

Econ 219A
Psychology and Economics: Foundations
(Lecture 5)

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February 18, 2015

Outline

1. Reference Dependence: Labor Supply
2. Reference Dependence: Equity Premium
3. Reference Dependence: Job Search
4. Reference Dependence: Endowment Effect I
5. Reference Points: Forward vs. Backward Looking
6. Reference Dependence: Disposition Effect (EXTRA)

1 Reference Dependence: Labor Supply

- Does reference dependence affect work/leisure decision?
- Framework:
 - effort h (no. of hours)
 - hourly wage w
 - Returns of effort: $Y = w * h$
 - Linear utility $U(Y) = Y$
 - Cost of effort $c(h) = \theta h^2/2$ convex within a day
- Standard model: Agents maximize

$$U(Y) - c(h) = wh - \frac{\theta h^2}{2}$$

- (Assumption that each day is orthogonal to other days – see below)
- Reference dependence: Threshold T of earnings agent wants to achieve
- Loss aversion for outcomes below threshold:

$$U = \begin{cases} wh - T & \text{if } wh \geq T \\ \lambda(wh - T) & \text{if } wh < T \end{cases}$$

with $\lambda > 1$ loss aversion coefficient

- Referent-dependent agent maximizes

$$\begin{aligned} wh - T - \frac{\theta h^2}{2} & \quad \text{if } h \geq T/w \\ \lambda(wh - T) - \frac{\theta h^2}{2} & \quad \text{if } h < T/w \end{aligned}$$

- Derivative with respect to h :

$$\begin{aligned} w - \theta h & \text{ if } h \geq T/w \\ \lambda w - \theta h & \text{ if } h < T/w \end{aligned}$$

1. Case 1 ($\lambda w - \theta T/w < 0$).

– Optimum at $h^* = \lambda w / \theta < T/w$

2. Case 2 ($\lambda w - \theta T/w > 0 > w - \theta T/w$)

– Optimum at $h^* = T/w$

3. Case 3 ($w - \theta T/w > 0$)

– Optimum at $h^* = w/\theta > T/w$

- Optimum:

$$L^S = w^*/\theta = a - bw^* = L^D$$

or

$$w^* = \frac{a}{b + 1/\theta}$$

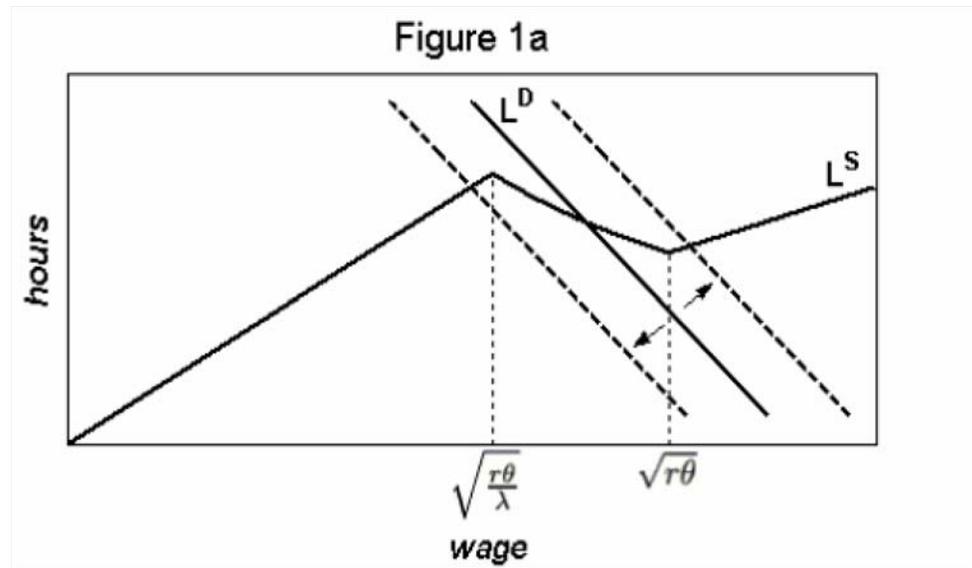
and

$$h^* = \frac{a}{b\theta + 1}$$

- Comparative statics with respect to a (labor demand shock): $a \uparrow \rightarrow h^* \uparrow$ and $w^* \uparrow$
- On low-demand days (low w) work less hard \rightarrow Save effort for high-demand days

- **Model with reference dependence ($\lambda > 1$):**

- Case 1 or 3 still exist
- BUT: Case 2. Kink at $h^* = T/w$ for $\lambda > 1$
- Combine Labor supply with labor demand: $h^* = a - bw$, with $a > 0, b > 0$.



- Case 2: Optimum:

$$L^S = T/w^* = a - bw^* = L^D$$

and

$$w^* = \frac{a + \sqrt{a^2 - 4Tb}}{2b}$$

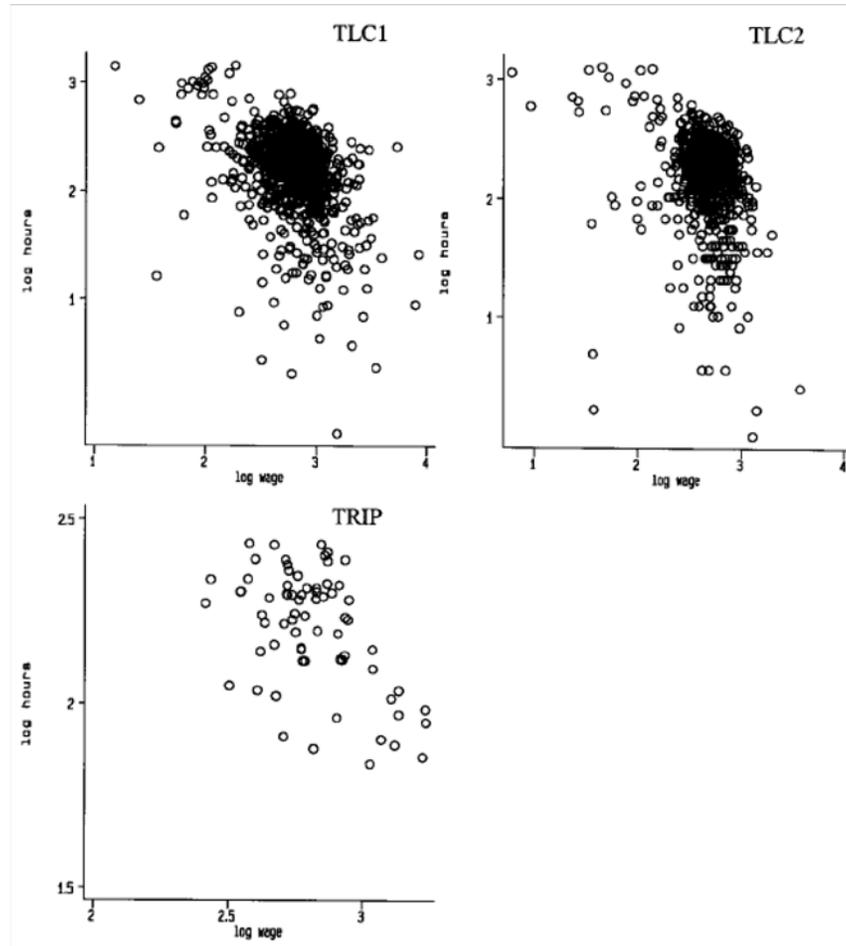
- Comparative statics with respect to a (labor demand shock):
 - $a \uparrow \rightarrow h^* \uparrow$ and $w^* \uparrow$ (Cases 1 or 3)
 - $a \uparrow \rightarrow h^* \downarrow$ and $w^* \uparrow$ (Case 2)
- Case 2: On low-demand days (low w) need to work harder to achieve reference point $T \rightarrow$ Work harder \rightarrow Opposite to standard theory
- (Neglected negligible wealth effects)

Camerer, Babcock, Loewenstein, and Thaler (QJE 1997)

- Data on daily labor supply of New York City cab drivers
 - 70 Trip sheets, 13 drivers (TRIP data)
 - 1044 summaries of trip sheets, 484 drivers, dates: 10/29-11/5, 1990 (TLC1)
 - 712 summaries of trip sheets, 11/1-11/3, 1988 (TLC2)
- Notice data feature: Many drivers, few days in sample

- Analysis in paper neglects wealth effects: Higher wage today \rightarrow Higher lifetime income
- Justification:
 - Correlation of wages across days close to zero
 - Each day can be considered in isolation
 - \rightarrow Wealth effects of wage changes are very small
- Test:
 - Assume variation across days driven by Δa (labor demand shifter)
 - Do hours worked h and w co-vary positively (standard model) or negatively?

- Raw evidence



- Estimated Equation:

$$\log(h_{i,t}) = \alpha + \beta \log(Y_{i,t}/h_{i,t}) + X_{i,t}\Gamma + \varepsilon_{i,t}.$$

- Estimates of $\hat{\beta}$:

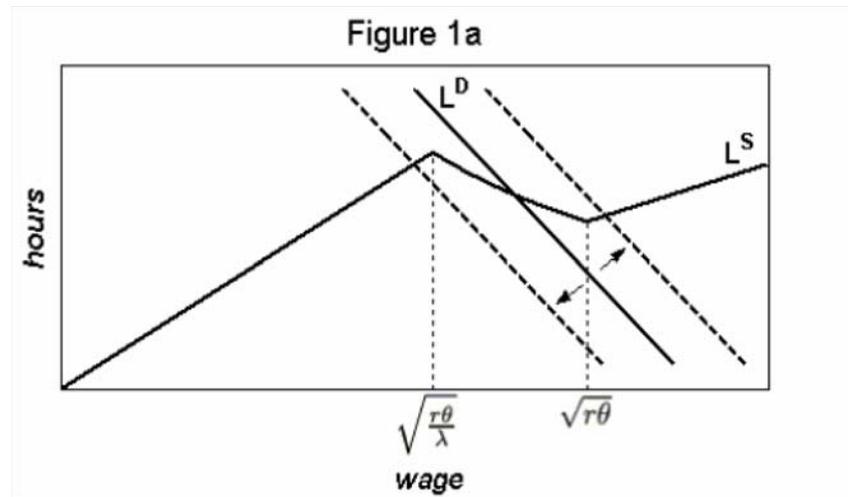
- $\hat{\beta} = -.186$ (s.e. 129) – TRIP with driver f.e.

- $\hat{\beta} = -.618$ (s.e. .051) – TLC1 with driver f.e.

- $\hat{\beta} = -.355$ (s.e. .051) – TLC2

- Estimate is not consistent with prediction of standard model
- Indirect support for income targeting

- Issues with paper:
- Economic issue 1. Reference-dependent model does not predict (log-) linear, negative relation



- What happens if reference income is stochastic? (Koszegi-Rabin, 2006)

- Econometric issue 1. Division bias in regressing hours on log wages
- Wages is not directly observed – Computed at $Y_{i,t}/h_{i,t}$
- Assume $h_{i,t}$ measured with noise: $\tilde{h}_{i,t} = h_{i,t} * \phi_{i,t}$. Then,

$$\log(\tilde{h}_{i,t}) = \alpha + \beta \log(Y_{i,t}/\tilde{h}_{i,t}) + \varepsilon_{i,t}.$$

becomes

$$\log(h_{i,t}) + \log(\phi_{i,t}) = \alpha + \beta [\log(Y_{i,t}) - \log(h_{i,t})] - \beta \log(\phi_{i,t}) + \varepsilon_{i,t}.$$

- Downward bias in estimate of $\hat{\beta}$
- Response: instrument wage using other workers' wage on same day

- IV Estimates:

TABLE III
IV LOG HOURS WORKED EQUATIONS

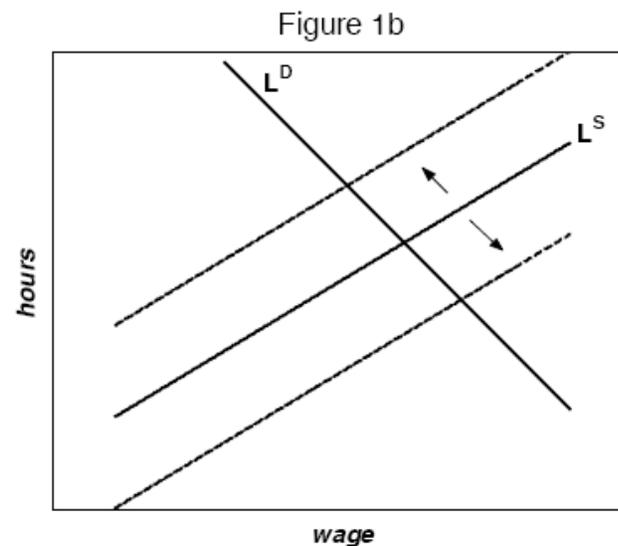
Sample	TRIP		TLC1		TLC2
Log hourly wage	-.319 (.298)	.005 (.273)	-1.313 (.236)	-.926 (.259)	-.975 (.478)
High temperature	-.000 (.002)	-.001 (.002)	.002 (.002)	.002 (.002)	-.022 (.007)

- Notice: First stage not very strong (and few days in sample)

First-stage regressions

Median	.316 (.225)	.026 (.188)	-.385 (.394)	-.276 (.467)	1.292 (4.281)
25th percentile	.323 (.160)	.287 (.126)	.693 (.241)	.469 (.332)	-.373 (3.516)
75th percentile	.399 (.171)	.289 (.149)	.614 (.242)	.688 (.292)	.479 (1.699)
Adjusted R^2	.374	.642	.056	.206	.019
P -value for F -test of instruments for wage	.000	.004	.000	.000	.020

- Econometric issue 2. Are the authors really capturing demand shocks or supply shocks?
 - Assume θ (disutility of effort) varies across days.
 - Even in standard model we expect negative correlation of $h_{i,t}$ and $w_{i,t}$



- – Camerer et al. argue for plausibility of shocks due to a rather than θ

- **Farber (JPE, 2005)**
- Re-Estimate Labor Supply of Cab Drivers on new data
- Address Econometric Issue 1
- Data:
 - 244 trip sheets, 13 drivers, 6/1999-5/2000
 - 349 trip sheets, 10 drivers, 6/2000-5/2001
 - Daily summary not available (unlike in Camerer et al.)
 - Notice: Few drivers, many days in sample

- First, replication of Camerer et al. (1997)

TABLE 3
LABOR SUPPLY FUNCTION ESTIMATES: OLS REGRESSION OF LOG HOURS

Variable	(1)	(2)	(3)
Constant	4.012 (.349)	3.924 (.379)	3.778 (.381)
Log(wage)	-.688 (.111)	-.685 (.114)	-.637 (.115)
Day shift011 (.040)	.134 (.062)
Minimum temperature < 30126 (.053)	.024 (.058)
Maximum temperature ≥ 80041 (.055)	.055 (.064)
Rainfall	...	-.022 (.073)	-.054 (.071)
Snowfall	...	-.096 (.036)	-.093 (.035)
Driver effects	no	no	yes
Day-of-week effects	no	yes	yes
R^2	.063	.098	.198

- Farber (2005) however cannot replicate the IV specification (too few drivers on a given day)

- Key specification: Hazard model that does not suffer from division bias
 - Dependent variable is dummy $Stop_{i,t} = 1$ if driver i stops at hour t :

$$Stop_{i,t} = \Phi \left(\alpha + \beta_Y Y_{i,t} + \beta_h h_{i,t} + \Gamma X_{i,t} \right)$$

- Control for hours worked so far ($h_{i,t}$) and other controls $X_{i,t}$
- Does a higher earned income $Y_{i,t}$ increase probability of stopping ($\beta > 0$)?

