"The overweening conceit which the greater part of men have of their own abilities, is an ancient evil remarked by the philosophers and moralists of all ages.

Their absurd presumption in their own good fortune, has been less taken notice of. It is, however, if possible still more universal. [...]"

"The chance of gain is by every man more or less over-valued, and the chance of loss is by most men under-valued [...]."

Adam Smith

*The Wealth of Nations*, Book I, Chapter X
Motivation

- Evidence of widespread optimistic behavior.

- Psychology literature, Taylor (1989):
  - People believe the future will be better than the present, and will continue to improve;
  - Individual’s optimistic view applies to others but especially strong concerning self:
  - Good things more likely to happen to self, bad things less likely so.
  - Favorably biased assessment of probabilities confirmed by experimental evidence.

- Entrepreneurial activity:
  - Very high dropout rates among starting entrepreneurs:
    - Evans and Leighton (1989):
      * In US, a third of entrants leave self-employment within three years.
      * Exit rates likely to be severely underestimated.
    - Daly (1990): in UK, more than 30% of new businesses close within 3 years.
• Question(s) in this paper:

• Given that objective priors frequently inexpensive, assuming rational behavior,

  *Why do people choose to be optimistic?*

• Since biased beliefs likely to be costly,

  *Are there benefits to holding optimistic beliefs? What are those benefits?*

• Answer:

  – *Rational* individuals value actual outcome of future realizations of uncertainty; but

  – They also experience anticipation utility from contemplating desirable outcomes.

• Objective priors useful to maximize expected utility from realizations.

• Optimistic (hence distorted) beliefs useful to enhance anticipation utility.

• Rational decision makers choose beliefs that balance realization and anticipation utility.
Example:

- Contemplate starting new business.

- Two possible outcomes: success or failure.

- $p$: objective probability of success (as provided by bank).

- Expected utility maximizer:
  - Start business if
    \[
    pu(\text{success}(p)) + (1 - p)u(\text{failure}(p)) \geq u(\text{status quo}) .
    \]

- Let $q$ be the \textit{believed} probability of success.

- Anticipation utility:
  \[
  qu(\text{success}(q)) + (1 - q)u(\text{failure}(q)) .
  \]
  The greater $q$, the greater the ut. from anticipation.

- Start business if
  \[
  (1 - \lambda)\text{Exp.Ut}_p(\text{Realization}(q)) + \lambda \text{Exp.Ut}_q(\text{Anticipation}(q)) \geq u(\text{status quo}) .
  \]
Related Literature

- Anticipation: idea that utility today is in part the result of savoring future events
  - Roots in Utilitarianism (Bentham, Jevons, ...)
  - Jevons (1905), “Three distinct ways are recognizable in which pleasurable or painful feelings are caused:
    (1) By memory of past events;
    (2) By the sensation of present events;
    (3) By anticipation of future events.”
  Jevons considered the latter the most important in understanding economic behavior.

- More recent examples, usually from psychology and economics:

- Effects of time on utility
  - Loewenstein (1987)
    Total utility is the sum of anticipation and realization components.
    Anticipation component is discounted flow of actual future outcomes.
    Anticipation-specific discount rate in addition to time-discount factor.
    No uncertainty: no role for beliefs.
    Applications include: value of postponing consumption, estimation of “discount-rates,” ...
- Kahneman, Wakker and Sarin (1997)

Past experiences affect current utility.
Normative theory that takes into account intensity of past experiences.
Utility measure is an aggregation over current and past experienced utilities.

- Geanakoplos, Pearce and Staccheti (1989)

Enlarging the domain of game theory to allow beliefs (own and of others) to enter payoffs.
Allows consideration of belief-dependent emotions such as surprise, gratitude, disappointment, ...
Payoffs depend not only on what everybody does but also on what everybody thinks.
Payoffs become endogenous in the same sense as equilibrium strategies are.
Show Nash equilibria, Perfect equilibria and subgame perfect equilibria exist.
- Caplin and Leahy (2001)
  
  Consider explicitly emotions associated with partial resolution of uncertainty;
  
  Preferences defined over today’s outcomes and the resulting lotteries for future outcomes (as well as over second – and final – period outcomes).
  
  Show that an expected utility representation exists for these preferences.
  
  Very general: analysis of broad range of emotions including anxiety and anticipation.
  
  Beliefs are exogenous.

- Belief choice/distortion

- Akerlof and Dickens (1982)
  
  First paper where beliefs are optimally chosen.
  
  Workers in a hazardous industry choose belief concerning probability of accident.
  
  Belief affects positively level of fear experienced.
  
