

Learning and Life Cycle Patterns of Occupational Transitions

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Occupational Mobility

- Occupational decisions are important for an individual's early career development.
- Much of wage growth is attributable to human capital gained at the occupational (or task) level.
- Increasing occupational mobility accounts for increasing wage dispersion (Kambourov and Manovskii)

Theories of Occupational Switching

Two theories of learning:

1. **Sorting:** Workers learn about their type and switch to best job for them. Johnson (1978), Miller (1984), Papageorgiou (2010).
2. **Occupational Ladders:** Workers gain skills on lower rungs and move up. Jovanovic and Nyarko (1997).

This Paper

Understand life cycle patterns of occupational mobility:

1. Look at life cycle occupational choices using data from NLSY79.
 - Initial characteristics are informative of occupational decisions.
 - Sizable group of workers switch often (implies large shocks or small costs of switching).
 - Timing of switches.
2. Develop a simple sorting model of life cycle occupational transitions: initial beliefs, switching costs, sector specific wage shocks.

Literature

Understand life cycle patterns of occupational mobility:

1. Early career decisions: Flinn (1986), Topel and Ward (1992), Keane and Wolpin (1997), Sullivan (2010), Hoffmann (2010), Kambourov and Manovskii (2008, 2009b).
2. Specificity of Human Capital: Altonji and Shakotko (1987), McCall (1990), Neal (1995), Parent (2000), Kambourov and Manovskii (2009a), Poletaev and Robinson (2008), Gathmann and Schonberg (2010).
3. Models of Occupational Choice: Johnson (1978), Miller (1984), Papageorgiou (2010), Jovanovic and Nyarko (1997), Neal (1999), Wong (2011).

NLSY79

- Longitudinal sample of 12,686 individuals between the ages of 14 and 22 years of age in 1979.
- Restrict sample to workers at age 19 or younger at time of first interview and construct data through 1994 sample when survey goes to every 2 years.
- Restrict sample to individuals with exactly high school degree.
- Occupations are coded into two categories: blue and white collar (following Keane and Wolpin (1997)).
- Examine occupational choice patterns for workers between age 19 and 28.

Occupations and Career Patterns

- Blue Collar Jobs: craftsmen, operatives, transport, laborers, farm workers, service workers (fire, police, janitor, dishwasher, waiter). Manual tasks.
- White Collar Occupations: professional, managers, sales, clerical and unskilled. Analytical and interactive tasks.
- With sample restrictions blue collar workers have higher average wages.
- Actual occupational patterns are varied: meter reader → plumber, storekeeper → cleaner, secretary → janitor, manager → painter, construction, maintenance, health aide → salesman → health aide → cook.

Summary Statistics by Initial Occupational Choice

Variable	Blue Collar	White Collar	Total	Observations
First Occupation White Collar	0 (0)	1 (0)	0.352 (0.478)	4180
Mother's Years of Schooling	10.51 (2.846)	10.78 (2.817)	10.61 (2.838)	3944
Father's Years of Schooling	10.31 (3.472)	10.89 (3.429)	10.52 (3.468)	3558
Mother's Main Occupation WC	0.355 (0.479)	0.451 (0.498)	0.390 (0.488)	2391
Father's Main Occupation WC	0.244 (0.430)	0.311 (0.463)	0.268 (0.443)	2960
Male	0.628 (0.483)	0.294 (0.456)	0.511 (0.500)	4180
White	0.541 (0.498)	0.532 (0.499)	0.538 (0.499)	4180
Urban	0.748 (0.434)	0.828 (0.377)	0.777 (0.417)	4162
Family Poverty	0.398 (0.489)	0.330 (0.470)	0.374 (0.484)	3998
Class Percentile	0.370 (0.254)	0.481 (0.263)	0.413 (0.263)	2251
AFQT Percentile	0.310 (0.227)	0.378 (0.233)	0.334 (0.231)	4015

Note: Mean of each variable with standard deviation in parentheses.

