

Weather, Mood, and Economic Behavior: Evidence from the Financial Marketplace

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Economic Psychology: Past, Present, Future
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Decision under Risk

- Lottery = ?
 - States
 - Payoffs
 - Probabilities

Examples: coin / dice toss



State	heads	tails
payoff	-\$50	+\$100
probability	1/2	1/2

State	1	2	3	4	5	6
payoff	-\$50	-\$20	-\$10	+\$50	+\$80	+\$100
probability	1/6	1/6	1/6	1/6	1/6	1/6

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Investment Decisions

- Risk vs. Uncertainty



State	heads	tails
payoff	-\$50	+\$100
probability	1/2	1/2

S ₋₁₀₀	...	S ₋₁	S ₀	S ₊₁	S ₊₂
-100%	...	-1%	0%	+1%	+2%	...	+∞

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**Economic Modelling Approaches:
"Rational" vs. "Behavioral"
40's vs. 90's**

Expected Utility Theory (EUT)

- von Neumann & Morgenstern (1944)
- *Linearity in Probabilities*
- ❖ EUT is 'NORMATIVE'
(→ what people 'should' do)

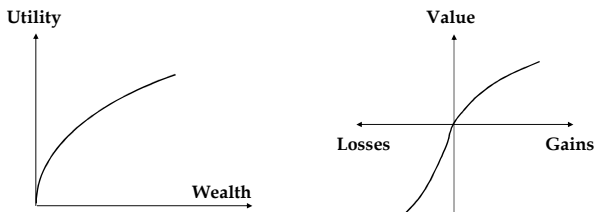
Prospect Theory (PT)

- Tversky & Kahneman (1979, 1992)
- *Decision Weights*
- ❖ PT is 'DESCRIPTIVE'
(→ what people 'will' do)
- ❖ Nobel Prize in Economics (2002)

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**Economic Modelling Approaches:
"Rational" vs. "Behavioral"
40's vs. 90's**

- EUT: Utility function defined on *total wealth*
- PT: Value function defined on *wealth changes*

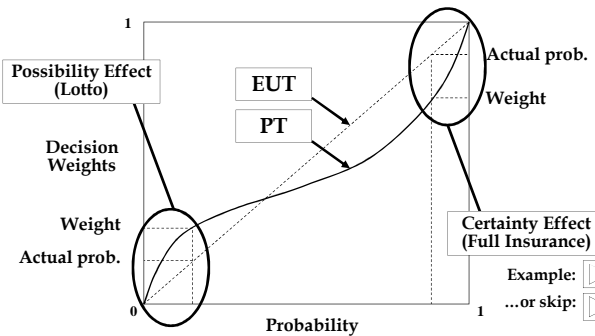


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PT: Decision Weights

=> Probability Weighting Function (PWF)

- Property: high sensitivity at the extremes
- Implication: under/overweighting of events



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Certainty Effect:
(Kahneman & Tversky, *Econometrica*, 1979)

<p>■ Problem I: choose between lotteries A&B</p>	
<p>A: 2,500 with probability 0.33 2,400 with probability 0.66 0 with probability 0.01 18%</p>	<p>B: 2,400 with certainty 82%</p>
<p>■ Problem II: choose between lotteries C&D</p>	
<p>C: 2,500 with probability 0.33 0 with probability 0.67 83%</p>	<p>D: 2,400 with probability 0.34 0 with probability 0.66 17%</p>

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Certainty Effect:
(Kahneman & Tversky, *Econometrica*, 1979)

❖ BUT: II is constructed from I:

<p>■ Problem I: choose between lotteries A&B</p>	
<p>A: 2,500 with probability 0.33 2,400 with probability 0.66 0 with probability 0.01 18%</p>	<p>B: 2,400 with probability 0.34 2,400 with probability 0.66 82%</p>
<p>↓ choosing B=choosing D</p>	
<p>■ Problem II: choose between lotteries C&D</p>	
<p>C: 2,500 with probability 0.33 0 with probability 0.67 83%</p>	<p>D: 2,400 with probability 0.34 0 with probability 0.66 17%</p>

❖ **preference reversal!**

Research Idea:
Employ Financial Market Data to Elicit Investors' Behavior

Agenda:

