INRA SCIENCE & IMPACT

The Cost of Dominance

A New and Robust Measure of the Attraction Effect

Paolo Crosetto, Alexia Gaudeul - Rome, 14.4.2016

Economist.com

SUBSCRIPTIONS

OPINION
WORLD
BUSINESS
FINANCE & ECONOMICS
SCIENCE & TECHNOLOGY
PEOPLE
BOOKS & ARTS
MARKETS & DATA
DIVERSIONS

Welcome to
The Economist Subscription Centre

Pick the type of subscription you want to buy or renew.

❑ **Economist.com subscription** - US $59.00
One-year subscription to Economist.com. Includes online access to all articles from *The Economist* since 1997.

❑ **Print & web subscription** - US $125.00
One-year subscription to the print edition of *The Economist* and online access to all articles from *The Economist* since 1997.

Economist.com

OPINION
WORLD
BUSINESS
FINANCE & ECONOMICS
SCIENCE & TECHNOLOGY
PEOPLE
BOOKS & ARTS
MARKETS & DATA
DIVERSIONS

SUBSCRIPTIONS

Welcome to
The Economist Subscription Centre

Pick the type of subscription you want to buy or renew.

- ❑ **Economist.com subscription** - US $59.00
  One-year subscription to Economist.com. Includes online access to all articles from *The Economist* since 1997.

- ❑ **Print subscription** - US $125.00
  One-year subscription to the print edition of *The Economist*.

- ❑ **Print & web subscription** - US $125.00
  One-year subscription to the print edition of *The Economist* and online access to all articles from *The Economist* since 1997.

Subscribing to the Economist, 1

Dan Ariely, *Predictably Irrational*

- When presenting only two choices

Option	**Online only**	**Online & Print**	**Print only**
Price	59	125	–
Choice %	68%	32%	–

Subscribing to the Economist, 1

Dan Ariely, *Predictably Irrational*

- When presenting only two choices

Option	**Online only**	**Online & Print**	**Print only**
Price	59	125	–
Choice %	68%	32%	–

- When presenting all three choices

Option	**Online only**	**Online & Print**	**Print only**
Price	59	125	125
Choice %	16%	84%	0%

Asymmetric Dominance

ADE

This is called the **Asymmetric Dominance Effect**.

Adding to a choice set an asymmetrically dominated option – that is, an option that is dominated by some but not all the alternatives in the set – increases the choice share of the now-dominant option, at the expense of the others.

Some terms :

Target	the asymmetrically dominant option
Decoy	the asymmetrically dominated option
Competitor	the other option

Why is this a problem ?

ADE is a **violation** of the Independence to Irrelevant Alternatives axiom of rational choice.

Under I.I.A, if in the set

$$\{target, competitor\} \Rightarrow competitor \succcurlyeq target,$$

then in a set

$$\{target, competitor, decoy\} \Rightarrow target \not\succ competitor.$$

At the aggregate level, this implies *regularity*

$$Pr(target)\{target, competitor\} \leq Pr(target)\{target, competitor, decoy\}$$

That is, preferences are **context-independent** : changing the choice set should not affect choice

