

THE IMPACT OF TIME PREFERENCE ON JOB SEARCH WITH UNEMPLOYMENT INSURANCE

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MOTIVATION

1. Job-search behavior is important for the design of UI policy
2. Studies about workers' search effort
 - ▶ Unemployed workers devote 41 minutes daily to job search on weekdays
Krueger and Mueller (2010)
 - ▶ Anticipated unemployment spell lasts less than the actual spell
Spinnewijn (2014)
 - ▶ Unemployment duration correlates with measurement of short-term impatience
DellaVigna and Paserman (2005)
3. Findings across countries on the impact of UI policy
 - ▶ Higher UI benefits and longer UI eligibility duration significantly reduce the job-finding hazard rate
Classen (1977), Feldstein and Poterba (1984), Katz and Meyer (1990)
 - ▶ Yet, these policies have small impact on subsequent job match quality
Card *et al.* (2007), Schmieder *et al.* (2010), Nekoei and Weber (2014)

TIME PREFERENCE IN JOB SEARCH

1. Exponential discounting in intertemporal choices

- ▶ A traditional time-consistent model of discounting

$$DU_t = u_t + \delta u_{t+1} + \delta^2 u_{t+2} + \delta^3 u_{t+3} + \dots$$

- ▶ A wide range of discount factor estimates across studies (Frederick, Loewenstein, and O'donoghue 2002)

2. Hyperbolic discounting in intertemporal choices

- ▶ A “present-bias” approach

$$DU_t = u_t + \beta[\delta u_{t+1} + \delta^2 u_{t+2} + \delta^3 u_{t+3} + \dots]$$

- ▶ Naive vs. sophisticated agent
- ▶ Suggestive evidence of naive present-bias in job search (DellaVigna and Paserman, 2005; Spinnewijn, 2014)

THIS PAPER

- ▶ Adds hyperbolic-discounting to explain the impact of UI policy change
 1. Canonical partial-equilibrium sequential search model (Mortensen 1977)
 - ▶ Optimal search strategy includes reservation wage and searching effort
 - ▶ Searching intensity increases and reservation wage decreases as time goes on
 2. Unemployed workers who exhibit dynamic-inconsistent discounting
 - ▶ Invest too little search effort today (compared to anticipated effort)
 - ▶ Believe they will search harder in the future, so they set their reservation wage as high as if they have exponential discounting preference
 3. Tests the model with Illinois Unemployment Insurance Experiment
 - ▶ The treatment lowers UI benefit receipt
 - ▶ There is no evidence of post unemployment match-quality deterioration
 - ▶ Horse-race between exponential and hyperbolic discounting models

MAIN FINDINGS

1. In an exponential-discounting search model

- ▶ Workers care about the future at the weekly discount factor $\delta = 0.9999$
- ▶ Their wage offers come from a log normal distribution with variation close to 0

2. In a hyperbolic-discounting search model

- ▶ Workers care about future at the weekly discount factor $\delta = 0.989$
- ▶ Workers have an average short-term discount factor $\beta = 0.76$
- ▶ Their wage offers come from a log normal distribution with low variation

PRESENTATION OUTLINE

1. Structural model

- ▶ Benchmark model with exponential discounting
- ▶ Add hyperbolic discounting to the job search model

2. Estimation strategy

- ▶ Introduce the Reemployment Bonus Experiment
- ▶ Structural estimation result

3. Evaluating the policy impact

- ▶ The empirical treatment effect
- ▶ The predictions based on different models

I. A SEQUENTIAL SEARCH MODEL

JOB SEARCH WITH UI BENEFITS

1. The time line assumption

- ▶ Workers have limited time eligibility to receive UI benefit

2. Optimal searching strategy

- ▶ The searching effort can be mapped to the probability of a wage offer arriving
- ▶ Reservation wage makes him indifferent between working or staying unemployed
- ▶ Reservation wage profile is downward sloping

3. Hyperbolic discounting preference

When compared to exponential-discounting workers with the same level of δ

- ▶ Lowers a worker's search effort in current period but his anticipated search effort in future period is as high as if $\beta = 1$
- ▶ Does not affect his reservation wage profile

SIMPLIFYING ASSUMPTIONS

1. Unemployment benefit b_t with expiration at week T_1

e.g. $T_1 = 26$

2. A worker has to find a job in a limited time T

$T > T_1$ e.g. $T = 75$

3. Predetermined parameters:

- ▶ Workers' time preference (β, δ)
- ▶ Marginal search cost γ
- ▶ Workers' wage offer distribution, $\log(w) \sim N(\mu, \sigma^2)$

4. After taking a job with that wage, the worker keeps it forever

There is no on-the-job search.

