Risky Choices in a Natural Experiment: "Var Mısın Yok Musun" TV Game Show

Ertunç Aydoğdu, Ceyhun Elgin, Orhan Torul

Department of Economics
Boğaziçi University

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Outline

Introduction

- **How risky choices are made?**
- A vast body of theories:
  - Expected Utility Theory (von Neumann and Morgenstern, 1944)
  - Prospect Theory (Kahneman and Tversky, 1979)
  - Yaari's Dual Theory (E. Yaari, 1987)
  - Regret Theory (Loomes, G. and R. Sugden, 1982)
  - Fanning-out Hypothesis (Machina, 1982)
- **Empirical testing** of these theories is a difficult task via thought experiments or labaratory experiments.
- **The problem is small monetary amounts!**

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- *"Var Mısın Yok Musun"* has a special environment with clearly defined decision problems
  - The stakes are high
  - There are substantial variations in the prizes, thus bank offers
  - Minimal -even no- skill and knowledge is required
  - The choices to be made are repetitive under risk in a ceteris paribus environment of each round *-almost full information set.*

Motivation

- The effect of prior outcomes on risk attitudes: testing the predictions of expected utility of wealth and prospect theory.

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- The effect of prior outcomes on risk attitudes: testing the predictions of expected utility of wealth and prospect theory.
- The effect of contestant heterogeneity on ultimate decisions: heterogeneity in terms of observable individual characteristics
- Comparison of the findings from a developing country with considerably different income, wealth and cultural characteristics -**Turkey**- to those of the developed countries -**the United States, the Netherlands, and Germany**-

Literature Review

- Post et al. (2008, AER) points to prospect theory rather than expected utility theory, and suggests that path-dependence is relevant by using US, Dutch and German data
- De Roos and Sarafidis (2010, JAE)
- Blavatskyy and Pogrebna (2010, JAE)