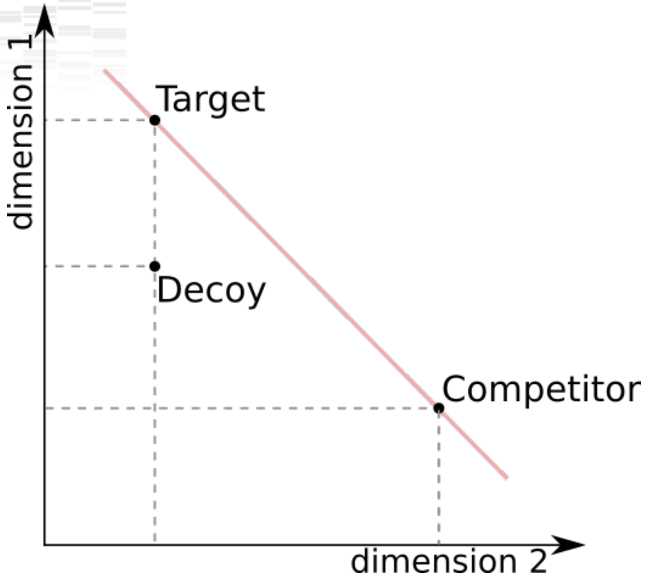
Evidence for ADE

- The ADE has been found in **product** choices among products :
  - beer 6-packs (quality *vs.* price) [Huber et al.]
  - cars (ride quality *vs.* gas mileage) [Huber et al.]
  - restaurants (distance *vs.* quality) [Huber et al.]
  - lotteries (payoff *vs.* probabilities) [Herne]
  - televisions (resolution *vs.* durability) [Pan and Lehman]
  - apartments (size *vs.* location) [Pan and Lehman]
- **Herne** also found ADE in **political** opinions in Finland
- Curiously, the effect has been observed in **animals** (honeybees, gray jays : Shafir et al)

How is ADE measured ?

The bulk of the evidence on ADE is obtained through

- **Between-subjects.** Some subjects get 2-option sets, some 3-options
- **Hypothetical choices.** Subjects are asked to choose one and only one option
- **2-attributes.** Options vary along two not easily comparable dimensions
- **Aggregate measure.** evidence for ADE is a change in the choice share of the target in 3- *vs.* 2-sets. This measure is
  - sufficient to show a violation of regularity
  - measured at the aggregate level
  - relies on preferences being roughly equal across treatments


dimension 1
Target
Decoy
Competitor
dimension 2

Indifference

In the existing literature, all experiments assume indifference

[t]o the extent that a decision maker has clear preferences between the target and the competitor, the effect of adding an undesired decoy will be muted. [...] However, when prior preferences are weak, stemming either from unfamiliarity or indifference, [...] context will matter. [...] Put differently, the most critical condition is that people have either very weak or initially uninformed preferences between the target and the competitor. They will be the people most affected by the attraction effect (Huber, Payne and Puto JMR 2014)

This paper

Our experiment

We construct our study around **two** main questions :

1. What happens when subjects are **not indifferent** among options ?
2. Can we measure **how much** subjects prefer the target to the competitor, in presence of a decoy ?

Our experiment

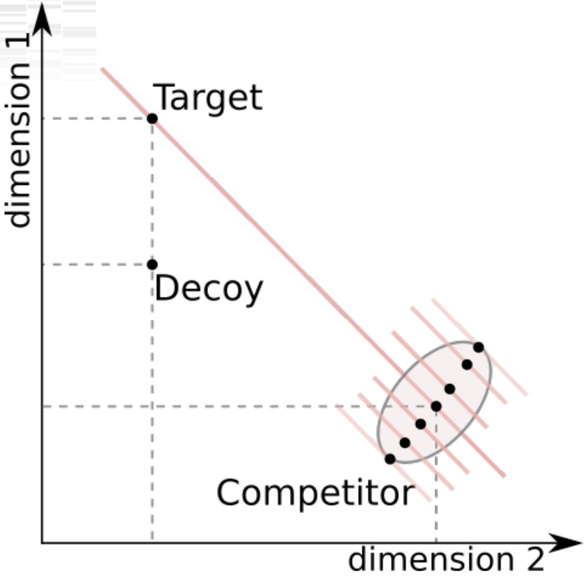
We construct our study around **two** main questions :

1. What happens when subjects are **not indifferent** among options ?
2. Can we measure **how much** subjects prefer the target to the competitor, in presence of a decoy ?

We answer to the questions introducing two main changes :

1. **Induced** preferences allow us to manipulate indifference
2. **Within-subjects** design with several trials allows us to **measure** ADE and not just show it.

Two measures of ADE :
traditional *frequency* + *monetary* measure


dimension 1
Target
Decoy
Competitor
dimension 2

Task

Design

- We **induce** preferences to control indifference curves
- We **repeat** choices to get individual estimates
- We need a task in which the optimal choice is always computable...
- ...but not directly available to consumers [trivial]

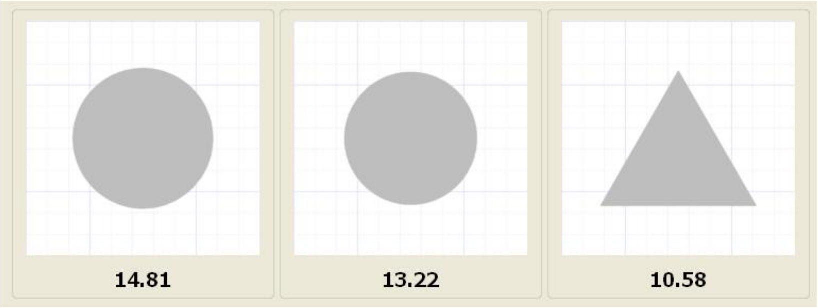
Design

- We **induce** preferences to control indifference curves
- We **repeat** choices to get individual estimates
- We need a task in which the optimal choice is always computable...
- ...but not directly available to consumers [trivial]