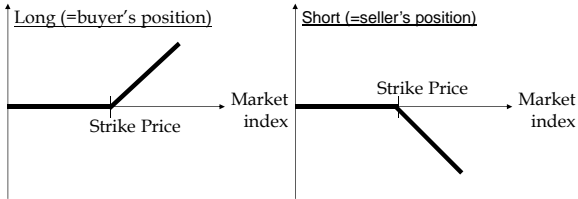
- The data: Market Index Options
- Research steps:
 - (1) Assess investors' risk aversion (RA)
=> RA is time varying
 - (2) Compare the alternative models (EUT vs. PT)
=> PT outweighs EUT
 - (3) Analyze *time varying, behavioral*, decision making
=> Model
=> Empirical analysis and results

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Market Index Options

- **Definition: An Index Call Option is**
a contract granting the right to buy the market index, at a specified price (the Strike Price), by a specified date (the expiration date).

- **Option payoff at expiration:**

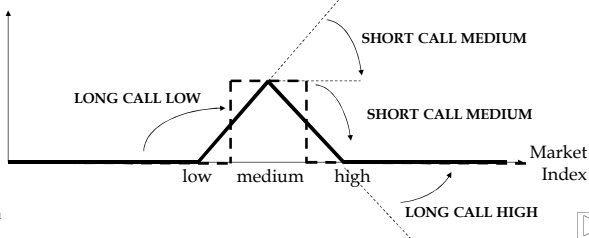


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Market Index Options

- **Butterfly Spread:**
 - * Long 1 option with low strike price;
 - * Short 2 options with medium strike price;
 - * Long 1 option with high strike price.
- **Butterfly Spreads ≈ 'state contingent claims'**
 => the building blocks of most economic models
 => valuing Butterfly Spreads we approximate 'state prices'

- **Payoff at expiration:**



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Research Idea: Employ Financial Market Data to Elicit Investors' Behavior

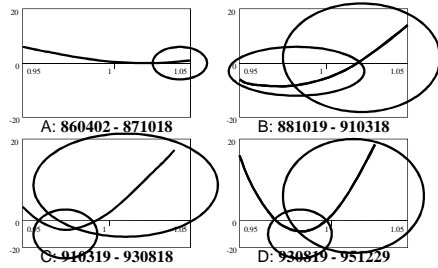
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**Investors' risk Aversion:
Research background**

■ Jackwerth, 2000:

* Market RA Function over 1986 to 1995



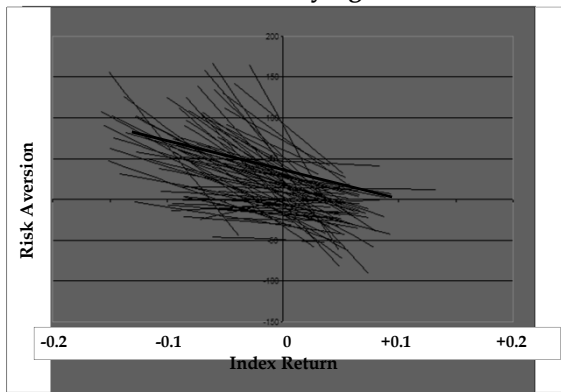
■ => Results:

- * Function Estimate is time sensitive;
- * Occasionally: (i) negative RA; (ii) increasing RA.

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Investors' risk Aversion:

=>RA function is time varying



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Kliger & Levy, 2003, *Journal of Economic Behavior and Organization*

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Model Comparison: =>PT outweighs EUT

- To wit:
 - * ~~linearity in probabilities~~
 - * ~~inverse-s-shaped PWFs:~~

● Sensitivity (i): post-1987 crash estimation:

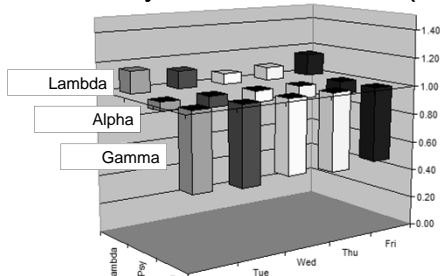
Base Case	CPT, T&K '92	CPT, Prelec '98
Alpha (std. err)	0.974 (0.008)	0.967 (0.008)
Lambda (std. err)	1.206 (0.056)	1.163 (0.033)
Gamma (std. err)		0.527 (0.016)
Gamma (-) (std. err)	0.526 (0.016)	
Gamma (+) (std. err)	0.625 (0.014)	

