Clubs, Beliefs, and Entrapment

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AMS Session on Behavioral Sciences
Joint Mathematics Meetings
January 7, 2009

Overview

Overview

Question

Why do people join clubs?

Overview

Question

Why do people join clubs they would rather not be in?

Overview

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Why do people join clubs they would rather not be in?

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Question

Why do people join clubs they would rather not be in?

Classical Answer

Because they have to.

Overview

Question

Why do people join clubs they would rather not be in?

Subtle Answer

Because they have to.

Overview

Question

Why do people join clubs they would rather not be in?

Subtle Answer

Because they think they have to.

Overview

Question

Why do people join clubs they would rather not be in?

Subtle Answer

Because they think they have to.

Examples

Question

Why do people join clubs they would rather not be in?

Examples

Question

Why do we tip in restaurants?

Examples

Question

Why do we tip in restaurants?

Answer

Because we have to.

Examples

Question

Why do we tip in restaurants?

Answer

Because we have to.

- But the *first* tippers. . .

Examples

Question

Why do we tip in restaurants?

Answer

Because we have to.

- But the *first* tippers wanted to.

Examples

Question

Why do we tip in restaurants?

Answer

Because we have to.

- But the *first* tippers wanted to.

Examples

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Why do we tip in restaurants?

Answer

Because we have to.

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Positive utility from early adoption

Examples

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Why do we tip in restaurants?

Answer

Because we have to.

- But the *first* tippers wanted to.

Positive utility from early adoption + network effect

Examples

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Answer

Because we have to.

- But the *first* tippers wanted to.

Positive utility from early adoption + network effect = entrapment!

Examples

Question

Answer

-

Positive utility from early adoption + network effect = entrapment!

Examples

Question

Why do we use VHS tapes, instead of Betamax?

Answer

-

Positive utility from early adoption + network effect = entrapment!

Examples

Question

Why do we use VHS tapes, instead of Betamax?

Answer

Because we have to.

- Positive utility from early adoption + network effect = entrapment!

Examples

Question

Why do we use VHS tapes, instead of Betamax?

Answer

Because we have to.

- But the *first* VHS users...

Positive utility from early adoption + network effect = entrapment!

Examples

Question

Why do we use VHS tapes, instead of Betamax?

Answer

Because we have to.

- But the *first* VHS users had to *hope* that VHS would catch on.

Positive utility from early adoption + network effect = entrapment!

Examples

Question

Why do we use VHS tapes, instead of Betamax?

Answer

Because we have to.

- But the *first* VHS users had to *hope* that VHS would catch on.

Positive utility from early adoption + network effect = entrapment!

Examples

Question

Why do we use VHS tapes, instead of Betamax?

Answer

Because we have to.

- But the *first* VHS users had to *hope* that VHS would catch on since Betamax was "better".

Positive utility from early adoption + network effect = entrapment!

Examples

Question

Why do we use VHS tapes, instead of Betamax?

Answer

Because we have to.

- But the *first* VHS users had to *hope* that VHS would catch on since Betamax was “better”.

Positive utility from early adoption + network effect = entrapment!

Examples

Question

Why do we use VHS tapes, instead of Betamax?

Answer

Because we have to.

- But the *first* VHS users had to *hope* that VHS would catch on since Betamax was "better".

~~Positive utility from early adoption~~ + network effect = entrapment!

Math Model

Notation

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- $N > 1$ players, indexed $i = 1, 2, \ldots, N$

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  - Must (simultaneously) choose

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Join	Status Quo

Math Model

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- $N > 1$ players, indexed $i = 1, 2, \ldots, N$
  - Must (simultaneously) choose

Join	Status Quo
$J(i, n)$	$S(i, n)$

Math Model

Notation

- $N > 1$ players, indexed $i = 1, 2, \ldots, N$
  - Must (simultaneously) choose

Join	Status Quo
$J(i, n)$	$S(i, n)$

where n = number of others choosing Join

Math Model

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$J(i, n)$	$S(i, n)$

Math Model

Our Assumptions

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
-

Join	Status Quo
$J(i, n)$	$S(i, n)$

Math Model

Our Assumptions

- Players sorted in order of enthusiasm for JOIN:

$$\frac{\partial A}{\partial i} < 0, \quad \frac{\partial S}{\partial i} > 0$$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
JOIN	STATUS QUO
$J(i,n)$	$S(i,n)$