Predicting Initial Occupational Choice

Probit Regression of Initial Characteristics on Choosing White Collar for First Occupation		
Variables	(1) First Occupation WC	(2) First Occupation WC
Mother's Years of Schooling	-0.00239 (0.00399)	-0.0129* (0.00670)
Father's Years of Schooling	0.0142*** (0.00328)	0.0174*** (0.00548)
Mother's Main Occupation WC		0.0683** (0.0299)
Father's Main Occupation WC		0.0206 (0.0317)
Male	-0.292*** (0.0175)	-0.313*** (0.0255)
White	-0.0808*** (0.0209)	-0.0747** (0.0309)
Urban	0.111*** (0.0203)	0.0953*** (0.0306)
Family Poverty	-0.0385** (0.0195)	-0.0678** (0.0309)
Class Percentile	0.360*** (0.0511)	0.430*** (0.0746)
AFQT Percentile	0.143*** (0.0528)	0.0389 (0.0778)
Observations	3,160	1,490
R ²	0.131	0.144

Marginal effects reported. Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Initial Characteristics Predict Future Switches

Variables	(1) White Collar	(1) Blue Collar	(2) White Collar	(2) Blue Collar
Probability	-0.679*** (0.0934)	0.449*** (0.0593)	-0.609*** (0.130)	0.467*** (0.0810)
Observations	934	2,226	457	1,033

Probit Regression of Fitted Probability of Choosing White Collar on Ever Switching Occupations. Estimates reported are marginal effects from the probit regression. The first two columns use the fitted probability from the probit regression with the variables for Mother's and Father's main occupation omitted. The second two columns include these variables in the construction of the fitted probability. Standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

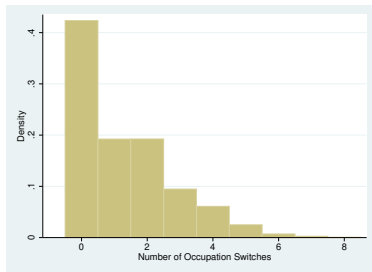
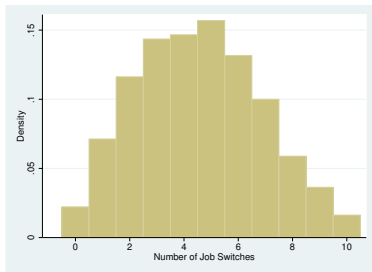
Initial Characteristics Predict Future Switches

Variable	(1) White Collar	(1) Blue Collar	(2) White Collar	(2) Blue Collar
Probability	1.382** (0.548)	-1.392*** (0.376)	1.187 (0.783)	-0.982* (0.506)
Constant	2.373*** (0.260)	3.801*** (0.143)	2.403*** (0.399)	3.545*** (0.201)
Observations	529	1,239	255	594
R-squared	0.012	0.011	0.009	0.006

Regression of Fitted Probability of Choosing White Collar on the Timing of the First Occupational Switch. The first two columns use the fitted probability from the probit regression with the variables for Mother's and Father's main occupation omitted. The second two columns include these variables in the construction of the fitted probability. Standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Histogram of Years with Job and Occupational Switches



Timing of Switches

	Blue Collar	White Collar	Total
Time to First Occupational Switch	3.179 (2.041)	2.355 (1.798)	2.883 (1.996)
Time to Second Occupational Switch	1.732 (1.307)	2.199 (1.760)	1.899 (1.502)

Average Time to First and Second Occupational Choice by Initial Occupation. Mean of each variable with standard deviation in parentheses. Conditional on switching at least twice.

Workers

- Individual lives for Y periods with period utility function:

$$u(c) = \frac{e^{-\gamma c} - 1}{-\gamma}, \quad \gamma > 0$$

- $\mu \in \{b, w\}$ denotes the type of the agent.
- Each agent is type w with probability p_{-1} .
- A worker's assets evolve according to:

$$a' = (1 + r)a + w_{is}^{\mu} - c - \mathbb{I}_{switch}k$$

- The cost of switching occupations is k .

Jobs

- Agents can work in occupation, $i \in \{B, W\}$. Where $i = W$ is better type w and $i = b$ is better for type b workers.
- In occupation, i , and state, s , output for a worker of type μ are given by:

$$x_{is}^{\mu} = \bar{x}_{is}^{\mu} + \varepsilon_i$$

Where $\varepsilon_i \sim N(0, \sigma_i^2)$.