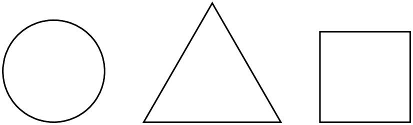
- Subjects must buy *paint* to paint a given area.
- Buckets come in different *shapes* and *sizes*.
- Subjects are not told *unit prices*
- The target and the competitor have different shapes and sizes.
- The decoy has the same shape/size of the target, higher price.

Live demo

A live demo is worth 1000 words...

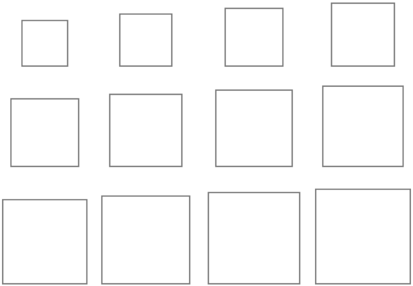

14.81
13.22
10.58

Shapes



- Only regular shapes used to limit confusion
- Keep the number of shapes low, also to limit confusion
- Literature on regular shapes comparisons (triangles look bigger) $\Rightarrow$control for shape and size

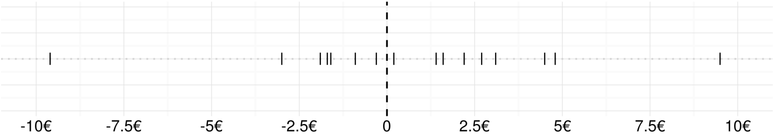
Sizes



- 12, Sizes from 10% to 43% of the total area 'to be painted'.
- Steps are small (3%) to minimize learning across choices.

Tasks and payoff premium

- We analyze data from 18 tasks (out of a larger experiment)
- Across the tasks, unit prices, shapes, sizes vary
- As a result, the profit difference between target and competitor varies :



Measures

Measures : psychometric function

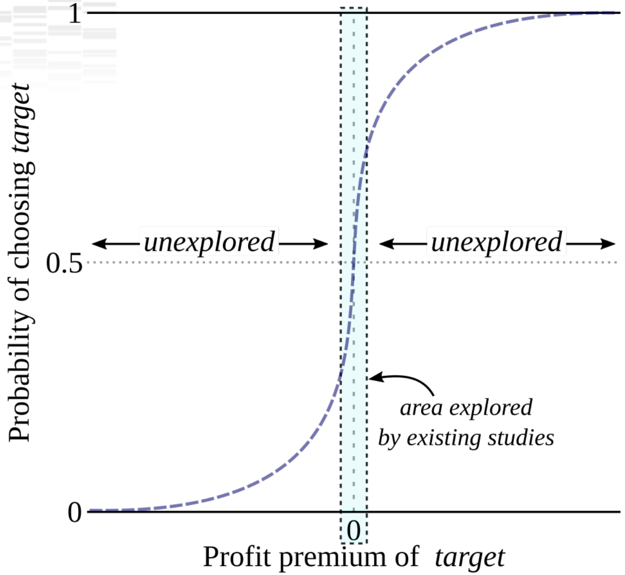
To measure ADE we rely on a **psychometric** approach

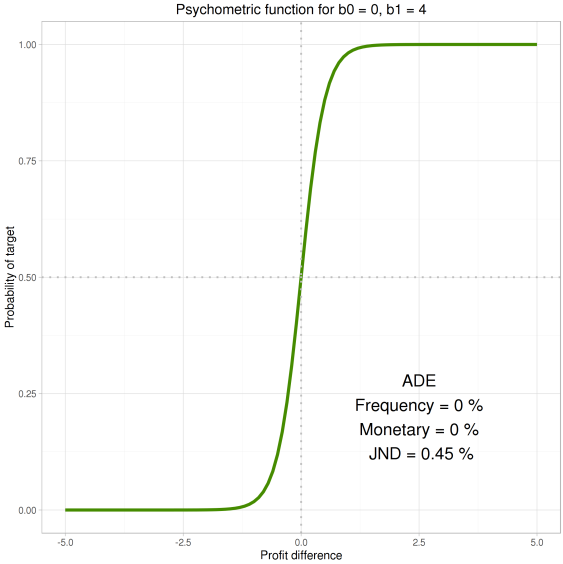
- psychometric functions are estimated sigmoid functions relating
  - a forced binary choice and
  - a continuously and independently varying stimulus.
- Approach used in **psychophysics** (Lunn and Sommerville 2015)