Math Model

Our Assumptions

- Players sorted in order of enthusiasm for JOIN:

$$\frac{\partial A}{\partial i} < 0, \quad \frac{\partial S}{\partial i} > 0$$

- Positive network effect:

$$\frac{\partial A}{\partial n} > 0, \quad \frac{\partial S}{\partial n} < 0$$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
-

JOIN	STATUS QUO
$J(i,n)$	$S(i,n)$

Math Model

Our Assumptions

- Functional forms (following Dixit (2003)):

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
JOIN	STATUS QUO
$J(i, n)$	$S(i, n)$

Math Model

Our Assumptions

- Functional forms (following Dixit (2003)):

$$J(i,n) = \beta + \gamma n - \delta i$$

$$S(i,n) = \sigma i - \tau n$$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$J(i,n)$	$S(i,n)$

Math Model

Our Assumptions

- Functional forms (following Dixit (2003)):

$$J(i,n) = \beta + \gamma n - \delta i$$

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Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Math Model

Dixit's Assumptions

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
-

Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Math Model

Dixit's Assumptions

- Early adoption positive:

$$\beta > \delta + \sigma$$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Math Model

Dixit's Assumptions

- Early adoption positive:

$$\beta > \delta + \sigma$$

- Strong network effect:

$$\gamma + \tau \geq \delta + \sigma$$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Math Model

Dixit's Assumptions

- Early adoption positive:

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Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

Math Model

Dixit's Assumptions

- Early adoption positive:

$$\beta > \delta + \sigma$$

- Strong network effect:

$$\gamma + \tau \geq \delta + \sigma$$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
-

JOIN	STATUS QUO
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $N - 1$ JOIN $\Rightarrow$ N JOIN:

$$\frac{\beta + (N-1)(\gamma + \tau)}{N} > \delta + \sigma$$

Math Model

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta + (N-1)(\gamma + \tau)}{N} > \delta + \sigma$

Math Model

Our Assumptions

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$

Math Model

Our Assumptions

- Common *ex ante* belief

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta + (N-1)(\gamma + \tau)}{N} > \delta + \sigma$

Math Model

Our Assumptions

- Common *ex ante* belief:

$$\mathrm{Prob}(\text{others } \textsc{Join}) = q$$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
-

Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$

Math Model

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta + (N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others Join}) = q$

Math Model

Key Condition

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others } \textsc{Join}) = q$

Math Model

Key Condition

- Player i JOINS $\iff$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
JOIN	STATUS QUO
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others JOIN}) = q$

Math Model

Key Condition

- Player i JOINS $\iff$

$$q(\beta + \gamma(N-1) - \delta i) + (1-q)(\beta - \delta i)$$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
-

JOIN	STATUS QUO
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta + (N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\text{Prob}(\text{others JOIN}) = q$

Math Model

Key Condition

- Player i JOINs $\iff$

$$q(\beta + \gamma(N-1) - \delta i) + (1-q)(\beta - \delta i) >$$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
JOIN	STATUS QUO
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta + (N-1)(\gamma + \tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others JOIN}) = q$

Math Model

Key Condition

- Player i $\textsc{Joins}$ $\iff$

$$q(\beta + \gamma(N-1) - \delta i) + (1-q)(\beta - \delta i) > q(\sigma i - \tau(N-1)) + (1-q)(\sigma i)$$

Notation

- $N > 1$ players $i = 1, 2, \dots, N$
-

Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta + (N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others } \textsc{Join}) = q$

Math Model

Key Condition

- Player i JOINs $\iff$

$$\frac{\beta + q(N-1)(\gamma+\tau)}{i} > \sigma + \delta$$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
-

JOIN	STATUS QUO
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others JOIN}) = q$

Math Model

Results

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta + (N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others Join}) = q$

Math Model

Results

- At least $\left\lfloor N \left(\frac{\beta + q(N-1)(\gamma+\tau)}{\beta+(N-1)(\gamma+\tau)} \right) \right\rfloor$ players JOIN!

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
JOIN	STATUS QUO
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others JOIN}) = q$

Math Model

Results

- At least $\left\lfloor N\left(\frac{\beta+q(N-1)(\gamma+\tau)}{\beta+(N-1)(\gamma+\tau)}\right)\right\rfloor$ players Join!
- When $\beta = 0$ (no early adoption benefit), this is $\lfloor Nq \rfloor$.

