Governing the commons: swords or covenants?

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Plenary Lecture

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Introductory remarks

• I want to thank Mary Hedges, Stephen Knowles, Bill Kaye-Blake and members of the NZAE Council for inviting me

• Though If I had known, before agreeing to be a keynote speaker, about the company I would be placed in, I probably would have had serious second thoughts…

• I would like to thank Tim Harford for his books

• But more for the fact that I routinely pilfer teaching material from them, especially *The Undercover Economist*

• And thank you all for coming along to this talk early in the morning
• I use experiments with human participants to understand decision-making in an economic context

• More and more economists are turning to experiments to study a wide variety of questions

  – Oswald (2010): “...experimental papers are becoming common in the highest impact-factor journals ...Some economists think that experimental-method papers may even take over as the dominant style of work. I am not sure; it is easy to get carried away with the latest fashions.... But true-experiment papers will surely make up a much bigger slice of the future of economics than has been common up to this point.”

• Most of you will have some familiarity with experiments, but to set the stage for my talk, I will begin by running a representative decision-making experiment
A public goods game

• Here is the key feature of this game

• Any amount that is contributed to the public account

• is **Doubled**

• and *re-distributed equally among all four members of the group*
What would you do in this situation?

Let us find out… by having some people actually play this game
Suppose everyone puts $5.00 into the public account

Doubled to $40.00

Redistributed equally gives everyone $10.00
A public goods game

• Analogous to a multi-person Prisoner’s Dilemma game

• From society’s point of view the best outcome is for each player to invest all $5 into the public account

• A total of $20 which gets doubled to $40

• Each player gets back $10; 100% return on investment
A public goods game

• But self-regarding behaviour suggests otherwise

• Suppose I contribute $1 into the public account; and suppose no one else puts in anything...

• $1 gets doubled to $2

• Redistributed equally: $0.50 for each member

• I lose $0.50 while the others, who have not contributed anything, gain $0.50
A public goods game

• Rational self-interest suggests that an individual player has \textit{no} incentive to contribute

• \textit{Economists refer to this as “free-riding”}
Example: Catch 22 by Joseph Heller

• Sharing a tent with a man who was crazy wasn’t easy but Nately didn’t care. He was crazy, too, and had gone every free day to work on the officers’ club that Yossarian had not helped build.

Actually, there were many officers’ clubs that Yossarian had not helped build, but he was the proudest of the one on Pianosa. It was a sturdy and complex monument to his powers of determination. Yossarian never went there to help until it was finished; then he went there often, so pleased was he with the large, fine, rambling shingled building. It was truly a splendid structure, and Yossarian throbbed with a mighty sense of accomplishment each time he gazed at it and reflected that none of the work that had gone into it was his.
A public goods game

• But if everyone thinks like that, no one will contribute as everyone tries to free-ride!

• *Economists suggest that the inevitable outcome of this process is zero contribution!*
“Suppose we let you pick your missions and fly milk runs,” Major Major said. “That way you can fly the four missions and not run any risks.”

“I don’t want to fly milk runs. I don’t want to be in the war any more.”

“Would you like to see our country lose?” Major Major asked.

“We won’t lose. We’ve got more men, more money and more material. There are ten million people in uniform who can replace me. Some people are getting killed and a lot more are making money and having fun. Let somebody else get killed.”

“But suppose everybody on our side felt that way.”

“Then I’d certainly be a damned fool to feel any other way. Wouldn’t I?”
What does this game represent?

• Collective action problems
• Governing the commons
  – Exploitation of common pool resources
• Voluntary contributions of money and/or effort to charitable causes
• Teamwork in organizations
• Private provision of public goods
  – non-rival and non-excludable
So what did you decide?

Are you Yossarian or are you Nately?
A typical pattern of contributions when the game is played ten times with a known end-point

Chaudhuri & Paichayontvijit (2006)
A public goods game

- At least two things to note

- More cooperation than theory predicts

- But cooperation seems *fragile* with people reducing their contributions over time
A public goods game

• There are actually **two separate** questions here

• Why do the contributions decay over time?

• How can we sustain cooperation by reducing free-riding over time?
Why do people do what they do?

- Not everyone contributes in the middle to start with

- Some people contribute everything at the beginning while others contribute less

- Some contribute nothing from the very beginning
Why do people do what they do?