Measures : psychometric function

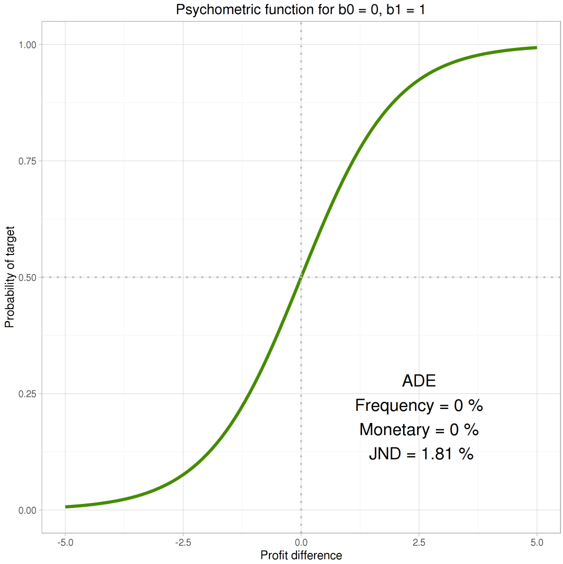
To measure ADE we rely on a **psychometric** approach

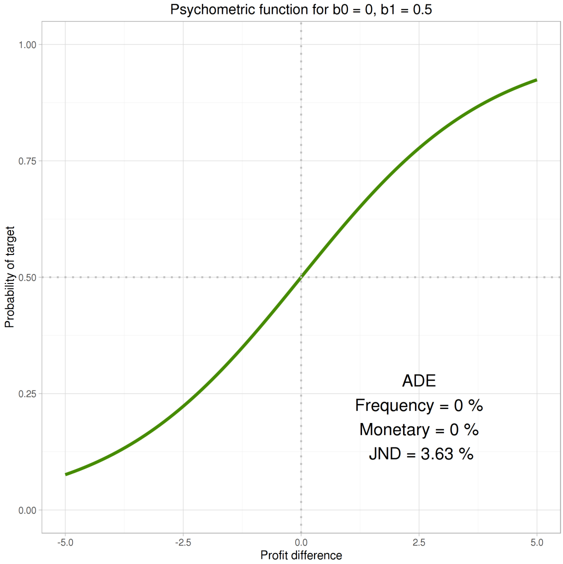
- psychometric functions are estimated sigmoid functions relating
  - a forced binary choice and
  - a continuously and independently varying stimulus.
- Approach used in **psychophysics** (Lunn and Sommerville 2015)
- We treat the data as a binary choice of target and competitor/decoy
- We exploit the variation in payoff difference

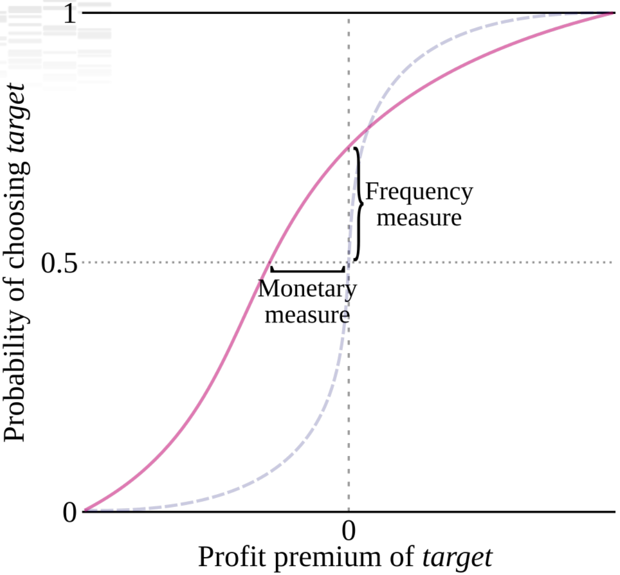

1
0.5
0
Probability of choosing *target*
unexplored
unexplored
area explored
by existing studies
0
Profit premium of *target*



