Occupation Change and Inequality in the Short and Long Run

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Central Bank of Chile Annual Conference
November 2026

Context: Technology, Occupations and Inequality

Much recent work examines the following links, often in the context of studying automation:

$$\Delta \text{ Technology} \rightarrow \Delta \text{ Demand for Occupational Services} \rightarrow \Delta \text{ Inequality}$$

Roadmap for today's talk:

1. **Describe some structure to sharpen the questions that we ask.**
   In particular, to distinguish between:
   -short vs long run effects
   -across vs within occupation effects
2. **Present some results on decomposing long run effects.**
   -Key message: long run changes in inequality driven by how technology affects within occupation productivity.

Textbook Roy Model

- Two occupations, skill prices P_j, $j = 1, 2$
- Individual i endowed with occupation specific skills s_{ij}
- (s_{i1}, s_{i2}) distributed log normally, parameters σ_1^2, σ_2^2, ρ_{12}
- Individual i earns $s_{ij} P_j$ when choosing occupation j
- Individuals choose occupations to maximize earnings$\rightarrow$distribution of earnings within and across occupations.
- Model is partial equilibrium, i.e., skill prices are taken as given.
- To make model GE we add an aggregate production function with occupational labor services as inputs: $Y = F(S_1, S_2)$

Technical Change in the Roy Model

- Standard approach: model changes to the aggregate production function F that change relative demand for occupations.
  - e.g., changes in weights in a CES production function.
  - This reflects what I call "across occupation" effects.
- But changes in technology also affect the productivity of individuals within occupations.
  - see, e.g., Freund and Mann (Job Transformation, Specialization and the Labor Market Effects of AI) and Fan and Restrepo (A Theory of Partial Automation: Will Jobs be Commoditized or Winner Take All?).
  - to capture this we allow the distribution of idiosyncratic productivities to be affected by a change in technology.
  - this is what I call "within occupation" effects.

A Conceptual Framework

Initial SS$\longrightarrow$new technology arrives unexpectedly$\longrightarrow$transition phase as technology diffuses$\longrightarrow$New SS

- Economy begins in "steady state" with skill prices constant.
- A new technology arrives unexpectedly and diffuses over time.
- Ultimately, the economy reaches a new steady state, with constant skill prices and a new distribution of occupational productivities.
- Skill prices will change on impact when the new technology arrives and will continue to change as the new technology diffuses.
- This conceptualization akin to Greenwood and Yorokoglu (1974) and Atkeson and Kehoe (Modelling the Transition to a New Economy: Lessons from Two Technological Revolutions).

Inequality and Technology

- Given the preceding conceptual framework, two issues arise:
  - Distinguishing changes in inequality across steady states versus on impact
    - when comparing across steady states we are comparing outcomes when individuals make choices given different menus.
    - during the transition, effects may reflect unexpected shocks.
    - specifically, unexpected mid-career disruptions.
  - Decomposing the change in inequality across steady states into components due to changes in skill prices versus changes in the individual skill distribution

Job Loss During the Transition

- A large literature documents the costs of job loss.
- Jacobson, Lalonde and Sullivan (AER 1993)

