6. Repetition and Reputation: Resolving the Prisoner’s Dilemma

6.1 Repetition: The Folk Theorem

The Folk Theorem of game theory says that for sufficiently low discount rates, any price between the monopoly (or joint-profit-maximising) price and the break-even or competitive price (any individually rational price) can be sustained as an equilibrium in the infinitely repeated Prisoner’s Dilemma. (shaded below)

Figure 1. Payoffs for the Repeated Prisoner’s Dilemma

A low discount rate is equivalent to low impatience.

For the two-person Prisoner’s Dilemma, any individually rational outcome can
be supported for sufficiently low discount rates.
6.1.1 Coordinating on an equilibrium

The Folk Theorem doesn’t guarantee an equilibrium, and achieving a desired equilibrium, one amongst many, is a coordination problem, such as faced Shirl and Hal.

To price cooperatively, firms must coordinate on a strategy, such as Tit for Tat. A collusive agreement would achieve this — but illegal.

**Tit for Tat**: start off cooperating (pricing high) and then mirror the other player’s action in the last round.

Without an agreement or overt communication, the firms must find a focal point — a strategy so compelling that it would be natural for all firms to expect others to adopt it.

Focal points are highly context- or situation-specific. Especially difficult to coordinate in competitive markets that are turbulent and changing rapidly.

Sometimes facilitated by traditions and conventions that make rivals’ moves easier to follow or their intentions easier to interpret.

(See Hofstadter in the Package.)
6.1.2 Why Is Tit-for-Tat So Compelling?

Consider the Grim Trigger Strategy:

Starting with this period, we shall raise our price to the high, joint-profit-maximising price; if, in any following period, any firm deviates from this price, then we shall drop our price to our break-even price in the next period and keep it there forever.

Relies on the threat of an infinitely long price war to support collusive pricing.

Why Tit for Tat? Why not the Grim Trigger? Well, Tit for Tat is:

• clear — easy to describe and understand
• nice — starts off cooperating
• provocable — one defection and you’re on
• forgiving — one cooperation and it relents.

Moreover, it’s pretty robust, as Axelrod’s computer experiments showed, but it’s not always the best (at best it can tie with another strategy).

But flawed? Misperception of the other’s last move can be very costly: misreading a Cooperate as a Defection → DC, CD, DC, ⋯ Breakdown, mistake echoes.
TfT doesn’t include “Enough is enough”. It’s too easily provoked. If the probability of mistakes → 50%, then Always Defect.

How about:

1. begin cooperating
2. continue cooperating
3. keep count of how many times the other side appears to have defected while you have cooperated
4. when this count becomes “too high”, then TfT (as punishment, that is)

The question remains of defining “too high”.

**Case:** How misunderstanding can lead to price wars

It may be that many real-life price wars are not started by deliberate attempts by one firm to steal business from its competitors, but instead flow from misreads and misunderstanding of rivals’ behaviour.

Such as Besanko’s tyre manufacturers (in the Package).
6.1.3 How market structure affects the sustainability of cooperative pricing

Under certain market structures firms will find it difficult to coordinate on a focal strategy, and their behaviour may be influenced by market structure.

Four conditions of market structure that may affect the attainment of cooperative pricing and competitive stability:

1. Market concentration (the number and distribution of firms),
2. Structural conditions that affect reaction speeds and detection lags,
3. Asymmetries among firms,
4. Multi-market contact between firms.
Four reasons why a firm’s response to its rivals’ actions might be delayed:

1. infrequent interactions,
2. lags in confirming rivals’ prices
3. ambiguities in identifying exactly who (among a group) is cutting price
4. difficulties in separating falls in sales due to rivals’ stealing from those due to unanticipated contractions in market demand.

All of these slow the firm’s reaction time, and so the effectiveness of retaliatory price cuts against defecting firms.

Several structural conditions affect the importance of these factors:

- Market concentration
- Lumpiness of Orders
- Information about sales transactions
- The number and size of buyers
- Volatility of demand and cost conditions
6.1.4 End-Game Behaviour

Beware end-game behaviour:

If players know when the game will end (how many rounds to go), then there may be unravelling of any cooperation/collusion.

But cooperation is observed anyway, perhaps because:

a. no fixed number, or

b. “nice” players initially, waiting to defect, or

c. low discounting of the future, so cheating deterred.