- Why do people cooperate at the beginning and free-ride later?

- If they are going to free-ride why do they not start to do so immediately?

- And if they are going to cooperate, then why do they not continue to do so over time?
Why do people do what they do?

• We have already argued that free-riding is the self-interested course of action
  – So maybe that is easier to understand

• But how about the ones who contribute a lot?
  – Are they being purely altruistic?
  – The “warm-glow” of giving?
Conditional cooperation

- Recent research suggests that the pattern of decay is explained by appealing to the interaction between “heterogeneous” players.

- The most notable finding in the area is that many participants behave as “conditional cooperators”,

- *whose contribution to the public good is positively correlated with their beliefs about the contributions to be made by their group members.*
The role of beliefs and conditional cooperation

- Fischbacher, Gächter and Fehr (2001)
- Players are asked to choose
  - An unconditional contribution
  - A conditional contribution, i.e., for every given average contribution of the other members they decide how much to contribute.
    - A selfish player is predicted to always choose a conditional contribution of zero.
The role of beliefs and conditional cooperation

- After this players play the actual game
- Some are free to choose any contribution regardless of what they said they would choose
- **But**, some others, picked randomly, have to contribute what they said they would contribute based on others’ contributions
  - This means...
Free riding

Averagely, tokens contributed to the public account by the other group members were 1.3 (SD = 1.3). 

Fishchbacher, Gächter and Fehr, (2001)
Average tokens contributed to the public account by the other group members

Fishchbacher, Gächter and Fehr, (2001)
Fishchbacher, Gächter and Fehr, (2001)
Conditional Cooperator

Fishchbacher, Gächter and Fehr, (2001)
Other studies of conditional cooperation

- The fact that a plurality of participants are *conditional cooperators* has been widely replicated

  - Brandts, J. and A. Schram (2001)
  - Bryan, J. and M. Test (1967)
  - Kelley, H and A. Stahelski (1970)
  - Keser, C. and F. van Winden (2000)
  - Sonnemans, J., A. Schram and T. Offerman (1999)
Robustness of conditional cooperation

- FGF use the “strategy method” or “cold (hypothetical) responses”, prior to players learning about the actions of their peers

- Kurzban and Houser (2005)
- Fischbacher and Gächter (2010)
- Chaudhuri and Paichayontvijit (2011)

  - Strong positive correlation between beliefs about others’ contribution and one’s own contribution even when information elicited multiple times during repeated play of the stage game
Correlation between beliefs and contributions

Beliefs about other's contribution

Percentage

Round

Contribution

31
Correlation between beliefs and contributions

Beliefs about other’s contribution

Own contribution

Percentage

Round

Contribution

Beliefs
Why do contributions decay then?

• Given that across many studies, a plurality (or majority) of participants are *conditional cooperators*

• But also given that many groups do contain free-riders, albeit a minority

• One possible reason behind the decay is that once the conditional cooperators become aware that others are free-riding, they start to reduce their contributions
Why do contributions decay then?

• But there is an alternative possibility behind this decay which does not rely on the presence of free-riders.

• Conditional cooperators can have optimistic or pessimistic beliefs about their peers.

• So the “heterogeneity” among players does not necessarily have to arise from differences in preferences but could be due to differences in prior beliefs.
Why do contributions decay then?

• This in turn suggests one reason why contributions may decay over time
• Those with optimistic beliefs start out with high contributions…
• But over time they begin to understand that there are others who are contributing less…
• Maybe because they have pessimistic beliefs…
• Inducing the optimists to reduce their contribution over time…
Beliefs and contributions in a public goods game (Chaudhuri and Paichayontvijit, 2010)

• Groups of 4 play a public goods game for 24 rounds with 10 tokens in each round

• In one treatment, they do not get any feedback about others’ contributions or their own earnings; in other treatments they get feedback as usual

• Participants classified into three groups (based on their prior beliefs about others’ contributions)
  – Optimists (others will contribute 7 tokens or more)
  – Realists (others will contribute 4 - 6 tokens)
  – Pessimists (others will contribute 3 tokens or less)
Pattern of contributions over time

No feedback treatment; Virtually no decay in contributions

Chaudhuri and Paichayontvijit (2010)
Pattern of contributions over time

Chaudhuri and Paichayontvijit (2010)
Contributions in the no feedback treatment by the three types

Optimists

Chaudhuri and Paichayontvijit (2010)
Contributions in the no feedback treatment by the three types

Chaudhuri and Paichayontvijit (2010)
Contributions in the no feedback treatment by the three types

Chaudhuri and Paichayontvijit (2010)
What happens when players get to see what others are doing?