Psychometric function for b0 = 0, b1 = 4
Probability of target
1.00
0.75
0.50
0.25
0.00
-5.0
-2.5
0.0
2.5
5.0
Profit difference
ADE
Frequency = 0 %
Monetary = 0 %
JND = 0.45 %


Psychometric function for b0 = 0, b1 = 1
Probability of target
1.00
0.75
0.50
0.25
0.00
-5.0
-2.5
0.0
2.5
5.0
Profit difference
ADE
Frequency = 0 %
Monetary = 0 %
JND = 1.81 %


Psychometric function for b0 = 0, b1 = 0.5
Probability of target
1.00
0.75
0.50
0.25
0.00
-5.0
-2.5
0.0
2.5
5.0
Profit difference
ADE
Frequency = 0 %
Monetary = 0 %
JND = 3.63 %


1
0.5
0
Probability of choosing *target*
Frequency measure
Monetary measure
0
Profit premium of *target*

Econometric model, I

We estimate a mixed effects logit model :

$$\ln\left[\frac{Pr(y_i = target)}{1 - Pr(y_i = target}\right] = (\beta_0 + u_i) + (\gamma_0 + v_i)premium, \qquad (1)$$

in which

- *premium* is the % profit premium of the target,
- β_0 and γ_0 are fixed effects coefficients describing the average effect in the population,
- u_i and v_i are the random effects, allowed to vary across subjects.