5. Workers live hand-to-mouth

Consumption equals to income at each period

BENCHMARK — EXPONENTIAL DISCOUNTING MODEL

1. Workers' value function for accepting a job with wage w

- ▶ Consumption utility at week t : $u_t(w) = \frac{w^{1-\eta}}{1-\eta}$
- ▶ The net present value for accepting the job: $V_t^E(w) = \frac{w^{1-\eta}}{(1-\delta)(1-\eta)}$

2. Calculate the optimal searching effort s_t

- ▶ s_t represents the probability of that wage offer arriving
- ▶ the utility cost of search is $c(s_t) = \frac{1}{2}\gamma s_t^2$

3. The value of staying unemployed at week $t < T$

$$\begin{aligned} V_t^U &= \frac{b_t^{1-\eta}}{1-\eta} - c(s_t) + \delta(1 - s_t Pr(w_t > w_t^*))V_{t+1}^U \\ &\quad + \delta s_t Pr(w_t > w_t^*)E[V_{t+1}^E(w)|w > w^*] \end{aligned}$$

4. After the final searching week, the value of being unemployed $V_{T+1}^U = 0$

BACKWARD INDUCTION SOLUTION

1. A worker accepts any job offer at week T :

$$V_T^U = -c(s_T) + \frac{\delta s_T}{(1-\delta)(1-\eta)} E[w^{1-\eta}]$$

2. When $t < T$, the value of staying unemployed becomes

$$V_t^U = \frac{b_t^{1-\eta}}{1-\eta} - c(s_t) + \delta(1 - s_t \Pr(w_t > w_t^*)) V_{t+1}^U + \delta s_t \Pr(w_t > w_t^*) E[V_{t+1}^E(w) | w > w^*]$$

3. First order condition gives the optimal search intensity:

$$s_t^* = \frac{1}{\gamma} \delta \Pr(w_t > w_t^*) (E[V_{t+1}^E(w) | w > w^*] - V_{t+1}^U)$$

4. Reservation wage equalizes V_{t+1}^E and V_{t+1}^U

$$w_t^* = ((1-\delta)(1-\eta)V_{t+1}^U)^{1/(1-\eta)}$$

5. Boundary condition

$$s_t = \begin{cases} s_t^* & \text{if } s_t^* \in [0, 1] \\ 0 & \text{if } s_t^* < 0 \\ 1 & \text{if } s_t^* > 1 \end{cases}$$

HYPERBOLIC DISCOUNTING SEARCH MODEL

1. Time discounting parameters include

- ▶ a long-term (exponential) discount factor δ
- ▶ a short-term discount factor β

2. Net present value for accepting a job with wage w

$$V_t^E(w) = \beta \frac{w^{1-\eta}}{(1-\delta)(1-\eta)}$$

3. The value function of staying unemployed at week t becomes

$$V_t^U = \frac{b_t^{1-\eta}}{1-\eta} - c(s_t) + \delta\beta(1 - s_t Pr(w_t > w_t^*))V_{t+1}^U + \delta\beta s_t Pr(w_t > w_t^*)E[V_{t+1}^E(w)|w > w^*]$$

4. Reservation wage profile is the same as the benchmark case

$$w_t^* = ((1-\delta)(1-\eta)V_{t+1}^U)^{1/(1-\eta)}$$

5. However, a worker's optimal search effort is different

- ▶ Anticipated search effort

$$\tilde{s}_t = \frac{1}{\gamma} \delta Pr(w_t > w_t^*) (E[V_{t+1}^E(w)|w > w^*] - V_{t+1}^U)$$

