

Edgeworth Price Cycle and Oligopoly Coordination: Trial Evidence from Australia*

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Abstract

Asynchronous-move leads to a free rider problem at the bottom of a Maskin and Tirole (1988) Edgeworth price cycle, and this free rider problem, in the presence of three or more firms, gives rise to coordination failures in equilibrium. Evidence from a recent trial in Australia, in particular a data set that records the inter-firm communication patterns and the exact time (down to the minute) and size of price increases, shows strongly that the retail gasoline price cycles observed in an Australian market are Edgeworth price cycles. Importantly, the firms increase prices sequentially, and despite the use of explicit communication and other facilitating practices, the coordination to return price to the cycle top often failed.

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1. Introduction

Supergame-theoretic oligopoly pricing models have been confronted with field data in many empirical studies (e.g., Porter 1983, Slade 1992, Ellison 1995, and Shepard and Borenstein 1996). On the other hand, the Maskin and Tirole (1988, hereafter MT) approach to dynamic oligopoly pricing, which contrasts sharply with the supergame approach, has not received much empirical testing in the literature. This paper presents strong evidence from a recent trial in Australia to show that the firms in an Australian gasoline market coordinated (colluded) explicitly on the MT Edgeworth price cycle equilibrium.

In the MT Edgeworth cycle equilibrium, two firms undercut each other alternately until the price reaches the competitive level, at which point the two firms engage in a war of attrition. Importantly, the asynchronous-move assumption results in a coordination problem at the cycle bottom: both firms wish the price to be hiked to the monopoly level, but neither would like to be the first to do so. Relenting is a public good. Mixed strategy is used by MT to resolve the coordination problem: a firm attaches positive probability to keeping its price at the competitive level so that it relents with probability of less than one.

The logic of the MT model suggests that, as the number of firms increases, the coordination problem becomes more severe. In a 2-player model, once one firm relents, the other firm is guaranteed to follow by the force of strategic complementarity. In a N -player model, where $N \geq 3$, after one firm has relented, the $N-1$ remaining firms all wish to follow, but each still has the incentive to be the last to hike price; the free rider problem still exists. If the firms rely only on mixed strategies to decide which firm is the next to relent, a firm should attach positive probability to keeping its price at the competitive level as long as it is not the last firm to hike price. It is not until $N-1$ firms happen to hike their prices *consecutively* that the force of strategic complementarity comes into play and assures the

success of the price hike. Therefore, in a N-player MT model, the firms have the incentive to coordinate price hikes through facilitating practices other than mixed strategies.

A few recent studies (Eckert 2002, 2003; Noel 2004, 2005) have documented that the retail gasoline price observed in a number of Canadian cities exhibits a cyclical pattern that is very similar in shape to the MT Edgeworth cycle. This literature, to be reviewed, has made considerable progress toward understanding the observed gasoline price cycles. However, this literature has not attempted to address explicitly the deep questions in testing the MT cycle theory: (1) Do the firms in a gasoline market set prices sequentially? (2) Are they subject to the coordination problem inherent in the MT cycle equilibrium? If so, how do they resolve the coordination problem? It is important to answer these questions not only for the purpose of testing theory, but also for making sound policy recommendations. The issue of regular gasoline price cycle is currently a subject of public debate and government scrutiny in Canada and Australia, and was a subject of debate in the US in the 1960s and early 1970s.¹ Noel (2005, p.2) concludes that “evidence suggestive of Edgeworth Cycles would help rule out other hypothesis such as covert collusion, the subject of numerous resource-consuming investigations.” Is this the right policy recommendation?

This paper documents that the gasoline firms in the Australian city of Ballarat colluded explicitly on the MT Edgeworth cycle equilibrium. The evidence comes from a recent trial before the Federal Court of Australia. The retail gasoline price in the Ballarat market exhibited the Edgeworth shape,² and the key issue of the trial is whether three

¹ See the 1998 Report of the Liberal Committee on Gasoline Pricing in Canada for the controversies surrounding the regular price cycles in Canada. See Australian Competition and Consumer Commission (2001, 2002) for the controversies surrounding the regular price cycles in Australian major cities. Allvine and Patterson (1972) document that retail gasoline prices exhibited a cyclical pattern in a large number of US cities in the 1960s and early 1970s.

² The retail gasoline price in the Ballarat market “was characterized by gradual decreases in price followed by a sudden and significant increase.” December 17, 2004 Judgment, ¶29. Put in another way, retail gasoline prices

contesting firms were participants to a price-fixing understanding that “provided a process by which price increases may be fixed or controlled.”³ The trial produced a detailed record about the price-increase processes that highly accommodates empirical testing. The analysis in this paper is straightforward and the evidence is based largely on a price data set that records the exact time (down to the minute) and size of the price increases over a roughly 18-month period and a complete record of the inter-firm phone activities during a 3-month period. The Judgment by the trial Court and the testimonies of a few individuals are used to provide the institutional background for the analyses and to interpret the empirical findings.

The main findings are the following. **First**, the price setters in the market were firms that controlled the retail sites through ownership or vertical restraints. A large number of inter-firm phone calls were made to coordinate the price-hikes on those days when several firms hiked their prices, but few or no inter-firm calls existed on the other days. **Second**, the firms always set their prices in sequential orders. In particular, a system of price leadership and uncommitted followership was in place. The price leaders initiated notification and follow-up phone calls, but market followers, even after receiving calls, often did not follow the leaders’ price hikes soon enough, thus forcing the leaders to return their prices to the cycle bottom. **Third**, a firm always hiked its price to the cycle top in a single jump and the reactions were very fast: half of the successful price-hike attempts were finished within 5 hours and 20 minutes.

The rest of the paper is organized as follows. Section 2 reviews the MT dynamic pricing theory and related literature. Section 3 presents the background information on the

“follow a ‘sawtooth pattern’, that is, prices increase rapidly over a short period of time and then steadily decrease.” March 17, 2005 Judgment, ¶3.

³ December 17, 2004 Judgment, ¶47.

players in the market. Section 4 examines the communication patterns and the coordination process. Section 5 analyzes the cycle dynamics. Section 6 concludes.

2. The Maskin and Tirole Theory and Related Literature

In the MT dynamic pricing model, a symmetric Bertrand duopoly game is infinitely repeated. This model departs from the standard supergame framework in two important aspects: the timing of play and the strategy available to the players. The players are assumed to set their prices alternately rather than simultaneously to “capture the idea of reactions based on short-run commitment,” and to play Markov strategies in that the price of a firm in a particular period is a function of payoff-relevant variables only, i.e., the price set by the other firm in the previous period.

Notice that market demand and marginal cost are constant in this model, yet in this stationary environment, Maskin and Tirole shows that Edgeworth price cycle can emerge as the equilibrium. Edgeworth price cycle has a radically asymmetric shape: the price of a particular firm is characterized by a sequence of small-size decreases over many periods, but a one-step hike from the competitive level to approximately the monopoly level. The single-step price hike is able to achieve the strategic benefit of starting a new cycle near the monopoly level because, with only two players, once one firm has hiked its price, the other firm’s best response, due to the presence of strategic complementarity, is to follow with a slightly smaller price hike in the subsequent period. The size of undercutting is small since neither firm, assumed not to use strategies of punishment nature, would like to rush back to the cycle bottom.