- Worker's are paid their output in each period:

$$w_{is}^{\mu} = x_{is}^{\mu}$$

- Denote the CDF of output of a worker in sector i as:

$$G_{is}(x|\mu) \sim N(\bar{x}_{is}^{\mu}, \sigma_i^2)$$

Learning

- Based on their observed output, workers update their beliefs each period.
- For any belief, p , the expected distribution of output for a worker in occupation i is given by:

$$\psi_{is}(x, p) = p \frac{1}{\sigma_i \sqrt{2\pi}} e^{-\frac{1}{2} \left(\frac{x - \bar{x}_{is}^w}{\sigma_i} \right)^2} + (1 - p) \frac{1}{\sigma_i \sqrt{2\pi}} e^{-\frac{1}{2} \left(\frac{x - \bar{x}_{is}^b}{\sigma_i} \right)^2}$$

- The updated belief, p' , is formed by conducting a probability ratio test:

$$f_{is}(p, x) \equiv p' = \frac{p e^{-\frac{1}{2} \left(\frac{x - \bar{x}_{is}^w}{\sigma_i} \right)^2}}{p e^{-\frac{1}{2} \left(\frac{x - \bar{x}_{is}^w}{\sigma_i} \right)^2} + (1 - p) e^{-\frac{1}{2} \left(\frac{x - \bar{x}_{is}^b}{\sigma_i} \right)^2}}$$

Value Functions

- Before choosing initial occupation the worker observes a signal equivalent to α periods of output in sector B. Updating p_{-1} , this generates a non-degenerate distribution of initial beliefs p_0 .
- At time zero the agent chooses between B and W:

$$\max \left\{ \mathbb{E}_s \int V_B(a, x, s, p', 0) H(dx, p_0), \mathbb{E}_s \int V_W(a, x, s, p', 0) H(dx, p_0) \right\}$$

Where H_i is the distribution of wage draws given current belief p :

$$H_i(x, p) = pG_i(x|\mu = w) + (1 - p)G_i(x|\mu = b)$$

Value Functions

- After time 0, the value function can be written as:

$$V_i(a, x, s, p, y) = \max_{a'} \frac{e^{-\gamma((1+r)a+x-a'-\mathbb{I}_{switch}k)} - 1}{-\gamma} + \frac{1}{1+r} \tilde{V}(a', s, p, y)$$

- When $y < Y$, \tilde{V} is given by:

$$\tilde{V}(a', s, p, y) =$$

$$\max \left\{ \mathbb{E}_{s'|s} \int V_i(a', x, s', p', y+1) H(dx, p), \mathbb{E}_{s'|s} \int V_{-i}(a', x, s', p', y+1) H(dx, p) \right\}$$

- When $y = Y$, \tilde{V} is given by:

$$\tilde{V}(a', s, p, Y+1) = \frac{1+r}{-\gamma r} e^{-\gamma(ra'+R)} + \frac{1+r}{\gamma r}$$

Where R is the retirement benefit earned by the worker at the end of her career.

Value Functions

Proposition

The value function can be written as:

$$V_i(a, x, s, p, y) = \frac{1+r}{-r\gamma} e^{-\gamma(ra+v_i(x,s,p,y))} + \frac{1+r}{r\gamma}$$

Where when $y < Y$, $v_i(x, s, p, y)$ solves the recursive equation given by:

$$v_i(x, s, p, y) \equiv \frac{\tilde{v}_i(x, s, p, y) + rx - r\mathbb{I}_{switch}k}{1+r}$$

$$\tilde{v}_i(x, s, p, y) = -\frac{1}{\gamma} \ln \left[-\max \left\{ \mathbb{E}_{s'|s} \int -e^{-\gamma v_i(x, s', p', y+1)} H(dx, p), \right. \right. \\ \left. \left. \mathbb{E}_{s'|s} \int -e^{-\gamma v_{-i}(x, s', p', y+1)} H(dx, p) e^{\gamma \frac{r}{1+r} u} \right\} \right]$$