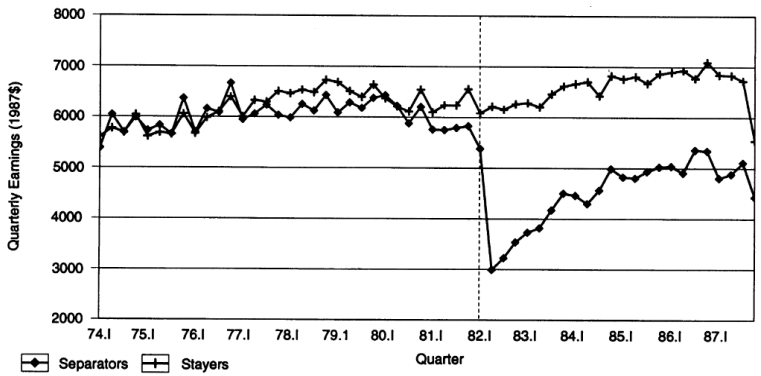
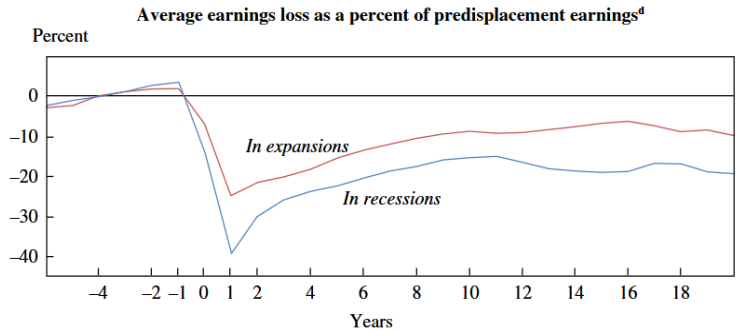


FIGURE 1. QUARTERLY EARNINGS (1987 DOLLARS) OF HIGH-ATTACHMENT WORKERS SEPARATING IN QUARTER 1982:1 AND WORKERS STAYING THROUGH QUARTER 1986:4

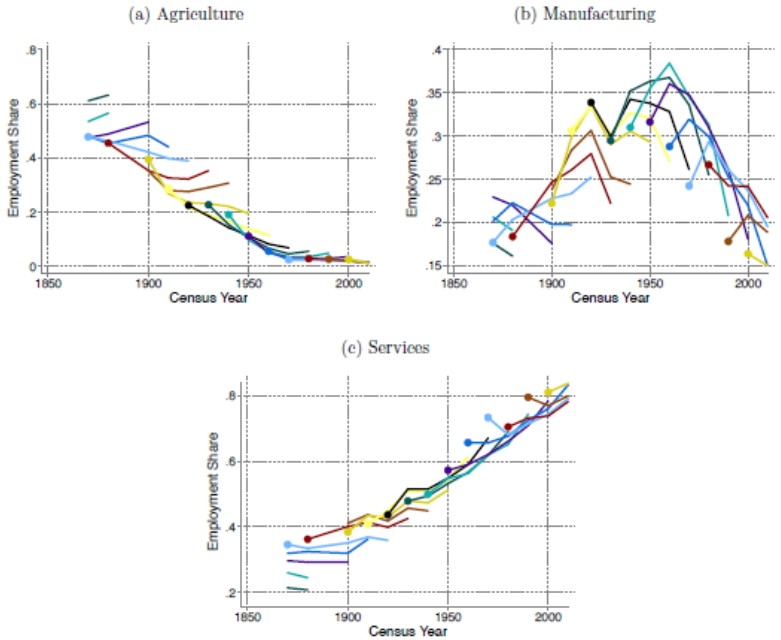
- Davis and von Wachter (Brookings 2011)



The Need for Job Loss

- Much research implicitly assumes that changes in occupational employment structure necessitate job loss.
- Incorporating demographics$\longrightarrow$ this outcome is overstated.
- Consider an economy with a stable occupational structure, and working lives of 40 years.
  - 2.5% of each occupation retires each year without job loss.
  - reduced entry alone can potentially achieve large changes in employment structure.
- Population growth strengthens this argument

Figure 1: Structural Transformation in the United States



- More than 50% of structural change accounted for by new cohorts.
- Substantial component of within cohort change accounted for by workers in their 20s
- Similar results for other countries

Costs of Job Loss by Age

- Even if layoffs are necessary, young experience much lower costs of job loss, so relatively large reallocations can be achieved with relatively low costs.
- Population growth strengthens this argument
- Figure from Albrecht (2019)