Flowchart of The Game

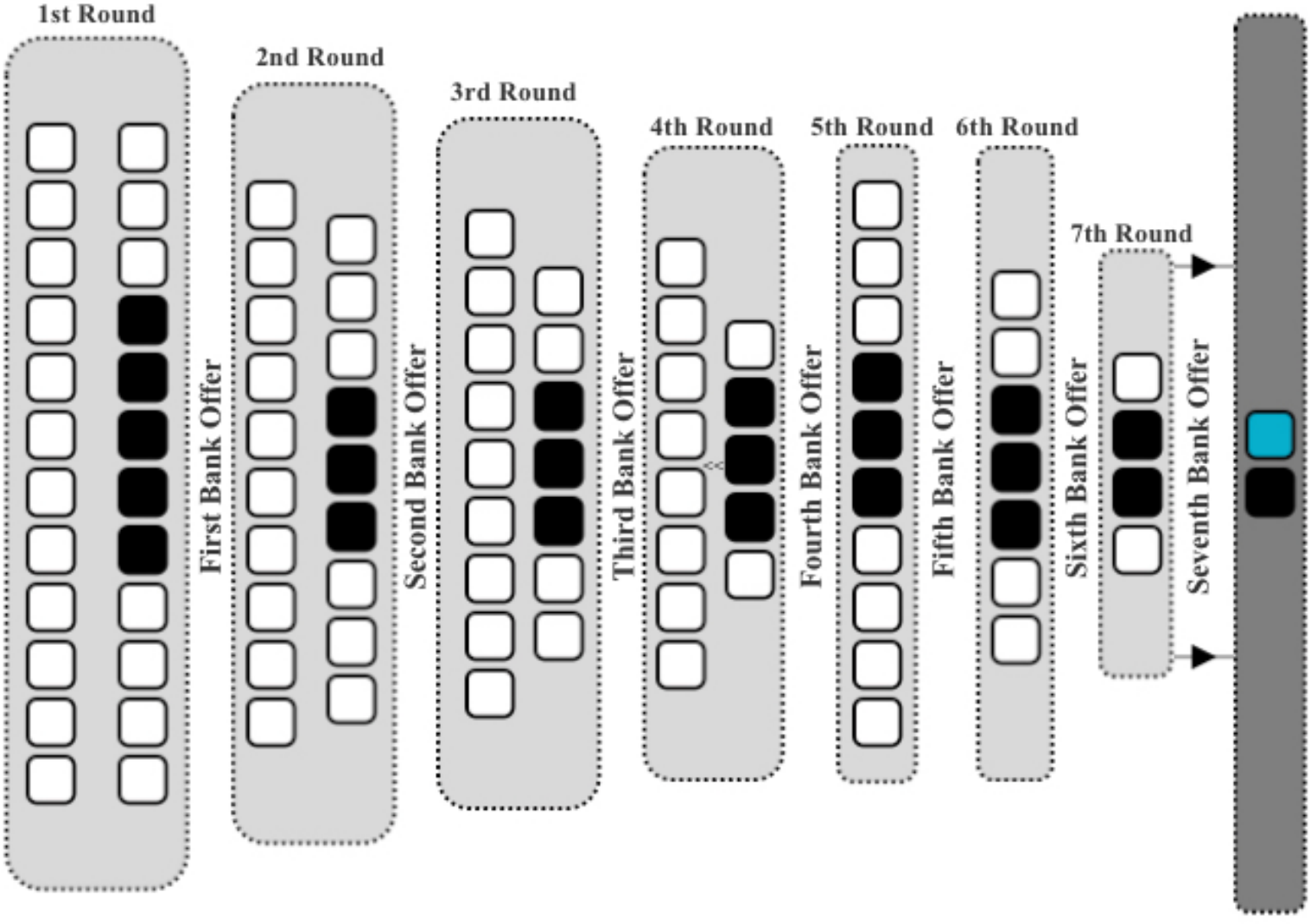

Table: Main Game Display

First Offer Comes in...		
1		20,000
2		30,000
5		40,000
10		50,000
25		150,000
50		200,000
100		250,000
200		500,000
300		500,000
500		500,000
750		500,000
10,000		500,000
Deal or No Deal		

The Contestant

- In the first round, five boxes to be opened
- The numbers of boxes to be opened in the maximum of six subsequent rounds are 3, 3, 3, 3, 3, 2, and 1.
- The number of prizes left in the game decreases to 19, 16, 13, 10, 7, 4, and 2.
- If the contestant rejects all seven offers, she receives the prize in her own box.

The Banker: Stylized Facts

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- **The offers are not informative**.The banker does not know the distribution of the prizes over the briefcases. $\Rightarrow$ No correlation between the percentage bank offer and the relative value of the prize in the contestant's own box.
- The banker offers a relatively high percentage of the average remaining prize to **loosers**.

Data Description

- Data on Turkish version (308 contestants) is not open to public. It is collected by getting authorization from the Turkish broadcaster to watch each episodes in their offices.
- Data on the US (53), Dutch (51) and German (47) versions of the show is provided by Post et al. 2008.

Turkey Data

- The first season uses 22 prizes instead of 24, and is also played over a maximum of 7 game rounds.
- We choose to drop some episodes from our sample:
  - Pooling episodes with 22 boxes with the ones with 24 boxes would distract the results. ***#28 observations are dropped***
  - In case a contestant reaches the last round with two boxes containing considerably small amounts, either "The Banker" does not want to make an offer or the contestant does not want to get. In other words, the contestant implicitly rejects the offer without seeing it. ***#14 observations are dropped.***
  - There are also some missing observations due to purely random reasons, arising largely from videotaping/data-collecting issues. ***#7 observations are dropped.***

Turkey Data

- We will continue with the remaining 248 obserations.
- Along with simple "Deal or No Deal" decisions of the contestants, we also collected data on ...
  - eliminated and remaining prizes at each round
  - the bank offers at each round
  - gender
  - age
  - marital status
  - marriage longevity
  - number of children
  - education
  - region of birthplace
  - application region