  If fear level is high, workers will buy safety equipment available in period 2.
  
  Belief distorted in the knowledge that safety equipment will not be purchased in the future.
  
  Reduction in belief about accident probability raises utility as it reduces fear level;
  
  But it also reduces utility since workers engage in reckless behavior.
  
  Optimal belief balances these two forces.

• Example: agent with time horizon $1, \ldots, T$.

• Utility function at time $t$:

$$\hat{E} \left[ U (c_1, \ldots, c_T) \big| s_t \right].$$

This is “agent’s time $t$ felicity.”

Depends on beliefs $\hat{\Pi}|_{s_t} \neq \Pi|_{s_t}$.

• Example:

$$u(c_1) + \ldots + \beta^{t-2} u(c_{t-1}) + \beta^{t-1} u(c_t) + \hat{E} \left[ u(c_{t+1}) + \ldots + \beta^{T-t-1} u(c_T) \big| s_t \right].$$

Agent chooses felicity maximizing course of action, $c_t$.

Resource constraint $x_{t+1} = g(x_t, c_t, s_{t+1})$.

$x_t$: state variable; $s_t$: is uncertainty state realization.

Terminal condition $h(x_{T+1}) \geq 0, x_0$ given.

Result: $\{c^*(s_t, \{\hat{\pi}\})\}$. 
Choice of beliefs

- Define *lifetime well-being* $\mathcal{W}$ as:

\[
\mathcal{W} \equiv \frac{1}{T} E \left[ \sum_{t=1}^{T} \hat{E} \left[ U \left( c_1^*, c_2^*, \ldots, c_T^* \right) \mid s_t \right] \right] \\
= \frac{1}{T} E \left[ \hat{E} U \left( c^* \right) + \hat{E} U \left( c^* \mid s_1 \right) + \ldots + \hat{E} U \left( c^* \mid s_{T-1} \right) \right].
\]

- Lifetime wellbeing (Caplin and Leahy 2000):
  - Average felicity over lifetime.
  - Optimal beliefs $\hat{H}^*$ defined as those maximizing $\mathcal{W}$ (subject to regularity conditions).

- What is good about distorted beliefs?
  - Since $c^* = c^* (\hat{\pi}; \cdot)$, beliefs distort actions wrt alternative $c = c (\pi, \cdot)$.
  - Since beliefs distort decisions, what do they enhance?
  - The part of felicity that is uncertain – future utils:

\[
... + \beta^t \hat{E} \left[ u \left( c_{t+1}^* \right) + \ldots + \beta^{T-t-1} u \left( c_T^* \right) \mid s_t \right].
\]

Anticipation Ut.

- *Expected* utility format:
  - Beliefs complementary with good outcomes:
  - Shift mass toward “good states.”
• Applications:
  
  – Portfolio choice
  
  – General equilibrium with heterogeneous beliefs
  
  – Consumption and saving over time

• Unlike our agent, BP’s agent does not choose what beliefs to adopt.
  
  – BP’s agent has no incentive to adopt optimal expectations as defined.

• BP’s model is more general and abstract than our own.

• Our model: beliefs are optimal given preferences of agent.

• In addition, focus on effects of anticipation parameter $\lambda$:
  
  – Individual heterogeneity allows individuals to behave differently toward risk.
The Model

- Rational optimists possess two personalities:
  - Thinker and believer.

- Both face a world with two (or more) states: G and B.

- Start from an objective prior \((p, 1 - p)\).

- Thinker: chooses what beliefs to adopt, \((q, 1 - q)\).
  - Passes them on to the believer.
  - Thinker is altruistic toward the believer.

- Believer: accepts \((q, 1 - q)\) and chooses an action based on those beliefs.
  - Action: investment amount, effort level, ...

- Uncertainty resolved by Nature.
• Rational optimists have two sources of utility:
  
  – The anticipation of future payoffs as conditioned by the adopted beliefs:
    This is a purely psychological event.
  
  – The realized payoff: to be experienced by the thinker, alone.
  
  – In choosing the beliefs, the thinker must balance the two sources of utility.
    The believer will not.
  
• Interaction between thinker and believer:
  Dynamic game of complete information.

Game structure:

1. Two states, \( G \) and \( B \), \( p \) is true probability \( G \).

2. Thinker observes \( p \), adopts possibly biased \( q \).

3. Believer observes \( q \) and chooses action \( v \).
   
   – Believer also sees \( p \) (game of complete info.).
   
   – His (anticipation) utility depends only on \( q \), \( p \) ignored.

4. Nature resolves uncertainty according to probability vector \((p, 1 - p)\).
5. Given action $v$:

Expected anticipation ut. derived using $(q, 1 - q)$.
Expected realization utility derived with $(p, 1 - p)$.