- ▶ Actual search effort

$$s_t^* = \frac{1}{\gamma} \beta \delta Pr(w_t > w_t^*) (E[V_{t+1}^E(w)|w > w^*] - V_{t+1}^U)$$

APPLICATION IN THE BONUS EXPERIMENT

1. Reemployment bonus treatment

- ▶ Workers can receive reemployment bonus X by finding a job within $T_0 = 11$
- ▶ Workers need to keep working for $m = 16$ weeks to receive the bonus
- ▶ The reemployment bonus increase the value of a job and decreases a worker's reservation wage in the first T_0 weeks

2. Unemployment insurance benefit

- ▶ Unemployed workers can receive the benefit till week $T_1 = 26$
- ▶ The benefit amount correlates with his previous earnings and is predetermined
- ▶ The benefit determines the value of staying unemployed in the first T_1 weeks

3. Likelihood function is based on

- ▶ When workers exit unemployment
- ▶ Reemployment wages of workers

IN EXPONENTIAL DISCOUNTING MODEL

1. $t < T_0$, workers can receive reemployment bonus X

- ▶ Accept a job $V_t^E(w) = \frac{w^{1-\eta}}{(1-\delta)(1-\eta)} + \delta^m \frac{X^{1-\eta}}{1-\eta}$
- ▶ Reservation wage $w_t^* = ((1-\delta)(1-\eta)(V_{t+1}^U - \delta^m \frac{X^{1-\eta}}{1-\eta}))^{1/(1-\eta)}$
- ▶ Search intensity $s_t^e = \frac{1}{\gamma} \delta Pr(w_t > w_t^*) (E[V_{t+1}^E(w)|w > w^*] - V_{t+1}^U)$

2. $t > T_0$ and $t < T_1$, workers can collect UI benefits

- ▶ Accept a job $V_t^E(w) = \frac{w^{1-\eta}}{(1-\delta)(1-\eta)}$
- ▶ Reservation wage $w_t^* = ((1-\delta)(1-\eta)V_{t+1}^U)^{1/(1-\eta)}$
- ▶ Search intensity looks the same to 1

3. After T_1 , UI benefits end for unemployed workers

- ▶ $V_t^U = -c(s_t) + \delta(1 - s_t Pr(w_t > w_t^*))V_{t+1}^U + \delta s_t Pr(w_t > w_t^*)E[V_{t+1}^E(w)|w > w^*]$
- ▶ Search intensity and the reservation wage look the same to 2

IN HYPERBOLIC DISCOUNTING MODEL

1. $t < T_0$, workers can receive re-employment bonus X

- ▶ Accept a job $V_t^E(w) = \beta[\frac{w^{1-\eta}}{(1-\delta)(1-\eta)} + \delta^m \frac{X^{1-\eta}}{1-\eta}]$
- ▶ Reservation wage $w_t^* = ((1-\delta)(1-\eta)(V_{t+1}^U - \delta^m \frac{X^{1-\eta}}{1-\eta}))^{1/(1-\eta)}$
- ▶ Search intensity $s_t^h = \beta s_t^e$

2. $t > T_0$ and $t < T_1$, workers can collect UI benefit

- ▶ Accept a job $V_t^E(w) = \beta \frac{w^{1-\eta}}{(1-\delta)(1-\eta)}$
- ▶ Reservation wage $w_t^* = ((1-\delta)(1-\eta)V_{t+1}^U)^{1/(1-\eta)}$
- ▶ Search intensity looks the same to 1

3. After T_1 , UI benefit is 0 for unemployed workers

- ▶ $V_t^U = -c(s_t) + \delta\beta(1-s_t)Pr(w_t > w_t^*)V_{t+1}^U + \delta\beta s_t Pr(w_t > w_t^*)E[V_{t+1}^E(w)|w > w^*]$
- ▶ Search intensity and the reservation wage look the same to 2

LOG LIKELIHOOD FUNCTION

- ▶ Individual i exits unemployment at week k receiving wage w_1

$$\begin{aligned} \text{Likelihood} &= \prod_i^N Pr_i(k) = \prod_i^N \left\{ \prod_{t=1}^{k-1} (1 - s_t (1 - \Phi(\frac{\log(w_t^*) - \mu}{\sigma}))) \right. \\ &\quad \left. \cdot s_t (1 - \Phi(\frac{\log(w_k^*) - \mu - \rho(\log(w_1) - \mu)}{\sigma \sqrt{1 - \rho^2}})) \cdot \phi(\frac{w_1 - \mu}{\sqrt{\sigma^2 + \theta^2}}) \right\} \end{aligned}$$