Descriptive Statistics

	Turkey (N=248)				
Variable(s)	Mean	Std. Dev.	Min	Median	Max
Age, *in years*	30.82	11.45	18	27	83
Gender, *female=1*	0.54	0.50	0	1	1
Education, *high=1*	0.61	0.49	0	1	1
Stop round	6.88	0.83	5	7	8
Best offer rejected, %	**51.73**	22.03	15.78	44.18	117.22
Offer accepted, *%*	**67.19**	26.57	25.17	62.69	122.50
Amount won, *TL*	56,572	46,996	1	49,500	360,000
	Netherlands (N=51)				
Age, *in years*	45.31	11.51	21	43	70
Gender, *female=1*	0.27	0.45	0	0	1
Education, *high=1*	0.55	0.50	0	1	1
Stop round	5.22	1.75	3	5	10
Best offer rejected, %	**55.89**	32.73	10.17	55.32	119.88
Offer accepted, *%*	**76.27**	30.99	20.77	79.29	165.50
Amount won, *€*	227,265	270,443	10	148,000	1,495,000
	Germany (N=47)				
Age, *in years*	36.47	8.17	20	35	55
Gender, *female=1*	0.34	0.48	0	0	1
Education, *high=1*	0.47	0.50	0	0	1
Stop round	8.21	1.53	5	8	10
Best offer rejected, %	**89.07**	33.90	37.31	88.22	190.40
Offer accepted, *%*	**91.79**	19.15	52.78	95.99	149.97
Amount won, *€*	20,603	25,947	0.01	14,700	150,000
	United States (N=53)				
Age, *in years*	34.98	10.03	22	33	76
Gender, *female=1*	0.57	0.50	0	1	1
Education, *high=1*	0.49	0.50	0	0	1
Stop round	7.70	1.29	5	8	10
Best offer rejected, %	**80.98**	17.57	44.04	83.52	112.00
Offer accepted, *%*	**91.43**	15.31	49.16	97.83	112.50
Amount won, *$*	122,545	119,446	5	94,000	464,000

Application Region	Frequency	Percent
Marmara	119	47.98
Black Sea	47	18.95
Aegean	21	8.47
Central Anatolia	21	8.47
Eastern Anatolia	13	5.24
Mediterranean	12	4.84
Southeastern Anatolia	5	2.42
Unknown	10	3.63
Total	248	100

Birth Region	Frequency	Percent
Marmara	136	54.84
Black Sea	28	11.29
Central Anatolia	15	6.05
Aegan	15	6.05
Mediterranean	10	4.03
Eastern Anatolia	7	2.82
Southeastern Anatolia	6	2.42
Unknown	31	12.50
Total	248	100

Employment Category	Frequency	Percent
Private Sector	87	35.08
Student	59	23.79
Unemployed	29	11.69
Public Sector	24	9.68
Self-Employed	24	9.68
Others	16	6.45
Retired	9	3.63
Total	248	100

Number of Children	Frequency	Percent
0	153	61.69
1	44	17.74
2	43	17.34
3	3	1.21
4	4	1.61
5	1	0.40
Total	248	100

Marriage Longevity	Frequency	Percent
0	162	65.32
1	86	34.68
Mean (excluding 0)	13.49	

	Unconditional			Deal			No Deal		
Round(s)	% BO	Stakes	No	% BO	Stakes	No	% BO	Stakes	No
Turkey (N=248)									
1	11.21	103,596	248	-	-	-	11.21	103,596	248
2	17.61	108,313	248	-	-	-	17.61	108,313	248
3	23.70	112,082	248	-	-	-	23.70	112,082	248
4	29.96	117,096	248	-	-	-	29.96	117,096	248
5	34.97	122,096	248	34.6	141,659	5	34.97	121,694	243
6	45.63	120,706	243	**48.9**	126,667	**87**	47.14	117,381	156
7	**72.74**	102,033	156	67.5	141,598	88	79.54	50,831	68
Netherlands (N=51)									
1	6	387,867	51	-	-	-	6	387,867	51
2	14	376,664	51	-	-	-	14	376,664	51
3	34	369,070	51	36	409,802	10	33	359,135	41
4	61	348,820	41	69	394,860	11	58	331,939	30
5	77	317,618	30	82	557,680	7	76	244,555	23
6	88	234,868	23	90	237,416	12	87	232,107	11
7	98	243,868	11	104	414,106	6	91	39,582	5
8	96	50,376	5	100	78,401	3	90	8,338	2
9	**106**	11,253	2	91	17,500	1	120	5,005	1
Germany (N=47)									
1	8	24,277	27	-	-	-	8	24,277	27
2	15	24,915	47	-	-	-	15	24,915	47
3	34	23,642	47	-	-	-	34	23,642	47
4	46	21,218	47	-	-	-	46	21,218	47
5	59	22,304	47	59	29,976	2	59	21,963	45
6	72	20,557	45	67	48,038	7	73	15,494	38
7	88	15,231	38	85	21,216	5	88	14,324	33
8	98	15,545	33	91	28,8213	10	101	9,776	23
9	**103**	14,017	23	109	13,925	11	99	14,101	12
United States (N=53)									
1	11	152,551	53	-	-	-	11	152,551	53
2	21	151,885	53	-	-	-	21	151,885	53
3	36	147,103	53	-	-	-	36	147,103	53
4	50	148,229	53	-	-	-	50	148,299	53
5	62	148,832	53	79	118,517	1	61	150,434	52
6	73	150,549	52	74	139,421	9	73	152,879	43
7	88	15,231	43	91	204,263	15	86	128,416	28
8	92	15,545	28	96	183,917	14	88	44,644	14
9	**98**	14,017	14	99	53,825	8	97	21,384	6

The Effect of Prior Outcomes

"Break-even" Effect

A willingness to gamble in order to get back to some perceived reference point.