As mentioned, the firms, at the cycle bottom, face the coordination problem of deciding which firm is the first to relent. Relenting has the properties of a public good, and

the provision of this public good is allocated through the mechanism of mixed strategy. In a 2-player model, if the two firms are symmetric, they are equally likely to be the price leader for a given cycle. If the two players are of unequal size, as in Eckert (2003)'s extension of the MT model, the probability of being a price leader depends on their relative size. For some parameter values, the bigger firm is more likely to be a price leader, and for other values, the smaller firm is more likely to be a price leader. Because of its clean resolution in the two-player models, the public good problem has not attracted the attention that it deserves. Importantly, in a model with three or more firms, the public good problem can lead some firms *in equilibrium* not to follow the price-hikes of others. As a successful price-hike "attempt" requires $N - 1$ consecutive price increases, it becomes more difficult to return price back to the cycle top as the number of firm increases. It is reasonable to postulate that if the number of firms is very large, the MT Edgeworth price cycle cannot arise because the probability of all firms hiking their prices consecutively converges to zero. This provides a unique exemplary model for the intuitive but hard to formalize idea that coordination becomes more difficult as the number of firms increases.

My conceptual argument is supported by Noel's (2004a) simulation work.⁴ When simulating a 3-player MT model, Noel (p. 16) finds "'delayed' starts in which following firms do not follow immediately and even 'false' starts in which the relenting firm returns to the bottom when others do not follow soon enough." This simulation result is expected. In a market with three players, after one firm has raised its price, the second firm to move may keep its price at the cycle bottom as a result of the free rider problem. The third firm to move is then not bound to hike price either, and consequently, the first firm may return its

⁴ Noel (2004a) finds that Edgeworth price cycle can exist under a variety of settings, including 2-player models with product differentiation, capacity constraints, size asymmetry or market disturbances.

price to the cycle bottom. It is not until two firms happen to hike their prices successively that the price returns to the cycle top.

Unlike supergame models, where interesting dynamics are largely driven by uncertainty or fluctuating demand,⁵ the MT Edgeworth cycle is generated in a stationary market environment (constant demand and cost). The empirical testing of the core structure and predictions of the MT model, therefore, can be conducted without using demand or cost data.⁶ However, it is difficult to uncover how the firms in a market resolve the coordination problem because the firms may resort to facilitating practices, tacit or explicit, that may be unobservable to economists. It is also difficult for economists to collect a data set that records the exact timing and size of the price changes, a data set that is needed for investigating the players' dynamic reactions.

There exists a small but growing literature attempting to understand the price cycles observed in various gasoline markets. Castanias and Johnson (1993) is the first to recognize that the gasoline price cycles have the Edgeworth shape. Eckert (2002) finds evidence that Edgeworth cycle may explain the empirical regularity that retail gasoline price responds quickly to wholesale price increase but slowly to wholesale price decrease. Eckert's (2003) model of two asymmetric players is motivated by his empirical evidence that the presence of gasoline price cycles in Canadian cities is correlated with the presence of small independent firms. Eckert shows that cycle exists in his model for any feasible relative firm size, but the kinked demand equilibrium cannot exist if one firm is much larger than the other. Noel (2004b) also presents evidence that gasoline price cycles are more likely to occur in those Canadian markets with larger presence of independent firms. With a self-collected data set

⁵ Green and Porter (1984) assume demand uncertainty and asymmetric information. Rotemberg and Saloner (1986) and Haltiwanger and Harrington (1991) assume fluctuating demand.

⁶ Demand and cost conditions in a market could affect the cycle dynamics, but do not alter the core structure and predictions of the cycle equilibrium.

of twice-daily retail prices for 22 gasoline stations in Toronto over a four-month period, Noel (2005) is able to show that the observed gasoline price cycle matches the Edgeworth shape very well, even though the data does not reveal the exact timing and size of the price changes. The retail price data also enables Noel to observe that retail sites of major brands are more likely to initiate price hike and sites of small brands are more likely to initiate price decrease. One may infer from this result that price leadership may have been used by the vertically integrated oil firms in the Toronto market to tacitly coordinate their price-hikes, but Noel (2005, p.20) writes that “there is no single price leader in the data. Several different firms lead prices higher and many different firms lead prices lower. The data also shows that each station’s price ranking changes frequently along the cycle, inconsistent with a central organizational (covert or tacit) structure.”

Wang (2005a) presents evidence showing that the MT Edgeworth price cycle can still arise even if the timing of price setting is synchronous. Wang studies the gasoline price cycles observed in the Perth metropolitan area, Western Australia, where the prices posted by every gasoline station, due to a law called the 24-hour-rule, must be set synchronously once every 24 hours. This law has been generating a data set that records the daily prices of all the (over 300) gasoline stations in the Perth metropolitan area since January 3, 2000. This remarkable data set affords the luxury of focusing directly on the pricing behavior of the oligopoly firms instead of the individual gasoline stations. The data shows that short-term commitment arises endogenously, giving rise to asynchronous price setting. The data also shows that the oil firms in the Perth market synchronize and homogenize intra-brand retail price increases through vertical restraints, and use a price leadership and followership system to coordinate price-hikes as well. However, unlike in the Ballarat market, price leadership in the Perth market appears to be allocated by mixed strategies and followership

is nearly automatic, thus coordination failure rarely exists. By estimating the firms' reactions function, Wang also tests and finds support for the Markov restriction. Wang (2005b) estimates the demand functions for a number of individual gasoline stations in the Perth market by matching their daily prices with daily sales quantities. The estimated own price elasticity of demand for individual gasoline stations ranges from -5 to -19.

3. The Players in the Ballarat Gasoline Market

Table 1 provides the basic information of the firms or price setters in the Ballarat gasoline market over the period June 1999 to December 2000.⁷ Column 2 is the firms that operated or controlled the retail sites and column 3 shows the gasoline brands.⁸ BP, Mobil, Shell and Ampol⁹ were the major oil brands in the market. The retail sites of a major brand in the Ballarat market may be operated by two separate firms. Shell branded retail sites in the market were controlled by two firms: Brumar and Triton. Brumar was a multi-site Shell franchisee, whose fuel was supplied by Shell Australia. Triton was a wholesale distributor that supplied Shell branded gasoline to independent Shell retail outlets. Triton was found by the Court to be a participant in the price-fixing understanding, because Triton effectively controlled the retail price of the independent Shell sites through a special form of vertical restraints that will be discussed in section 4. While most of the Ampol branded retail sites in the market were controlled by the firm Chisholm, two Ampol branded sites (called Ampol Road Pantries) were operated by Ampol franchisees.

⁷ The trial was focused on the 18-month period, but many individuals testified and the trial Court accepted that the price-fixing understanding started in the early 1990s. The Ballarat gasoline market is thought to be the area in and around the city of Ballarat, a city with a population of about 84,000.

⁸ The firms controlled the retail sites by direct ownership or consignment agreement. Consignment agreement is a commission agreement that enables the firm to own the right of fuel until it is sold at the retail outlet.

⁹ Ampol, a petroleum firm, was merged with Caltex in 1995. Some Ampol sites may carry the Caltex brand.

Swift, Apco, United, Alien, Safeway, and Liberty were the independent brands in the market. United opened a retail site in the Ballarat market in early 1999, and it “aggressively challenged Apco’s position as the discount leader.”¹⁰ Safeway, a supermarket chain, started to operate a gasoline station in early 2000, and it offered a 6-cent per liter discount to those customers who purchased from Safeway certain amount of non-fuel products.

Table 1: Basic Information of the Firms in the Ballarat Market

No.	Firm	Brand	No. of sites	Respondent to the case?
1	Leahy	BP	6-25	Y
2	Balgee	Mobil	8	Y
3	Chisholm	Ampol	5	Y
4	Brumar	Shell	5	Y
5	Triton	Shell	5	Y
6	Swift	Swift	4-5	Y
7	Apco	Apco	2	Y
8	United	United	1	N
9	Franchisees	Ampol	2	N
10	Alien	Alien	1	N
11	Safeway	Safeway	1	N
12	IGA/Liberty	Liberty	1	N

Sources: This table is constructed from the various documents in the case. The number of retail sites for each firm is found at ¶13, ¶33 ¶107, ¶166, ¶168 and ¶257 of the December 17, 2004 Judgment, at ¶10, ¶11, ¶13, ¶16 and ¶ 75 of the March 17, 2005 Judgment, and the testimonies of various individuals. In particular, according to the ACCC, Leahy controlled between 18 and 25 sites during the relevant period, but Leahy claimed that it controlled between 6 and 15 sites (March 17, 2005 Judgment, ¶13, ¶75). Chisholm controlled about 17 sites in the greater Ballarat area, but only the 5 sites within the city of Ballarat was thought to be involved in the price-fixing understanding (March 17, 2005 Judgment, ¶11).