- ▶ w_t^* is individual i 's the reservation wage at week t
- ▶ $\rho = \frac{\sigma}{\sqrt{\sigma^2 + \theta^2}}$
- ▶ w_1 represents the realized re-employment wage, $\ln(w_1) = \ln(w) + \epsilon$
Measurement error $\epsilon \sim N(0, \theta^2)$ – the discrepancy between accepted wage w and observed wage w_1
- ▶ Use wage before the unemployment w_0 to normalize the mean of wage offer across individuals
The parameter of interest μ is transformed to α , where $\mu = \alpha w_0$

II. STRUCTURAL ESTIMATION

DATA SOURCES

- ▶ Illinois Unemployment Insurance Experiment (1984-85)
- ▶ Random assignment of reemployment bonus treatment
 - ▶ Claimants received \$500 once they met the conditions
 - ▶ Filed a claim for UI and were eligible to receive these benefits
 - ▶ Must find a full-time position within 11 weeks of receiving the UI benefit
 - ▶ Must be employed for no less than four months
- ▶ Baseline survey and administrative data
 - ▶ 40% claimants failed to find a position during the required period
 - ▶ 26% of claimants who are treated received bonus
 - ▶ Key variables: base period earnings, unemployment duration, reemployment wages and demographic characteristics
 - ▶ Sample size: treatment group $N = 2555$; control group $N = 2234$

STRUCTURAL ESTIMATION

► Long-term discount factor

weekly δ in both models

► Short-term discount factor

β — in hyperbolic discounting model

► Workers' wage offer distribution

the mean of the distribution $\mu = \alpha w_0$, the standard deviation σ

► Life-time cost of search

γ — the marginal cost of searching effort to increase offer arrival rate

Parameter	Exponential	Hyperbolic
δ	0.9999	0.9896
β	-	0.7619
α	1.0789	1.3271
σ	0.0025	0.0743
γ	22711	17494
Log Likelihood	-766.7779	-762.6871

INTERPRETATION OF THE COEFFICIENTS

1. In exponential-discounting model

- ▶ weekly discount factor $\delta = 0.9999 \sim$ annual discount factor at 0.995
- ▶ $\alpha = 1.079$, the mean is similar to previous wages w_0
- ▶ $\sigma = 0.0025$, the wage offer distribution has almost zero variation

2. In hyperbolic-discounting model

- ▶ weekly discount factor $\delta = 0.9896 \sim$ annual discount factor at around 0.60
- ▶ present vs. future discount factor $\beta = 0.7619$
- ▶ $\alpha = 1.327$, the mean can be slightly higher than previous wages w_0
- ▶ $\sigma = 0.0743$, the wage offer distribution has low variation

3. Comparing these to previous estimates of β

- ▶ $\beta = 0.61$ for women receiving welfare who search for a job (Fang *et. al.*, 2002)
- ▶ $\beta \in [0.51, 0.82]$ in life-cycle consumption (Laibson *et. al.*, 2007)
- ▶ $\beta \in [0.40, 0.89]$ in job search of workers in NLSY79 (Paserman, 2008)

III. POLICY IMPACT

REEMPLOYMENT BONUS TREATMENT EFFECT

1. Reducing the duration of unemployment

- ▶ Average unemployment spell lasts about 12 weeks
- ▶ Treatment group received 1 fewer weeks UI benefit
- ▶ Treatment group found the next job 1.5 week faster

2. No strong evidence of post unemployment match-quality deterioration

- ▶ Post-unemployment spell earnings were similar between two groups
- ▶ Treatment and control groups refiled for unemployment claim with similar frequency