TABLE 5
HAZARD OF STOPPING AFTER TRIP: NORMALIZED PROBIT ESTIMATES

Variable	X*	(1)	(2)	(3)	(4)	(5)
Total hours	8.0	.013 (.009)	.037 (.012)	.011 (.005)	.010 (.005)	.010 (.005)
Waiting hours	2.5	.010 (.010)	-.005 (.012)	.001 (.006)	.004 (.006)	.004 (.005)
Break hours	.5	.006 (.008)	-.015 (.011)	-.003 (.005)	-.001 (.005)	-.002 (.005)
Shift income ÷ 100	1.5	.053 (.022)	.036 (.030)	.014 (.015)	.016 (.016)	.011 (.015)
Driver (21)		no	yes	yes	yes	yes
Day of week (7)		no	no	yes	yes	yes
Hour of day (19)	2:00 p.m.	no	no	yes	yes	yes
Log likelihood		-2,039.2	-1,965.0	-1,789.5	-1,784.7	-1,767.6

NOTE.—The sample includes 13,461 trips in 584 shifts for 21 drivers. Probit estimates are normalized to reflect the marginal effect at X* of X on the probability of stopping. The normalized probit estimate is $\beta \cdot \phi(X^*\beta)$, where $\phi(\cdot)$ is the standard normal density. The values of X* chosen for the fixed effects are equally weighted for each day of the week and for each driver. The hours from 5:00 a.m. to 10:00 a.m. have a common fixed effect. The evaluation point is after 5.5 driving hours, 2.5 waiting hours, and 0.5 break hour in a dry hour on a day with moderate temperatures in midtown Manhattan at 2:00 p.m. Robust standard errors accounting for clustering by shift are reported in parentheses.

- Positive, but not significant effect of $Y_{i,t}$ on probability of stopping:
 - 10 percent increase in Y (\$15) \rightarrow 1.6 percent increase in stopping prob. (.225 pctg. pts. increase in stopping prob. out of average 14 pctg. pts.) \rightarrow .16 elasticity
 - Cannot reject large effect: 10 pct. increase in Y increase stopping prob. by 6 percent
- Qualitatively consistent with income targeting
- Also notice:
 - Failure to reject standard model is not the same as rejecting alternative model (reference dependence)
 - Alternative model is not spelled out

- Final step in Farber (2005): Re-analysis of Camerer et al. (1997) data with hazard model
 - Use only TRIP data (small part of sample)
 - No significant evidence of effect of past income Y
 - However: Cannot reject large positive effect

TABLE 7
DRIVER-SPECIFIC HAZARD OF STOPPING AFTER TRIP: NORMALIZED PROBIT ESTIMATES

VARIABLE	DRIVER					
	4	10	16	18	20	21
Hours	.073 (.060)	.056 (.047)	.043 (.015)	.010 (.007)	.195 (.045)	.198 (.030)
Income ÷ 100	.178 (.167)	.039 (.059)	.064 (.041)	.048 (.020)	-.160 (.123)	-.002 (.150)
Number of shifts	40	45	70	72	46	46
Number of trips	884	912	1,754	2,023	1,125	882
Log likelihood	-124.1	-116.0	-221.1	-260.6	-123.4	-116.9

- Farber (2005) cannot address the Econometric Issue 2: Is it Supply or Demand that Varies
- **Fehr and Goette (AER 2007)**. Experiments on Bike Messengers
- Use explicit randomization to deal with Econometric Issues 1 and 2
- Combination of:
 - *Experiment 1*. Field Experiment shifting wage and
 - *Experiment 2*. Lab Experiment (relate to evidence on loss aversion)...
 - ... on the same subjects
- Slides courtesy of Lorenz Goette

The Experimental Setup in this Study

Bicycle Messengers in Zurich, Switzerland

- Data: Delivery records of Veloblitz and Flash Delivery Services, 1999 - 2000.
 - Contains large number of details on every package delivered.
 - Observe hours (shifts) and effort (revenues per shift).

- Work at the messenger service
 - Messengers are paid a commission rate w of their revenues r_{it} . ($w =$ „wage“). Earnings wr_{it}
 - Messengers can freely choose the number of shifts and whether they want to do a delivery, when offered by the dispatcher.
 - suitable setting to test for intertemporal substitution.

- Highly volatile earnings
 - Demand varies strongly between days
 - Familiar with changes in intertemporal incentives.

Experiment 1

■ The Temporary Wage Increase

- Messengers were randomly assigned to one of two treatment groups, A or B.
 - $N=22$ messengers in each group
- Commission rate w was increased by 25 percent during four weeks
 - Group A: September 2000
(Control Group: B)
 - Group B: November 2000
(Control Group: A)

■ Intertemporal Substitution

- Wage increase has no (or tiny) income effect.
- Prediction with time-separable preferences, $t=$ a day:
 - Work more shifts
 - Work harder to obtain higher revenues
- Comparison between TG and CG during the experiment.
 - Comparison of TG over time confuses two effects.

Results for Hours

- Treatment group works 12 shifts, Control Group works 9 shifts during the four weeks.
- Treatment Group works significantly more shifts ($\chi^2(1) = 4.57, p < 0.05$)
- Implied Elasticity: 0.8

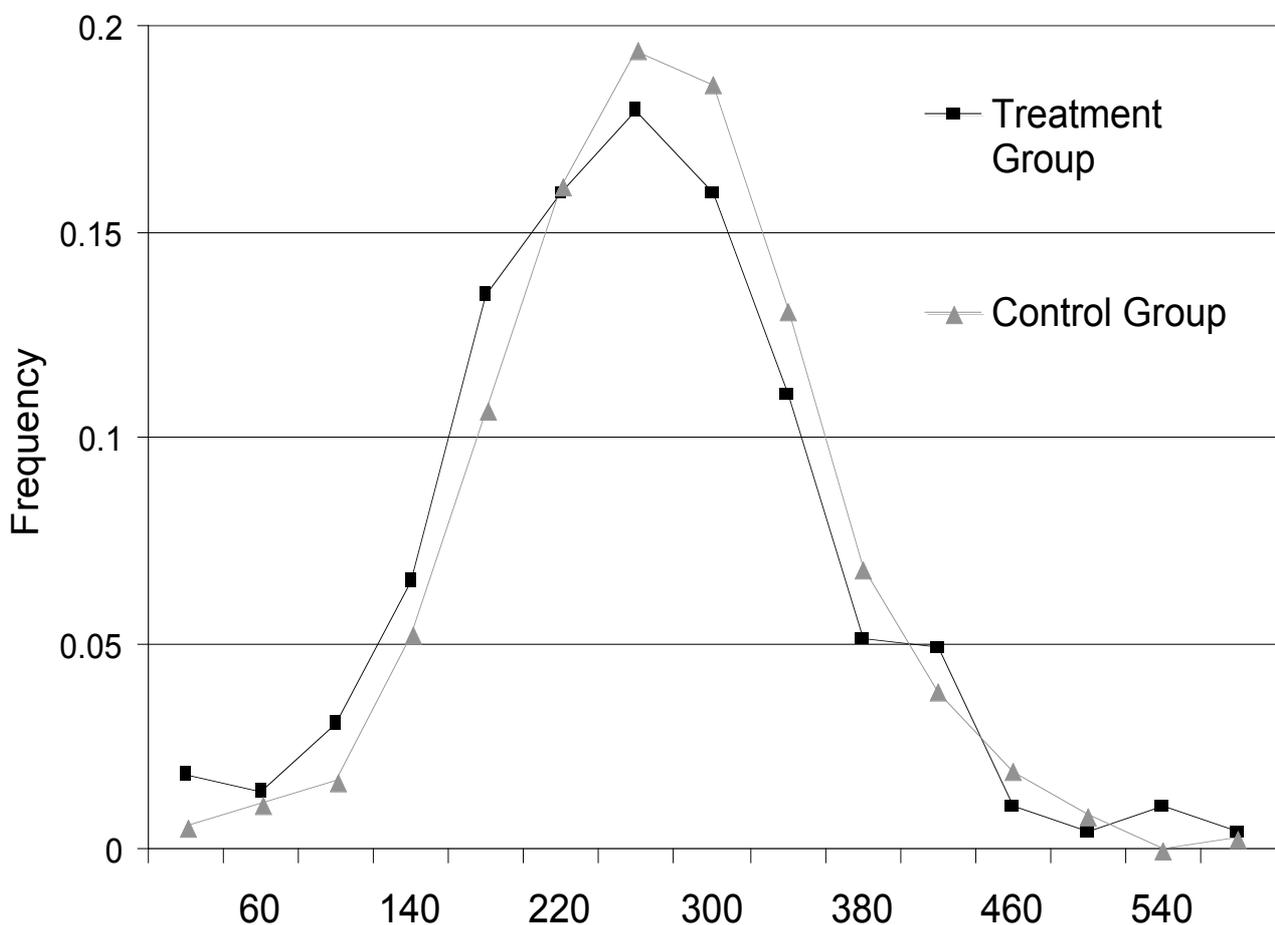


Figure 6: The Working Hazard during the Experiment

Results for Effort: Revenues per shift

- Treatment Group has lower revenues than Control Group: - 6 percent. ($t = 2.338, p < 0.05$)
- Implied *negative* Elasticity: -0.25

The Distribution of Revenues during the Field Experiment



- Distributions are significantly different (KS test; $p < 0.05$);

Results for Effort, cont.

- **Important caveat**

- Do lower revenues relative to control group reflect lower effort or something else?

- **Potential Problem: Selectivity**

- Example: Experiment induces TG to work on bad days.
- More generally: Experiment induces TG to work on days with unfavorable states
 - If unfavorable states raise marginal disutility of work, TG may have lower revenues during field experiment than CG.

- **Correction for Selectivity**

- Observables that affect marginal disutility of work.
 - Conditioning on experience profile, messenger fixed effects, daily fixed effects, dummies for previous work **leave result unchanged.**
- Unobservables that affect marginal disutility of work?
 - Implies that reduction in revenues only stems from sign-up shifts in addition to fixed shifts.
 - **Significantly lower revenues on fixed shifts, not even different from sign-up shifts.**

Corrections for Selectivity

- **Comparison TG vs. CG without controls**
 - Revenues 6 % lower (s.e.: 2.5%)

- **Controls for daily fixed effects, experience profile, workload during week, gender**
 - Revenues are 7.3 % lower (s.e.: 2 %)

- **+ messenger fixed effects**
 - Revenues are 5.8 % lower (s.e.: 2%)

- **Distinguishing between fixed and sign-up shifts**
 - Revenues are 6.8 percent lower on fixed shifts (s.e.: 2 %)
 - Revenues are 9.4 percent lower on sign-up shifts (s.e.: 5 %)

- **Conclusion: Messengers put in less effort**
 - Not due to selectivity.

Measuring Loss Aversion

- **A potential explanation for the results**

- Messengers have a daily income target in mind
 - They are loss averse around it
 - Wage increase makes it easier to reach income target
- That's why they put in less effort per shift

- **Experiment 2: Measuring Loss Aversion**

- Lottery A: Win CHF 8, lose CHF 5 with probability 0.5.
 - 46 % accept the lottery
- Lottery C: Win CHF 5, lose zero with probability 0.5; or take CHF 2 for sure
 - 72 % accept the lottery
- Large Literature: Rejection is related to loss aversion.

- **Exploit individual differences in Loss Aversion**

- Behavior in lotteries used as proxy for loss aversion.
- Does the proxy predict reduction in effort during experimental wage increase?

Measuring Loss Aversion

- **Does measure of Loss Aversion predict reduction in effort?**
 - Strongly loss averse messengers reduce effort substantially: Revenues are 11 % lower (s.e.: 3 %)
 - Weakly loss averse messenger do not reduce effort noticeably: Revenues are 4 % lower (s.e. 8 %).
 - No difference in the number of shifts worked.
- **Strongly loss averse messengers put in less effort while on higher commission rate**
 - Supports model with daily income target
- **Others kept working at normal pace, consistent with standard economic model**
 - Shows that not everybody is prone to this judgment bias (but many are)

Concluding Remarks

- **Our evidence does not show that intertemporal substitution is unimportant.**
 - Messenger work more shifts during Experiment 1
 - But they also put in less effort during each shift.

- **Consistent with two competing explanations**
 - Preferences to spread out workload
 - But fails to explain results in Experiment 2

 - Daily income target and Loss Aversion
 - Consistent with Experiment 1 and Experiment 2

 - Measure of Loss Aversion from Experiment 2 predicts reduction in effort in Experiment 1

 - Weakly loss averse subjects behave consistently with simplest standard economic model.

 - Consistent with results from many other studies.

