Learning to Coordinate: A Study in Retail Gasoline

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1The views and opinions expressed in our paper and in this talk are strictly those of the authors, and do not necessarily reflect those of the ACCC nor the Western Australian Government.
Green and Porter (1984): “It is logically possible for this agreement to be a tacit one which arises spontaneously. Nevertheless, in view of the relative complexity of the conduct to be specified by this particular equilibrium and of the need for close coordination among its participants, it seems natural to assume here that the equilibrium arises from an explicit agreement.”

Green, Marshall and Marx (2015), Ivaldi et al. (2003): the implementation of collusive agreements, both tacit and explicit, has been explored extensively. The issue of how collusion is initiated has largely been abstracted from, or presumed to be explicit.

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- the issue of how collusion is initiated has largely been abstracted from, or presumed to be explicit
This paper

We empirically study the tacit initiation of a collusive pricing structure

Context and data: urban retail gasoline market where we have the universe of daily station-level retail prices for 15 years

Our analysis of the evolution of pricing and conduct reveals 3 interconnected mechanisms for initiating collusion tacitly:

- price leadership
- focal points
- experimentation
Related literature

Ex-post case studies of known cartels and explicit collusion


Empirical studies of tacit collusion and coordinated effects


Learning and coordination dynamics in oligopoly

Roadmap

1. Overview of the context and data
2. 15 years of retail pricing
   - 2001-2009: (comparatively) competitive pricing
   - 2010-today: tacit collusion
3. Mechanisms for initiating tacit collusion
   - price leadership, focal points, experimentation
4. Collusive outcomes
   - price-cost margins, price stability, conflict resolution
5. Summary, policy implications
Retail gasoline market of Perth, Australia
- 1.7 million people, 472 gasoline stations
- 4 major retailers: BP, Caltex, Coles, Woolworths
  - station shares: 22%, 16%, 16%, 13%
  - prices centrally set by the major retailers
  - shares stable from 2004-2015

Price transparency policy - Fuelwatch
- price reporting website
- 24-hour rule
Context and Data

Data

Universe of station-level daily prices for 15 years
- 3 January 2001 - 31 December 2015
- \(\approx 1.8\) million station-date observations

Marginal cost: terminal gate price (TGP)
Context and Data

Data

Universe of station-level daily prices for 15 years
  ➤ 3 January 2001 - 31 December 2015
  ➤ \( \approx 1.8 \) million station-date observations

Marginal cost: terminal gate price (TGP)

In sum, the data and environment are characterized by
  ➤ simultaneous price setting
  ➤ perfect monitoring of rivals’ current and past actions
  ➤ common daily cost shocks

Context aligns well with standard repeated games framework for collusion (Friedman 1977)
Context and Data

Retail pricing

<table>
<thead>
<tr>
<th>Month</th>
<th>BP</th>
<th>Caltex</th>
<th>Woolworths</th>
<th>Coles</th>
<th>TGP</th>
</tr>
</thead>
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<td>01 Jan 2011</td>
<td>120</td>
<td>130</td>
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<td>150</td>
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<td>01 Apr 2011</td>
<td>150</td>
<td>160</td>
<td>170</td>
<td>180</td>
<td>150</td>
</tr>
</tbody>
</table>
Context and Data

Monthly average prices, costs and margins

[Graph showing trends over time with annotations for Coles Entry, Hurricanes, Crude oil shock, BP-Caltex price war, and marginal cost (TGP).]

- BP
- Caltex
- Woolworths
- Coles
- Marginal Cost (TGP)
- Cycle Breakdown
15 Years of Retail Pricing

To study the evolution of pricing, it is helpful breakdown price cycles into two components

- price jumps
- price cuts
Price jumps, cycle restarts
“Day 1 of the cycle”

15 Years of Retail Pricing
Defining price jumps, cuts and cycle length
15 Years of Retail Pricing
Defining price jumps, cuts and cycle length

Price cuts
“Days 2,3,4,… of the cycle”
15 Years of Retail Pricing
Distribution of price changes: 2001-2003
15 Years of Retail Pricing

Distribution of price changes: 2006-2007
15 Years of Retail Pricing
Distribution of price changes: 2009-2015
15 Years of Retail Pricing

Inter-temporal variation in price cuts

![Graph showing mean price change over time with different cycles marked.](image)
15 Years of Retail Pricing

Day of the week when price jumps occur

[Graph showing the day of the week with price jumps marked, with dates ranging from 01 Jan 2000 to 01 Jan 2015. The graph indicates that price jumps tend to occur on weekends, particularly on Saturdays.]
15 Years of Retail Pricing
Inter-temporal variation in cycle length
In summary, starting in 2010 we observe
- Emergence of 2 focal points
  - 2 cpl daily price cuts
  - Thursday price jumps
- \( \approx 75\% \) increase in profit margins

This tacitly collusive pricing structure took a long time to emerge - 10 years!
- despite perfect observability/monitoring of own and rivals’ daily prices and price history
Initiating Tacit Price Coordination

Overview

How was tacit collusion initiated?