Kliger & Levy, 2009, *Journal of Economic Behavior and Organization*

Model Comparison: =>PT outweighs EUT

- To wit:
 - * ~~linearity in probabilities~~
 - * ~~inverse-s-shaped PWFs:~~

● Sensitivity (iia):
Day of week estimates (Prelec '98):

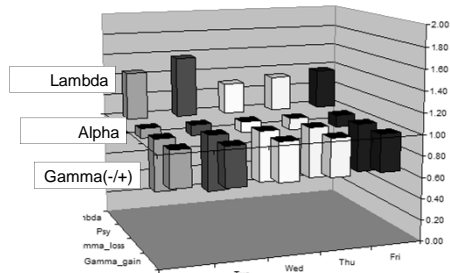


Kliger & Levy, 2009, *Journal of Economic Behavior and Organization*

Model Comparison: =>PT outweighs EUT

- To wit:
 - * ~~linearity in probabilities~~
 - * ~~inverse-s-shaped PWFs:~~

● Sensitivity (iib):
Day of week estimates (T&K '92):



Kliger & Levy, 2009, *Journal of Economic Behavior and Organization*

Model Comparison: =>PT outweighs EUT

● To wit:

* ~~linearity in probabilities~~

* *inverse-s-shaped PWFs:*

● Robustness (i):

Imposing small probabilities of mkt crash:

Base Case	CPT, T&K '92	CPT, Prelec '98	1% prob of mkt crash	CPT, T&K '92	CPT, Prelec '98
Alpha (std. err)	0.950 (0.009)	0.963 (0.009)	Alpha (std. err)	0.959 (0.009)	0.967 (0.010)
Lambda (std. err)	1.274 (0.054)	1.113 (0.033)	Lambda (std. err)	1.591 (0.112)	1.210 (0.040)
Gamma (std. err)		0.537 (0.011)	Gamma (std. err)		0.448 (0.024)
Gamma (-) (std. err)	0.529 (0.010)		Gamma (-) (std. err)	0.486 (0.016)	
Gamma(+) (std. err)	0.625 (0.014)		Gamma(+) (std. err)	0.605 (0.015)	

Kliqer & Levy, 2009, *Journal of Economic Behavior and Organization*

Model Comparison: =>PT outweighs EUT

● To wit:

* ~~linearity in probabilities~~

* *inverse-s-shaped PWFs:*

● Robustness (ii):

Modifying the reference level:

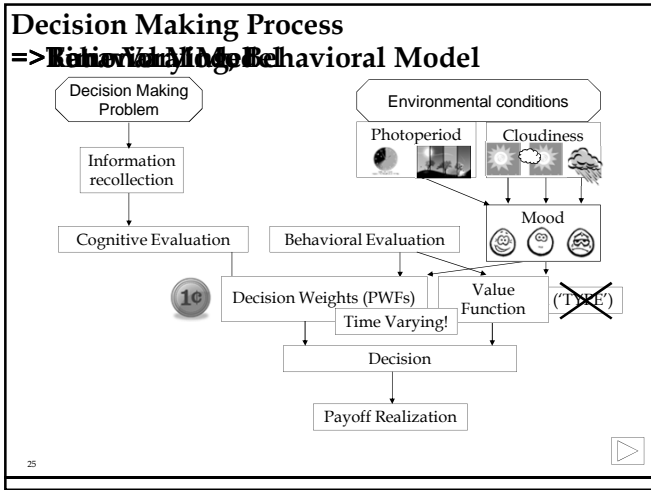
Base Case (status quo)	CPT, T&K '92	CPT, Prelec '98	Ref Level= Risk free ret.	CPT, T&K '92	CPT, Prelec '98
Alpha (std. err)	0.950 (0.009)	0.963 (0.009)	Alpha (std. err)	0.889 (0.011)	0.911 (0.011)
Lambda (std. err)	1.274 (0.054)	1.113 (0.033)	Lambda (std. err)	1.500 (0.059)	1.182 (0.033)
Gamma (std. err)		0.537 (0.011)	Gamma (std. err)		0.512 (0.010)
Gamma (-) (std. err)	0.529 (0.010)		Gamma (-) (std. err)	0.498 (0.008)	
Gamma(+) (std. err)	0.625 (0.014)		Gamma(+) (std. err)	0.627 (0.013)	