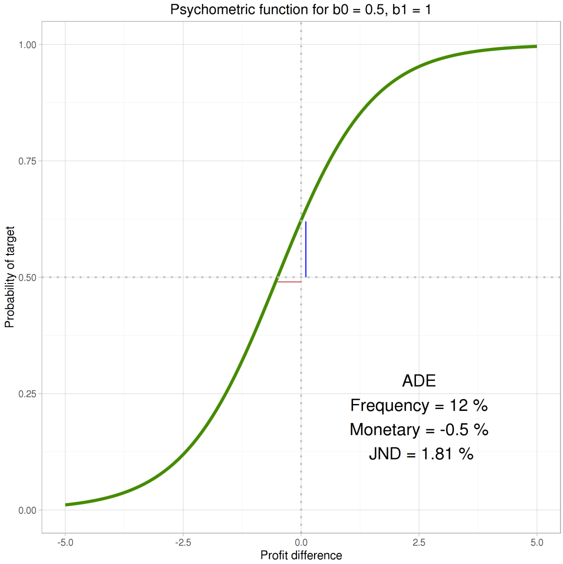
Econometric model, II

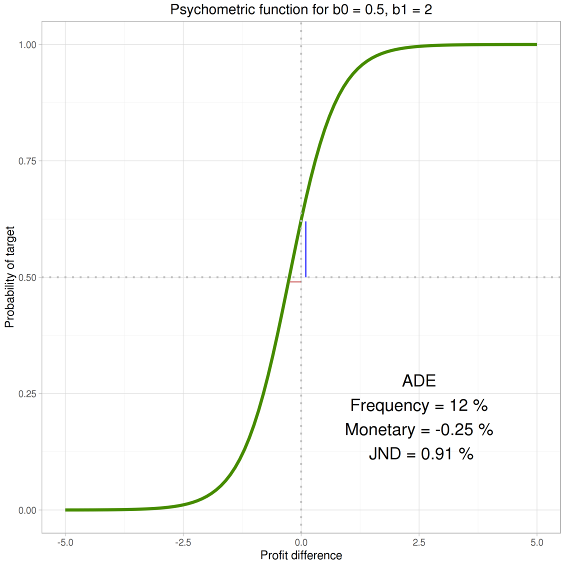
The two ADE measures are given by

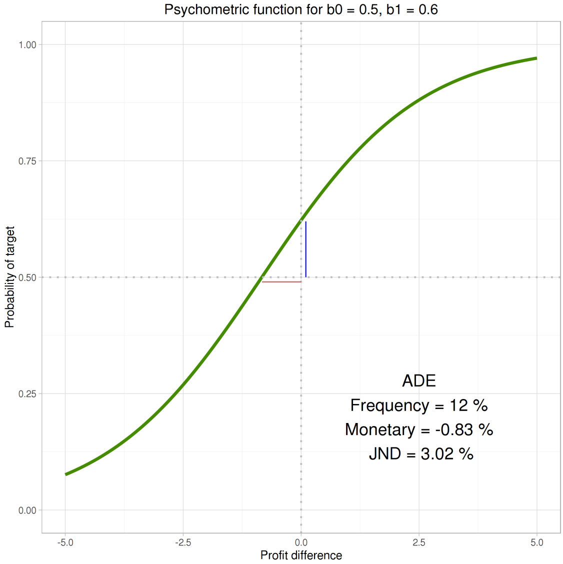
$$\text{Frequency-ADE}_i = \frac{1}{1 + e^{-(\beta_0 + u_i)}} \tag{2}$$

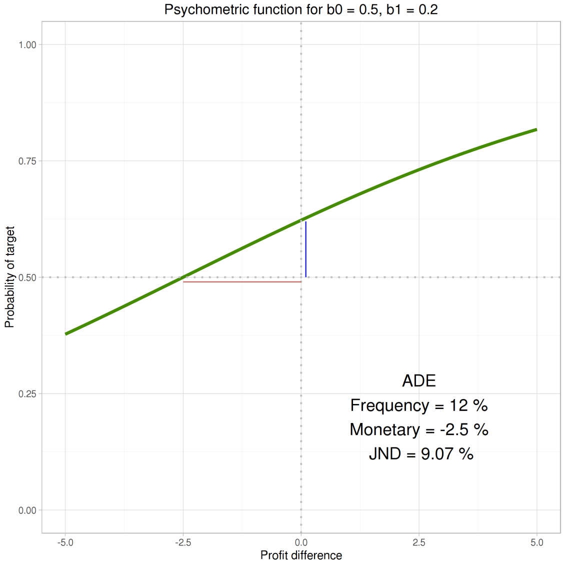
while the *monetary* ADE measure is given by imposing the probability of the target to 50%, thus giving the ratio

$$\text{Monetary-ADE}_i = -\frac{\beta_0 + u_i}{\gamma_0 + v_i}. \tag{3}$$


Psychometric function for b0 = 0.5, b1 = 1
Probability of target
1.00
0.75
0.50
0.25
0.00
-5.0
-2.5
0.0
2.5
5.0
Profit difference
ADE
Frequency = 12 %
Monetary = -0.5 %
JND = 1.81 %


Psychometric function for b0 = 0.5, b1 = 2
1.00
0.75
0.50
0.25
0.00
Probability of target
-5.0
-2.5
0.0
2.5
5.0
Profit difference
ADE
Frequency = 12 %
Monetary = -0.25 %
JND = 0.91 %


Psychometric function for b0 = 0.5, b1 = 0.6
Probability of target
1.00
0.75
0.50
0.25
0.00
-5.0
-2.5
0.0
2.5
5.0
Profit difference
ADE
Frequency = 12 %
Monetary = -0.83 %
JND = 3.02 %


Psychometric function for b0 = 0.5, b1 = 0.2
Probability of target
1.00
0.75
0.50
0.25
0.00
-5.0
-2.5
0.0
2.5
5.0
Profit difference
ADE
Frequency = 12 %
Monetary = -2.5 %
JND = 9.07 %

Results

Results, all choices

We first analyze results by considering **all** choices. That is

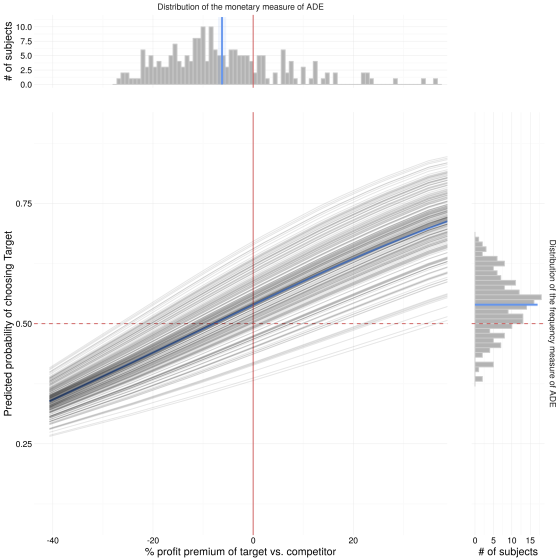
- Dependent variable is choice = target
- DV takes value 0 if choice = competitor *or* choice = decoy