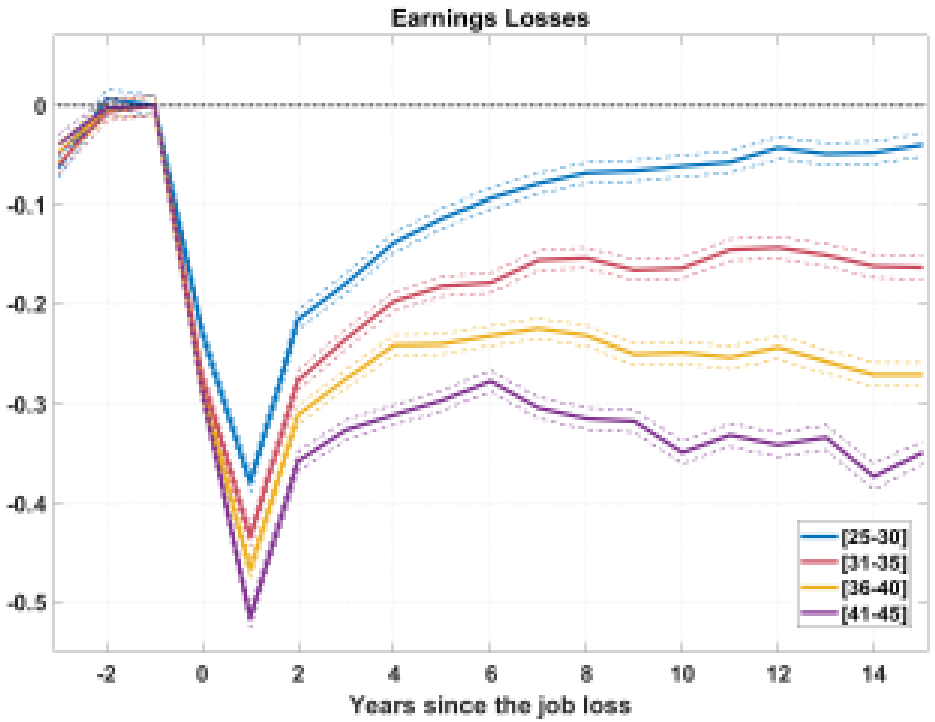


Figure 2: Earnings Losses of Displaced Workers, Partition: Age

How Prominent Are These Job Loss Effects?

- A literature in the 1990s investigated the idea that technological change was making jobs less secure
- These papers found little effect on the tenure distribution (Diebold et al (1997), Farber (1998)).
- Recent work by Molloy et al (2024) paints a more nuanced picture, but overall effects still seem small.
- Recent evidence from the US on initial unemployment insurance claims
    - flow remains stable at a low level despite much talk of jobs being eliminated

Transition Effects: Summary

- Arrival and diffusion of new technology creates potential for mid-career disruptions.
- Relatively large changes in occupational structure can be accommodated without displacing any continuing workers.
- Historical evidence shows that much sectoral reallocation has been accomplished by either new cohorts and younger workers.
- Pace of diffusion/technological improvement is a key variable. See Grigsby and Zorzi (How Do Rapid Sectoral Shifts Affect Workers).
- Literature on transitions: Heckman and Sedlacek (1985), Dix Carneiro (2014), Smeets et al (2025)