Kliqer & Levy, 2009, *Journal of Economic Behavior and Organization*

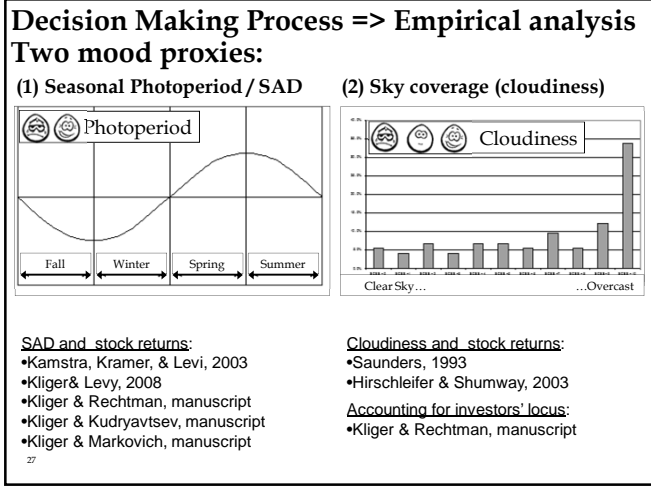
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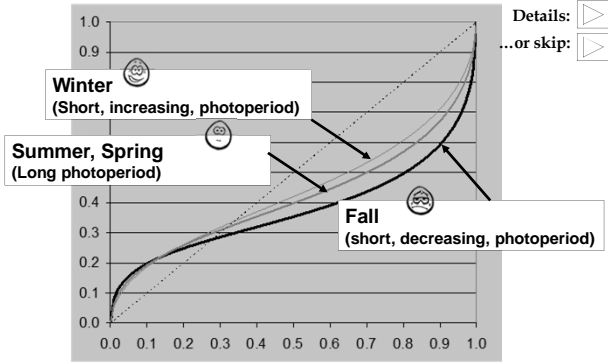
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- ### Research Idea: Employ Financial Market Data to Elicit Investors' Behavior
- The data: Market Index Options
 - Research steps:
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Decision Making Process => Empirical analysis
Result (1): Photoperiod-dependent PWFs (loss domain)



Kliger & Levy, 2008, *Journal of Socio-Economics*

Decision Making Process => Empirical analysis
Result (1): Photoperiod-dependent PWFs (loss domain)

◆ **Estimated equations:**

$$v(x) = \begin{cases} x^\alpha & \text{if } x \geq 0 \\ -\lambda(-x)^\alpha & \text{if } x < 0 \end{cases} \quad \text{PWF of T\&K '92:}$$

$$w^-(p) = p^{\gamma^-} / [p^{\gamma^-} + (1-p)^{\gamma^-}]^{1/\gamma^-}$$

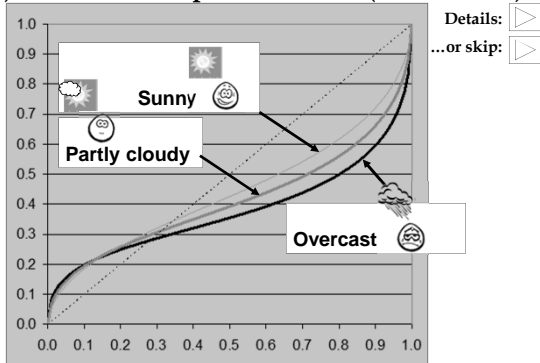
$$w^+(p) = p^{\gamma^+} / [p^{\gamma^+} + (1-p)^{\gamma^+}]^{1/\gamma^+}$$

◆ **Estimation results:**

	F	S	W		v(S)-v(F)	v(W)-v(F)	v(W)-v(S)
Gamma (-) (std. err)	0.500 (0.029)	0.568 (0.031)	0.609 (0.024)	Est. (prob.)	0.068 (4.11%)	0.109 (0.08%)	0.041 (12.83%)
Gamma (+) (std. err)	0.762 (0.051)	0.788 (0.047)	0.859 (0.056)	Est. (prob.)	0.026 (36.79%)	0.097 (10.36%)	0.071 (12.04%)
Alpha (std. err)	0.845 (0.018)						
Lambda (std. err)	1.262 (0.094)						

Kliger & Levy, 2008, *Journal of Socio-Economics*

Decision Making Process => Empirical analysis
Result (2): Cloudiness-dependent PWFs (loss domain)



Kliger & Levy, 2008, *Journal of Socio-Economics*

Decision Making Process => Empirical analysis
 Result (2): Cloudiness-dependent PWFs (loss domain)