- Other work:
- **Farber (AER 2008)** goes beyond Farber (JPE, 2005) and attempts to estimate model of labor supply with loss-aversion
 - Estimate loss-aversion δ
 - Estimate (stochastic) reference point T
- Same data as Farber (2005)
- Results:
 - significant loss aversion δ
 - however, large variation in T mitigates effect of loss-aversion

Parameter	(1)	(2)	(3)	(4)
$\hat{\beta}$ (contprob)	-0.691 (0.243)	---	---	---
$\hat{\theta}$ (mean ref inc)	159.02 (4.99)	206.71 (7.98)	250.86 (16.47)	---
$\hat{\delta}$ (cont increment)	3.40 (0.279)	5.35 (0.573)	4.85 (0.711)	5.38 (0.545)
$\hat{\sigma}^2$ (ref inc var)	3199.4 (294.0)	10440.0 (1660.7)	15944.3 (3652.1)	8236.2 (1222.2)
Driver $\hat{\theta}_i$ (15)	No	No	No	Yes
Vars in Cont Prob				
Driver FE's (14)	No	No	Yes	No
Accum Hours (7)	No	Yes	Yes	Yes
Weather (4)	No	Yes	Yes	Yes
Day Shift and End (2)	No	Yes	Yes	Yes
Location (1)	No	Yes	Yes	Yes
Day-of-Week (6)	No	Yes	Yes	Yes
Hour-of-Day (18)	No	Yes	Yes	Yes
Log(L)	-1867.8	-1631.6	-1572.8	-1606.0
Number Parm's	4	43	57	57

- δ is loss-aversion parameter
- Reference point: mean θ and variance σ^2

- **Crawford and Meng (AER 2011)**
- Re-estimates the Farber paper allowing for two dimensions of reference dependence:
 - Hours (loss if work more hours than \bar{h})
 - Income (loss if earn less than \bar{Y})
- Re-estimates Farber (2005) data for:
 - Wage above average (income likely to bind)
 - Wages below average (hours likely to bind)
- Perhaps, reconciling Camerer et al. (1997) and Farber (2005)
 - $w > w^e$: hours binding \rightarrow hours explain stopping
 - $w < w^e$: income binding \rightarrow income explains stopping

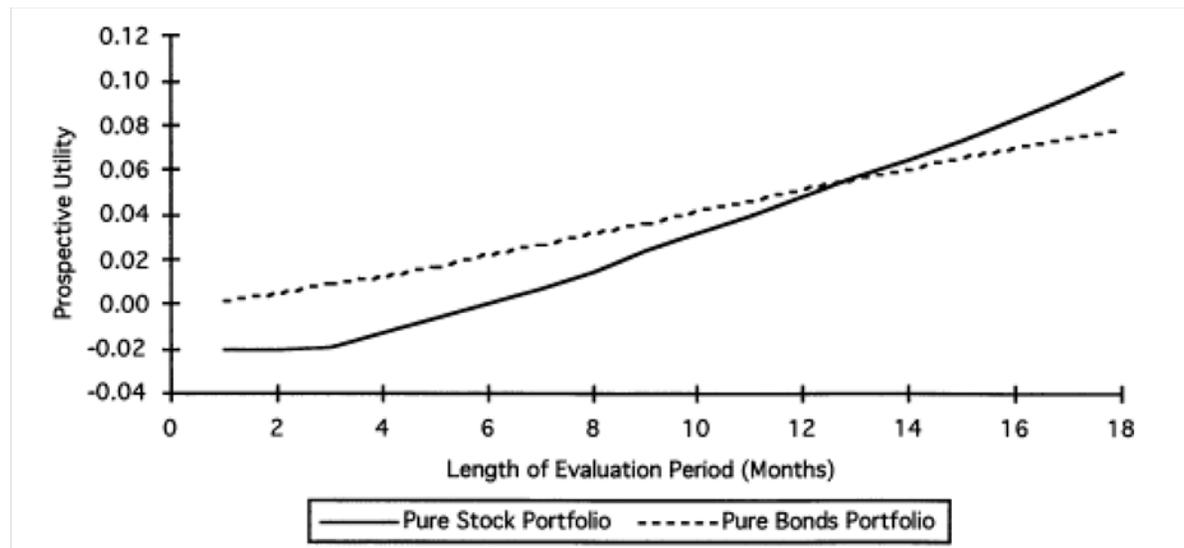
Table 1: Probability of Stopping: Probit Model with Linear Effect

Variable	(1)			(2)			(3)		
	Pooled data	$w^a > w^e$	$w^a \leq w^e$	Pooled data	$w^a > w^e$	$w^a \leq w^e$	Pooled data	$w^a > w^e$	$w^a \leq w^e$
Total hours	.013 (.009)*	.005 (.009)	.016 (.007)**	.010 (.003)**	.003 (.004)	.011 (.008)**	.009 (.006)*	.002 (.005)	.011 (.002)**
Waiting hours	.010 (.003)**	.007 (.007)	.016 (.001)**	.001 (.009)	.001 (.012)	.002 (.004)	.003 (.010)	.003 (.012)	.005 (.003)**
Break hours	.006 (.003)**	.005 (.001)**	.004 (.008)	-.003 (.006)	-.006 (.009)	-.003 (.004)	-.002 (.007)	-.004 (.009)	-.002 (.001)
Income/100	.053 (.000)**	.076 (.007)**	.055 (.007)**	.013 (.010)	.045 (.019)**	.009 (.024)	.010 (.005)**	.042 (.019)**	.002 (.011)
Min temp<30	-	-	-	-	-	-	Yes	Yes	Yes
Max temp>80	-	-	-	-	-	-	Yes	Yes	Yes
Hourly rain	-	-	-	-	-	-	Yes	Yes	Yes
Daily snow	-	-	-	-	-	-	Yes	Yes	Yes
Location dummies	-	-	-	-	-	-	Yes	Yes	Yes
Driver dummies	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes
Day of week	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes
Hour of day	-	-	-	Yes	Yes	Yes	Yes	Yes	Yes
Log likelihood	-2039.2	-1148.4	-882.6	-1789.5	-1003.8	-753.4	-1767.5	-9878.0	-740.0
Pseudo R2	0.1516	0.1555	0.1533	0.2555	0.2618	0.2773	0.2647	0.2735	0.2901
Observation	13461	7936	5525	13461	7936	5525	13461	7936	5525

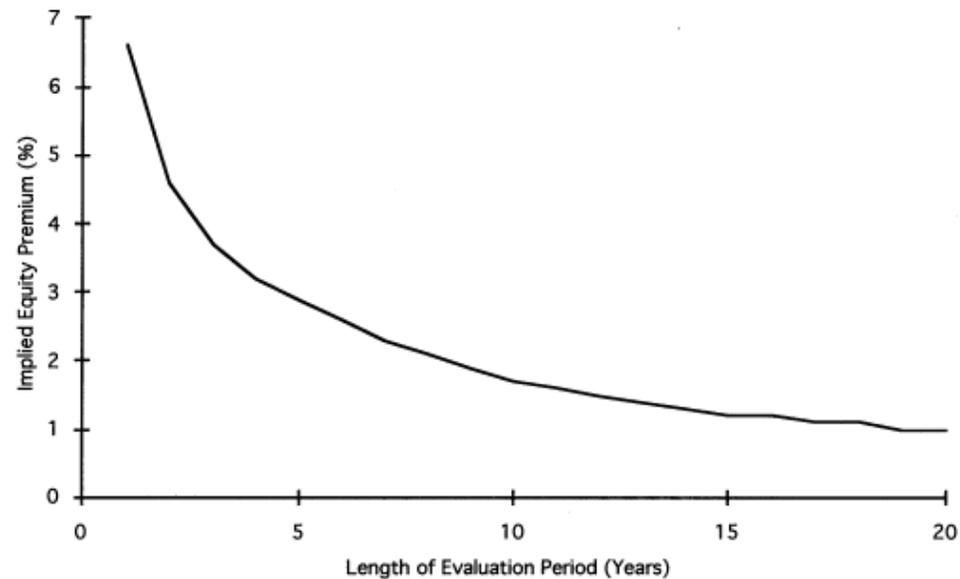
2 Reference Dependence: Equity Premium

- Equity premium (Mehra and Prescott, 1985)
 - Stocks not so risky
 - Do not covary much with GDP growth
 - BUT equity premium 3.9% over bond returns (US, 1871-1993)
- Need very high risk aversion: $RRA \geq 20$
- **Benartzi and Thaler (1995)**: Loss aversion + narrow framing solve puzzle
 - Loss aversion from (nominal) losses \rightarrow Deter from stocks
 - Narrow framing: Evaluate returns from stocks every n months

- More frequent evaluation—> Losses more likely -> Fewer stock holdings
- Calibrate model with λ (loss aversion) 2.25 and full prospect theory specification -> Horizon n at which investors are indifferent between stocks and bonds



- If evaluate every year, indifferent between stocks and bonds
- (Similar results with piecewise linear utility)
- Alternative way to see results: Equity premium implied as function on n



- **Barberis, Huang, and Santos (2001)**

- Piecewise linear utility, $\lambda = 2.25$
- Narrow framing at aggregate stock level
- Range of implications for asset pricing

- Barberis and Huang (2001)

- Narrowly frame at individual stock level (or mutual fund)

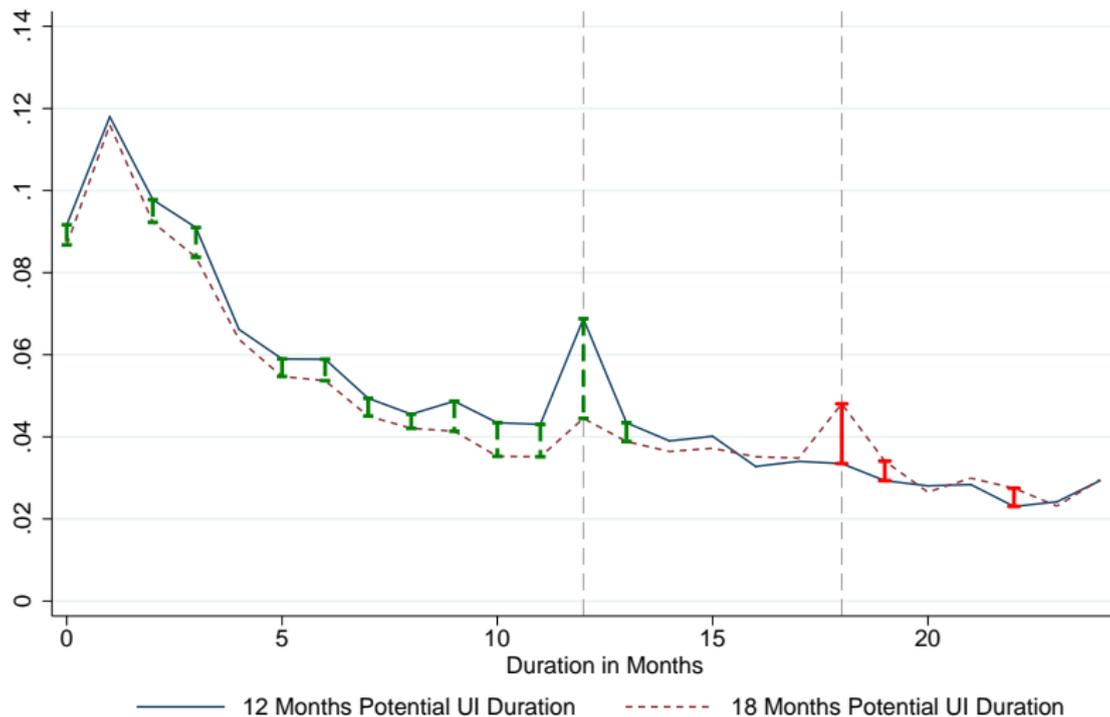
3 Reference Dependence: Job Search

- **DellaVigna, Lindner, Reizer, Schmieder (2014)**
- Insert slides

Introduction

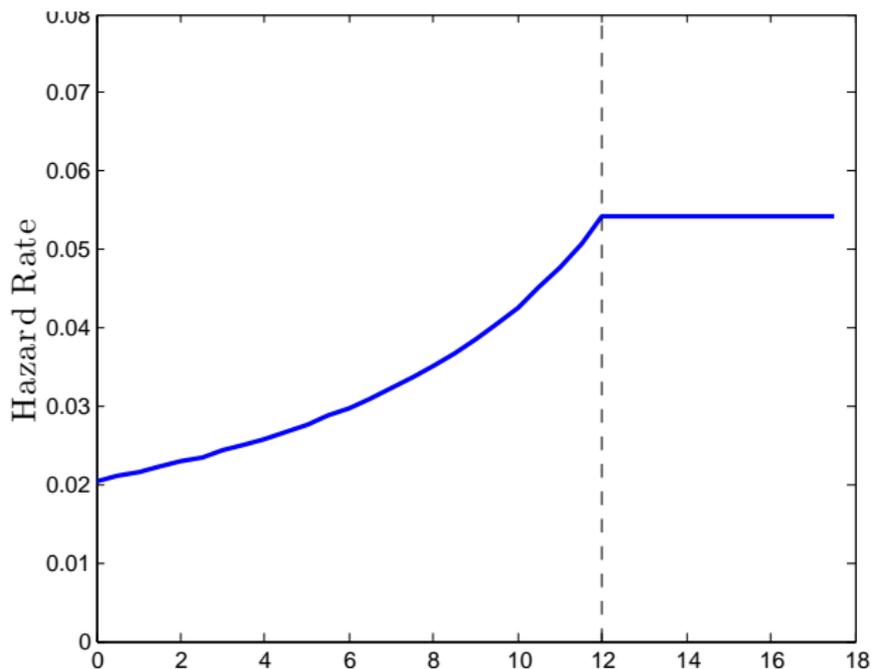
- Large literature on understanding path of hazard rate from unemployment with different models.
- **Typical finding:** There is a **spike** in the hazard rate at the **exhaustion point** of unemployment benefits.
- ⇒ Such a spike is **not easily explained** in the standard (McCall / Mortensen) model of job search.
- ⇒ To explain this path, one needs unobserved heterogeneity of a special kind, and/or storeable offers

Germany - Spike in Exit Hazard



Source: Schmieder, von Wachter, Bender (2012)

Simulation of Standard model



Predicted path of the hazard rate for a standard model with expiration of benefit at period 25

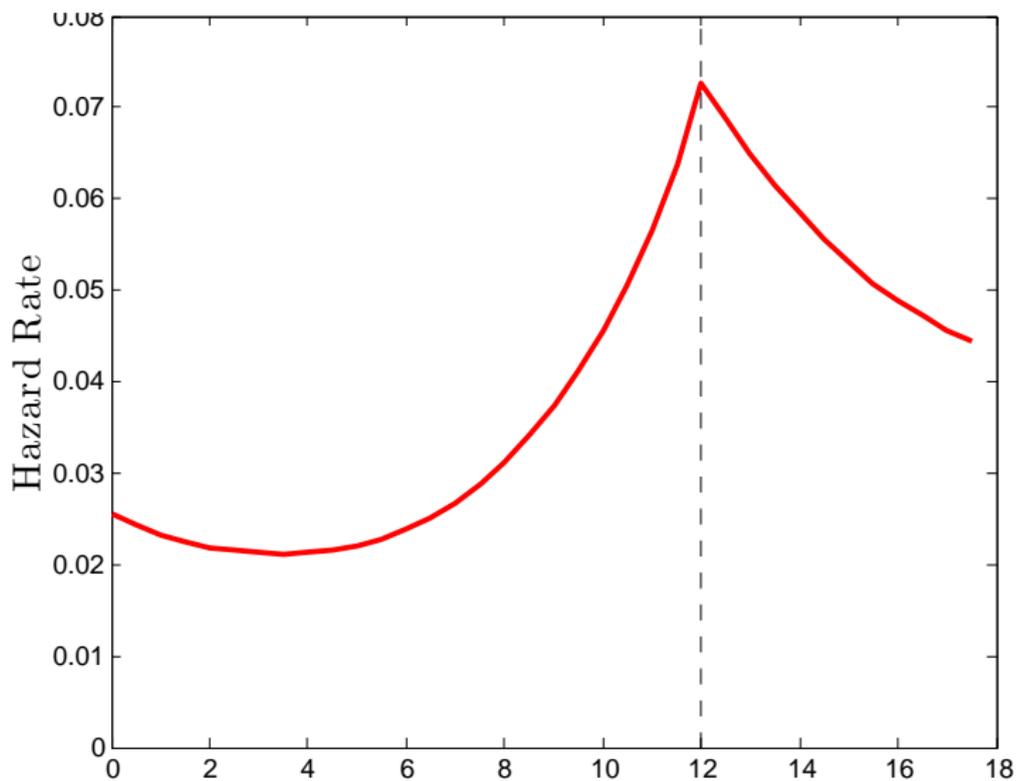
Alternative Explanation for Spike

- We propose an alternative model of job search with **reference-dependent preferences**
- This model **naturally accommodates the observed hazard path** without extra assumptions
- Building on Kahneman and Tversky (1979) and following, we assume that unemployed workers have a **reference-dependent utility of consumption**
 - [For today: Assume hand-to-mouth workers:
consumption=income]
- Critically, the **reference point** is the **average of recent consumption**

Preview

- This **Reference Dependence (RD)** model generates a spike in the exit **hazard**:
 - **Initially** the worker works very hard because of the **high disutility of being unemployed** given the **loss relative to the previous earnings**
 - then the worker **gets used to the lower UI benefits** and searches less hard
 - then the workers **anticipates the exhaustion of benefits** and works harder
 - finally, the workers **gets used to the lower UA benefits** again

Simulation of the RD model



Model

- We integrate a **reference dependent utility** function into the standard McCall / Mortensen model of job search.
- The model is set in **discrete time** and models the job search behavior of an unemployed worker throughout the spell of unemployment.
- In each period individuals optimally choose:
 - a **search** intensity s_t , normalized to be the probability of receiving an offer in period t
 - a **reservation wage** w_t^* , such that all jobs above w_t^* are accepted.
- Search intensity comes at a per period cost of $c(s_t)$, which is increasing and convex.