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$
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Math Model

Results

- At least
  $$\left\lfloor N \left(\frac{\beta+q(N-1)(\gamma+\tau)}{\beta+(N-1)(\gamma+\tau)} \right) \right\rfloor$$
  players JOIN!
- When $\beta = 0$ (no early adoption benefit), this is $\lfloor Nq \rfloor$.
  - $q = 1$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
-

JOIN	STATUS QUO
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others JOIN}) = q$

Math Model

Results

- At least
  $$\left\lfloor N\left(\frac{\beta+q(N-1)(\gamma+\tau)}{\beta+(N-1)(\gamma+\tau)}\right)\right\rfloor$$
  players $\textsc{Join}$!
- When $\beta = 0$ (no early adoption benefit), this is $\lfloor Nq \rfloor$.
  - $q = 1 \Rightarrow$ all $\textsc{Join}$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others } \textsc{Join}) = q$

Math Model

Results

- At least $\left\lfloor N\left(\frac{\beta+q(N-1)(\gamma+\tau)}{\beta+(N-1)(\gamma+\tau)}\right)\right\rfloor$ players JOIN!
- When $\beta = 0$ (no early adoption benefit), this is $\lfloor Nq \rfloor$.
  - $q = 1 \Rightarrow$ all JOIN
  - $q = 0$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
-

JOIN	STATUS QUO
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others JOIN}) = q$

Math Model

Results

- At least
  $$\left\lfloor N\left(\frac{\beta+q(N-1)(\gamma+\tau)}{\beta+(N-1)(\gamma+\tau)}\right)\right\rfloor$$
  players JOIN!
- When $\beta = 0$ (no early adoption benefit), this is $\lfloor Nq \rfloor$.
  - $q = 1 \Rightarrow$ all JOIN
  - $q = 0 \Rightarrow$ none JOIN

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
JOIN	STATUS QUO
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others JOIN}) = q$

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- $q = 1 \Rightarrow$ all $\textsc{Join}$
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- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta + (N-1)(\gamma + \tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others } \textsc{Join}) = q$

Math Model

Results

- $q = 1 \Rightarrow$ all Join
- $q = 0 \Rightarrow$ none Join

convincing rumor

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta + (N-1)(\gamma + \tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others Join}) = q$

Math Model

Results

- $q = 1 \Rightarrow$ all JOIN
- $q = 0 \Rightarrow$ none JOIN

$$\begin{array}{rr} & \text{convincing rumor} \\ + & \text{network effect} \\ \hline \end{array}$$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
JOIN	STATUS QUO
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$
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- $q = 1 \Rightarrow$ all $\textsc{Join}$
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$$\begin{array}{rr} & \text{convincing rumor} \\ + & \text{network effect} \\ \hline & \text{entrapment!} \end{array}$$

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Results

- $q = 1 \Rightarrow$ all $\textsc{Join}$
- $q = 0 \Rightarrow$ none $\textsc{Join}$

$$\begin{array}{rr} & \text{convincing rumor} \\ + & \text{network effect} \\ \hline & \text{entrapment!} \end{array}$$

$\mathbb{QED}$

Notation

- $N > 1$ players $i = 1, 2, \ldots, N$
Join	Status Quo
$\beta + \gamma n - \delta i$	$\sigma i - \tau n$

Our Assumptions

- $\frac{\beta+(N-1)(\gamma+\tau)}{N} > \delta + \sigma$
- $\mathrm{Prob}(\text{others } \textsc{Join}) = q$

Acknowledgments

Acknowledgments

- Prof. Avinash Dixit and Prof. Andrei Shleifer

Acknowledgments

- Prof. Avinash Dixit and Prof. Andrei Shleifer
- Mrs. Susan Schwartz Wildstrom

Acknowledgments

- Prof. Avinash Dixit and Prof. Andrei Shleifer
- Mrs. Susan Schwartz Wildstrom
- Harvard College PRISE

Acknowledgments

- Prof. Avinash Dixit and Prof. Andrei Shleifer
- Mrs. Susan Schwartz Wildstrom
- Harvard College PRISE
- Family

Acknowledgments

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- Mrs. Susan Schwartz Wildstrom
- Harvard College PRISE

- Family, friends

Acknowledgments

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- Mrs. Susan Schwartz Wildstrom
- Harvard College PRISE

- Family, friends, and you!

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