"House-money" Effect

An increased willingness to gamble when someone thinks she is playing with **"someone else's money."**

Break-even Effect — ID Number: 38152359

TL	1	2	3	4	5	6	7
1	1	1	1	1	1	0	0
2	1	1	1	0	0	0	0
5	1	0	0	0	0	0	0
10	1	1	1	0	0	0	0
25	1	1	1	1	1	1	1
50	1	1	1	1	1	1	0
100	1	0	0	0	0	0	0
200	1	1	1	0	0	0	0
300	1	0	0	0	0	0	0
400	1	1	1	1	1	1	1
500	1	1	0	0	0	0	0
750	1	1	1	1	1	0	0
10,000	1	1	1	1	0	0	0
20,000	1	1	1	1	1	1	0
30,000	1	1	1	1	0	0	0
40,000	0	0	0	0	0	0	0
50,000	1	1	1	1	1	0	0
100,000	0	0	0	0	0	0	0
150,000	1	1	0	0	0	0	0
500,000	0	0	0	0	0	0	0
500,000	0	0	0	0	0	0	0
500,000	0	0	0	0	0	0	0
500,000	1	1	0	0	0	0	0
500,000	1	1	1	1	**0**	0	0
Average	66,439	78,871	47,033	61,122	10,175	5,118	212
Offer	6,000	16,000	13,000	22,000	9,000	6,000	200
% Offer	9.03	20.29	27.64	35.99	**88.45**	**117.22**	94.12

House-Money Effect — ID Number: 38252289

TL	1	2	3	4	5	6	7
1	1	1	1	1	0	0	0
2	0	0	0	0	0	0	0
5	1	1	1	0	0	0	0
10	0	0	0	0	0	0	0
25	1	1	1	1	1	1	0
50	1	1	1	1	1	1	0
100	0	0	0	0	0	0	0
200	0	0	0	0	0	0	0
300	1	1	1	1	0	0	0
400	0	0	0	0	0	0	0
500	1	1	1	1	1	0	0
750	1	1	1	0	0	0	0
20,000	1	1	1	1	1	0	0
30,000	1	0	0	0	0	0	0
40,000	1	1	0	0	0	0	0
50,000	1	1	1	1	1	0	0
100,000	1	1	1	1	1	1	**1**
150,000	1	1	1	1	1	1	**1**
200,000	1	1	1	1	0	0	0
250,000	1	1	0	0	0	0	0
500,000	1	0	0	0	0	0	0
500,000	1	0	0	0	0	0	0
500,000	1	1	0	0	0	0	0
500,000	1	1	1	0	0	0	0
Average	149,560	113,227	78,587	52,087	45,796	62,518	125,000
Offer	50,000	26,000	15,000	23,000	20,000	42,000	121,000
% Offer	33.43	22.96	19.09	44.16	43.67	67.18	**96.80**

A Rough Classification: Winner vs Looser

"Winner"

If the average after eliminating the largest remaining prize is among the **best one-third**.

$$WC_r = \frac{n_r \overline{x}_r - x_r^{max}}{n_r - 1}$$

"Looser"

If the average remaining prize after eliminating the lowest remaining prize is among the **worst one-third.**

$$BC_r = \frac{n_r \overline{x}_r - x_r^{min}}{n_r - 1}$$

- $\overline{x}_r$: the average remaining prize
- n_r: the number of remaining briefcases
- BC_r: the average remaining prize in the best-case scenario
- WC_r: the average remaining prize in the worst-case scenario

	Loser			Neutral			Winner		
Round(s)	% BO	No	% D	% BO	No	% D	% BO	No	% D
				Turkey (N=248)					
1	8.3	83	-	9.6	82	-	15.7	83	-
2	14.2	83	-	15.5	82	-	23.2	83	-
3	20.5	83	-	22.7	82	-	28.0	83	-
4	29.0	83	-	27.0	82	-	34.0	83	-
5	37.7	83	-	33.0	82	1.23	34.2	83	4.8
6	55.2	81	18.52	38.3	81	55.6	43.4	81	33.3
7	85.1	51	17.65	63.6	57	82.5	70.5	48	66.7
1-7			**5.17**			**19.90**			**14.97**

