes: Data from the monthly Current Population Survey.

Table: Observed and counterfactual changes in population shares (p.p.)

	Observed	Propensity	Change only in propensities of key groups
	(1)	(2)	(3)
A. 1979-2014			
Routine	-9.30	-7.67	-6.20
B. 1989-2014			
Routine	-9.37	-7.90	-5.68

Table: Observed and counterfactual changes in population shares (p.p.)

	Observed	Propensity	Change only in propensities of key groups
	(1)	(2)	(3)
A. 1979-2014			
Routine	-9.30	-7.67	-6.20
Non-Routine Manual	3.85	6.55	4.17
Non-Employment	-1.27	4.03	3.14
B. 1989-2014			
Routine	-9.37	-7.90	-5.68
Non-Routine Manual	2.71	4.68	2.81
Non-Employment	3.14	5.88	4.21

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Table: Observed and counterfactual changes in population shares (p.p.)

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A. 1979-2014			
Routine	-9.30	-7.67	-6.20
Non-Routine Manual	3.85	6.55	4.17
Non-Employment	-1.27	4.03	3.14
B. 1989-2014			
Routine	-9.37	-7.90	-5.68
Non-Routine Manual	2.71	4.68	2.81
Non-Employment	3.14	5.88	4.21

- **Takeaway:** Key demographic groups that account for most of the change in routine employment also account for substantial fraction of observed changes in NRM and Non-Employment

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Summary of Empirical Findings

- Fall in Routine can be traced to specific demographic groups

- Significant fraction of the fall is because of propensities change

- These same groups are also key in understanding the rise of non-employment and NRM

- Suggests link between that these long-run labor market changes

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Model

- Study a general, flexible model featuring:

    - Endogenous participation.

    - Occupational choice.

- Analytical analysis of automation effects on the labor market.

- Quantitative evaluation.

- Template for evaluation of automation and other channels.

- Generalization of Autor-Dorn (2013)

Key Insights from the Model

- Automation shock that substitutes routine workers will:

  1. Induce workers to switch to manual jobs, because of changes in relative wages across occupations

  2. Induce workers to leave employment, because of a decrease in the expected wage conditional on working

Key Insights from the Model

- Automation shock that substitutes routine workers will:

    1. Induce workers to switch to manual jobs, because of changes in relative wages across occupations

    2. Induce workers to leave employment, because of a decrease in the expected wage conditional on working

- **But:** the model features a **tradeoff between participation and occupational sorting changes**

    - Larger reallocation into the manual occupation requires lower elasticity of labor demand in manual jobs

    - But flatter labor demand implies smaller changes in expected wages and hence smaller changes in employment rates

    - A steeper labor demand in manual jobs increases impact on participation, but reduces impact on occupational change

Quantitative Results

Pareto Routine Ability; Zero Cross-Elasticities; Different Own-Elasticity Pairs ($\eta_{G_R,R}, \eta_{G_I...L_M}$)
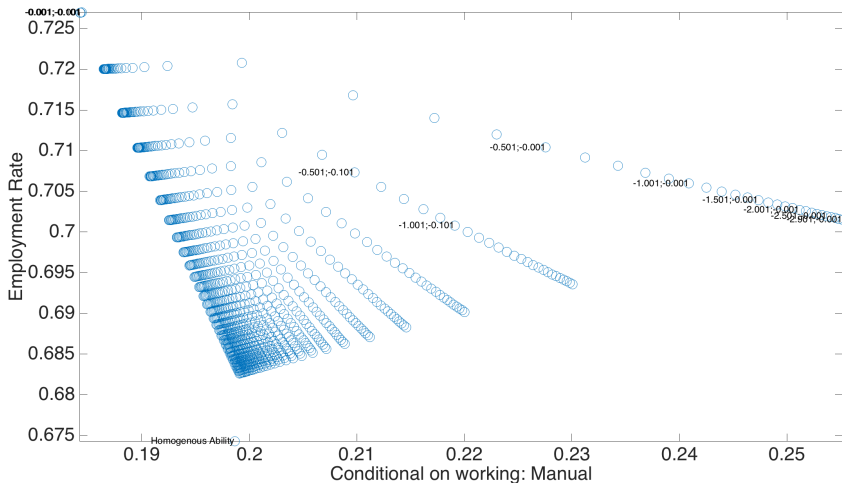
Target: Emp Rate 0.727→0.649; Share Manual: 0.184→0.309

Key Insights from the Model

- We estimate the magnitude of the automation shock based on data on ICT capital

- The estimated shock does not generate changes in employment and occupational shares as large as what we observe in the data

- This is true even when we allow for a wide range of parameters in the model

- Automation shock would have to be roughly twice as large as our estimate in order to match the changes in employment and occupational shares observed in the data

- Difficult to account for the changes solely through automation (as measured by ICT capital) in a standard neoclassical framework

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- Fall in Routine can be traced to specific demographic groups

- Significant fraction of the fall is because of propensities change

- These groups have gone to NRM and Non-Employment

- Account for a significant fraction of the changes in NRM and Non-Employment

- We develop a general model of occupational choice and participation which can serve as a template for future analysis

- Flexible parametrization of basic neoclassical model struggles to jointly generate observed reallocation towards NRM and non-employment given observed automation shock

Future work

- What are the forces that account for our empirical findings?

- Concentrated solely on the impact of automation on routine and non routine wages and employment.

- Other (relevant?) changes observed in the U.S. economy

  - Changes in the share of high-skilled workers and their occupational choice

  - Outsourcing and trade

  - Policy changes affecting incentive to work