Utility Function

- Individuals receive unemployment benefits b_t when they are unemployed
- Flow utility from these benefits also depends on a reference point r_t such that:

$$u_t(b_t, r_t) = \begin{cases} v(b_t) + \eta(v(b_t) - v(r_t)) & \text{if } b_t \geq r_t \\ v(b_t) + \eta\lambda(v(b_t) - v(r_t)) & \text{if } b_t < r_t \end{cases}$$

- η signifies the relative importance of the reference-dependence
- $\lambda > 1$ parameterizes loss aversion
- This builds on Kahneman and Tversky (1979) and is in the spirit of Koszegi and Rabin (2006)

Reference Point

- Unlike in Koszegi and Rabin (2006), but like in habit formation literature, reference point is backward-looking
- The reference point in period t is simply the **average income** earned over the $N \geq 1$ periods **directly preceding period t** :

$$r_t = \frac{1}{N} \sum_{k=t-N}^{t-1} b_k$$

- Consider a drop in UI benefits by db ,
 - In the short term, there will be a sharp drop in the flow utility of about $\Delta u_{short} \approx db \times v'(b_t) (1 + \eta\lambda)$
 - However over time the reference point will adjust to the new consumption level
 - The long term drop in flow utility is: $\Delta u \approx db \times v'(b_t)$

Value Function of Unemployed

- An unemployed workers value function is given as:

$$V_t^U(b_t, r_t) = \max_{s_t, w_t^*} \left\{ u_t(b_t, r_t) - c(s_t) + (1 - s_t)\delta V_{t+1}^U(b_{t+1}, r_{t+1}) + s_t\delta \int_{w_t^*}^{\infty} V_{t+1}^E(w, r_{t+1}) dF(w) \right\}$$

- Value function when employed in steady-state:

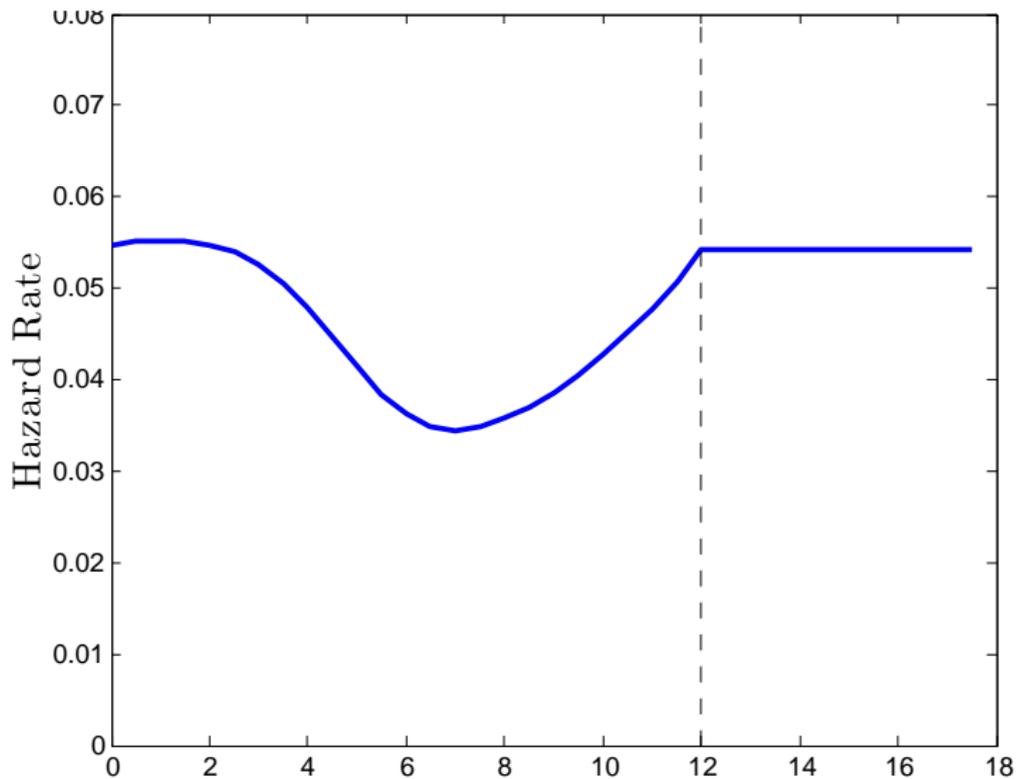
$$V_t^E(w_t, r_t) = \frac{u_t(w_t, r_t)}{1 - \delta}$$

- We assume that there is a point \bar{T} after which the environment becomes stationary.
 - Solve for optimal s_t and w_t^* using backward induction.

Standard vs. RD Model

- In order to **give the standard model** a fighting chance we have to incorporate **heterogeneity**.
 - In this case the standard model can generate a spike at exhaustion due to **selection over the spell**.
 - Suppose there is a group of individuals with a very elastic cost function but low exit rate initially.
 - At the exhaustion point these workers increase their search intensity dramatically and quickly exit. Hazard first increases and then falls again after this high elasticity group has exited.
 - From the existence of the spike alone it is thus hard to tell apart the Standard and the RD model.
- ⇒ Need a reform where the two models yield different predictions!

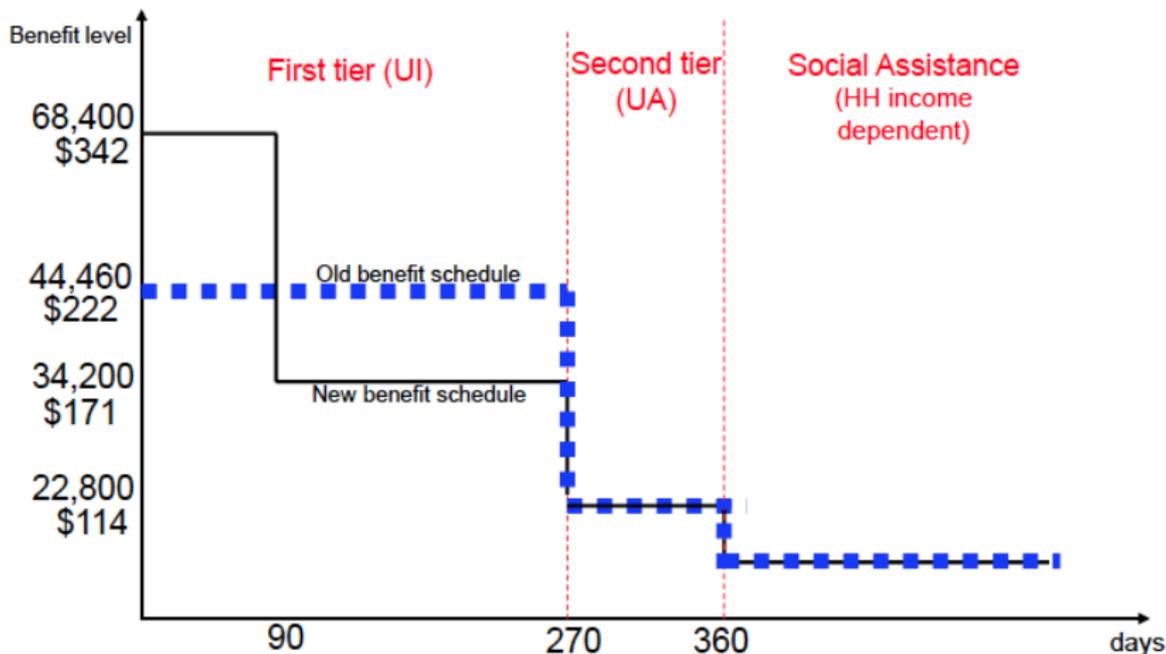
Standard model with heterogeneity



Unemployment Insurance in Hungary

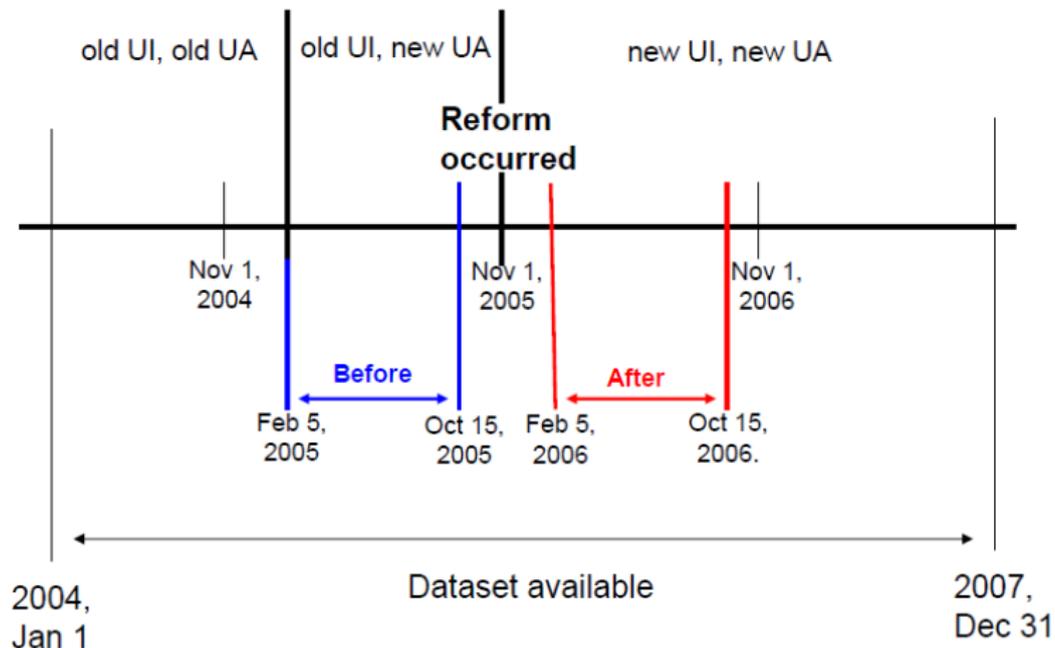
- We analyze a reform of the UI system in Hungary.
 - Focus on people at the maximum benefit level (benefits are fixed replacement rate up to maximum, most interesting variation at the maximum).
- Prior to November 2005, system similar to US:
 - Constant benefits for 270 days, then fall to second tier (unemployment assistance UA).
- After November 2005, benefits were increased in first 90 days and lowered between 90 and 270 days.
- Total amount of benefits is the same if unemployed for 270 or more days.

Benefit schedule before and after the reform (age below 50, earn above HUF114,000)



Eligible for 270 days, base salary is higher than 114,000HUF

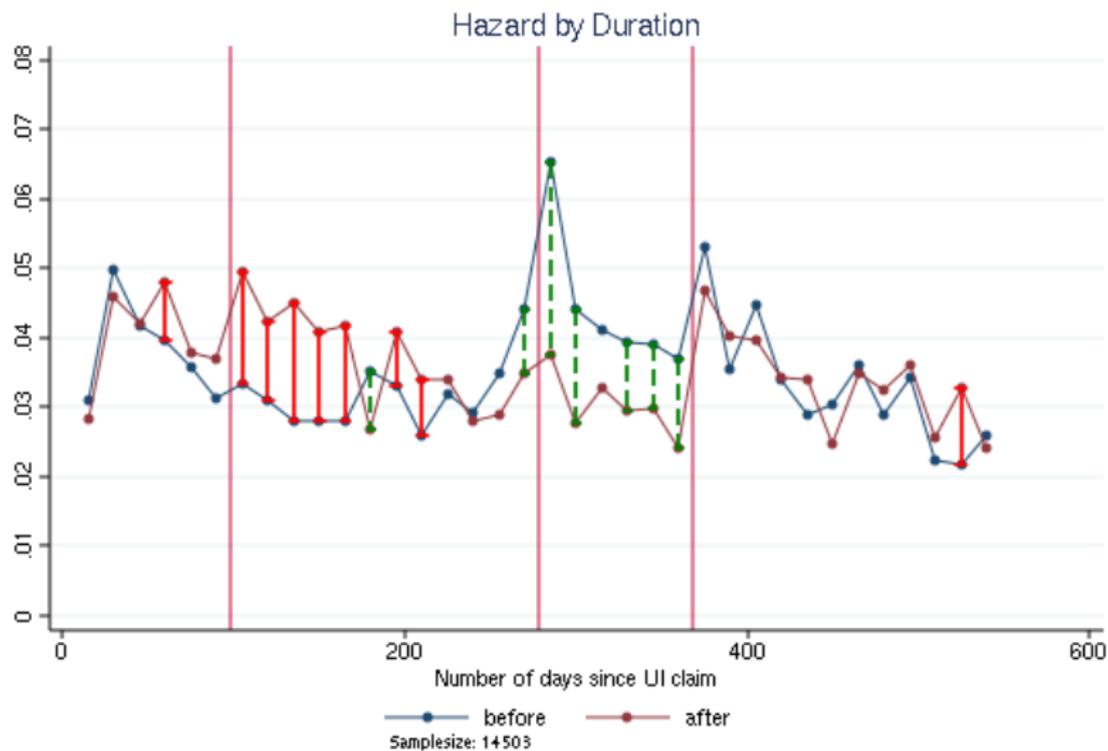
Define before and after



Predictions

- The reform changes the benefit schedule to be more front loaded.
 - Similar to a lump sum payment, in that sense it should be less distortionary.
 - Both standard and RD model would predict a reduction in unemployment durations, but shape of hazards different.
- The **drop** in UI benefits at the 270 day point in the **Before** period is much **larger** than in the **After** period, but after 270 days benefit levels are the same.
 - Standard model: predict that hazard rates are the same after 270 days in both periods.
 - RD Model: predict that after 270 days hazard rate is higher in the Before period, since reference point needs time to adjust.