Treatment Effect on Average Worker's Labor Market Outcomes

Dep Var:	Job-Finding Week	UI Benefit Week	Post-UI Wage	Refilng UI
Bonus Treatment	-1.429*** (0.374)	-1.007*** (0.256)	-0.0188 (0.0285)	0.0029 (0.0158)
Weekly UI Benefit	0.0126 (0.0108)	0.0147* (0.0077)	0.0053*** (0.0009)	0.0013*** (0.0004)
Pre-UI Wage	-0.776 (0.606)	-0.500 (0.422)	-0.743*** (0.0494)	-0.167*** (0.0250)
Age	-0.0115 (0.0209)	0.0238 (0.0152)	0.0031* (0.0017)	0.0038*** (0.0009)
Black	1.853*** (0.524)	0.657* (0.342)	-0.0298 (0.0393)	0.102*** (0.0206)
Male	1.245*** (0.377)	0.606** (0.264)	0.143*** (0.0293)	0.108*** (0.0162)
Ethnicity	X	X	X	X
Observations	3,811	3,811	3,811	3,811
R-squared	0.012	0.011	0.138	0.045
Robust standard errors in parentheses				

Heterogeneous Treatment Effect by Previous Earnings

Dep Var:	UI Benefit Week		Wage Diff Post and Pre UE	
	Bottom Half	Top Half	Bottom Half	Top Half
Bonus Treatment	-1.169** (0.560)	-1.673*** (0.494)	0.0005 (0.0451)	-0.0681* (0.0373)
Weekly UI Benefit	0.0043 (0.0092)	0.0246 (0.0212)	-0.0053*** (0.0008)	-0.0011 (0.0015)
Age	-0.0043 (0.0301)	-0.0177 (0.0287)	0.0055** (0.0028)	-0.0044* (0.0023)
Black	2.165*** (0.711)	1.659** (0.779)	0.0858 (0.0572)	-0.0586 (0.0569)
Male	2.094*** (0.553)	0.210 (0.521)	0.226*** (0.0463)	0.0513 (0.0402)
Ethnicity	X	X	X	X
Mean Benefit Week	10.66	8.885		
Observations	1,908	1,904	1,907	1,904
R-squared	0.016	0.012	0.036	0.007

Robust standard errors in parentheses

SIMULATE TREATMENT EFFECT

1. Use point estimates in structural estimation

- ▶ The mean of wage offer distribution $\mu = 5.5$ (average pre-unemployment wage)
- ▶ Average unemployment insurance benefit: $b_t = 120$ for $t < T_1$, $b_t = 0$ after T_1
- ▶ In exponential discounting model, $\delta = 0.9999$, $\gamma = 22700$
- ▶ In hyperbolic discounting model, $\delta = 0.989$, $\beta = 0.76$, $\gamma = 17500$

2. Both models can fit the average treatment effect

- ▶ 1-1.5 week reduction in the duration of unemployment (total duration of 12 weeks)
- ▶ Small difference in average wage before and after unemployment

3. Hyperbolic-discounting model may generate more realistic estimates

- ▶ Wage offer distribution has larger than zero variation
- ▶ Workers' weekly discount factor is consistent with previous estimates

Policy Simulation in Exponential Discounting Model

<i>Average Effect</i>	$\delta = 0.9999, \beta = 1$		$\delta = 0.99, \beta = 1$	
	$\sigma = 0.002$	$\sigma = 0.07$	$\sigma = 0.002$	$\sigma = 0.07$
Unemployed Week (Control)	13.58	36.37	10.96	9.68
Unemployed Week (Treatment)	12.62	36.37	10.50	9.20
Post-UI Wage (Control) \$	245.00	277.31	244.69	247.62
Post-UI Wage (Treatment) \$	244.98	277.15	244.69	247.39
Difference in Week	0.96	0	0.48	0.83
Difference in Wage %	0	0.1	0	0.1

Policy Simulation in Hyperbolic Discounting Model

<i>Average Effect</i>	$\delta = 0.989, \beta = 0.76$		$\delta = 0.989, \beta = 0.70$	
	$\sigma = 0.002$	$\sigma = 0.07$	$\sigma = 0.002$	$\sigma = 0.07$
Unemployed Week (Control)	10.96	12.26	11.93	12.92
Unemployed Week (Treatment)	10.50	11.06	11.35	12.03
Post-UI Wage (Control) \$	244.70	248.03	244.68	248.08
Post-UI Wage (Treatment) \$	244.69	247.29	244.69	247.58
Difference in Week	0.46	1.2	0.6	0.9
Difference in Wage %	0	0.3	0	0.2