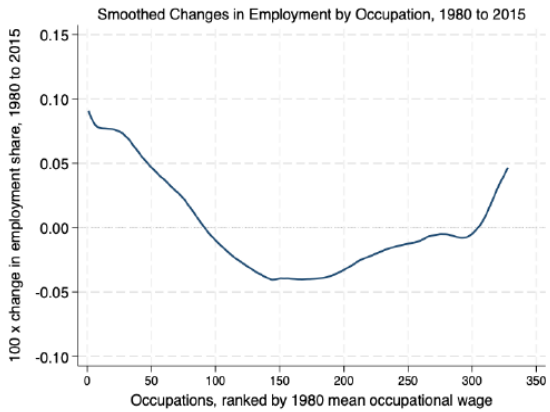
Long Run Effects

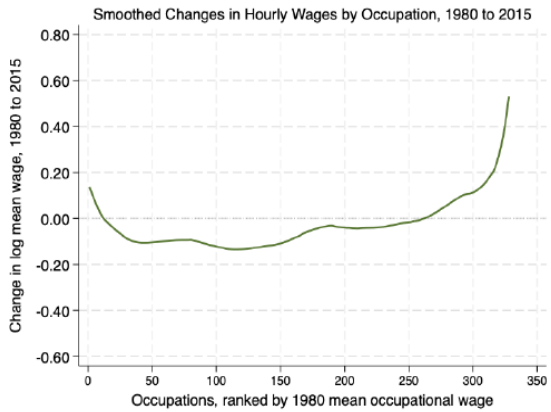
- Key effect during transition is that skill prices and/or occupational productivities experience unexpected changes relative to what was perceived at the time of career choices.
- When looking at long run effects, initial career choices are made knowing these changes.
- In what follows I examine long run changes in inequality in the US between 1980 and 2019 and distinguish between the role of skill price changes and occupational productivity distribution changes.
- Results come from my work with Erosa, Fuster and Kambourov: "Labor Market Polarization and Inequality: A Roy Model Perspective"

Evidence on Changes in Inequality in the US: 1980-2015

- We analyze the change in inequality for full time male workers aged 25-61.
- Using CPS data we construct measures of mean wages and employment shares at the 3 digit level.
- We pool data from 1976-1985 for the initial period and 2010-2019 for the final period.
- Wage inequality increases significantly over this time period: variance of log wages increases from 0.27 to 0.44.
- This period corresponds to a period of large technical change associated with the diffusion of ICT.

Polarization

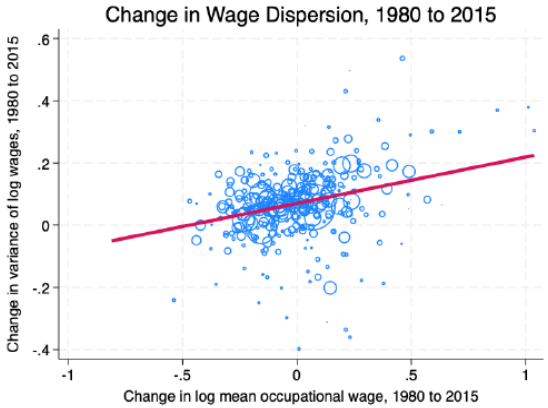


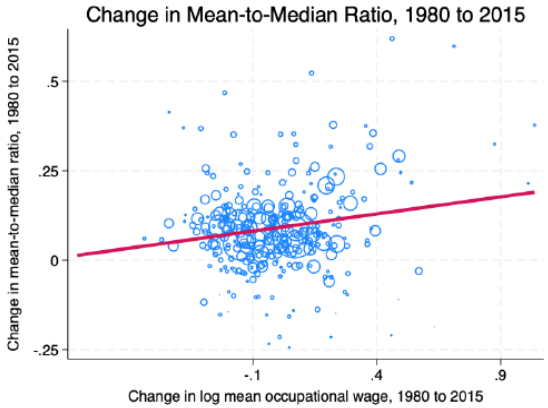


Polarization Narrative

- In both 1980 and 2015, create discrete wage distributions that reflect mean wage and employment shares for each 3 digit occupation.
- The change in the variance of log wages between these two distributions is 0.13 or roughly 2/3rds of the overall increase
- To the extent that changes in skill prices can lead to changes in mean wages and changes in employment shares, this has led some individuals to emphasize changes in relative demand as a key driving force behind the rise in inequality.