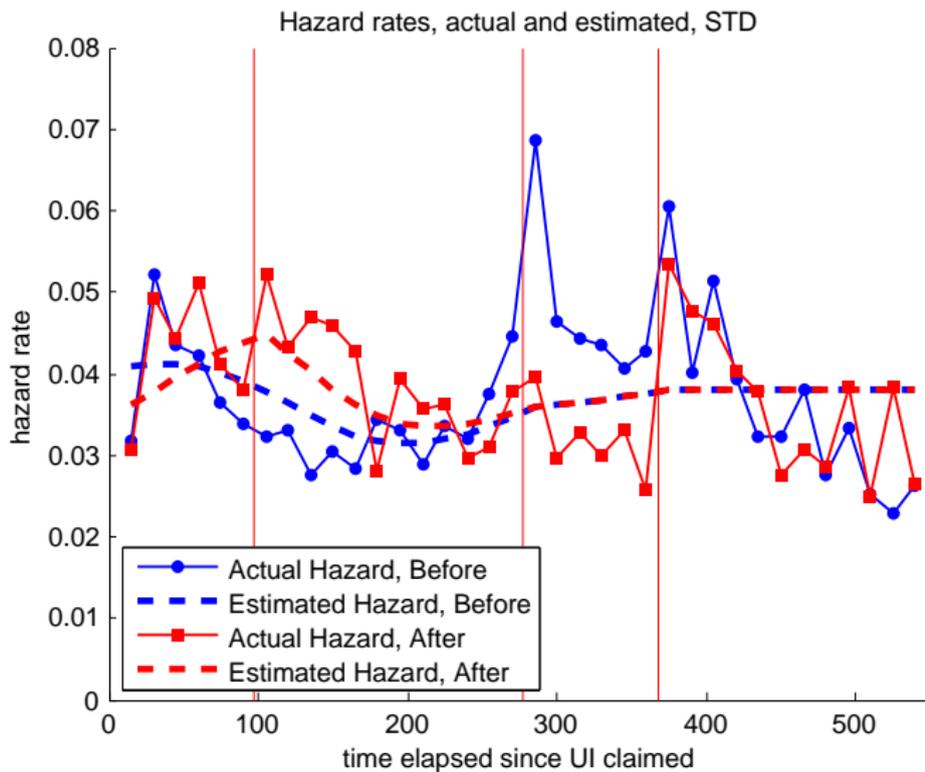
Hazard rates before and after



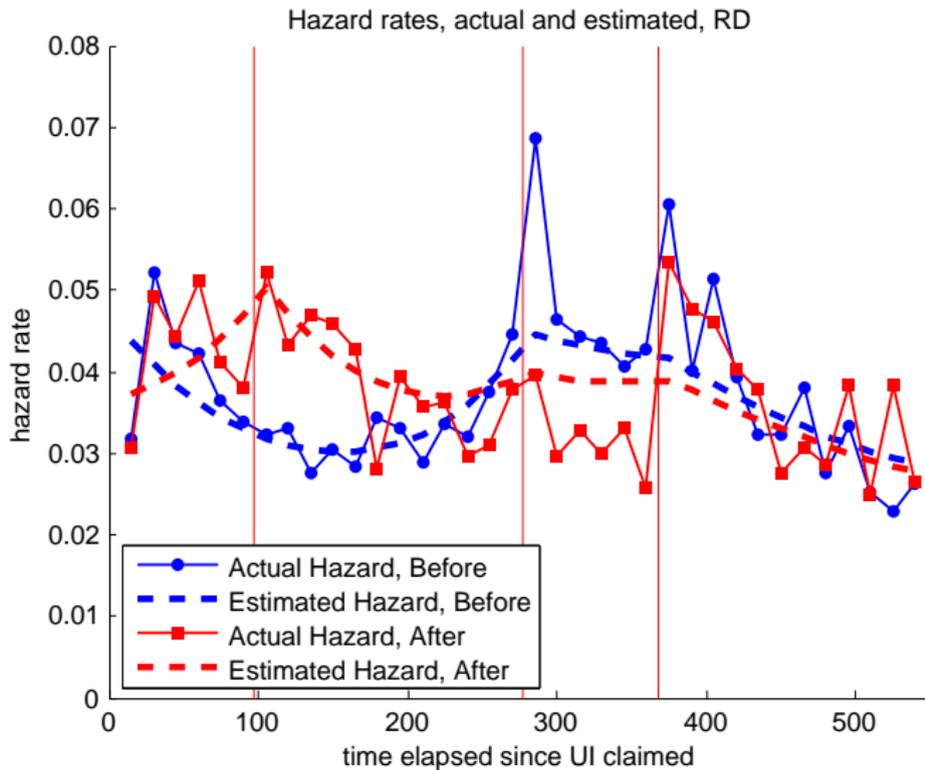
Estimation

- We estimate our search model (Standard and Reference Dependent) using a minimum distance estimator.
- We try to match the estimated hazard rates in the pre- and post period.
 - Moments: estimated hazard rates in 36 periods Before and After.
- Parameters to estimate:
 - λ size of gain loss component in utility function ($\lambda = 0$ implies the standard model).
 - N adjustment time for reference period.
 - $c(.) = k_j \frac{s^{1+\gamma}}{1+\gamma}$
- There are two types with different k_j : k_h and k_l . We estimate k_h and k_l and the proportion of high cost types.

Simulation of Standard Model



Simulation of RD Model



4 Reference Dependence: Endowment Effect I

- **Plott and Zeiler (AER 2005)** replicating **Kahneman, Knetsch, and Thaler (JPE 1990)**
 - Half of the subjects are given a mug and asked for WTA
 - Half of the subjects are shown a mug and asked for WTP
 - Finding: $WTA \simeq 2 * WTP$

Table 2: Individual Subject Data and Summary Statistics from KKT Replication

Treatment	Individual Responses (in U.S. dollars)	Mean	Median	Std. Dev.
WTP (n = 29)	0, 0, 0, 0, 0.50, 0.50, 0.50, 0.50, 0.50, 1, 1, 1, 1, 1, 1.50 2, 2, 2, 2, 2, 2.50, 2.50, 2.50, 3, 3, 3.50, 4.50, 5, 5	1.74	1.50	1.46
WTA (n = 29)	0, 1.50, 2, 2, 2.50, 2.50, 3, 3.50, 3.50, 3.50, 3.50, 3.50, 4, 4.50 4.50, 5.50, 5.50, 5.50, 6, 6, 6, 6.50, 7, 7, 7, 7.50, 7.50, 7.50, 8.50	4.72	4.50	2.17

- How do we interpret it? Use reference-dependence in piece-wise linear form
 - Assume only gain-loss utility, and assume piece-wise linear formulation (1)+(3)
 - Two components of utility: utility of owning the object $u(m)$ and (linear) utility of money p
 - Assumption: No loss-aversion over money
 - WTA: Given mug $\rightarrow r = \{\text{mug}\}$, so selling mug is a loss
 - WTP: Not given mug $\rightarrow r = \{\emptyset\}$, so getting mug is a gain
 - Assume $u\{\emptyset\} = 0$

- This implies:

- WTA: Status-Quo \sim Selling Mug

$$u\{mug\} - u\{mug\} = \lambda[u\{\emptyset\} - u\{mug\}] + p_{WTA} \text{ or}$$
$$p_{WTA} = \lambda u\{mug\}$$

- WTP: Status-Quo \sim Buying Mug

$$u\{\emptyset\} - u\{\emptyset\} = u\{mug\} - u\{\emptyset\} - p_{WTP} \text{ or}$$
$$p_{WTP} = u\{mug\}$$

- It follows that

$$p_{WTA} = \lambda u\{mug\} = \lambda p_{WTP}$$

- If loss-aversion over money,

$$p_{WTA} = \lambda^2 p_{WTP}$$

- Result $WTA \simeq 2 * WTP$ is consistent with loss-aversion $\lambda \simeq 2$
- Plott and Zeiler (*AER* 2005): The result disappears with
 - appropriate training
 - practice rounds
 - incentive-compatible procedure
 - anonymity

Pooled Data	WTP (n = 36)		6.62	6.00	4.20
	WTA (n = 38)		5.56	5.00	3.58

- What interpretation?
- Interpretation 1. Endowment effect and loss-aversion interpretation are wrong
 - Subjects feel bad selling a ‘gift’
 - Not enough training
- Interpretation 2. In Plott-Zeiler (2005) experiment, subjects did *not* perceive the reference point to be the endowment

- Koszegi-Rabin: Assume reference point $(.5, \{mug\}; .5, \{\emptyset\})$ in both cases

– WTA:

$$\begin{bmatrix} .5 * [u\{mug\} - u\{mug\}] \\ +.5 * [u\{mug\} - u\{\emptyset\}] \end{bmatrix} = \begin{bmatrix} .5 * \lambda [u\{\emptyset\} - u\{mug\}] \\ +.5 * [u\{\emptyset\} - u\{\emptyset\}] \end{bmatrix} + p_{WTA}$$

– WTP:

$$\begin{bmatrix} .5 * \lambda [u\{\emptyset\} - u\{mug\}] \\ +.5 * [u\{\emptyset\} - u\{\emptyset\}] \end{bmatrix} = \begin{bmatrix} .5 * [u\{mug\} - u\{mug\}] \\ +.5 * [u\{mug\} - u\{\emptyset\}] \end{bmatrix} - p_{WTP}$$

– This implies no endowment effect:

$$p_{WTA} = p_{WTP}$$

- Notice: Open question, with active follow-up literature
 - Plott-Zeiler (*AER* 2007): Similar experiment with different outcome variable: Rate of subjects switching
 - Isoni, Loomes, and Sugden (*AER* 2010):
 - * In Plott-Zeiler data, there is endowment effect for lotteries in training rounds on lotteries!
 - * New experiments: for lotteries, mean WTA is larger than the mean WTP by a factor of between 1.02 and 2.19
- Rejoinder paper(s)?

- List (*QJE* 2003) – Further test of endowment effect and role of experience
- Protocol:
 - Get people to fill survey
 - Hand them memorabilia card A (B) as thank-you gift
 - After survey, show them memorabilia card B (A)
 - "Do you want to switch?"
 - "Are you going to keep the object?"
 - Experiments I, II with different object
- Prediction of Endowment effect: too little trade

- Experiment I with Sport Cards – Table II

TABLE II
SUMMARY TRADING STATISTICS FOR EXPERIMENT I: SPORTSCARD SHOW

Variable	Percent traded	<i>p</i> -value for Fisher's exact test
Pooled sample (n = 148)		
Good A for Good B	32.8	<0.001
Good B for Good A	34.6	
Dealers (n = 74)		
Good A for Good B	45.7	0.194
Good B for Good A	43.6	
Nondealers (n = 74)		
Good A for Good B	20.0	<0.001
Good B for Good A	25.6	

a. Good A is a Cal Ripken, Jr. game ticket stub, circa 1996. Good B is a Nolan Ryan certificate, circa 1990.
 b. Fisher's exact test has a null hypothesis of no endowment effect.

- Experiment II with Pins – Table V

Variable	Percent traded	<i>p</i> -value for Fisher's exact test
Pooled sample (n = 80)		
Good C for Good D	25.0	<0.001
Good D for Good C	32.5	
Inexperienced consumers (<7 trades monthly; n = 60)	25.0	<0.001
Experienced consumers (≥7 trades monthly; n = 20)	40.0	0.26
Inexperienced consumers (<5 trades monthly; n = 50)	18.0	<0.001
Experienced consumers (≥5 trades monthly; n = 30)	46.7	0.30

- **Finding 1.** Strong endowment effect for inexperienced dealers
- How to reconcile with Plott-Zeiler?
 - Not training? No, nothing difficult about switching cards
 - Not practice? No, people used to exchanging cards
 - Not incentive compatibility? No
 - Is it anonymity? Unlikely
 - Gift? Possible
- **Finding 2.** Substantial experience lowers the endowment effect to zero
 - Getting rid of loss aversion?
 - Expecting to trade cards again? (Koszegi-Rabin, 2005)

- Objection 1: Is it experience or is it just sorting?
- Experiment III with follow-up of experiment I – Table IX

TABLE IX
SUMMARY STATISTICS FOR EXPERIMENT III: FOLLOW-UP SPORTSCARD SHOW

	Increased number of trades	Stable number of trades	Decreased number of trades
No trade in Experiment I; trade in Experiment III	13	1	2
No trade in Experiment I; no trade in Experiment III	8	7	11
Trade in Experiment I; Trade in Experiment III	4	0	0
Trade in Experiment I; No trade in Experiment III	2	0	5
Σ	27	8	18

a. Columns denote changes in subjects' trading experience over the year; rows denote subjects' behavior in the two field trading experiments.
b. Fifty-three subjects participated in both Experiment I and the follow-up experiment.

- Objection 2. Are inexperienced people indifferent between different cards?
- People do not know own preferences – Table XI

TABLE XI
SELECTED CHARACTERISTICS OF TUCSON SPORTSCARD PARTICIPANTS

	Dealers		Nondealers	
	WTA mean (std. dev.)	WTP mean (std. dev.)	WTA mean (std. dev.)	WTP mean (std. dev.)
<i>Bid or offer</i>	8.15 (9.66)	6.27 (6.90)	18.53 (19.96)	3.32 (3.02)
<i>Trading experience</i>	16.67 (19.88)	15.78 (13.71)	4.00 (5.72)	3.73 (3.46)
<i>Years of market experience</i>	10.23 (5.61)	10.57 (8.13)	5.97 (5.87)	5.60 (6.70)

- Objection 3. Is learning localized or do people generalize the learning to other goods?
- **List (EMA, 2004)**: Field experiment similar to experiment I in List (2003)
- Sports traders but objects are mugs and chocolate
- Trading in four groups:
 1. Mug: "Switch to Chocolate?"
 2. Chocolate: "Switch to Mug?"
 3. Neither: "Choose Mug or Chocolate?"
 4. Both: "Switch to Mug or Chocolate?"