6. Believer’s expected utility is expected anticipation utility, only.

Thinker’s expected utility is weighted average of anticipation and realization.

The number $\lambda \in [0, 1]$ measures the weight attached to anticipation.

For $\lambda = 0$, rational optimists turn into expected utility maximizers.

![Figure 1: Dynamic Game of Complete Information](image)
Lotteries are general object of choice in model:

\[
(w + \pi(v), p(v); w - c(v), 1 - p(v)),
\]

where

- \(w\) is initial wealth;

- \(c(v)\) is the cost of action \(v\) in bad state.

- \(\pi(v)\) is the net payoff of action \(v\) in the good state;

- \(p(v)\) is probability of good state.

Specialize to Christmas lottery:

- Action \(v\) is share of income spent on lottery, \(v \in [0, 1]\).

- Probability of winning \(p(v) = p\).

- Initial wealth \(w\) normalized to 1.

- \(\pi(v) = \beta v\), with \(\beta > 1\).
• Expected anticipation utility of believer:

\[ E_A[u|v, q] \equiv qu(1 + \beta v) + (1 - q)u(1 - v). \]

Given \( q \), believer chooses \( v(q) \) to maximize \( E_A[\cdot] \).

• Believer’s first-order condition (interior):

\[ \frac{u'(1 + \beta v)}{u'(1 - v)} = \frac{1 - q}{\beta q}. \]

Can be shown that

\[ \frac{\partial v^*}{\partial q} > 0. \]

• Thinker’s problem:

\[ \max_q \{(1 - \lambda)E_R[u|v(q), p] + \lambda E_A[u|v(q), q]\}, \]

where

\[ E_R[u|v(q), q] = pu(1 + \beta v(q)) + (1 - p)u(1 - v(q)). \]
• Thinker’s foc:

\[
(1 - \lambda) \frac{p \beta u' (1 + \beta v^* (q)) - (1 - p) u' (1 - v^* (q))}{\partial q} \frac{\partial v^*}{\partial q} + \lambda [u (1 + \beta v^*) - u (1 - v^*)] = 0
\]

Foc of expected utility maximizer

Anticipation value of higher q

• If \( v^* \) interior \( (v^* \in (0, 1)) \), rational optimists gamble more than expected utility maximizers:

\[ v^* > v^{EU} . \]

• Simplifying assumptions:

  – CRRA utility → Log utility.

  – Fair bet:

    \[ p \beta = 1 - p \iff p = \frac{1}{1 + \beta} . \]
• Believer's choice:

\[ v^*(q) = \frac{q(1 + \beta) - 1}{\beta}. \]

• Thinker's foc:

\[
\left[ \frac{1}{1 + \beta v^*(q)} - \frac{1}{1 - v} \right] = \frac{\lambda}{1 - \lambda} \ln \frac{1 + \beta v^*(q)}{1 - v^*(q)}.
\]

Solve for implicit function \( q^* = q^*(\lambda). \)

Obtain \( v^*(q) \) and associated \( v^*(\lambda). \)

• Define \( \lambda_{\text{min}} = \lambda_{\text{min}}(\beta). \)

\[
\lambda_{\text{min}} = \frac{-4\beta + 2 \left( 4\beta^2 + (\beta - 1)^2 \beta \right)^{1/2}}{(\beta - 1)^2},
\]

\[ \lambda_{\text{min}} \in (0, 0.5). \]
**Proposition** There is $\bar{\lambda} \in (\lambda_{\text{min}}, 0.5)$ such that:

$$v^*(\lambda) : \begin{cases} = 0 & \text{for } \lambda < \bar{\lambda} \\ > 0 & \text{for } \lambda \geq \bar{\lambda} \end{cases}.$$ 

Further, for $\lambda \geq \bar{\lambda}$:

$$v^* = v^*(\lambda), \text{ with } \lim_{\lambda \to 1} v^*(\lambda) = 1.$$
• Discontinuity in optimal betting amounts as a function of $\lambda$:
  
  - For small $\lambda$, behave as exp. ut. maximizer:
    
    $$q = p, \ v^* = 0.$$ 
  
  - Once $\lambda$ goes above $\bar{\lambda}$, $v^*$ becomes strictly positive.

• In current context (1 period), BP corresponds to the special case $\lambda = 0.5$.
  
  - Agents are too optimistic: very high share of income gambled ($\approx 90\%$).

• Risk aversion:
  
  - Each $v \in (0,1)$ corresponds to different lottery.
  
  - Same expected value (zero), variance increasing in $v$.
  