The number of retail sites operated by each firm is suggestive of its market share. Also informative is the fact that some retail stations are high-volume sites while others are low-volume ones.¹¹ The retail sites of Brumar (Shell), Swift, Apco, United, Ampol Road

¹⁰ December 17, 2004 Judgment, ¶33.

¹¹ High-volume sites are generally high-visibility sites that are located on major road or at corners with a large amount of passing traffic. These sites usually have multiple pumps to accommodate several customers simultaneously.

Pantries and Safeway are all high-volume sites. The sites of Chisholm (Ampol),¹² Alien, Liberty and Triton (Shell) were all low-volume sites. The sites of Leahy (BP) and Balgee (Mobil) include both high- and low-volume ones.

Note that only the first seven firms in table 1 are respondents to the proceeding.¹³ Leahy (BP), Balgee (Mobil), Chisholm (Ampol), Swift and/or the individuals acted on their behalf admitted to the price-fixing understanding. In particular, these four firms initiated inter-firm phone calls to coordinate the price hike process. The issue in the proceeding is whether the three contesting firms (Apco, Triton and Brumar) were parties to the price-fixing understanding. The trial Court found all three contesting firms to be participants, but Apco appealed and the full Court reversed the trial Court's conclusion with regard to Apco.

4. Communication and Coordination

4.1 Communication Patterns

The communication between the players primarily takes the form of phone calls; face to face meetings are rare.¹⁴ The pattern of phone calls can be seen from one of the key documents in the case, Exhibit DA-13.¹⁵ This document records the exact time of every phone call between the first 10 players in table 1 on every day over the 90-day period February 1 to April 30, 2000. Exhibit DA-13 also reports information of price changes by a

¹² From ¶8 of the December 17, 2004 Judgment, one may infer that some sites operated by Chisholm were high-volume sites, but the witness statements of both Robert Levick of Balgee, at ¶61, and Brendan Zala of Chisholm, at ¶40, stated that the Chisholm sites are low-volume sites.

¹³ A number of individuals who acted on behalf of these firms are also respondents to the case. It is useful to note that the individual who acted on behalf of Chisholm is not a respondent to the case.

¹⁴ In about June 1999, a meeting was held to discuss the impact of the entry of United on the market, which is reduced margin and more frequent price cycles, and the need to ask United to be included in the price-coordinating process. A meeting was held in August 2000 and another meeting was held in December 2000. At both meetings, the participants discussed the impact of the discount program offered by Safeway on the gasoline market.

¹⁵ The original Exhibit DA-13 is to the affidavit of David Ablett affirmed September 1, 2003. The amended version, used in this paper, is Exhibit NMA-6 to the affidavit of Natalie Maree Atrill sworn April 14, 2004.

sample of 9 retail sites: one site for each of the first 6 respondent firms (Leahy, Balgee, Chisholm, Brumar, Triton and Swift), the 2 Apco sites and the United site. Further details of the price data are provided in section 5. For the moment, suffices to note that the number of retail sites that increased price on a given day can be easily identified.

Table 2, derived from Exhibit DA-13, reports the daily number of phone calls among the players and the number of retail sites that increased price on a given day over the 90-day period. It is clear that these two time series exhibit periodic jumps that appear to coincide with each other. While no retail site increased price on 61 days and only one or two sites increased price on 13 days, four or more retail sites increased their prices significantly on the other 16 days. These 16 days are called by the Australia Competition and Consumer Commission (ACCC) and the trial Court as price-increase days and the other 74 days as non-price-increase days. On each of the 16 price-increase days, a large number of phone calls were made by the players to each other: the average is 36.8 per day and the minimum is 21. On the 74 non-price-increase days, however, only an average of 3.9 inter-firm calls per day was made.

< Insert Table 2 around here >

The much larger number of inter-firm phone calls on the price-increase days led the ACCC to draw the inference that the inter-firm calls on the price-increase days were related to the price increases on those days. This observed communication pattern is consistent with the N-player MT model. Recall that the model does not predict the use of explicit communication, but it does show that the *incentive* for coordination exists when the firms attempt to return price back to the cycle top, and that incentive does not exist during the cycle falling phase. Hence, explicit communication, if used, is more likely to occur on those days when the firms attempt to hike their prices, such as the price-increase days identified

by the ACCC. It is not inconsistent with the model that a considerable number of calls occurred on some days when none of the sample sites increased price. The calls on those days may be about the price-hikes in the preceding or following days. It is also not inconsistent with the model that there were very few or no phone calls on some of the days when only one or two sites hiked price, for those price increases may not represent distinctive price-hike attempts and the theory does not predict communication must occur.

Tables 3(a) and 3(b) display the total number of inter-firm phone calls, by caller and receiver, on the 16 price-increase days and the 74 non-price-increase days, respectively. A cell in either table records the total number of calls the row player made to the column player. Several cross section patterns of inter-firm communication emerge from these two tables. **First**, 509 (86%) out of the 589 inter-firm phone calls on the 16 price-increase days were made by four firms: Chisholm-Ampol (236), Balgee-Mobil (149), Leahy-BP (65), and Swift (59). This evidence is consistent with the trial Court's finding that these four firms are the initiating respondents. **Second**, the calls received by a particular market follower on the price-increase days came largely from a single caller: 44 out of the 47 calls to Apco were from Leah-BP; the 26 calls to Brumar-Shell were all from Triton; the 18 calls to United were all from Swift; 61 out of the 62 calls to Ampol Road Pantries were from Chisholm-Ampol. Notice that there were no phone calls among the market followers except for those between Triton and Brumar, both under the Shell brand. **Third**, there were a small number of inter-firm phone calls between some of the players on the non-price-increase days. The trial Court stated that there were normal commercial transactions between Apco and Leahy,

Apco and Swift, Brumar and Triton, but there was “little or no reason for the other corporate respondents to have extensive telephone communications with each other.”¹⁶

< Insert Tables 3(a) and 3(b) around here >

The observed call patterns appear to be a reflection of the underlying communication arrangement. The market leaders called the followers through specific points of contact. Leahy and, to a much lesser degree, Swift were the points of contact for Apco; Chisholm was the contact for Ampol Road Pantries; Swift was the main contact for United; Three market leaders contacted Triton, but none of the market leaders had direct access to Brumar; Triton (Shell) is the sole intermediary between the market leaders and Brumar (Shell). These communication channels are related to the social and business ties between the firms. For example, the Apco director refused to take calls from Chisholm, but took calls from Swift and Leahy for the Apco director and the individuals acting on behalf of Swift and Leahy were either family friends or had an established relationship for many years.¹⁷

4.2 The Coordination Process

How the inter-firm phone calls were used by the players to coordinate the price-hikes was brought to light by the testimonies of various individuals, including individuals who participated in the phone conversations and admitted to doing so. The coordinating process generally started with a market leader that intended to start a new attempt making calls to another leading firm about the size and approximate time of the intended price hike. The price-hike information was then communicated to other leading firms and, through the

¹⁶ December 17, 2004 Judgment, ¶284.