	Preferred Exchange	<i>p</i> -Value for Fisher's Exact Test
<i>Panel D. Trading Rates</i>		
Pooled nondealers ($n = 129$)	.18 (.38)	< .01
Inexperienced consumers (< 6 trades monthly; $n = 74$)	.08 (.27)	< .01
Experienced consumers (≥ 6 trades monthly; $n = 55$)	.31 (.47)	< .01
Intense consumers (≥ 12 trades monthly; $n = 16$)	.56 (.51)	.64
Pooled dealers ($n = 62$)	.48 (.50)	.80

- Large endowment effect for inexperienced card dealers
- No endowment effect for experienced card dealers!
- Learning (or reference point formation) generalizes beyond original domain
- Next time: Ericson and Fuster (QJE 2011)

5 Reference Points: Forward vs. Backward Looking

- Papers so far assume a backward-looking reference point
 - Salient past outcomes
 - * Purchase price of home
 - * Purchase price of shares
 - * Amount withheld
 - * Recent earnings
 - Status quo
 - * Ownership in endowment effect
 - Cultural norm

- * 52-week high for mergers
- * Round numbers (as running goals)
- For bunching and shifting test, reference point needs to be
 - Deterministic
 - Clear to the researcher
- For other predictions, such as in job search, exact level less critical
- Koszegi and Rabin (2006) propose forward-looking reference points
 - Reference point is expectations of future outcomes
 - Reference point is stochastic
 - Solve with Personal Equilibria

- Motivations:
 - Motivation 1: It often makes sense for people to compare outcomes to expectations
 - Motivation 2: Reference point does not need to be assumed
- Drawbacks of forward-looking reference points:
 - Stochastic \rightarrow Lose sharpest tests of reference dependence (bunching and shifting)
 - Often multiplicity of equilibria
- Next week, cover papers where reference points are expectations
 - Reference point is often taken as expectation, rather than full distribution, to simplify

- Start with revisiting endowment effect
- Future research: Would be great to see papers with reference point r

$$r = \alpha r_0 + (1 - \alpha) r_f$$

- r_0 backward-looking reference point
- r_f forward-looking reference point

6 Reference Dependence: Disposition Effect (EX-TRA)

- **Odean (JF, 1998):** Do investors sell winning stocks more than losing stocks?
- Individual trade data from Discount brokerage house (1987-1993)
- Rare data set → Most financial data sets carry only aggregate information
- Share of realized gains:

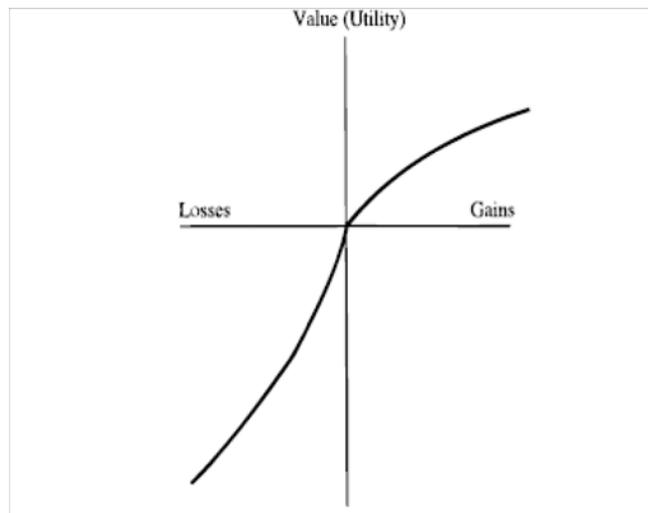
$$PGR = \frac{\text{Realized Gains}}{\text{Realized Gains} + \text{Paper Gains}}$$

- Share of realized losses:

$$PLR = \frac{\text{Realized Losses}}{\text{Realized Losses} + \text{Paper Losses}}$$

- These measures control for the availability of shares at a gain or at a loss

- Tax advantage to sell losers
 - Can post a deduction to capital gains taxation
 - Stronger incentives in December, can post for current tax year
- Prospect theory intuition:
 - Reference point: price of purchase
 - Convexity over losses \longrightarrow gamble, hold on stock
 - Concavity over gains \longrightarrow risk aversion, sell stock



- Construction of measure:
 - Observations are counted on all *days* in which a sale or purchase occurs
 - On those days the paper gains and losses are counted
 - Reference point is *average* purchase price:
 - Example: $PGR = \frac{13,883}{13,883+79,658} = 0.148$

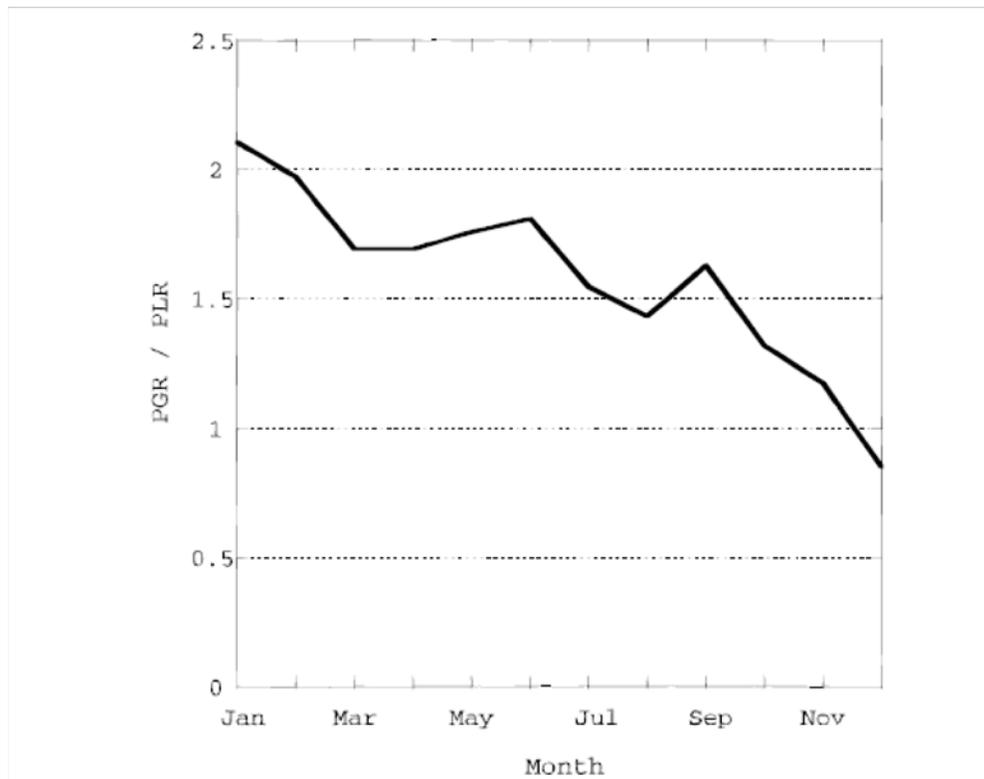
Table I

PGR and PLR for the Entire Data Set

This table compares the aggregate Proportion of Gains Realized (PGR) to the aggregate Proportion of Losses Realized (PLR), where PGR is the number of realized gains divided by the number of realized gains plus the number of paper (unrealized) gains, and PLR is the number of realized losses divided by the number of realized losses plus the number of paper (unrealized) losses. Realized gains, paper gains, losses, and paper losses are aggregated over time (1987–1993) and across all accounts in the data set. PGR and PLR are reported for the entire year, for December only, and for January through November. For the entire year there are 13,883 realized gains, 79,658 paper gains, 11,930 realized losses, and 110,348 paper losses. For December there are 866 realized gains, 7,131 paper gains, 1,555 realized losses, and 10,604 paper losses. The *t*-statistics test the null hypotheses that the differences in proportions are equal to zero assuming that all realized gains, paper gains, realized losses, and paper losses result from independent decisions.

	Entire Year	December	Jan.–Nov.
PLR	0.098	0.128	0.094
PGR	0.148	0.108	0.152
Difference in proportions	–0.050	0.020	–0.058
<i>t</i> -statistic	–35	4.3	–38

- Strong support for disposition effect
- Effect monotonically decreasing across the year



- Tax reasons are also at play

- Robustness: Across years and across types of investors

	1987–1990	1991–1993	Frequent Traders	Infrequent Traders
Entire year PLR	0.126	0.072	0.079	0.296
Entire year PGR	0.201	0.115	0.119	0.452
Difference in proportions	-0.075	-0.043	-0.040	-0.156
<i>t</i> -statistic	-30	-25	-29	-22

- Alternative Explanation 1: **Rebalancing** → Sell winners that appreciated
 - Remove partial sales

	Entire Year	December
PLR	0.155	0.197
PGR	0.233	0.162
Difference in proportions	-0.078	0.035
<i>t</i> -statistic	-32	4.6

- Alternative Explanation 2: **Ex-Post Return** → Losers outperform winners ex post
 - Table VI: Winners sold outperform losers that could have been sold

	Performance over Next 84 Trading Days	Performance over Next 252 Trading Days	Performance over Next 504 Trading Days
Average excess return on winning stocks sold	0.0047	0.0235	0.0645
Average excess return on paper losses	-0.0056	-0.0106	0.0287
Difference in excess returns	0.0103	0.0341	0.0358
(<i>p</i> -values)	(0.002)	(0.001)	(0.014)

- Alternative Explanation 3: **Transaction costs** → Losers more costly to trade (lower prices)
 - Compute equivalent of *PGR* and *PLR* for additional purchases of stock
 - This story implies $PGP > PLP$
 - Prospect Theory implies $PGP < PLP$ (invest in losses)
- Evidence:

$$PGP = \frac{\text{Gains Purchased}}{\text{Gains Purchased} + \text{Paper Gains}} = .094$$

$$< PLP = \frac{\text{Losses Purchased}}{\text{Losses Purchased} + \text{Paper Losses}} = .135.$$

- Alternative Explanation 4: **Belief in Mean Reversion** → Believe that losers outperform winners
 - Behavioral explanation: Losers do not outperform winners
 - Predicts that people will buy new losers → Not true
- How big of a cost? Assume \$1000 winner and \$1000 loser
 - Winner compared to loser has about \$850 in capital gain → \$130 in taxes at 15% marginal tax rate
 - Cost 1: Delaying by one year the \$130 tax ded. → \$10
 - Cost 2: Winners overperform by about 3% per year → \$34

- **Ivkovich, Poterba, and Weissbenner (AER 2005)**

- Compare taxable accounts and tax-deferred plans (IRAs)
- Disposition effect should be stronger for tax-deferred plans

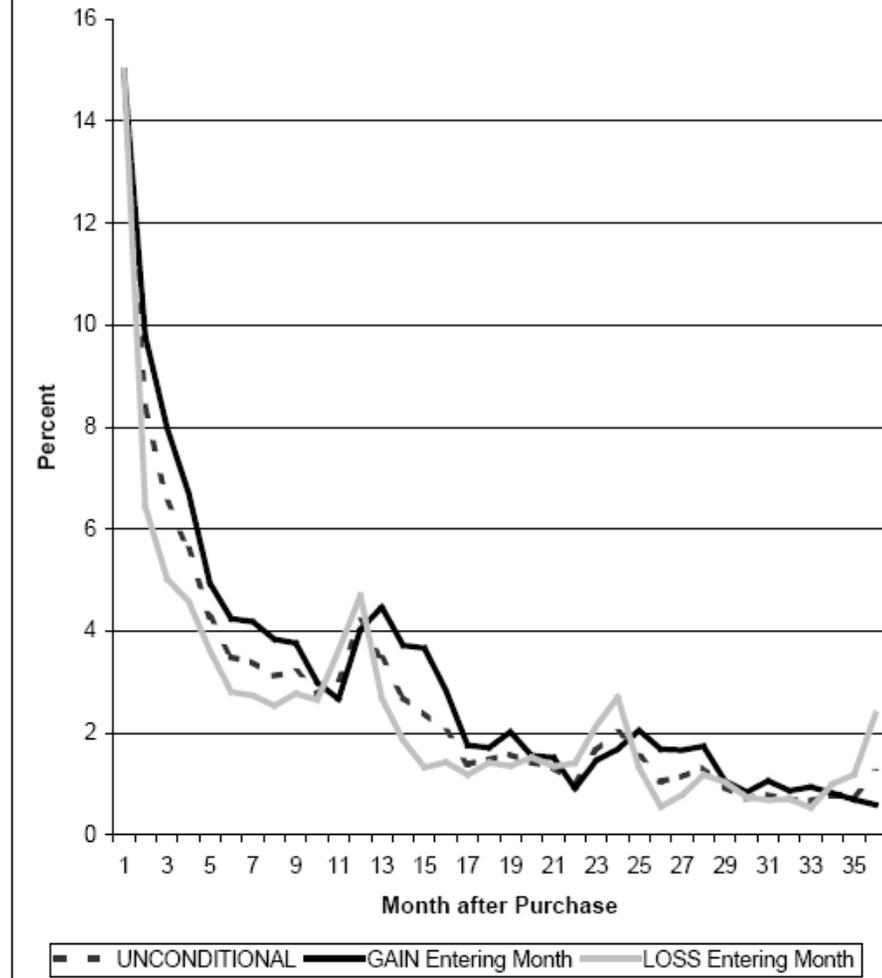
- Methodology:

- Hazard regressions of probability of buying and selling monthly, instead of *PGR* and *PLR*
- Avoid selection involved in computing PGR/PLR only when sale
- For each month t , estimate linear probability model:

$$SELL_{i,t} = \alpha_t + \beta_{1,t}I(Gain)_{i,t-1} + \beta_{2,t}I(Loss)_{i,t-1} + \varepsilon_{i,t}$$

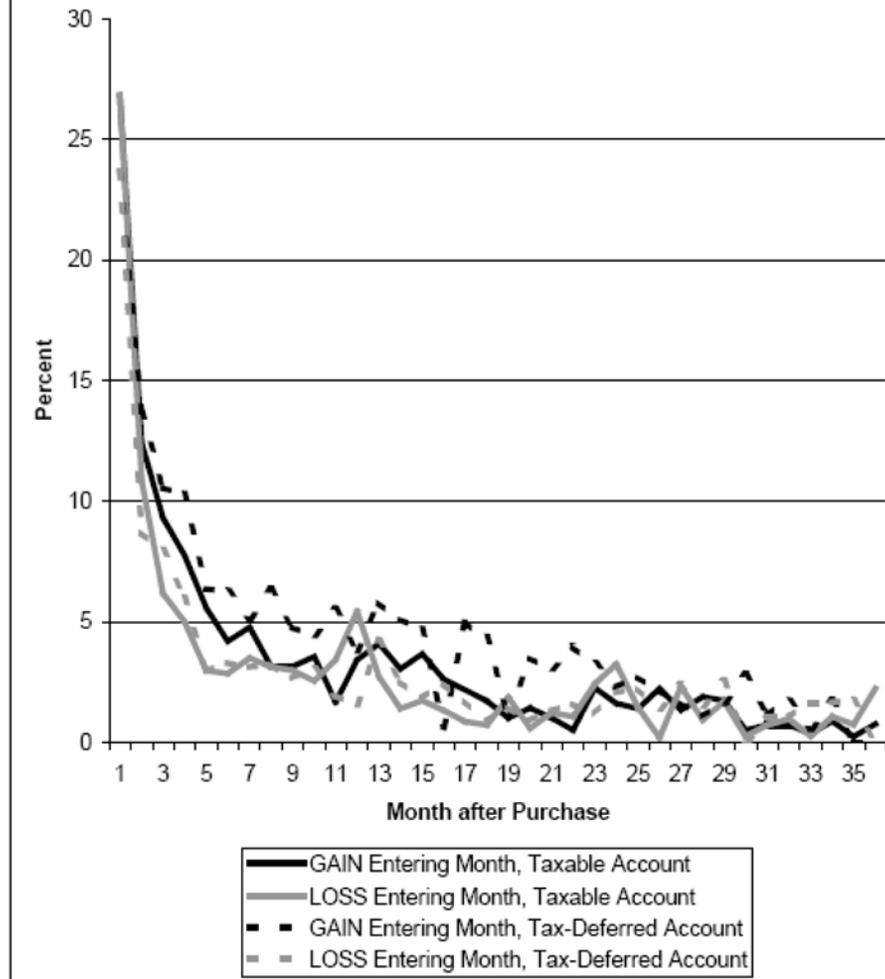
- α_t is baseline hazard at month t
- β_s always consistent with disposition effect, except in December