Table: Good and Bad Fortune

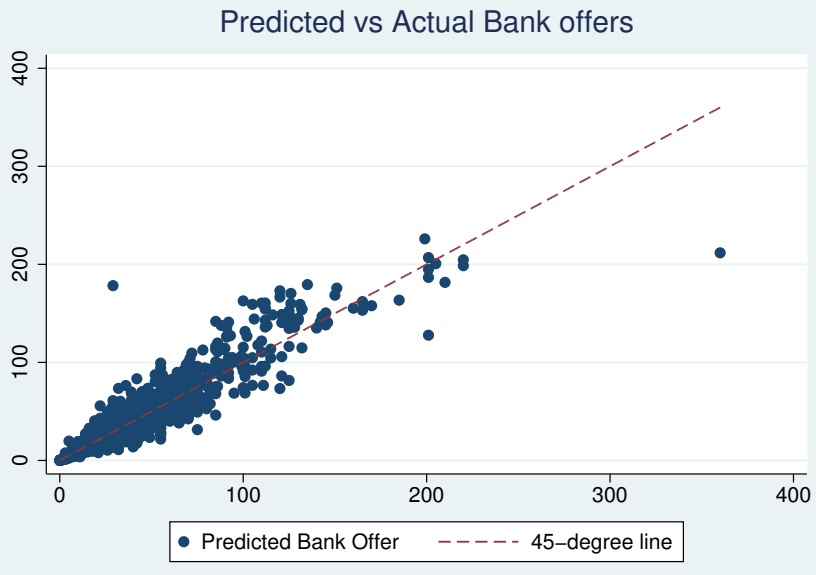
Bank Behavior

$$B(x_{r+1}) = b_{r+1}\overline{x}_{r+1}$$
$$b_{r+1} = b_r + (0.7 - b_r)\rho^{(9-r)}$$

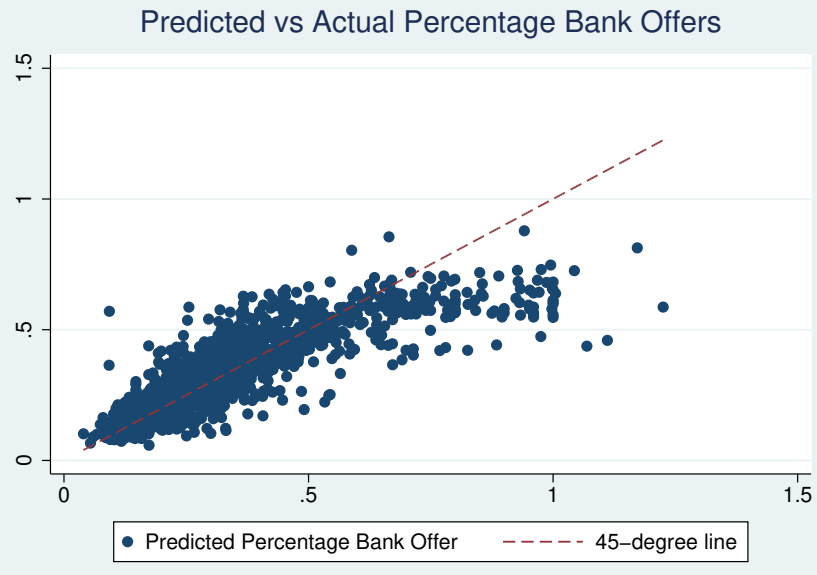
- B_r: Bank offer
- b_r: Percentage bank offer
- x_r: Set of remaining prizes
- $0 \leqslant \rho \leqslant 1$: the speed at which the percentage offer goes to %70

Results: Non-Linear Least Square Estimation

- Convergence parameter: $\rho = 0.62$
- The model explains well 70% of the total variation in **percentage offers**.
- The explanatory power is higher, approximately 90% of in estimating **monetary offers**.