¹⁷ December 17, 2004 Judgment, ¶149, ¶158.

specific contacts, to the market followers.¹⁸ It was often the case that, even after receiving the advanced notice of price increase, some firms, in the pursuit of being the last to increase price, would not hike their prices at the proposed time. The individual who acted on behalf of Apco put it this way: “Not everybody was up in the market when they rang me the first time. United mightn’t have been up. So I’ve said, ‘Give me another ring in an hour, two hours. Check United again, give me a ring.’”¹⁹

When two or more firms strive to be the last to hike price, the need for further coordination arises. As most of the market followers did not communicate with each other directly, the market leaders acted as the intermediary and performed the task of coordination through follow-up calls. Despite the follow-up calls, many of the price-hike attempts failed. The trial Court observed that “on many of the price-increase days the price increase [attempt] did not take effect as it was not matched during the day by all of the main competitors.”²⁰ This is because “the price-fixing understanding provided for a process that enabled price increases to take effect, rather than for a commitment between all of the parties to it to increase their prices.”²¹ The firm who initiated the calls hiked price first, but “there was no expectation by any of the respondents that Apco’s preparedness to receive calls ... meant that Apco would substantially match the increased prices.”²² It is this finding of Apco’s lack of commitment led the full Court to reverse the trial Court’s conclusion that Apco was a party to the price-fixing understanding.²³

¹⁸ The price-hike information may be conveyed indirectly by coded languages such as “The market has moved” or “Go for a drive.” Both signal that the prices at some sites in the market have been hiked.

¹⁹ December 17, 2004 Judgment, ¶153.

²⁰ December 17, 2004 Judgment, ¶290.

²¹ December 17, 2004 Judgment, ¶290.

²² December 17, 2004 Judgment, ¶368. Note that United, another aggressive price discounter, is not a respondent to the case at all.

²³ Apco is the only party that appealed the case.

However, Apco understood that the purpose of the notification and follow-up calls “was to persuade or influence him to match the increase and that if he did not do so the price increase would collapse.”²⁴ Apco also “conceded in cross-examination that the information he received from [the phone calls] was useful because it helped him to know precisely when to tell his franchisees to check prices which helped him to ascertain the appropriate time to raise Apco’s prices. It also was helpful in that it allowed him to confirm that his franchisees were providing him with price-increase information in a timely and accurate fashion.”²⁵ One individual who acted on behalf of Chisholm testified that his purpose of participating in the phone calls was to “maximize the chance of the board price increase sticking.”²⁶

4.3 Vertical Control as a Facilitating Device

As mentioned in section 3, Triton was a wholesale distributor that supplied gasoline to independent Shell retail outlets, but it was found by the trial Court to be an active participant in the price-fixing understanding. This finding was based partly on the fact that Triton participated in the notification and follow-up calls and partly on that Triton exerted great control of the price of the Shell branded retail outlets through a price support system. An example is enough to illustrate the mechanism of price support.²⁷ Suppose the prevailing retail gasoline price is 80 cents per liter, but the independent Shell branded outlets have the contractual obligation to pay Triton a wholesale price of 85 cents per liter. Because the wholesale price is higher than the prevailing retail price, the retailers have to rely on the price support provided by Triton. By changing the size of the price support, Triton was able

²⁴ August 17, 2005 Full Court Judgment, ¶30.

²⁵ August 17, 2005 Full Court Judgment, ¶25.

²⁶ Brendan Zala, ¶77.

²⁷ Details of the price support system can be found at ¶13 through ¶21 of the December 17, 2004 Judgment.

to exert great influence on the retail price.²⁸ To hike the retail price, Triton withdrew its price support by calling the retail sites on the price-increase days.

In the N-player MT model, a large number of price setters is an impediment to successful coordination. Vertical price control has the effect of reducing the number of price setters. It is not surprising that in the Perth gasoline market, a similar price support system is used by one oil firm and multi-site franchisee agreements are adopted by the other oil firms (Wang 2005a). Price support schemes were also common in those US markets where gasoline price cycles were observed in the 1960s and early 1970s (Allvine and Patterson 1972, chapter 7). In Canada, the major oil firms are vertically integrated,²⁹ thus vertical price restraints are unnecessary.

4.4 The Incentive to be the Last to Hike Price

Why do some firms, *ex post*, strive to be the last to increase price? In the MT model, the last player to increase price enjoys the benefit of being the first to undercut. In the gasoline market, the players may have stronger incentives. Consider the following cross examination transcripts regarding Apco:³⁰

You would sometimes try to hold the price rise back a little bit to get the benefit of increased volume? --- Yes, I could.

I think you said ... that you would hold it back until the Indians [got] restless? --- Yes, I could.

Who are the Indians who would get restless? --- Well, it would be the locals in the town because if I didn't move up they'd come back down to match me.

Yes? --- There was always a period of time you knew you could stretch it to before it would fall over.

The Indians then were your competitors? --- Yes, competitors.

...

²⁸ It was Triton's practice to give a guaranteed 3 cents per liter margin to the retailers. Thus, in this example, Triton would provide a price support of 8 cents per liter, thus lowering the effective wholesale price to 77 cents per liter. Although a retailer is entitled to set a price different from 80 cents per liter, it has little incentive to do so: a higher retail price loses market share while a smaller price squeezes the margin.

²⁹ See the Report of the Liberal Committee on Gasoline Pricing in Canada, Ottawa, 1998.

³⁰ December 17, 2004 Judgment, ¶172.

Because if you didn't increase the increase wouldn't stick? --- I knew I could stretch it to a certain length of time when the market had moved up and then I'd have to move.

That's right. You have to move because if the Indians got restless they would bring their price back down? --- Yes.

You wanted to time it so that you got your increase just before the Indians got restless? --- Yes.

The individual who acted on behalf of Apco was not located in Ballarat, thus was not a local. The above transcripts suggest that one of the benefits of delaying price hike may be the increased volume of gasoline sales. Increased sales volume brings benefits to a price follower for two possible reasons. First, if a follower's price-cost margin is still positive while the leaders have hiked their prices, more volume means more profit. Second, it is very likely that increased gasoline sales also lead to increased sales of non-fuel products that command higher profit margins. A typical gasoline station sells many non-fuel products through its accompanying convenience store. In this context of multi-product firm, gasoline may be used a loss leader. Indeed, gasoline possesses the properties of a loss leader discussed by Lal and Matutes (1994) and Chevalier, Kashyap and Rossi (2003): it is a frequently purchased product, and its price is much easier to observe than the non-fuel products inside the store. The reported rationale for Safeway to offer the 6-cent per liter discount program is to attract customers into buying its non-fuel products.

5. Cycle Dynamics

5.1 Price Data

The price data for regular unleaded gasoline comes from two documents compiled by the ACCC. The first document is Exhibit DA-13 that has been used in section 4. Exhibit DA-13 records the positive price changes made by the 9 sample retail sites over the period February 1 to April 30, 2000. It also records the negative price changes made by the Apco

and United sites on the 16 price-increase days identified by the ACCC. The price information available for February 4, 2000, one of the 16 price-increase days, is shown in table 4. The price unit is Australian cents per liter. A remarkable strength of the price data is that it records the exact hour and minute of most price increases. The limited availability of negative price changes, however, prevents a study of the falling phase of the price cycles.

The second document is Annexure A.³¹ Similar to Exhibit DA-13, Annexure A provides price information on 53 more price-increase occasions³² identified by the ACCC over two periods (June 22, 1999 to January 31, 2000 and May 1 to December 8, 2000) that are adjacent to the 3-month period covered by Exhibit DA-13. Different from Exhibit DA-13, Annexure A does not record the positive price change, if there is any, on those days that are deemed by the ACCC as non-price-increase occasions.