Figure 1: Hazard Rate of Having Sold Stock
in Taxable Accounts, Full Sample

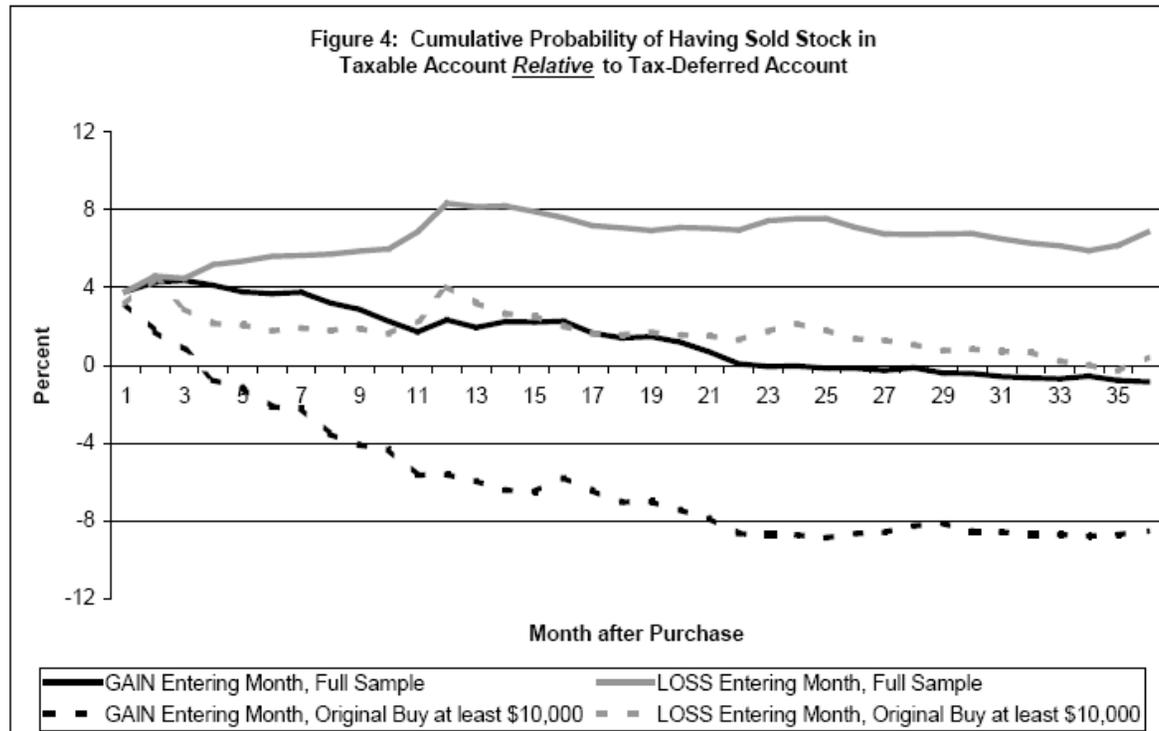


Notes: Sample is January purchases of stock 1991-96 in taxable accounts. The hazard rate for stock purchases unconditional on the stock's price performance, as well as conditional on whether the stock has an accrued capital gain or loss entering the month, is displayed.

Figure 2: Hazard Rate of Having Sold Stock in Taxable and Tax-Deferred Accounts, Original Buy at least \$10,000



Notes: Sample is January purchases of stock of at least \$10,000 from 1991-96. The hazard rate for stock purchases conditional on whether the stock has an accrued capital gain or loss entering the month is displayed for taxable and tax-deferred accounts.



Notes: Sample is January purchases of stock 1991-96. If $h(t)$ denotes the hazard rate in month t , the probability that the stock is sold by the end of month t is $[1 - (\prod_{s=1,t} (1-h(s)))]$. Figure 4 displays cumulative probability of sale in a taxable account less than in a tax-deferred account for each month.

- – Different hazards between taxable and tax-deferred accounts → Taxes
- Disposition Effect very solid finding. Explanation?

- **Barberis and Xiong (JF 2009)**. Model asset prices with full prospect theory (loss aversion+concavity+convexity), except for prob. weighting
- Under what conditions prospect theory generates disposition effect?
- Setup:
 - Individuals can invest in risky asset or riskless asset with return R_f
 - Can trade in $t = 0, 1, \dots, T$ periods
 - Utility is evaluated only at end point, after T periods
 - Reference point is initial wealth W_0
 - utility is $v(W_T - W_0 R_f)$

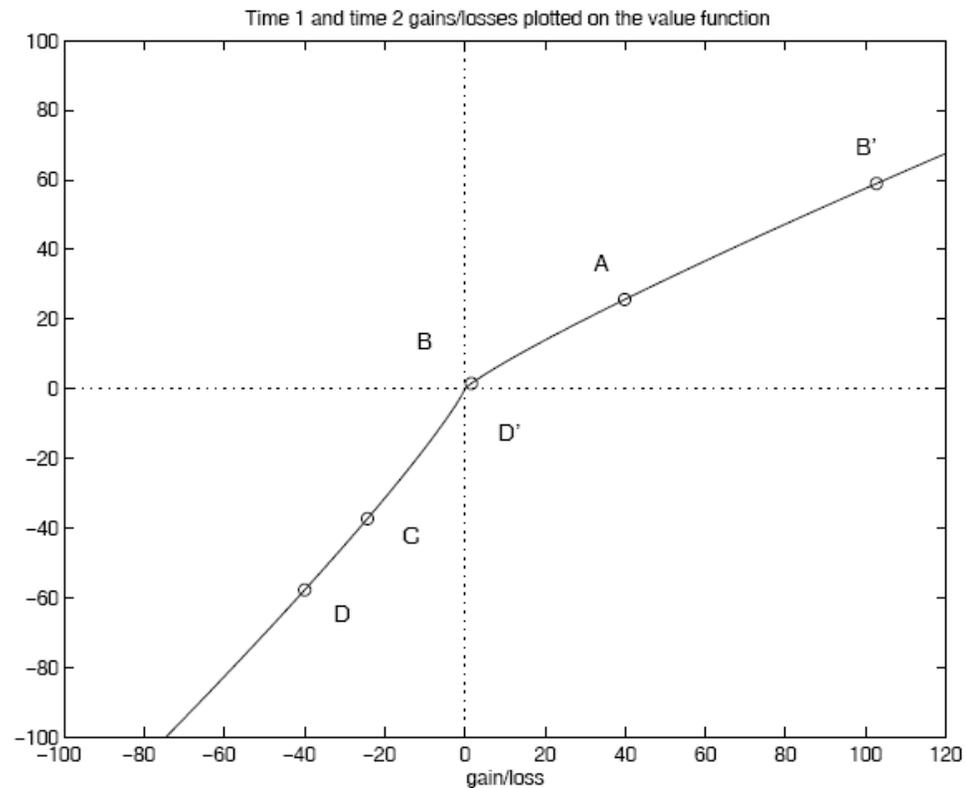
- Calibrated model: Prospect theory may not generate disposition effect!

Table 2: For a given (μ, T) pair, we construct an artificial dataset of how 10,000 investors with prospect theory preferences, each of whom owns N_S stocks, each of which has an annual gross expected return μ , would trade those stocks over T periods. For each (μ, T) pair, we use the artificial dataset to compute PGR and PLR, where PGR is the proportion of gains realized by all investors over the entire trading period, and PLR is the proportion of losses realized. The table reports “PGR/PLR” for each (μ, T) pair. Boldface type identifies cases where the disposition effect fails (PGR < PLR). A hyphen indicates that the expected return is so low that the investor does not buy any stock at all.

μ	$T = 2$	$T = 4$	$T = 6$	$T = 12$
1.03	-	-	-	.55/.50
1.04	-	-	.54/.52	.54/.52
1.05	-	-	.54/.52	.59/.45
1.06	-	.70/.25	.54/.52	.58/.47
1.07	-	.70/.25	.54/.52	.57/.49
1.08	-	.70/.25	.48/.58	.47/.60
1.09	-	.43/.70	.48/.58	.46/.61
1.10	0.0/1.0	.43/.70	.48/.58	.36/.69
1.11	0.0/1.0	.43/.70	.49/.58	.37/.68
1.12	0.0/1.0	.28/.77	.23/.81	.40/.66
1.13	0.0/1.0	.28/.77	.24/.83	.25/.78

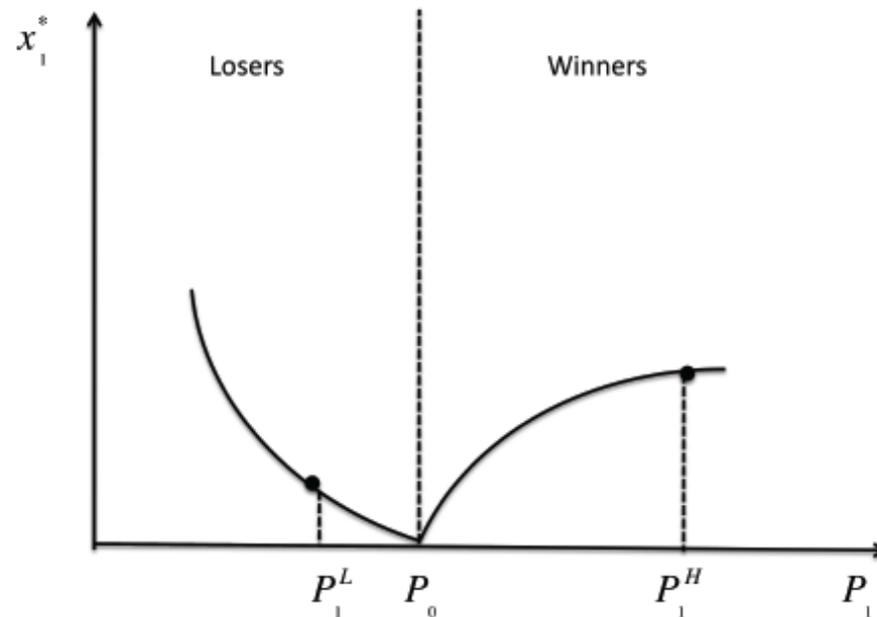
- Intuition:

- Previous analysis of reference-dependence and disposition effect focused on concavity and convexity of utility function
- Neglect of kink at reference point (loss aversion)
- Loss aversion induces high risk-aversion around the kink → Two effects
 1. Agents purchase risky stock only if it has high expected return
 2. Agents sell if price of stock is around reference point
- Now, assume that returns are high enough and one invests:
 - * on gain side, likely to be far from reference point → do not sell, despite (moderate) concavity
 - * on loss side, likely to be close to reference point → may lead to more sales (due to local risk aversion), despite (moderate) convexity