- Over time optimists reduce their contributions

- Pessimists actually raise their contributions

- But on average the increase in contributions coming from pessimists is not large enough to offset the decrease from optimists
Contribution of the 24-Intermittent Feedback Treatment by Belief level

Medium Belief-Level (58%)

Realists
Contribution of the 24-Intermittent Feedback Treatment by Belief level

- Realists
- Optimists

Graph showing percentage contribution over rounds.
Contribution of the 24-Intermittent Feedback Treatment by Belief level
Sustaining cooperation over time

• The nature of the heterogeneity among participants in turn suggests appropriate mechanisms/institutions that can help sustain cooperation.

• Is the heterogeneity in preferences?
  – Conditional cooperators/free riders

• Or is the heterogeneity in prior beliefs of conditional cooperators?
  – Optimists/pessimists
Sustaining cooperation over time

• If heterogeneity relates to player types (or inherent preferences) then in order to sustain cooperation we need to rely on punitive mechanisms involving punishment of free riders to keep selfish behavior in check.

• Indeed the punishment literature has been a dominant theme in public goods research in the last decade or so.

Sustaining cooperation over time

• But if, on the other hand, the heterogeneity is in prior beliefs of conditionally cooperative types, then it is possible to sustain cooperation without resorting to punishments.

• All that is needed are mechanisms that generate suitably optimistic beliefs among pessimistic conditional cooperators.

• This would suggest a different type of social learning and the possibility of sustaining cooperation via more benign institutions.
“Altruistic” punishments
Fehr and Gächter (2000, 2002)

• Stage 1: typical public goods game
• Stage 2: Punishment opportunity
  – Subjects are informed about each member’s contribution.
  – Subjects can punish other group members

• Punishments are costly!
  – Eg. If you are willing to give up $1 to punish a particular group member then the latter’s earnings are reduced by $3
Costly punishments
Fehr and Gächter (2000, 2002)

• Either groups are fixed
  – “partners” protocol

• Or players are randomly re-matched at the end of each round
  – “strangers” protocol
Partners

Strangers

With punishment

Period

Average tokens contributed to public account

Partners without punishment
Strangers without punishment
Partners with punishment
Strangers with punishment
Who gets punished?

Received punishment points per deviation from average and percentage of decisions

Contributions below group average

Contributions above group average
Choosing whether to punish or not
Gürerk, Irlenbusch and Rockenbach (2006)

• Multiple stages in each one of 30 rounds
• Stage 1, participants have an opportunity to choose to be in either a sanctioning or a sanction-free institution.
• Stage 2 participants participate in a linear public goods game.
  – The round ends here for participants who choose to be in the sanction-free institution.
• Participants who choose to be in the sanctioning institution continue to stage 3 where they can allocate either positive or negative sanction points to other members.
  – Reward ratio 1 token: 1 token
  – Punishment ratio 1 token for sender: 3 tokens for recipient
On the effectiveness of costly monetary punishments

- Nikiforakis and Normann (2008)
- Egas and Riedl (2007)

- While monetary punishments may lead to increased contribution, the impact on efficiency (earnings) is ambiguous

- Cost-effectiveness of punishments is crucial
  - 1 token sacrificed in punishment must inflict a cost of 3 tokens or more on the recipient for increasing efficiency
Comparing efficiency
Benchmark: control treatment with no punishment

Comparing efficiency

Benchmark: control treatment with no punishment

Comparing efficiency

Benchmark: control treatment with no punishment

Comparing efficiency

Benchmark: control treatment with no punishment

The possibility of “perverse” or “anti-social” punishments

- Nikiforakis (2008)
- Three stages
- Stage 1: standard linear public goods game
- Stage 2: Punishments using the FG (2000) approach
- Stage 3: Counter-punishments
  - Those punished in stage 2 can engage in counter-punishment with similar punishment costs as in Stage 2
  - Must have money to punish
  - “Targeted” punishment
The possibility of “perverse” or “anti-social” punishments

- The counter-punishment treatment leads to lower contributions compared to the punishment treatment

- and lower average earnings compared to both the punishment and the control treatments.