● Estimated equations:

$$v(x) = \begin{cases} x^\alpha & \text{if } x \geq 0 \\ -\lambda(-x)^\alpha & \text{if } x < 0 \end{cases} \quad \text{PWF of T\&K '92:}$$

$$w(p) = p^\gamma / [p^\gamma + (1-p)^\gamma]^{1/\gamma}$$

$$w^+(p) = p^{\gamma^+} / [p^{\gamma^+} + (1-p)^{\gamma^+}]^{1/\gamma^+}$$

● Estimation results:

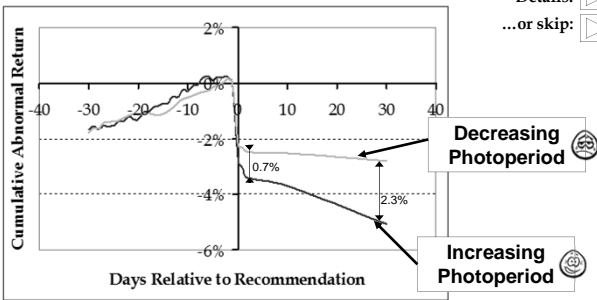
	L	M	H		$\gamma(M)-\gamma(L)$	$\gamma(H)-\gamma(L)$	$\gamma(H)-\gamma(M)$
Gamma (-) (std. err)	0.502 (0.030)	0.559 (0.024)	0.621 (0.036)	Est. (prob.)	0.057 (5.34%)	0.119 (0.38%)	0.062 (6.78%)
Gamma(+) (std. err)	0.740 (0.054)	0.801 (0.041)	0.878 (0.074)	Est. (prob.)	0.061 (19.98%)	0.138 (6.32%)	0.077 (14.92%)
Alpha (std. err)	0.839 (0.018)						
Lambda (std. err)	1.278 (0.094)						

Kliger & Levy, 2008, *Journal of Socio-Economics*

Decision Making Process => Empirical analysis

More Results:
 Analysts' Downgrade Recommendations and Stock Returns

Details:
 ...or skip:



Kliger & Kudryavtsev, manuscript

Decision Making Process => Empirical analysis

More Results:
 Analysts' Downgrade Recommendations and Stock Returns

Coefficient \ window	Day 0	0-1	0-2	0-10	0-30
Photoperiod Dummy (p. value)	-0.37 (6.18%)	-0.53 (2.07%)	-0.70 (0.43%)	-0.93 (2.30%)	-1.99 (0.85%)
Market ret. Dummy (p. value)	1.12 (0.00%)	1.32 (0.00%)	1.28 (0.00%)	1.65 (0.00%)	1.59 (0.00%)
Small Mcap Dummy (p. value)	-0.65 (3.87%)	-0.70 (11.40%)	-1.03 (3.77%)	-0.34 (65.80%)	-1.31 (31.45%)
Beta (p. value)	0.03 (81.68%)	-0.13 (47.31%)	-0.05 (79.04%)	-0.13 (69.08%)	-0.54 (35.18%)
Ret. Volatility (p. value)	-0.65 (0.00%)	-0.62 (0.40%)	-0.84 (0.02%)	-0.98 (4.14%)	-1.07 (1.75%)
Downgrade Magnitude (p. value)	0.65 (0.00%)	0.06 (95.07%)	0.16 (87.16%)	1.12 (42.59%)	4.14 (3.07%)
Recommendation Level controls	yes	yes	yes	yes	yes

Kliger & Kudryavtsev, manuscript

Summary

- Financial Market data:
Index Options, Stocks
- Environmental conditions:
Photoperiod, Cloudiness
- Findings:
 - ◆ Investors' risk aversion (RA) is time varying
 - ◆ PT outweighs EUT
 - ◆ Investors' decisions are affected by the environment:
Photoperiod & Cloudiness affect prices.

=> ChronoEconomic component
in human behavior and decision making

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A collage of research team members. It includes six individual portraits with their names below them: Dalia Gilad, Yosi Markivich, Smadar Siev, Gregory Gurevich, Ayelet Rachmilovich, Alex Rehtman, and Andrey Kudryavtsev. The text "My Research Team:" is written next to a circular icon. There are also icons of a sun and a smiley face. The text "Thank you!" is written in a large, bold font. At the bottom, it says "-- Doron Kliger."