Table 4: Price Data for February 4, 2000

Retail sites	Time (Hour : minute)	Initial price (Cents per liter)	New price (Cents per liter)
Leahy Truckstop	9:02	80.7	84.9
Apco Main Rd	10:04	80.7	80.5
Apco Skipton St	10:12	80.7	80.5
Brumar Car Spa	10:59	81.7	84.9
Balgee Depot	11:11	81.7	84.9
Swift Creswick Rd	11:16	80.5	84.9
Triton Taxi Co-op	13:44	82.9	84.9
Apco Main Rd	13:54	80.5	84.7
Apco Skipton St	14:06	80.5	84.7
Apco Skipton St	16:12	84.7	84.5
Chisholm Rowan View	n.a	81.7	84.7
United Howitt St	n.a	80.9	80.5
United Howitt St	n.a	80.5	84.7
United Howitt St	n.a	84.7	84.5
United Howitt St	n.a	84.5	84.3

Note: "n.a" stands for "not available".

³¹ The full name of this document is Further Amended Annexure A to the Statement of Claim. It is exhibit NMA-5 to the affidavit of Natalie Maree Attrill sworn April 14, 2004.

³² The term "occasion" is used here as the price hikes that constitute one attempt may take place over two days.

5.2 The Number of Price-hike Attempts

Does each of the 69 price-increase occasions identified by the ACCC in Exhibit DA-13 and Annexure A represent a distinctive price-hike attempt? A price-hike attempt might be said to have occurred if one or more firms in the market have hiked their prices, whether the price-hikes are followed or not. An observed positive price change can and should be presumed to be part of a price-hike attempt unless the data clearly indicates otherwise. This is due to the properties of the Edgeworth cycle equilibrium: any positive price change in equilibrium must take place at the cycle bottom, must be from the bottom to the cycle top, and must be of significant size. Price increase of small size does not occur in equilibrium because such a move loses market share, but cannot achieve the strategic benefit of starting a new price cycle near the monopoly level. The price data clearly indicates that the price-hikes on March 8, 2000 result from off-equilibrium behaviors,³³ thus the analysis that follows treats each of the other 68 price-hike occasions as a price-hike attempt.

How about the 13 days in Exhibit DA-13 on which only one or two sites hiked price? The price increases on 5 of those 13 days are very likely to be continuations of the price-hike attempts started the day before, and will be treated as such.³⁴ However, the single 4-cent price increase on March 3, 2000 may represent a price-hike attempt, though clearly failed, and the same may be said about the price increases on three additional days.³⁵ The

³³ An amazing sequence of price changes, the only one of its kind in the price record, took place on this day. At 8:34am, the United site decreased its price from 88.9 to 88.5 cents, indicating that the cycle is on the falling phase. However, at 9:26am and 9:31am, the two Apco sites decreased their prices sharply, from 88.9 to 80.9 cents. At 11:43am, the United site had another small step decrease, from 88.5 to 87.9 cents. At 1:08pm and 1:23pm, the two Apco sites raised from 80.9 to 87.9 cents. At 3:16pm, the United site decreased sharply, from 87.9 to 80.9 cents. At 3:40pm and 3:45pm, the two Apco sites decreased once again to 80.9 cents. Finally, at 5:35pm and 5:53pm, the two Apco sites increased from 80.9 to 87.5 cents, and at 6:19pm, so did the United site. These two firms clearly competed aggressively with each other.

³⁴ The five days are March 7, March 28, April 11, April 21 and April 29 of 2000.

³⁵ These three days are March 13, 14 and 15 of 2000. It is useful to note that the sample sites of Leahy and Balgee hiked price on each of the 68 price-hike attempts to be analyzed, but neither of them hiked price on these days.

price increases on three other days³⁶ probably do not represent price-hike attempts, because of their minuscule sizes, but if they do, the attempts certainly failed too. The analysis that follows ignores these seven days.

5.3 Basic Statistics

A total number of 706 price-change records is available for the 68 price-hike attempts. The maximum number of records for any attempt is 17 and the minimum is 7. Of the 706 price changes, 435 (61.6%) are positive, 188 (26.7%) are negative, and 83 (11.8%) are zero. The 188 negative price changes recorded here were all made by the Apco and United sites, and 104 (55.3%) out of the 188 recorded negative price changes are exactly 0.2 cents. For almost all of the records with a zero price change, only a statement as “Apco Main Rd No Change” is available. Sixteen price changes are known to be positive, but their sizes are unknown because the initial price is not available. For these 16 cases, only a statement as “[Chisholm] Rowan View increases to 79.9” is recorded.

The original price records from which Exhibit DA-13 and Annexure A were compiled are incomplete. Price record is always available for only three sample sites (Balgee, Brumar and Leahy). Price record is not available for the Swift site until the 23rd price-hike attempt on December 15, 1999. The United site has no record over 27 attempts, including 17 consecutive attempts over the period May 18, 2000 to September 25, 2000. The Chisholm site, the Apco Main Road site and the Triton site have no record over 1, 1, and 2 attempts, respectively. For these 53 instances of no record, a statement as “United Howitt St No Record” was recorded in Exhibit DA-13 or Annexure A. Nothing was said about the Apco site at Skipton Street over 8 attempts.

³⁶ The three days are February 25, March 2, and March 20 of 2000.

Figure 1: Histogram of 419 Price Increases

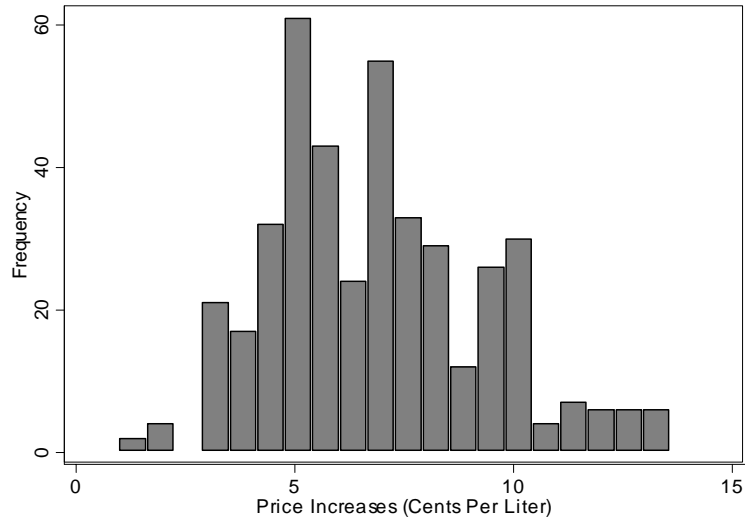


Figure 1 is the histogram of the 419 positive price increases for which the size is known. The average size is 6.9 cents per liter, with the minimum being 1.0 and the maximum 13.6 cents. Only 6 (1.4%) out of the 419 price increases have a size of less than 3 cents per liter. Considering that a normal price decrease is 0.2 cents, this fact is highly consistent with the MT price cycle theory: price increases of small size do not occur in cycle equilibrium. Also consistent with the theory, it is almost always the case that a sample site only hiked its price once during each attempt. The few exceptions are that Swift and Apco each hiked twice 3 times, and Balgee and Triton each hiked twice once. In each of these 8 exceptions, the second hike took place because the first hike was withdrawn. For this reason, the rest of the paper ignores the first hikes in these 8 cases and considers only the remaining 427 positive price increases, of which 411 have a known size.

5.4 Failed Attempts and Uncommitted Price Followership

The first aspect of the market leadership and followership in the Ballarat market, as documented in section 4, is about initiating and receiving price-hike phone calls. The second

aspect of the leader-follower mechanism concerns the manner in which the targeted price-hikes were carried out. This subsection tries to quantify how frequently a firm did not follow the price leadership and how many of the 68 attempts failed. The following subsection studies the dynamics of the successful price-hike attempts.