- Participants in this treatment engage in substantial amounts of “anti-social” punishment which can be attributed to one of two factors or a combination of those.

- One is the anticipation by some free-riders of the forthcoming punishment from cooperators and their willingness to retaliate those sanctions.
The possibility of “perverse” or “anti-social” punishments

• Here participants use counter-punishments strategically to signal that future sanctions will not be tolerated

• The second factor is the desire to avenge sanctions meted out to them in previous periods.

• Participants in the counter-punishment treatment are 15% less likely to punish free-riding compared to the punishment treatment.
The possibility of “perverse” or “anti-social” punishments

The possibility of “perverse” or “anti-social” punishments

- Cinyabuguma, Page and Putterman (2005)
- No “targeted” punishments
- Each participant is told the pattern of punishing high, average and low contributors in the group
- Then that participant can decide who to counter-punish, i.e. whether to counter-punish “pro-social” or “anti-social” punishers.
- Efficiency not lower in the counter-punishment treatment
Most people are not WEIRD!
(Western, Educated, Industrialized, Rich and Democratic)

Hermann, Thöni and Gächter (2008)
Most people are not WEIRD!
(Western, Educated, Industrialized, Rich and Democratic)

Hermann, Thöni and Gächter (2008)
Caveats: The verdict on costly monetary punishments

1. Punishment creates a second-level public good
   – Requires the creation of “meta-norms” of punishment in the words of Axelrod (1986).

2. The problem of “anti-social” punishments
   – cooperation enhancing effect of punishments seems more prominent in particular participant pools
   – the exact implementation of counter-punishment – whether targeted punishments are feasible or not - matters.

3. Efficiency implications ambiguous.
   • Cost-effectiveness of punishment crucial
Punishments more effective in the long run?

- Given a long enough time horizon, as in Gächter, Renner and Sefton (2008), the threat of punishment might be enough to sustain cooperation without the punishment actually having to be carried out.

- This makes punishments more efficient in the long run.

- 50 rounds of interaction with and without punishment as opposed to 10 rounds with and without punishment.

- The threat of punishment seems to be enough without the punishment actually having to be carried out.
n 50 rounds without punishment

10 rounds without punishment

10 rounds with punishment
50 rounds with punishment

50 rounds without punishment

10 rounds without punishment

10 rounds with punishment

Average net earnings

N10  P10  N50  P50
Sustaining cooperation via non-monetary punitive mechanisms

- Noussair and Tucker (2005)
  - Expressions of disapproval

  - Voting to expel group members
Even non-monetary punishments (scoldings?) seem to matter!

- Masclet et al. (2003) look at a “partners” treatment where participants play for 30 periods divided into 3 segments
  - No sanction (periods 1 through 10)
  - Monetary Sanction OR Non-Monetary Sanction (Periods 11 through 20)
  - No sanction (Periods 21 through 30)
Group Contributions Over Time

Monetary punishment

Non-monetary punishment

Monetary Average Contribution — Non-Monetary Average Contribution
Punishments may be sufficient but are they necessary? Creating culture in the laboratory

• Monetary punishments successful in increasing contributions

• Can moral suasion in the form of exhortative messages appealing to participants’ goodwill achieve a similar goal?

• Possibly by creating suitably optimistic beliefs among conditional cooperators?
Punishments may be sufficient but are they necessary? Creating culture in the laboratory

• After all, a society where cooperation is achieved

• on the basis of moral suasion would probably be a more benign one to live in

• than one where cooperation is sustained only by the actual use of punishments or threat thereof
Role of communication

Isaac and Walker (1988)
Dawes, McTavish and Shaklee (1977)
Role of communication

Communication

No communication

Percentage Contributions to the Public Account

Rounds
The Inter-generational paradigm

• A group of 5 subjects play the public goods game for 10 periods.

• After her participation, each agent is replaced by another, who plays the game for 10 periods again.