When $y = Y$, $v_i(x, s, p, y)$ is given by:

$$v_i(p, y) = \frac{1+r}{-\gamma r} e^{-\gamma \left(\frac{r}{1+r} (x-R) + R \right)}$$

Value Functions

- Therefore, the optimal decision about occupational choice is independent of assets.
- For every age y the optimal policy is characterized by a collection of thresholds $\{\bar{p}_{is}(y)\}_{i \in \{B,W\}}$ independent of current wealth a .
- Individual currently working in the B sector moves to the high sector if $p \geq \bar{p}_{Bs}(y)$ and if currently working in W, then move to the B sector if $p \leq \bar{p}_{Ws}(y)$.
- In the absence of a cost of switching (if $k = 0$),

$$\bar{p}_B(y) = \bar{p}_W(y) = \bar{p}(y)$$

Value Functions

Let $\hat{\tau}$ denote the years left prior to leaving current occupation i .

Proposition

Let $p^d(y)$ and $p^j(y)$ denote the beliefs at age y of individuals d and j . If $p^d(y) > p^j(y)$ and both individuals are employed in the same occupation then $E \{ \hat{\tau} | p^d(y), i = L \} \leq E \{ \hat{\tau} | p^j(y), i = L \}$ and $E \{ \hat{\tau} | p^d(y), i = H \} \geq E \{ \hat{\tau} | p^j(y), i = H \}$.

Quantitative Assessment

- Parameterize model to match wage distribution for 19 year old workers (in progress).
- Simulate model and analyze switching behavior.
- Assess how well the learning model can account for life cycle patterns of occupational switches.

Parameterization

- Baseline calibration: $\gamma = 1$, $r = 0.00327$, $R = 10$, $u = 0$ and $Y = 120$.
- Wage parameters set based on cross sectional wage distribution at age 19.
- Let blue collar be B and white collar W. Assume occupations at 28 correspond to true type to get initial proportions.
- Taking group specific medians of relative wages implies:
 $\bar{x}_B^b = 0.9225$, $\bar{x}_B^w = 0.8785$, $\bar{x}_W^b = 0.9080$, $\bar{x}_W^w = 0.9030$.

Parameterization

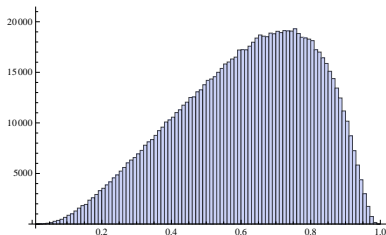
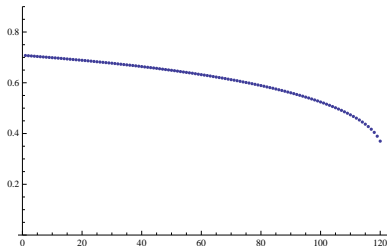
- Recall that mixture distributions have the following properties:

$$\mu_i = w_i^w \mu_i^w + w_i^b \mu_i^b$$

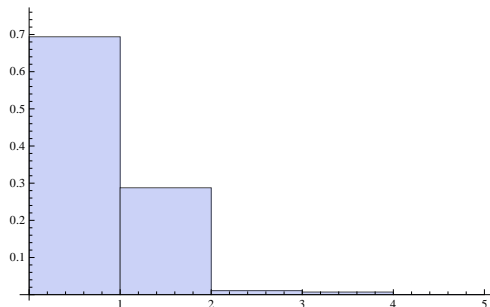
$$\bar{\sigma}_i^2 = w_i^w (\mu_i^w + \sigma_i^2) + w_i^b (\mu_i^b + \sigma_i^2) - \mu_i^2$$

- Using mixture distribution implies: $\sigma_W = 0.177$ and $\sigma_B = 0.274$.
- $\alpha = 30$ and $p_{-1} = 0.615$ matches the standard deviation of the fitted probabilities of 0.19 and the initial proportion of 36.4% of workers in white collar.

Baseline $\bar{p}(y)$ and p_0

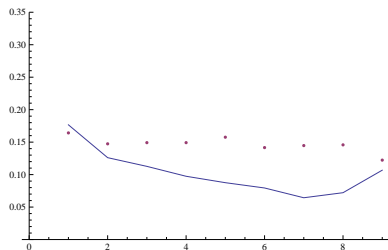


Distribution of Occupational Switches



Only about 2% of workers switch more than once compared to compared to almost 40% in the data.