Table 5 presents the frequency and probability with which each sample site hiked its price. The price data indeed shows that four of the five market follower sites frequently chose not to hike price. Note that the two Apco sites had the same choice over 59 of the 60 attempts for which both sites have price records.³⁷ The Leahy and Balgee sites, on the other hand, hiked their prices for every attempt, confirming their price leader status. The sites of Chisholm and Swift did not hike price with particularly high probabilities, a finding seemingly inconsistent with their market leader status. However, the individual who acted on behalf of Chisholm testified that Swift did not hike price as often as Leahy and Balgee did, and it was “common” for him to make follow-up calls to Swift.³⁸ Swift initiated phone calls, but it was an independent brand. An individual who acted on behalf of Balgee gave similar testimonies.³⁹

Table 5: Frequency and Estimated Probability with which Each Site Hiked Price

Site	Leahy	Balgee	Chisholm	Swift	Brumar	Triton	Apco Skipton	Apco Main	United
Price-hike Freq.	68	68	39	35	63	48	40	39	25
Record available	68	68	67	46	68	66	60	67	41
Price-hike Prob.	1	1	0.58	0.76	0.93	0.73	0.67	0.58	0.61

The individual who acted on behalf of Chisholm also testified that the prices of most Chisholm sites, the Rowan View site included, might not be hiked until he was confident

³⁷ The difference in their estimated probabilities of hiking is due to the fact that nothing was recorded about the Apco site at Skipton Street over 8 attempts, while “No Change” (7 attempts) and “No Record” (1 attempt) were recorded for the other Apco site over the same 8 attempts. For this reason, 0.60 (=40/67) is possibly a better estimate of the probability of hiking by the Apco site at Skipton Street.

³⁸ Zala, ¶84, 157.

³⁹ Levick, ¶175 through ¶179.

that the price-hike attempt would succeed.⁴⁰ Recall that the Chisholm sites were low volume sites. Chisholm carried out price leadership at its two sites that were located close to key competitor sites through unique practices. The retail price displayed on the price boards at one site was hiked early in the price-hike process, but the actual price shown at the pump thus charged to the customers was not hiked until Chisholm was confident that the price-hike attempt would succeed. For the other site, the price board was made blank (displaying no price) until Chisholm was confident that the price-hike attempt would succeed. These intriguing practices had at least two functions: saving menu costs by avoiding the efforts of filling in the paperwork that would be wasted if the price-hike attempt did not succeed and signaling to competitors that Chisholm was hiking or ready to hike its prices.⁴¹

A market participant easily recognizes whether or not a price-hike attempt was successful. A researcher would also be able to do so if the price changes, positive and negative, were available, for the price collapses that indicate the failure of an attempt are very different from the gradual price decreases that characterize the cycle falling phase. Because the negative price decreases available are very limited, I identify whether or not an attempt failed by utilizing the trial Court's following observation:

“The price increase would not ‘stick’ unless all of the high visibility sites in the Ballarat [gasoline] market increased their retail prices to match the increase of the initiating respondents. If that did not occur within a relatively short period the price increase would collapse and the prices at the various retail outlets controlled by the initiating respondents, and any other respondents that had increased their prices, would return to the discounted levels they were at before the increase.” (December 17, 2004 Judgment, ¶25)

This observation is consistent with the MT theory that a successful price-hike attempt along the cycle equilibrium requires all the players to hike their prices.

⁴⁰ Zala, ¶124, 125.

⁴¹ Zala, ¶120, 122, 123.

Simple accounting shows that at least one key site did not hike price over 34 of the 68 attempts, suggesting a failing rate of 50%. Under the assumption that the event of price-hike success is a sequence of *i.i.d.* Bernoulli random variables with the success rate of 50%,⁴² the standard error of the estimate is 6%. This is a rather high failing rate, considering that the price-hikes were explicitly coordinated. How much should we trust this estimate? First, the accuracy of the estimate relies heavily on the assumption that Exhibit DA-13 and Annexure A record all the positive price changes made by the sample sites in relation to the price-hike attempts. Fifteen attempts are deemed unsuccessful for one of the sample high-volume sites has a “No Change” entry.⁴³ If any of such entries should in fact be a positive price change, the estimated failing rate would be biased upward. It is worth noting that the ACCC has strong incentives to record every positive price change in relation to the price-hike attempts available from the price records supplied to the ACCC.⁴⁴ As part of its case, the ACCC counted the number of times each of the respondent firms gave effect to the price-fixing understanding during the period June 22, 1999 to December 8, 2000. A “giving effect to” contravention requires “evidence of both one or more calls between the respondents *and* a price increase that appears to be part of a coordinated price increase on the day.”⁴⁵ Note also that over 5 price-hike attempts, “Did Not Work [the targeted price level]” was recorded in the diary of the individual who acted on behalf of Chisholm.⁴⁶ The

⁴² Under this assumption, the number of failed price-hikes between two successful price-hikes should be distributed as a geometric distribution. The chi-square good-of-fitness test cannot reject this hypothesis.

⁴³ Over each of the other 19 attempts, 2 or more sample high-volume sites did not hike price.

⁴⁴ The original price records on which Exhibit DA-13 and Annexure A are based were supplied to the ACCC in the forms of hand-written day books, printed reports of electronic day books, cash register printouts and diaries recording price changes. Affidavit of David Ablett affirmed September 1, 2003, ¶25.

⁴⁵ December 17, 2004 Judgment, ¶298. Emphasis is in original.

⁴⁶ The individual testified that “it was [his] practice to record the board price changes in [his] diary when [he] telephoned each of the Chisholm controlled sites to instruct them to change their board prices.” Zala, ¶128. In writing “Did Not Work”, Zala “recorded the fact that a board price increase had been planned but board prices had not stuck in Ballarat and board prices had returned to about the original low level.” Zala, ¶132.

price data indeed confirms that at least one high volume site did not hike price over each of these 5 attempts.

Second, note that the price data does not cover every high volume site, in particular, the two Ampol Road Pantries sites and the Safeway site, and the price records for two key sample sites (Swift and United) are unavailable for a considerable number of attempts. If these data weaknesses did not exist, one might find some of these sites did not hike price for some attempts, thus the estimated failing rate may be higher. Moreover, recall that a few days on which only one or two sites hiked price are ignored from the analysis.

5.5 Successful Attempts and Firm Reaction

This subsection examines the successful price-hike attempts from two dimensions: timing and size. Because the data set records the hour and minute at which many of the price increases were made, we are able to observe, for each successful attempt, the time of the first or leading price-hike, the time lags of the following hikes, and the duration of the price-hike process. Since the data also records the exact size of the price-hikes, we are able to see the extent to which the following hikes match the leading price-hike.

< Insert Table 6 around here >

Table 6 presents the time of the first price hike for each of the successful attempts and the time lags of the following price hikes. Chisholm and United are not included in the table because these two sites' time of price hike is largely unavailable.⁴⁷ The first price hike took place in the morning for 24 attempts, in the afternoon for 9 attempts, and the night before for 1 attempt. The Leahy site was the first to hike price over 25 attempts – the first price hike for an attempt is the one with a zero time lag (in bold in table 6). The Balgee,

⁴⁷ Time is available for only one Chisholm price-hike and six United price-hikes.

Brumar, Triton, and Swift sites, in that order, followed with median time lags of 1 hour and 17 minutes, 2 hours 4 minutes, 3 hours 7 minutes, and 4 hours 39 minutes, respectively. The two Apco sites were usually the last two to hike price, with respective median time lags of 4 hour 57 minutes and 5 hours 11 minutes.

These median time lags estimated from the successful attempts are in line with the estimated probabilities of hiking in the preceding subsection. Those sites (Leahy and Balgee) with a zero or a small median time lag are the ones that always hiked prices, and those sites with larger time lags, especially the Apco sites, are the ones that often foiled the attempts by opting not to hike price. It is also worth noting that the two Apco sites generally hiked their prices within a short span of 14 minutes. This high level of within brand synchronization along with the previous finding that they almost always chose the same choice confirms that the two Apco sites were not independent price setters.