• Chaudhuri, Graziano and Maitra (Review of Economic Studies, 2006)
The Inter-generational paradigm

• Players in any generation can leave free-form written advice to their successors

• Players get two payoffs – what they earn plus what their progeny earn
Three Different Treatments

• In the **private advice** treatment advice from generation “t” player is given only to her successor in generation “t+1”

• In the **public knowledge advice treatment** advice from all players in generation “t” is given to all the players in generation “t+1”
Three Different Treatments

• In the **common knowledge advice treatment** advice from **all** players in generation “t” is given to **all** the players in generation “t+1” and is also **read aloud by the experimenter**

• The advice treatments are compared to behaviour in a control group where there is no opportunity to leave advice
The Inter-generational Paradigm

• In real-life when we are confronted with a social dilemma we often access to the wisdom of the past

• in the sense that predecessors, or at least immediate predecessors, are available to give us advice.
Proportion of participants contributing entire token endowment in each round
Proportion of participants contributing their entire token in each round
Proportion of participants contributing their entire token in each round

![Graph showing the proportion of participants contributing their entire token in each round. The graph includes three lines representing different advice conditions: No Advice, Private Advice, and Public Advice. The x-axis represents the period, and the y-axis represents the proportion contributing their entire token. The graph shows a decline in the proportion of participants contributing over time, with variations between the advice conditions.]
Proportion of participants contributing their entire token in each round

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Evolution of Contributions Across Generations – Private Advice
Evolution of Contributions Across Generations – Private Advice
Evolution of Contributions Across Generations – Private Advice
Contributions Across Generations – Common Knowledge
Contributions Across Generations – Common Knowledge
Contributions Across Generations – Common Knowledge
Role of Advice

• Subjects were asked to indicate a specific contribution in addition to providing free-form advice.

• Often, advice specified a dynamic rule:
  – “I would pick a high number for the first round like 9. But when you see the average start to drop, pick a small number so you don’t lose money.”
Role of Advice

• In the later generations of common knowledge advice treatment, advice becomes much more exhortative suggesting high contribution:
  
  – “Keep faith! No one should mess it up for the others. All 10 for all 10 rounds!”
  
  – “For goodness’ sake don’t be that morally vacant girl who prioritizes her own profit & takes advantage of everyone else!”
Histogram of Advice Left – Private Advice
Histogram of Advice Left – Private Advice
Histogram of Advice Left – Private Advice

Private Generation 1
Private Generation 2
Private Generation 3

Advice Left
Percentage

0 5 5.5 6 6.5 7 7.5 8 8.5 9 10
Histogram of Advice - Common Knowledge
Histogram of Advice - Common Knowledge
Histogram of Advice - Common Knowledge
The Inter-generational Paradigm

- In order to sustain cooperation it appears that
- Everyone needs to get the same message
- But also everyone needs to be *convinced* that everyone else is getting the same message
- Which only happens in the common knowledge of advice treatment
Beliefs *before* receiving common knowledge advice.
Beliefs after 12 years
Receiving common knowledge advice

Beliefs before receiving common knowledge advice

Number of tokens contributed to the public account

Number of players
Are punishments necessary? Comparing the impact of punishments and communication

  - Face-to-face communication
  - Internet chat room
  - Numerical Cheap talk
  - Each type of communication combined with punishment
  - Fixed groups

- Chaudhuri and Paichayontvijit (2010)
  - Recommended play versus punishments
  - Both fixed groups and random re-matching
Face-to-face with punishment

Face-to-face

Punishment

Baseline
Face to face with punishment

Average earnings

Round

Baseline  Punishment  Face-to-face  Face-to-face with punishment
Chaudhuri and Paichayontvijit (2010)

- Public goods game with 20 rounds
- Three treatments
- In each treatment, participants play 10 rounds at the beginning without any intervention
- In the *control* treatment, after the first set of 10 rounds end, they are told to continue playing for another 10 rounds
Recommended play and punishments

- **Recommendation treatment**
- Prior to beginning of round 11 and at the beginning of each successive round, public announcement:
  - "You should contribute 10 tokens in each round. NOTICE that if all participants in a group follow the message then every participant will make 100% return on their contributions. For example, if in a particular round all 4 players in your group contribute all 10 tokens to the public account, then each group member will receive 20 tokens in return of their investment of 10 tokens. You will be helping yourself and everyone else in the group if you contribute all 10 tokens in every round."
Recommended play and punishments

- **Punishment treatment**
- Beginning with round 11, in the second stage of each round participants allowed to engage in costly punishment of group members