Analysis consists of 4 parts

2. Price war (2009-10)
3. Price leadership and experimentation used to establish the focal points (2009-12)
4. Collusive outcomes: price-cost margins, price stability, conflict resolution
Aggregate Shocks and Price Leadership

Global Crude Oil Price Shock

[Graph showing trends for different dates with markers for BP Price, Caltex Price, Woolworths Price, Coles Price, and Global Crude Price Shock.]

- **BP Price**
- **Caltex Price**
- **Woolworths Price**
- **Coles Price**
- **Marginal Cost (TGP)**
- **BP Leaders**
- **Caltex Leaders**
- **Woolworths Leaders**
- **Coles Leaders**
- **Global Crude Price Shock**

[Table with dates and corresponding prices and leaders for each company.]
Price War

Pre-cursor to the new pricing structure
Price War

Pre-cursor to the new pricing structure
Price War
Pre-cursor to the new pricing structure
Price War
Pre-cursor to the new pricing structure
Focal point #1: Thursday price jumps

2011: BP price leadership with price jumps
Focal point #1: Thursday price jumps

2013: No price leadership with price jumps
Focal point #1: Thursday price jumps

Stations’ propensities to engage in Thursday Price jumps (BP)

BP re-initiates cycle after 2008-09 collapse
BP stops leading cycles on Weds

% of Stations Engaging in Price Jump

Date

Mon  Tue  Wed  Thu  Fri  Sat  Sun

22/29
Focal point #1: Thursday price jumps

Stations’ propensities to engage in Thursday Price jumps (Caltex)
Focal point #1: Thursday price jumps

Stations’ propensities to engage in Thursday Price jumps (Woolworths)
Focal point #1: Thursday price jumps

Stations’ propensities to engage in Thursday Price jumps (Coles)
Focal point #1: Thursday price jumps
Stations’ propensities to engage in Thursday Price jumps (Gull)
Focal point #1: Thursday price jumps

Zoomed in: **Wednesday** price jumps, all firms, start of 2010

![Diagram showing number of stations with Wednesday price jumps from 2009 to 2010, with data points for BP, Caltex, Woolworths, and Coles, and markers for BP Leadership, BP-Caltex Conflict Period, Gap 1, and Gap 2.]
Focal point #1: Thursday price jumps

Zoomed in: Thursday price jumps, all firms, start of 2010
Focal point #1: Thursday price jumps

BP price leadership and experiments

![Graph showing the number of stations leading price jumps over time, with markers for BP, Caltex, Woolworths, and Coles. The graph highlights gaps in price leadership and the end of BP's leadership experiment.]
Focal point #1: Thursday price jumps

BP price leadership and experiments

![Graph showing number of stations leading price jump over time for BP, Caltex, Woolworths, and Coles. The graph includes dates from 01Jan2009 to 01Jan2013, with a clear visual indication of BP price leadership ending and experiments.](image-url)
Focal point #1: Thursday price jumps

BP price leadership and experiments

BP  Caltex  Woolworths  Coles
BP Leadership  BP Experiment

BP Price Leadership Ends

01jan2009 01jan2010 01jan2011 01jan2012 01jan2013

Date

Number of Stations Leading Price Jump

0 10 20 30 40 50

01jan2009 01jan2010 01jan2011 01jan2012 01jan2013

BP Leadership

BP Experiment

Gap 1

Gap 2
Focal point #2: 2 cpl price cuts

Stations’ propensities to set 2 cpl price cuts
Focal point #2: 2 cpl price cuts

Testing the focal point

![Graph showing the fraction of stations with price cuts over time.](chart)
Summary

How is collusion initiated?

We found price leaders can establish focal points that facilitate tacit price coordination

Evidence points to experimentation is an important mechanism for initiating tacit collusion

- testing firms’ willingness to coordinate on focal pricing rules
- communicating intentions to coordinate
- creating common knowledge regarding collusive pricing strategy

Price leadership and experimentation, not punishment, was used to resolved conflict

Collusive outcomes: enhanced margins, price stability, improved conflict resolution
Empirics speak to earlier (e.g., pre-repeated games) theories of tacit collusion

- price leadership: Bain (1968)
- focal points: Schelling (1960), Scherer (1967)

Findings point to recent theories of communication, experimentation, and learning in games as frameworks for collusion initiation (Crawford 2016; Fudenberg and Levine 2016)

Despite perfect monitoring of rivals’ behavior...

- a relatively simple tacitly collusive pricing structure was implemented
- and it took 10 years for the pricing structure to emerge
Results point to 2 aspects of market structure that can potentially facilitate coordinated effects

- firm size asymmetry
- price transparency policies

Using rich price data (e.g., long panel data at high frequency) to detect collusion at the initiation stage