The last column in table 6 shows the maximum time lag for or the duration of each price-hike attempt. The estimated median duration is 5 hours and 20 minutes, indeed a “short period of time.” Only five attempts have a span of more than 12 hours, and four of those five attempts finished in the morning but started the day before. For this reason, the statistic of median instead of average time lag is used. In contrast, the median number of days between two successful price-hike attempts is 10 days, implying that the cycle falling phase is much longer than the price-hike process.

< Insert Table 7 around here >

Table 7 shows, for each successful attempt, the hiked price level of the Leahy site and the difference in hiked price between the Leahy site and the other 8 sample retail sites. The Leahy, Balgee, Brumar and Triton sites hiked their prices to the same level over the vast majority of the attempts. The hiked prices of the Chisholm and Swift sites were usually 0.2

and 0.3 cents, respectively, less than that of the Leahy site, and the hiked prices of the Apco and United sites were usually 0.4 cents less than that of the Leahy site. Note that the Swift and Apco sites were also the last ones to hike price, which is consistent with the structural characteristic of the Edgeworth cycle equilibrium: those that move later increase less. Note again that the two Apco sites almost always hiked to the same price level.

6. Conclusion

This paper uses the unique trial record from a price-fixing case in Australia to study the gasoline price cycles observed in an Australian gasoline market. The data shows, in a straightforward way, that the firms set their prices sequentially and that the firms experienced a coordination problem at the cycle bottom, fundamental features of the MT Edgeworth price cycle equilibrium. The finding that many of price-hike attempts failed is also highly consistent with the predictions of the MT price cycle model with three or more players. These findings point strongly to the conclusion that the observed gasoline price cycles are realizations of the MT price cycle equilibrium, even though the data set does not permit an analysis of the gradual undercutting phases of the gasoline price cycles. It is perhaps surprising to see that the pricing dynamics generated by the price-fixing cartel in the Ballarat gasoline market can be characterized so well by the MT model, given that most cartels documented in the literature exhibit behaviors that cannot be easily captured by formal theories (see Genesove and Mullin (2001) for an example, and Levenstein and Suslow (2005) for a comprehensive review of cartels).

It is worth emphasizing that many price-hike attempts in the Ballarat market failed despite the fact that the firms in the market used explicit communication, price leadership and vertical restraints to facilitate and coordinate the price-hikes. This result suggests that

the coordination problem at the bottom of the MT price cycle is hard to resolve if the number of players in the market is large. It is then not surprising that the MT price cycle is so far only observed in those gasoline markets where either vertical integration or vertical price restraints are present. The strategic players in these gasoline markets are a few oligopoly firms that control the large number of retail gasoline stations, not the individual gasoline stations. Furthermore, the Ballarat case shows that the MT Edgeworth price cycle theory is not incompatible with collusive behavior. The presence of the MT price cycles in a market invites the question that how the coordination problem at the cycle bottom is resolved by the firms in the market.

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Table 2: Daily Number of Inter-Firm Phone Calls and Retail Sites That Increased Price:
February 1, 2000 to April 30, 2000

Date	No. of calls	No. of sites increased price	Average size of increases	Date	No. of calls	No. of sites increased prices	Average size of increases	
2/1	3	0		3/17	20	0		
2/2	4	0		3/18	2	0		
2/3	9	0		3/19	0	0		
2/4	*	27	3.62	3/20	0	1	0.60	
2/5	0	0		3/21	1	0		
2/6	1	0		3/22	0	0		
2/7	2	0		3/23	2	0		
2/8	1	0		3/24	6	0		
2/9	*	39	4.36	3/25	4	0		
2/10	6	0		3/26	0	0		
2/11	12	0		3/27	*	32	7	3.73
2/12	0	0		3/28	3	2	3.80	
2/13	0	0		3/29	1	0		
2/14	1	0		3/30	1	0		
2/15	3	0		3/31	13	0		
2/16	8	0		4/1	0	0		
2/17	*	40	7.90	4/2	0	0		
2/18	11	0		4/3	9	0		
2/19	0	0		4/4	*	50	4	5.75
2/20	0	0		4/5	13	0		
2/21	*	34	8.93	4/6	*	31	4	5.03
2/22	2	0		4/7	9	0		
2/23	2	0		4/8	0	0		
2/24	10	0		4/9	0	0		
2/25	21	1	0.90	4/10	*	44	7	7.06
2/26	0	0		4/11	1	1	6.60	
2/27	0	0		4/12	4	0		
2/28	*	46	4.17	4/13	5	0		
2/29	6	0		4/14	10	0		
3/1	2	0		4/15	1	0		
3/2	6	2	0.85	4/16	0	0		
3/3	15	1	4.00	4/17	1	0		
3/4	0	0		4/18	19	0		
3/5	0	0		4/19	*	28	4	10.15
3/6	*	42	8.85	4/20	*	21	8	8.15
3/7	11	1	5.60	4/21	1	1	3.00	
3/8	*	57	6.73	4/22	0	0		
3/9	7	0		4/23	0	0		
3/10	*	49	5.97	4/24	0	0		
3/11	8	0		4/25	0	0		
3/12	0	0		4/26	1	0		
3/13	1	1	2.2	4/27	4	0		
3/14	4	1	5.2	4/28	*	22	4	9.05
3/15	4	2	2.85	4/29	0	1	6.00	
3/16	*	27	5.9	4/30	0	1	1.80	

Note: Dates marked by “*” are the days identified by the ACCC as price-increase days. Price unit is Australian cents per liter.

Table 3(a): Total Number of Inter-firm Phone Calls on the 16 Price-increase Days
between February 1 and April 30, 2000

Firm	Leahy	Chisholm	Balgee	Swift	Triton	Brumar	Apco	United	Ampol franchisees	Alien	Total Made
Leahy (BP)		5	16				44				65
Chisholm (Ampol)	1		89	66	18				61	1	236
Balgee (Mobil)	54	71		16	8						149
Swift		24	5		2		3	18	1	6	59
Triton (Shell)		9	5	3		26					43
Brumar (Shell)				7	11						18
Apco	11		1								12
United				7							7
Ampol franchisees											0
Alien											0
Total Received	66	109	116	99	39	26	47	18	62	7	589

Note: The row player is the firm who made the call.

Table 3(b): Total Number of Inter-firm Phone Calls on the 74 Non-price-increase Days
between February 1 and April 30, 2000

Brand	Leahy	Chisholm	Balgee	Swift	Triton	Brumar	Apco	United	Ampol franchisees	Alien	Total made
Leahy (BP)		9	15				56				80
Chisholm (Ampol)	1		33	13	2				15	1	65
Balgee (Mobil)	19	29		3			1				52
Swift		5	1			2	1	3		1	13
Triton (Shell)		3	3	2		13					21
Brumar (Shell)	1			7	12						20
Apco	39										39
United				1							1
Ampol franchisees											
Alien											
Total received	60	46	52	24	14	15	56	3	15	2	291

Note: The row player is the firm that made the call.