(a) Monetary Offers



(b) Percentage Offers

Expected Utility Theory

- Contestants are assumed to have the same preferences for a given choice problem, **irrespective of the path** traveled before arriving at this problem
- A variant of expo-power family of Atanu Saha (1993):

$$u(x) = \frac{1 - e^{-\alpha(W+x)^{1-\beta}}}{\alpha}$$

CRRA power function $\alpha \to 0$
CARA exponential function $\beta \to 0$

- **MLE:** the likelihood of the observed "Deal or No Deal" decisions based on the **stop value** and the **continuation value**.

Expected Utility Theory

- **Stop Value**: The utility of the current bank offer

$$sv(x_r) = u(B(x_r))$$

- **Continuation Value**: The expected utility of the unknown winnings when rejecting the offer

$$cv(x_r) = \sum_{y \in X(x_r)} u(B(y))p_r$$

  - Given the current set of prizes (x_r), the statistical distribution of the set of prizes in the next round (x_{r+1}) is known, for any given subset y of n_{r+1} elements from x_r.

$$p_r = Pr[x_{r+1} = y|x_r] = \binom{n_r}{n_{r+1}}^{-1}$$

  - $X(x_r)$: all such subsets

Expected Utility Theory

"Deal or No Deal" decision of a given contestant $i = 1, \ldots, N$ in a given game round $r = 1, \ldots, 9$ is based on:

$$cv(x_{i,r}) - sv(x_{i,r}) + \xi_{i,r}$$

where $\xi_{i,r} \sim N(0, \sigma_{i,r})$, and i.i.d.

$$\delta(x_{i,r}) = \sqrt{\sum_{y \in X(x_{i,r})} (u(B(y)) - cv(x_{i,r}))^2 p_r}$$

$$\sigma_{i,r} = \delta(x_{i,r})\sigma$$

Expected Utility Theory

The likelihood of the "Deal or No Deal" decision as,

$$l(x_{i,r}) = \begin{cases} \Phi\left(\dfrac{cv(x_{i,r}) - sv(x_{i,r})}{\delta(x_{i,r})\sigma}\right) & \text{if "No Deal"} \\ \Phi\left(\dfrac{sv(x_{i,r}) - cv(x_{i,r})}{\delta(x_{i,r})\sigma}\right) & \text{if "Deal"} \end{cases}$$

where $\Phi(.)$ is the cumulative standard normal distribution function
Aggregating the likelihood across contestants:

$$ln(L) = \sum_{i=1}^{N} \sum_{r=1}^{R_i} ln(l(x_{i,r}))$$

where R_i is the last game round played by contestant i.

- The unknown parameters in our model (α, β, W, and σ) are selected to maximize the overall log-likelihood.

Prospect Theory

- One can suffer "paper" losses -falling expected winnings-, and such losses may infuence their subsequent choices.

$$\Gamma\{x; RP(\Theta)\} = \begin{cases} -\lambda\{RP(\Theta) - x\}^{\alpha} & \text{if} \quad x \leqslant RP(\Theta) \\ \{x - RP(\Theta)\}^{\beta} & \text{if} \quad x > RP(\Theta) \end{cases}$$

$\lambda > 0$: loss-aversion parameter
$\alpha, \beta > 0$: curvature of the value function for each domain
$RP(\Theta)$: reference piont separating gains/losses

- Reference point specification ...
- Again, Maximum Likelihood Estimation over λ, α, β and $\Theta = \{\theta_1, \theta_2, \ldots\}$

mini-Conclusion

TABLE 6—EXPECTED UTILITY THEORY RESULTS

	Netherlands		Germany		United States	
α	0.424	(0.000)	1.58e-5	(0.049)	4.18e-5	(0.000)
β	0.791	(0.000)	0.000	(1.000)	0.171	(0.000)
W	75,203	(0.034)	544	(0.481)	101,898	(0.782)
σ	0.428	(0.000)	0.467	(0.000)	0.277	(0.000)
MLL	−0.365		−0.340		−0.260	
LR	24.29	(0.000)	3.95	(0.267)	15.10	(0.002)
Hits	76 percent		85 percent		89 percent	
No.	214		327		349	

Source: Post et al. (2008)

mini-Conclusion

- Bank offers gradually increases to **70 percent** (vs. **100%** in other countries) $\rightarrow$ risk aversion levels
- Low BO% accepted and BO% rejected $\rightarrow$ risk aversion levels
- The bank offer high percentage of the average remaining prize to **loosers** $\rightarrow$ path dependency
- Both winners and loosers have tendency to play compared to neutral contestants $\rightarrow$ path dependency
- Remarkably good fit for bank offers (**90%**)