Switching Rates from Blue to White and White to Blue

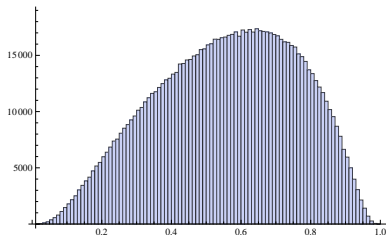
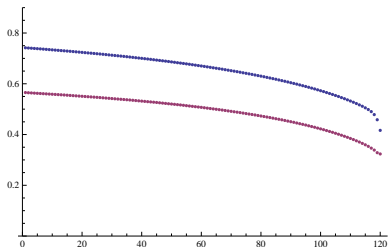


Model results in lines NLSY data points.

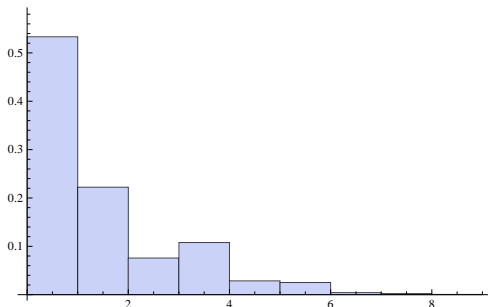
Simple Wage Shocks

- Wages in sector W can be in one of two states.
- In state 0, wages are multiplied by $(1 - \Delta)$ and in state 1, they are multiplied by $(1 + \Delta)$.
- With probability ρ the state is the same next period.
- Show results for $\rho = 0.7$ and $\Delta = 0.005$
- Let initial state be 1 with probability 0.5, then $\alpha = 30$ and $p_{-1} = 0.56$

Shocks $\bar{p}_0(y)$ $\bar{p}_1(y)$ and p_0

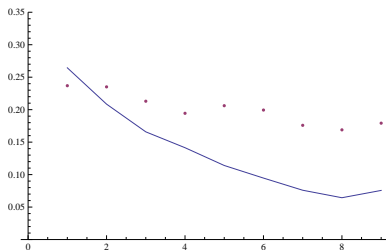
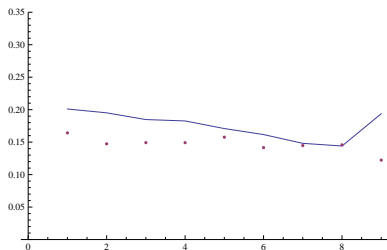


Distribution of Occupational Switches



Now 24.4% of workers switch more than once compared to almost 40% in the data.

Switching Rates from Blue to White and White to Blue

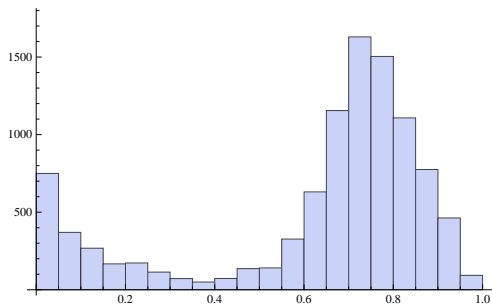


Model results in lines NLSY data points.

Timing of Switches

- Baseline Model: average times to first and second occupational switches are 1.93 and 1.68 respectively (small sample).
- With shocks: average times to first and second switches are 2.24 and 1.65.
- This compares with 2.88 and 1.90 in the data.

Distribution of Beliefs ($Y=120$)



Learning very slow in H sector.

Understanding Switching

Switches occur for two reasons:

1. Beliefs change pushing worker over the threshold.
2. Threshold shifts causing mass of workers to switch occupations.

Second effect becomes important in model with wage shocks in current model.

Conclusion

- Life cycle learning model accounts for many observed features of occupational transitions.
- What might we learn from this model?
 1. Size of switching costs (direct and indirect) small?
 - Direct costs believable: excess job switching.
 - Human capital loss?
 2. Quantitative magnitude of occupational shocks.