Table 6: Time of the 1st Price Hike and Time Lags of Following Price-hikes over the 34 Successful Price-hike Attempts

Successful Attempt No.	Overall Attempt No.	Date	Time of 1st Hike	Time Lags							
				Leahy	Balgee	Swift	Brumar	Triton	Apco Main	Apco Skipton	Max
1	1	06/22/99	7:44	0:00			2:36		8:32	8:32	8:32
2	2	06/30/99	13:04				0:00		0:47	0:42	0:47
3	6	08/04/99	14:07	0:00			2:53	1:21	4:56	4:56	4:56
4	7	08/11/99	10:04	0:00			1:43	1:56	1:39	1:28	1:56
5	9	08/19/99	12:03	0:00			2:27	2:19	3:10	3:23	3:23
6	11	08/30/99	10:07	0:01	0:00		2:17	1:45	3:36	3:46	3:46
7	14	09/14/99	10:08	0:16	0:00		1:12	1:51	3:13	3:10	3:13
8	16	09/28/99	10:09	0:00	0:29		1:36	3:05	4:57	4:57	4:57
9	19	10/25/99	10:11	0:00	0:02		0:48	0:23	3:13	3:22	3:22
10	20	11/15/99	9:00	0:00	1:06		3:10	3:38	3:33	3:34	3:38
11	21	11/25/99	8:53	0:00	1:25		2:16	2:57	4:36	4:36	4:36
12	22	12/06/99	9:37	0:00	0:54		1:18	8:32	5:18	5:15	8:32
13	23	12/15/99	7:04	1:56	3:29	0:00	3:19	3:58	7:55	8:45	8:45
14	24	12/23/99	9:02	0:00	1:21	2:21	2:58	6:16	4:53	5:05	6:16
15	26	01/07/00	9:00	0:00	1:22	4:15	3:15	2:02	4:57	5:13	5:13
16	27	01/14/00	9:06	0:00	1:33	6:08	2:46	3:07	6:35	6:40	6:40
17	29	01/24/00	11:52	0:00	1:17	5:20	3:18	3:57	4:58	5:09	5:20
18	30	01/31/00	14:13		0:00	2:40	1:02	1:42	3:25	3:31	3:31
19	31	02/04/00	9:02	0:00	2:09	2:14	1:57	4:42	4:52	5:04	5:04
20	32	02/09/00	9:00	0:00	1:21	5:51	2:44	2:37	6:58	6:50	6:58
21	34	02/21/00	10:55	0:00	1:25	3:32	2:42	7:01	6:24	6:25	7:01
22	35	02/28/00	10:58	0:00	1:24	5:47	1:08	7:26	6:12	6:17	7:26
23	36	03/06/00	9:06	0:00	1:06	10:02	3:49		6:19	6:22	
		03/07/00						22:25			22:25
24	37	03/10/00	9:32	0:00	1:45	5:54	1:49	1:55	5:49	6:10	6:10
25	38	03/16/00	10:17	0:00	0:59	3:16	1:36	2:20	4:08	4:11	4:11
26	39	03/27/00	13:05	0:11	0:00	6:20	1:30	2:00		8:28	
		03/28/00							32:10		32:10
27	42	04/10/00	10:03	0:00	0:16	4:00	0:40		4:57	6:09	
		04/11/00						21:57			21:57
28	44	04/20/00	13:23	0:36	0:00	4:16	3:44	5:20	1:44	1:26	5:20
29	50	06/01/00	12:11	0:06	0:53	5:01	0:00	5:00	5:42	5:37	5:42
30	54	07/07/00	11:10	0:00	3:53	6:28	2:19	6:01	6:30	7:16	7:16
31	58	08/10/00	8:25	0:00	10:52	8:08	8:02	10:33	11:09	11:06	11:09
32	59	08/15/00	15:40	0:00	0:35	1:50	0:20	2:42	4:51	4:52	4:52
33	64	09/24/00	22:08				0:00				
		09/25/00			10:20	11:43	10:48		10:36	11:35	12:46
34	68	12/07/00	15:50	0:00	2:48	1:01	2:09				
		12/08/00						16:50	17:32	18:34	18:34
		Median	10:08	0:00	1:17	4:39	2:03	3:07	4:57	5:11	5:20

Note: The firm with a time lag of zero (in bold) is the first firm to hike price.

Table 7: Hiked Price of the Leahy Site and the Other Sites' Price Difference from the Leahy site over the 34 Successful Price-hike Attempts

Successful Attempt No.	Overall Attempt No.	Date	Price of Leahy	Price Difference from Leahy							
				Balgee	Chisholm	Swift	Brumar	Triton	Apco Main	Apco Skipton	United
1	1	06/22/99	69.9	0.0	0.0		0.0		-0.4	-0.4	-0.2
2	2	06/30/99	72.9	0.0	0.0		0.0		0.0	0.0	-1.0
3	6	08/04/99	77.9	-0.4	0.0		-0.4	0.0	-0.4	-0.4	-0.4
4	7	08/11/99	79.9	0.0	0.0		0.0	0.0	0.0	0.0	-2.6
5	9	08/19/99	79.9	0.0	0.0		0.0	0.0	-0.2	-0.2	-0.2
6	11	08/30/99	79.9	0.0	-0.4		0.0	0.0	-0.4	-0.4	-0.4
7	14	09/14/99	81.9	0.0	-0.5		0.0	0.0	-0.5	-0.5	-0.5
8	16	09/28/99	81.9	0.0	-0.4		0.0	0.0	-0.4	-0.4	-0.4
9	19	10/25/99	79.9	0.0	-3.6		-3.4	0.0	-3.6	-3.6	
10	20	11/15/99	79.9	0.0			0.0	0.0	-0.2	-0.2	
11	21	11/25/99	82.9	0.0	-0.4		0.0	0.0	-0.4	-0.4	
12	22	12/06/99	82.9	0.0	-0.4		0.0	-1.0	-0.4	-0.4	
13	23	12/15/99	82.9	0.0	-0.4	-0.4	0.0	0.0	-0.4	-0.4	-0.4
14	24	12/23/99	82.9	0.0	-0.2	0.0	2.2	-0.2	-0.2	0.0	
15	26	01/07/00	82.9	0.0	-0.2	-0.2	0.0	0.0	-0.2	-0.2	
16	27	01/14/00	82.9	0.0	-0.2	-0.2	0.0	0.0	-0.2	-0.2	
17	29	01/24/00	82.9	0.0		-0.2	0.0	0.0	-0.2	-0.2	-0.2
18	30	01/31/00	83.9	0.0	-0.2	-0.6	0.0	0.0	-0.2	-0.2	-0.2
19	31	02/04/00	84.9	0.0	-0.2	0.0	0.0	0.0	-0.2	-0.2	-0.2
20	32	02/09/00	84.9	0.0	-0.4	-0.4	0.0	0.0	-0.4	-0.4	-0.4
21	34	02/21/00	86.9	0.0	-0.4	0.0	0.0	-0.4	-0.4	-0.4	
22	35	02/28/00	86.9	0.0	-0.4	-0.4	0.0	-0.4	-0.4	-0.4	
23	36	03/06/00	89.9	0.0	0.0	-0.4	0.0		-0.4	-0.4	-0.4
		03/07/00						-0.4			
24	37	03/10/00	92.9	0.0		-0.4	0.0	0.0	-0.4	-0.4	-0.4
25	38	03/16/00	93.9	0.0		0.0	0.0	0.0	-0.4	-0.4	-0.4
26	39	03/27/00	89.9	0.0		-0.8	0.0	0.0		-0.4	-0.4
		03/28/00			0.0				-1.4		
27	42	04/10/00	88.9	0.0	-1.4	-1.4	0.0		-1.4	-1.4	-1.6
		04/11/00						-2.0			
28	44	04/20/00	86.7	0.0	-4.8	-5.0	-4.8	-4.8	-0.2	0.0	-0.8
29	50	06/01/00	89.9	0.0	-1.2	-1.2	0.0	-1.2	-1.2	-1.2	
30	54	07/07/00	94.9	-1.0	-1.0	-1.2	-1.0	-1.0	-1.2	-1.2	
31	58	08/10/00	95.9	0.0	0.0	0.0	0.0	-1.0	0.0	0.0	
32	59	08/15/00	99.9	0.0		0.0	0.0	0.0	0.0	0.0	
33	64	09/24/00					0.0				
		09/25/00	99.9	-0.2	-0.2	-0.2		0.0	-0.2	-0.2	
34	68	12/07/00	99.9	0.0		0.0	0.0				
		12/08/00			0.0			0.0	0.0	0.0	-0.4
Median				0.0	-0.2	-0.3	0.0	0.0	-0.4	-0.4	-0.4

Note: The price unit is Australian cents per liter.