Results, all choices

We first analyze results by considering **all** choices. That is

- Dependent variable is choice = target
- DV takes value 0 if choice = competitor *or* choice = decoy

Lower bound of the effect – stringent condition – all choices



Distribution of the monetary measure of ADE
# of subjects
10.0
7.5
5.0
2.5
0.0
Predicted probability of choosing Target
0.75
0.50
0.25
-40
-20
0
20
% profit premium of target vs. competitor
Distribution of the frequency measure of ADE
0
5
10
15
# of subjects

Results

All choices

- The average frequency-ADE is 53.9% ($\neq$ 50%, t-test $p < 0.001$)
- The average monetary-ADE is -6.21% ($\neq 0$, t-test $p < 0.001$)
- 76.2% of subjects are affected by the ADE.

Results, dropping decoy choices

We can also conisder only choices between target and competitor, i.e. drop decoy choices. That is

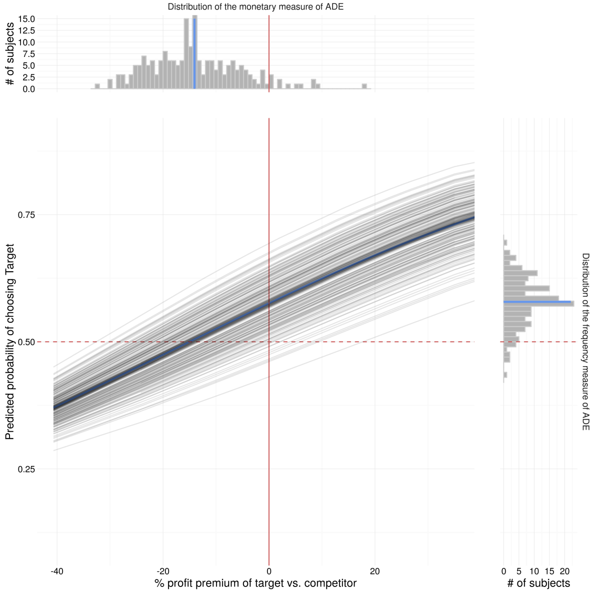
- Dependent variable is choice = target
- DV takes value 0 if choice = competitor
- DV is NA if choice = decoy
- results in dropping 5.8% of choices (bad !)

Results, dropping decoy choices

We can also conisder only choices between target and competitor, i.e. drop decoy choices. That is

- Dependent variable is choice = target
- DV takes value 0 if choice = competitor
- DV is NA if choice = decoy
- results in dropping 5.8% of choices (bad !)

Upper bound of the effect – 50% honest condition – but subset of choices


Distribution of the monetary measure of ADE
# of subjects
15.0
12.5
10.0
7.5
5.0
2.5
0.0
Predicted probability of choosing Target
0.75
0.50
0.25
-40
-20
0
20
% profit premium of target vs. competitor
Distribution of the frequency measure of ADE
0
5
10
15
20
# of subjects

Results

All choices

- The average frequency-ADE is 53.9% ($\neq$ 50%, t-test $p < 0.001$)
- The average monetary-ADE is -6.21% ($\neq 0$, t-test $p < 0.001$)
- 76.2% of subjects are affected by the ADE.

Dropping decoy choices

- The average frequency-ADE is 57.9% ($\neq$ 50%, t-test $p < 0.001$)
- The average monetary-ADE is -14.1% ($\neq 0$, t-test $p < 0.001$)
- 94% of subjects are affected by the ADE.

Regression output

	Choice of target	
	(1 : all choices)	(2 : drop dominated)
Fixed effects parameters		
Constant	0.164***	0.308***
	(0.045)	(0.044)
πpremium	0.020***	0.021***
	(0.002)	(0.002)
Random effects parameters		
$Var(u_i)$	0.380	0.339
$Var(v_i)$	0.004	0.002
Observations	3,423	3,423
Log Likelihood	−2,372.068	−2,195.247

Note : *p<0.1 ; **p<0.05 ; ***p<0.01

Discussion

Discussion

What do we learn ?

- We *measure* : we go further than just *showing* a behavioral bias
- Of course measures depend on the exact stimuli proposed...
  - not realistic
  - maybe too difficult ?
  - a vast space of possible tasks must be explored
- ...but research is on its way !

Thanks