A Cautionary Fact





A Generalized Roy Model

- Unit mass of workers, indexed by i
- J occupations, indexed by j, each with a skill price P_j
- Each worker endowed with a vector of occupation specific productivities $\varepsilon_i = (\varepsilon_{i1}, ...\varepsilon_{iJ})$
- The s_{ij} are distributed jointly log normal
- Worker i earns $P_j \varepsilon_{ij}$ when choosing occupation j
- Worker i also obtains amenity value v_{ij} when choosing occupation j
- For each j the v_{ij} are log normal
- Utility for individual i in occupation j is $u(P_j \varepsilon_{ij} v_{ij})$

Occupational Choice

- Each individual i observes their values for the ε_{ij} and the v_{ij} and chooses the occupation that maximizes their utility.
- This implies that they choose the j that maximizes $P_j \varepsilon_{ij} v_{ij}$, or equivalently, $\log(P_j \varepsilon_{ij} v_{ij}) = \log P_j + \log \varepsilon_{ij} + \log v_{ij}$

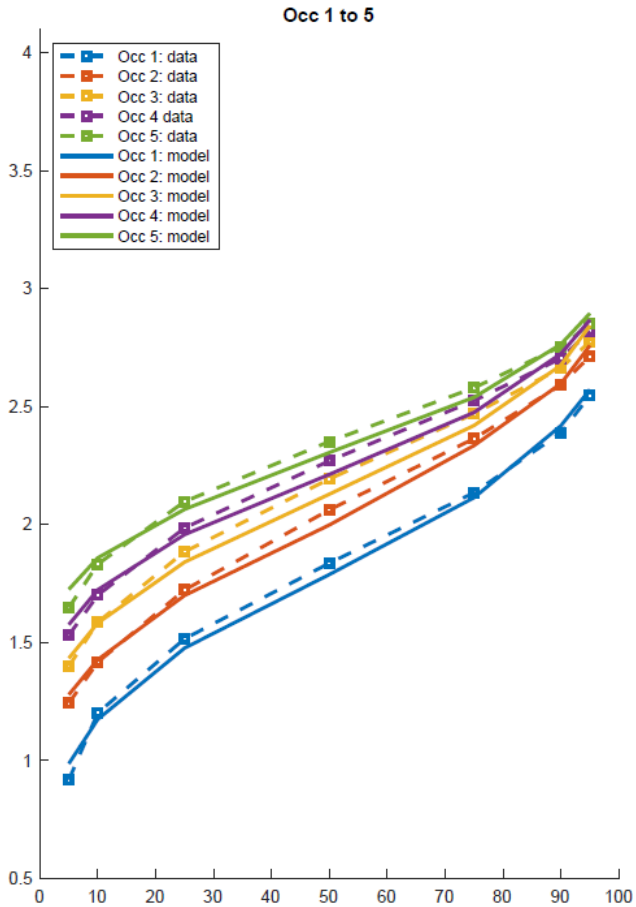
Calibration

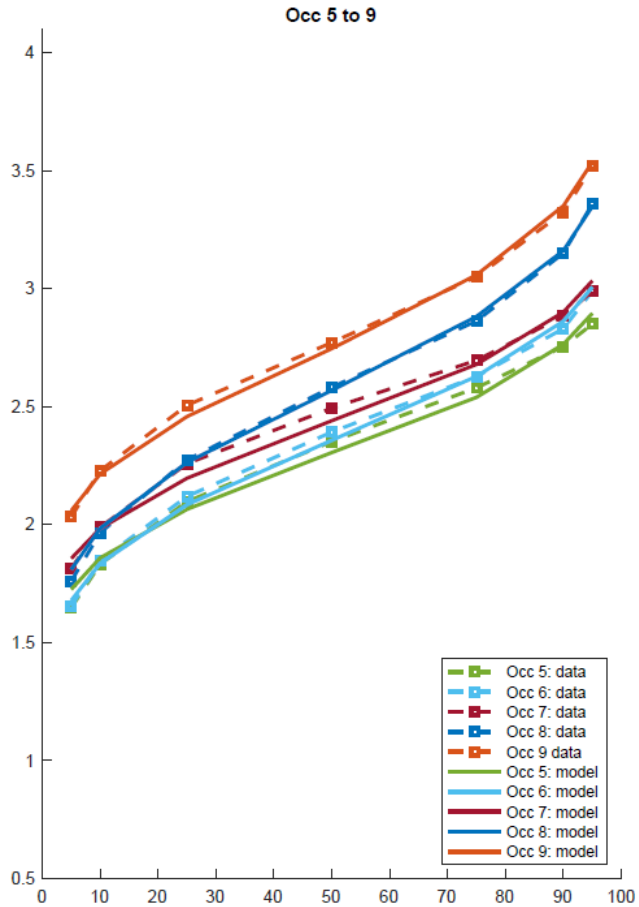
- We calibrate that model to match features of the data over the period 1976-1985.
- Curse of dimensionality limits the number of occupations we can consider.
- We choose $J = 9$.
- We group 3 digit occupations into 9 bins based on mean occupations wages.
- 71 parameters need to be calibrated (45 parameters for covariance matrix for ε distribution, 17 from v distribution, 9 skill prices).
- We match 7 percentiles of wage distributions within each occupation (5, 10, 25, 50, 75, 90,95) and 9 employment shares.

Calibrated Parameters

	Parameters				Calibration Results			
Occupation	w_j	$\sigma^2_{\epsilon_j}$	$\mu_{v,j}$	$\sigma^2_{v_j}$	Emp. Shares		Mean Wages	
					Data	Model	Data	Model
1	1.242	0.308	0.037	0.484	0.070	0.072	6.80	6.74
2	1.142	0.342	0.021	0.203	0.030	0.027	8.44	8.38
3	1.771	0.233	0.022	0.312	0.140	0.140	9.43	9.23
4	1.869	0.192	0.012	0.168	0.114	0.115	10.09	9.91
5	2.038	0.162	0.000	0.075	0.099	0.098	10.82	10.71
6	1.919	0.213	0.024	0.075	0.073	0.073	11.53	11.45
7	2.158	0.164	-0.023	0.038	0.140	0.141	12.47	12.26
8	2.145	0.303	-0.002	0.135	0.248	0.248	14.60	14.63
9	1.710	0.482	-0.013	0.012	0.086	0.086	17.65	17.66

Fit of Calibrated Models