One good turn deserves another. You scratch my back and I’ll scratch yours.
**Case:** The 1992 U.S. Airlines Fare War

Why did Northwest Airlines (NWA) start a fare war in northern spring 1992 that was matched and later escalated by its rivals? The fare war deepened the losses in the industry.

Given the immediate computerised information about fares, the others would know and respond: how to increase profits this way?

But asymmetries: NWA had a poor route system, an inferior FF programme, and a bad reputation. With high prices, NWA would get less business than would American and United, with better route structures and better FF programmes, and NWA would fly almost empty planes.

Cutting prices has an effect not emphasised above: if the industry prices fall, total demand will rise.

So two benefits to NWA:

1. with price-sensitive vacationers, NWA’s competitive disadvantages minimised,

2. a disproportionate share of additional traffic with NWA.

So if NWA could fill its planes only by stimulating market demand, should do so when demand most elastic, during the summer.

Low-quality or low-share firms may gain more from defection (pricing low), even if the higher-quality rivals immediately match.
(See Besanko in the Package.)
Case: Price discipline in the U.S. tobacco industry

Reflecting its high concentration, until the 1990s the U.S. cigarette industry had a high degree of pricing cooperation.

Dominant firms (PM and RJ R) would announce the list price rises twice a year, and the others would follow: much above the inflation rate, and highly profitable (40% operating profit margins).

But L&M’s share had fallen from 21% in 1947 to 2% in the late 1970s — shutdown? Least to lose from undercutting, by selling discount cigs at 30% below branded. By 1984 its share had tripled, selling 65% of its output as discounts.

An insignificant niche? But B&W lost $50 m in revenues in 1983, and in 1984 undercut L&M’s discounts, as did other rivals: L&M’s share of discounts fell from 90% to 15% by 1989.

L&M then introduced “deep discounts” 30% below discounts, and their rivals followed: in 1992 three segments — a premium ($69/1000), a discount ($49/1000), and a d-d ($31/1000).

(See Besanko in the Package.)
Coordination of pricing in three tiers more difficult than a single tier, and growth in the cheaper tiers have come from the premium tier (when the total market was shrinking), with considerable substitution.

On “Marlboro Friday,” 3/4/93, PM cut its flagship’s price by 20%: Marlboro’s share had fallen from 30% to 21% over five years. Reluctance of rivals to raise their d-d prices: highly elastic demand and retailer reluctance.

Since then return of market discipline? Price increases in all segments in 1993, 1994, 1995: premium prices down 26%, discount up 8%, d-d up 48%, and Marlboro’s share up to 30% by mid-1995.
6.1.5 Firms’ practices to facilitate pricing cooperation

Firms themselves can facilitate cooperative pricing by:

- Advance announcement of price changes
e.g. Continental Airlines
- Price leadership
- Most-Favoured-Customer (MFC) Clauses
- Uniform delivered prices
- Strategic use of inventories and order backlogs
6.2 Punishment is guaranteed (MFC)

Examples of enforcing price collusion through a punishment guarantee — all in the name of “competition.”

Crazy Eddie (since convicted of fraud in New York) and Newmark & Lewis and their implicit cartel:

N&L will refund 100% of the difference, plus another 25%, or more in kind (asymmetric, detection of cheating, punishment of cheaters)

A **most-favoured-customer** (MFC) guarantee.

Du Pont and its “most-favoured-customer” clause: the seller will offer to those most favoured customers the best price he offers to anyone, which made expanding market share more costly.
6.3 A Choice of Punishment

Want:

• simplicity & clarity
• certainty: defection punished & cooperation rewarded

Question: how severe? to fit the crime? higher? (is it a punishment or a deterrent?) what if there are mistakes in detection?
6.4 Tit for Tat is not SGP

Tit for Tat is not subgame perfect.

Recent paper on Cournot duopoly: (Selten et al. 1997):

- no prediction
- no random decisions
- fixed outputs for Periods 1 and 2
- last fixed output < Cournot quantity
- decisions guided by few “ideal” points
- test opponent’s willingness to cooperate
- punish excess output
- follow other’s moves up or down
- end phase

- nothing optimised
- fairness criterion → ideal points
- cooperate via measure-for-measure, reciprocation