CONCLUSION

1. Understanding time preference is important to evaluating UI policies
 - ▶ The discount factor determines the impact of a specific policy
2. Reemployment bonus experiment helps to estimate β and δ
 - ▶ A different perspective to explain the treatment effect
3. Hyperbolic discounting model fits the search outcomes better
 - ▶ It implies more realistic wage offer distribution and long-term discount factor

THANK YOU

SUMMARY STATISTICS

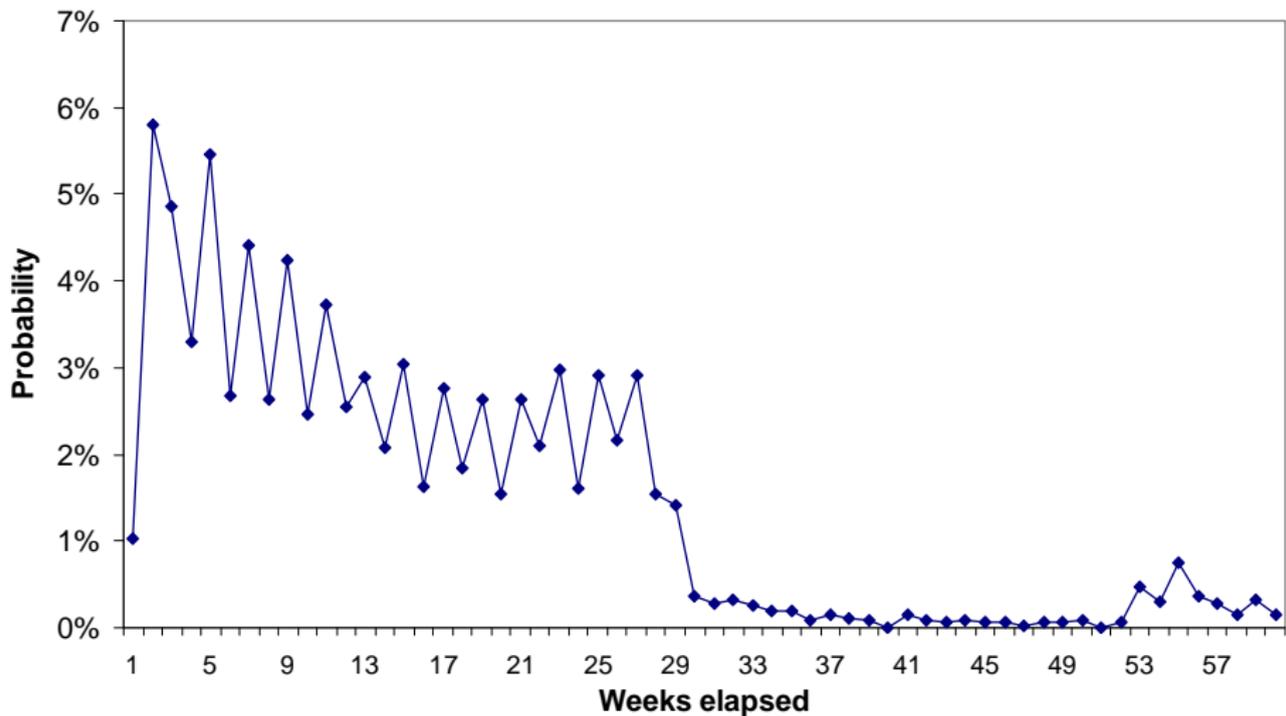
Demographic Characteristics

Male	57.8%
Female	42.2%
White	71.6%
Black	19.4%
Hispanic	7.0%
Other Race	1.5%
Age	32.5

Labor Market Outcomes

Unemployment Spell (week)	12.3
Weekly Benefit (\$)	120.2
Earning Before Unemployed (\$)	255.8
Earning After Re-employed (\$)	229.4
N	3812

Empirical Hazard Rate of Exit Week



Empirical Hazard Rate of Exit Week by Treatment