Exercise 1: Effect of Changing Skill Prices

- Changes in technology that only affect the relative demand for the services of different occupations can be captured as changes in skill prices
- We ask how changes in skill prices that lead to changes in occupational employment structure affect inequality in our calibrated model.
- In particular, we back out the changes in skill prices required to match the observed changes in employment shares and ask what they imply for changes in inequality.
- Exercise reflects what I called across occupation effects.
- Key finding: These changes have almost no impact on inequality.

Exercise 2: Sources of Changes in Inequality

- This exercise recalibrates the model to the 2015 data, allowing all model parameters to change, and specifically the distributions of individual productivity.
- We decompose the changes in inequality into parts due to different underlying changes in primitives.
- Key finding: the changes in inequality are driven by changes in the distribution of individual productivies. In particular, the variance of productivities increases significantly.
- One intepretation is that changes in technology over this period served to amplify differences in productivity at the individual level.

Limitations/Directions for Future Work

- Intended interpretation of the analysis is to think about how individuals make career choices in different environments.
- This interpretation calls for data on lifetime outcomes and career trajectories.
- This calls for richer data and richer models.
- Progress is being made on both fronts.
  - Afrouzi et al (2026), Gaur (2026),
  - Guvenen et al (2022)

Conclusion

- Looking backward in the US, dominant source of increased inequality is within occupation changes in productivity.
- A large component of changes in mean wages across occupations comes from changes in the distribution of productivities rather than changes in skill prices.
- Extrapolating to AI, from the perspective of thinking about long run changes in inequality we should be more focused on how AI shapes individual productivity distributions and less focused on changes in relative demands.