- Two matching protocols
- Participants are either
  - in *fixed groups for all rounds*
  - *randomly re-matched from one round to the next*
Contributions in randomly re-matched groups

![Graph showing contributions over rounds]
Contribution in randomly re-matched groups

![Graph showing contribution in randomly re-matched groups]
Contributions in randomly re-matched groups
Contributions in fixed groups

Percentage Contribution

Round

Control
Contributions in fixed groups

- Contributions
- Punishment

Graph showing the percentage contribution over rounds for control and punishment conditions.
Earnings in randomly re-matched groups

![Graph showing average earnings over rounds for the Control group.](image)
Earnings in randomly re-matched groups

The graph shows the average earnings over rounds for two groups: Control and Punishment. The earnings are measured on a scale from 0 to 1. The Control group maintains relatively stable earnings throughout the rounds, with a slight decrease in the middle and a slight increase towards the end. The Punishment group starts with lower earnings, shows an increase around the middle rounds, and then stabilizes towards the end. The graph indicates that the Punishment group's earnings surpass the Control group later on.
Earnings in randomly re-matched groups

![Graph showing earnings over rounds for Control, Recommendation, and Punishment groups. The graph indicates a decrease in average earnings for the Recommendation group compared to the Control and Punishment groups.](image-url)
Earnings in fixed groups

![Graph showing earnings in fixed groups over rounds]

- **Control** line on the graph shows the average earnings over the rounds.

The graph illustrates the decline in earnings over consecutive rounds.
Earnings in fixed groups

![Graph showing earnings over rounds for Control and Punishment groups.](image-url)
Earnings in fixed groups

![Graph showing earnings trends with labels for Control, Recommendation, and Punishment over 20 rounds.](image-url)
Will it make a difference if the interaction continues for longer?

- Next we let players play for 30 rounds
- The first 10 rounds are the same as before
- Then for the next 20 rounds we either allow for punishments or make an announcement just as before

- **Fixed groups of 4**
  - *Haven’t run the randomly re-matched groups yet*

- 10 tokens in each round
- Tokens in public account doubled and redistributed equally among group members
What happens to average contributions with 30 round interactions?
What happens to average contributions with 30 round interactions?
What happens to **average earnings** with 30 round interactions?
What happens to \textit{average earnings} with 30 round interactions?

![Graph showing average earnings over 30 rounds with recommendation and punishment phases.]

- **Average earnings**:
  - Recommendation: 1.5 to 1.8
  - Punishment: 0.2 to 1.1

- **Graph**:
  - X-axis: Round
  - Y-axis: Average earnings

- **Notes**:
  - Round 10 to 15 shows a sharp increase in earnings for recommendations.
  - Round 20 to 25 indicates fluctuations in earnings with punishment phases.
  - Recommendation and punishment phases are marked with distinct colors for clarity.
Combining communication and punishments

• The above suggests that public announcements have a more *immediate* effect

• But over time punishment stabilizes cooperation

• So possible benefits from combining them?
Combining communication and punishments

• Noussair and Tucker (2005) look at the impact of
  – (1) costly monetary punishments
  – (2) “scolding” which does not impose a monetary cost on either the sender or the receiver and
  – (3) a combination of both

• They find that it is the combination of the two that perform the best in terms of contributions/earnings

• Jordi Brandts and David Cooper suggest combining financial rewards/penalties with communication to achieve efficient outcomes in coordination problems
Applications to Economics

• The applications of these ideas to real life economic problems are many and probably obvious to all of you.

• They range from preserving common-pool resources to improving tax morale and tax compliance.

• Besides the other examples I talked about at the outset such as contributions to public goods or to charitable causes.
Elinor Ostrom, Winner of the Nobel Memorial Prize in Economics, 2009

- Elinor Ostrom has challenged the conventional wisdom that common property is poorly managed and should be either regulated by central authorities or privatized. Based on numerous studies of user-managed fish stocks, pastures, woods, lakes, and groundwater basins, Ostrom concludes that the outcomes are, more often than not, better than predicted by standard theories. She observes that resource users frequently develop sophisticated mechanisms for decision-making and rule enforcement to handle conflicts of interest, and she characterizes the rules that promote successful outcomes.
Well, that’s my story and I am sticking to it.
Further reading


• A copy of this presentation is available on my homepage http://homes.eco.auckland.ac.nz/acha192/