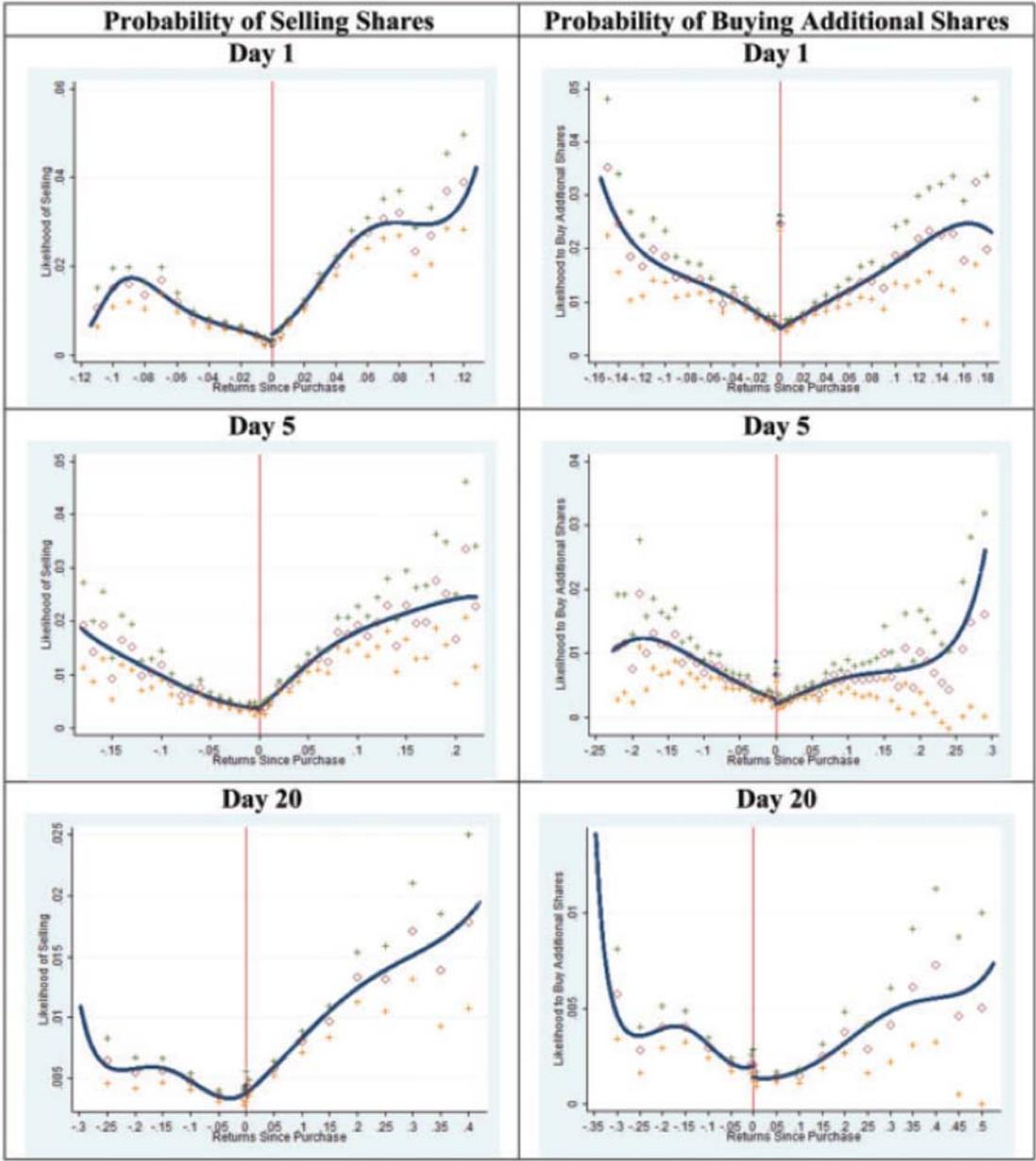


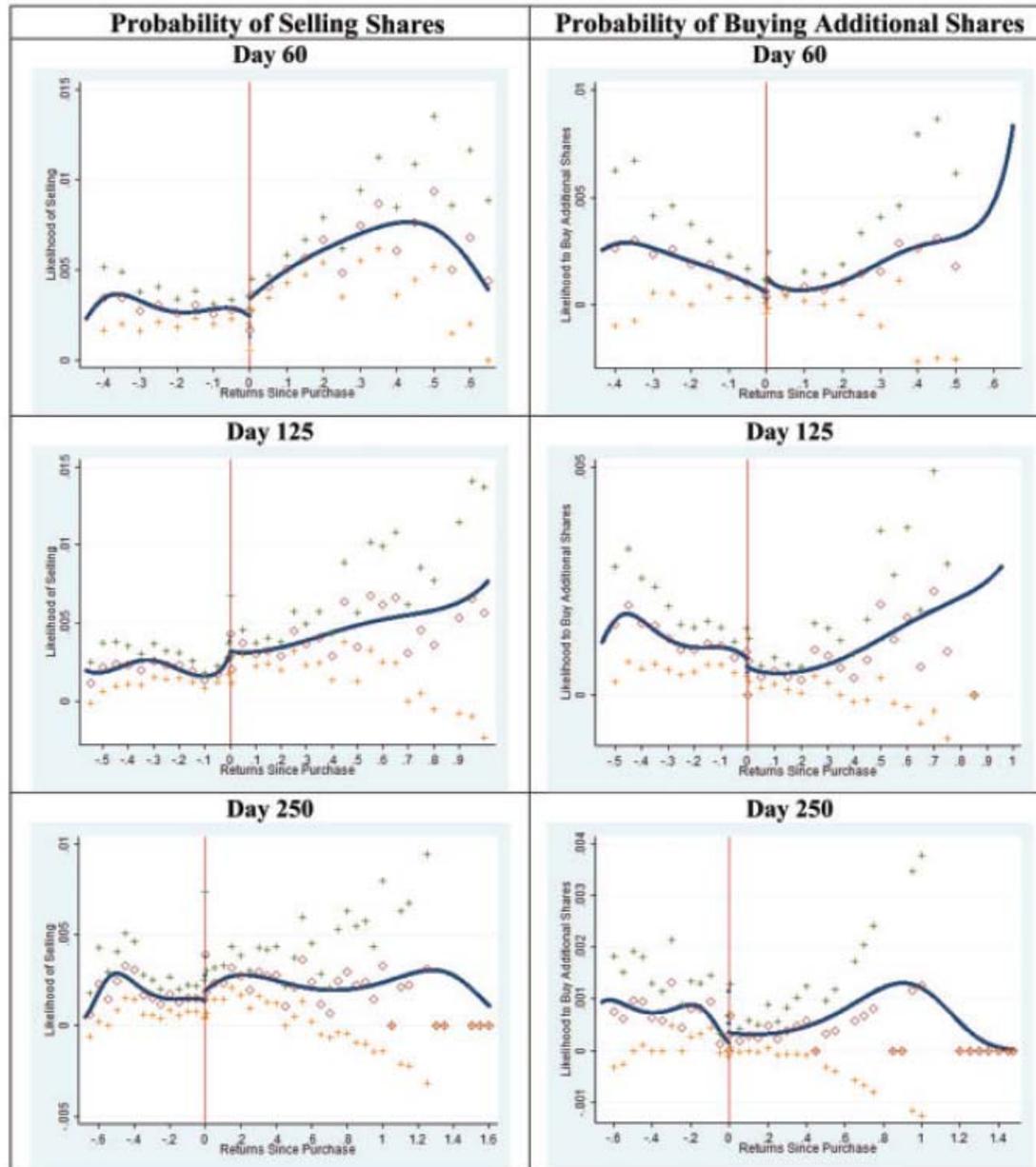
- Some novel predictions of this model:
 - Stocks near buying price are more likely to be sold, all else constant
 - Disposition effect should hold when away from ref. point

- **Meng (2010)** elaborates on this point
 - Model of two-period portfolio holding
 - Loss Aversion with respect to (potentially stochastic) reference point
 - Derives optimal value of holding of risk asset x as function of past returns



- Empirical test: When the return is near the purchase price we should see
 - More selling
 - Less buying
 - —> The selling hazard should be an *inverse V-shaped* function of price
 - —> The buying hazard should be a *V-shaped* function of price
- **Ben-David and Hirshleifer (RFS 2012)** plot the hazards above, that is,
 - $P(\text{Sell at } t | \text{holding at } t)$
 - $P(\text{Buy more at } t | \text{holding at } t)$





- Results

- Strikingly, probability of selling minimal for $P_t = P_0$
- Rejection of prospect theory model with purchase price as reference point.
- Could reference point be expected return (that is, $P_0 * (1 + r)$)?
- BUT No visible inverse V-shaped pattern for positive return

- Back to the drawing board

- Barberis-Xiong assumes that utility is evaluated every T period for all stocks
- Alternative assumption: Investors evaluate utility **only** when selling
- *Realization utility: Barberis and Xiong (JFE 2012)*
 - Individuals get utility only they liquidate a portfolio
 - Assume (piece-wise) linear realization utility
 - Loss from selling a loser $>$ Gain of selling winner
 - Sell winners when go above a certain threshold value
 - Never sell losers, hoping in option value

- Explains disposition effect → But too extreme

- Follow-up: **Ingersoll-Jin (RFS 2013)**

- Realization Utility model

- Assume value function as in prospect theory: concave over gains, convex over losses

- Convexity of losses → Sell losses if big enough so get to reset the clock

- Concavity on gains → Sell gains past a threshold

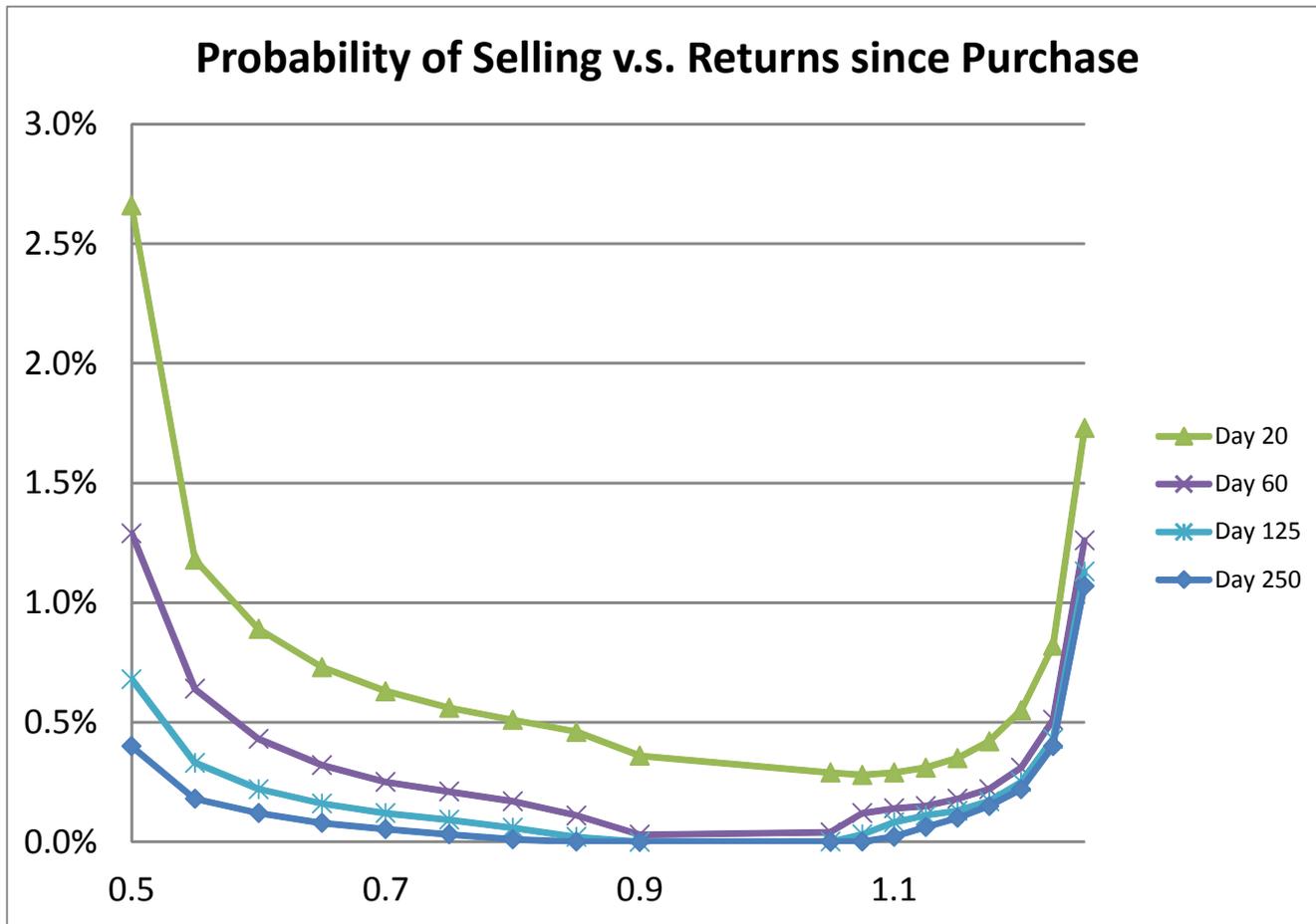
- Table 1: Calibration with loss aversion $\lambda = 2$ for varying concavity over gains (α_G) and convexity over losses (α_L)

Table 1
Summary statistics for reference-dependent realization utility model with scaled Tversky-Kahneman utility

	$\Theta - 1$	$\theta - 1$	Q_G	φ_G	$\mathbb{E}[\tau]$	PGR	PLR	\mathcal{O}	
Odean data	27.7%	-22.8%	53.8%	41.9%	312	14.8%	9.8%	1.51	
Dhar and Zhu data	—	—	65.8%	46.5%	122	13.2%	6.4%	2.06	
Fit to Odean's Θ, θ	27.7%	-22.8%	57.7%	50.7%	174	14.0%	10.9%	1.28	
Random trading (Poisson) model									
$\rho = 0.36$	72.2%	-22.8%	58.7%	58.7%	688	12.5%	12.5%	1	
$\rho = 0.80$	36.4%	-17.4%	55.9%	55.9%	312	12.5%	12.5%	1	
$\rho = 1.16$	27.7%	-15.2%	54.9%	54.9%	215	12.5%	12.5%	1	
$\rho = 1.94$	19.7%	-12.4%	53.8%	53.8%	129	12.5%	12.5%	1	
Realization model with scaled-TK utility									
$\alpha_G = 1$	$\left\{ \begin{array}{l} \beta = 0 \text{ or } 1 \\ \beta = 0.53 \end{array} \right.$	95.3%	never	100%	27.1%	3717	34.5%	0	∞
$\alpha_L = 1$		45.6%	never	100%	16.6%	2087	46.2%	0	∞
$\alpha_G = 0.88$	$\left\{ \begin{array}{l} \beta = 0 \\ \beta = 0.88 \end{array} \right.$	17.6%	never	100%	7.7%	901	65.0%	0	∞
$\alpha_L = 0.88$		96.2%	never	100%	27.3%	3743	34.4%	0	∞
$\alpha_G = 0.5$	$\left\{ \begin{array}{l} \beta = 0 \\ \beta = 0.3 \end{array} \right.$	3.9%	-13.5%	80.6%	21.5%	15	34.9%	3.4%	10.22
$\alpha_L = 0.88$		5.8%	-45.3%	93.8%	9.5%	85	58.6%	1.0%	60.64
$\alpha_G = 0.5$	$\left\{ \begin{array}{l} \beta = 0 \\ \beta = 0.3 \end{array} \right.$	3.8%	-6.3%	64.9%	36.7%	7	20.2%	7.3%	2.74
$\alpha_L = 1.0$		5.9%	-28.2%	87.6%	15.6%	50	44.5%	2.1%	21.64
$\alpha_G = 0.5$	$\left\{ \begin{array}{l} \beta = 0 \\ \beta = 0.3 \end{array} \right.$	4.0%	-47.3%	95.9%	6.5%	63	67.8%	0.6%	107.90
$\alpha_L = 0.5$		5.7%	-75.8%	98.3%	4.9%	169	74.3%	0.3%	293.06

The table reports $\Theta - 1$, $\theta - 1$: percentages above and below the reference level for realized gains and losses, Q_G : fraction of episodes that end in realized gains, φ_G : fraction of stocks with unrealized paper gains, $\mathbb{E}[\tau]$: average holding period in trading days (250 per year), PGR , PLR : proportions of gains and losses realized, and $\mathcal{O} \equiv PGR/PLR$: Odean's measure. Asset parameters are $\mu = 9\%$ and $\sigma = 30\%$. The accounts' sizes are fixed with $\bar{n} + \sigma_n^2/\bar{n} = 8.0$. Utility parameters are $\lambda = 2$ and $\delta = 5\%$ (except $\delta = 8\%$ for $\alpha_G = 0.88$ and $\delta = 10\%$ for $\alpha_G = 1$ to avoid a transversality violation). Transaction costs are $k_S = k_D = 1\%$, and the investor accounts for both costs in his

- Can also explain V-shape in selling

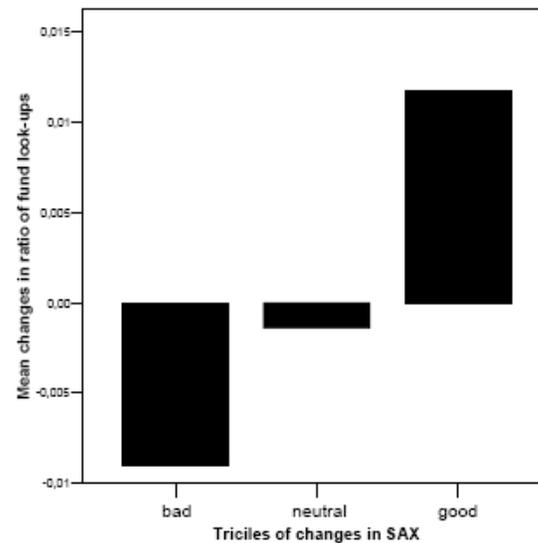


- But what about V-shape in buying?
- Ongoing debate in the literature

- **Karlsson, Loewenstein, and Seppi (JRU 2009): Ostrich Effect**
 - Investors do not want to evaluate their investments at a loss
 - Stock market down \rightarrow Fewer logins into investment account

Figure 4b: Changes in the SAX and ratio of fund look-ups to logins to personal banking page by investors at a large Swedish bank

The sample period is June 30, 2003 through October 7, 2003.



7 Next Lecture

- Start at 1pm
- Forward-looking Reference-Dependence
 - Employment and effort
 - Domestic Violence
 - Insurance
 - Real Effort