  - Lotteries with lower $v$ dominate those with higher $v$ in second-order stochastic sense.
  
  - Unlike exp. ut. maximizer, thinker’s utility not monotonic in variance (figure 2).
  
  - Thinker likes risk to the extent it fosters anticipation.
Figure 3: Optimal income share spent on lottery tickets

- Function $v^*(\lambda)$, for $\lambda \geq \bar{\lambda}$, is concave, inverted parabola.
  - Empirical analysis: $v^*(\lambda) = 1 - \theta (1 - \lambda)^2$.
  - Estimate $\theta$, $\bar{\lambda}$. 

Empirical Analysis

- Test model’s predictions using dataset on gambling.
- Look for quantitative evidence that optimism is relevant.

Data

- Gambling Impact and Behavior Study, 1997-99 (US)
- National Gambling Impact Study Commission:
  - Survey investigates gambling behavior and attitudes of adults and youth in US.

- Universe:
  - Civilian household population, 16+.
  - Telephone subuniverse:
    Households with at least one working telephone line.

- Focus on adult telephone survey:
  - Approximately 2400 completed phone interviews.
  - Comprehensive demographic information including household income.
  - Detailed questionnaire on gambling.
Empirical Strategy

- Accommodate “Consumption Value” of gambling.

- Define \( r_i \) as share of household \( i \)'s income spent gambling:

\[
 r_i = r_i^C + r_i^O,
\]

where
- \( r_i^C \) is the share spent for the consumption value;
- \( r_i^O \) is the share spent from optimism (model).

- Assume:

\[
 r_i^C = X_i \beta^C + \varepsilon_i,
\]

with

\[
 \varepsilon_i \sim \Gamma (\mu, \sigma),
\]

where \( \Gamma (\mu, \sigma) \) is a two-parameter distribution function.

Logistic probability function:

\[
 P(x) = \frac{e^{-(x-\mu)/\sigma}}{\sigma \left[1 + e^{-(x-\mu)/\sigma}\right]^2}.
\]

Logistic: higher kurtosis than Normal.

Higher peak/concentration around zero.
• Observable characteristics: gender.

• Gambling shares from optimism are deterministic:

\[ r_i^o = \begin{cases} 1 - \theta (1 - \lambda)^2 & \text{if } \lambda \geq \bar{\lambda} \\ 0 & \text{otherwise} \end{cases} \]

• Optimism parameter \( \lambda \) distributed in population according to beta distribution:

\[ P(x) = \frac{(1-x)^{\beta-1} x^{\alpha-1}}{B(\alpha, \beta)} \]

Beta distribution has support in \([0,1]\).
Includes uniform as a special case \((\alpha = \beta = 1)\);

For \( \alpha = 1 \) and high \( \beta \), \( \lambda \) highly concentrated at the origin.

• Vector of parameters to estimate:

\[ \{\alpha, \beta, \mu, \sigma, \theta, \bar{\lambda}\} \]
• Need:
  
  – $\theta > 0$, $\bar{\lambda} \in (0, 1)$, sensible values for all parameters.
  
  – Likelihood function significantly improved relative to no optimism ($\bar{\lambda} = 1$).

Sample Statistics

<table>
<thead>
<tr>
<th></th>
<th># Observations</th>
<th># Gamblers</th>
<th>Avg. Gamble (unc.)</th>
<th>Avg. Gamble (cond on $&gt;0$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>464</td>
<td>291</td>
<td>0.0109</td>
<td>0.0173</td>
</tr>
<tr>
<td>Women</td>
<td>429</td>
<td>249</td>
<td>0.0151</td>
<td>0.0260</td>
</tr>
<tr>
<td>Total</td>
<td>893</td>
<td>540</td>
<td>0.0129</td>
<td>0.0214</td>
</tr>
</tbody>
</table>

Summary statistics of dataset
Figure 4: Histogram of Shares of Income Spent Gambling

Figure 5: Histogram of Positive Gambling Shares – Males
- Under current empirical specification:
  - Restricted model (no optimism) does better:
  - Consumption model fits the data too well.
  - Exception: female sample, once two very large sharing observations allowed.
  - In the latter case, log likelihood significantly higher under unrestricted model.
  - Some problems, \( \hat{\theta} = 0 \);
  - \( \hat{\theta} \) is being estimated out of two parameters.
Conclusions

• New research path for choice under uncertainty:
  – Rational decision makers allowed to daydream.
  – Beliefs chosen taking into account implications for actual outcomes.

• Rich implications for choice under uncertainty.

• Empirical evidence unconvincing...
  – Look for other empirical implications of the model.