

Supermarket and Gasoline: An Empirical Study of Bundled Discount*

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Abstract

Many supermarkets offer grocery-gasoline bundled discounts whereby supermarket customers whose grocery purchase is above a certain dollar amount are offered a gasoline price discount. This paper takes a first step toward understanding this practice of bundled discount. We use nearly ideal gasoline price data to study the short- and long-run competitive effects of grocery-gasoline bundled discounts in an Australian market. The evidence suggests that bundling gasoline sites operated by supermarkets are pro-competitive in the short run and competition-neutral in the long run, and that supermarkets offer grocery-gasoline bundled discounts for non-exclusionary reasons.

JEL classification: K21, L4

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Supermarkets have transformed the retail gasoline industry in several countries. For example, supermarkets accounted for 56% of the gasoline sales in France and 28% in the U.K. (Gauthier-Villars 2004), and 44% in Australia (Australian Competition and Consumer Commission 2007). In the U.S., supermarkets and discount stores (Wal-Mart, Costco, and BJ) started to sell gasoline in the late 1990s and quickly captured 5.9% of the retail gasoline sales nationwide by the end of 2002 (Federal Trade Commission 2004). A closely related interesting development is that many supermarkets advertise a grocery-gasoline bundled discount whereby supermarket customers whose grocery purchases are above a certain dollar amount are offered a discount off the pump price of those gasoline sites operated by the supermarkets or some allied gasoline firms.¹ The fact that supermarkets and discount stores offer gasoline price discounts has led several U.S. states to introduce, modify, or enforce what are called sales-below-cost laws.² A supermarket in Colorado was ordered by a court to end its grocery-gasoline bundled discount program because the gasoline price discount violates Colorado's sales-below-cost law.³

What is the impact of supermarkets' grocery-gasoline bundled discounts on competition in gasoline markets? Why do supermarkets offer grocery-gasoline bundled discounts? In this paper, we take a first step at addressing these two important questions facing the retail gasoline industry. As the policy concern is that supermarkets may harm competition in retail gasoline markets, our emphasis is on the first question. Using essentially ideal gasoline price data from an Australian market, we document the short- and long-run impact of grocery-gasoline bundled

¹ Giant Eagle, for example, advertises a "fuelperks!" program that allows its customers to earn 10 cents off per gallon for every \$50 grocery purchases. Many major supermarkets in the U.S. offer similar bundled discount programs, including Albertsons, BI-LO, Harris Teeter, Jewel-Osco, Kroger, Roundy's, Safeway, Shaw's, Stop & Shop, and Winn-Dixie. The details of these supermarkets' discount programs can be easily found on the Internet.

² See FTC staff letter to The Honorable Gene DeRossett, Michigan House of Representatives (June 2004).

Available at <http://www.ftc.gov/os/2004/06/040618staffcommentmichiganpetrol.pdf>.

³ Parish Oil Co, Inc. v. Dillon Companies, Inc., 2006 WL 2632566 (D. Colo. 2006)

discounts on market average pump price, the relative pump price between bundling sites and non-bundling sites and that between different brands of bundling sites, dynamic pricing behavior, and site entry and exit. Our findings suggest that bundling gasoline sites operated by supermarkets are best characterized as pro-competitive in the short run and competition neutral in the long run, and that bundling sites allied with but not operated by supermarkets have little impact on competition. Overall, our evidence suggests that supermarkets offer grocery-gasoline bundled discounts for non-exclusionary purposes. Due to the lack of grocery data, we cannot assess the bundling programs' impact on the grocery market.

Our evidence comes from Perth, Western Australia. This market offers two major advantages. First, the bundling programs here are representative of those observed elsewhere.⁴ Woolworths and Coles were the two major supermarket chains in the market. Woolworths, for several years, offered a small bundling program by building or acquiring gasoline sites next to its supermarkets. The market then witnessed new bundling programs that were implemented through partnerships with existing gasoline firms. By purchasing the right to operate previously oil branded gasoline sites, Coles offered its bundling program and Woolworths expanded its program. In response, the independently owned supermarkets in the Perth area offered their own bundling program through a partnership with otherwise unrelated independent gasoline firms. Second, we have access to essentially ideal gasoline price data. We observe the daily pump price of every gasoline site in the Perth area for a 10-month period before and a 51-month period during and after the new bundling programs took effect. We observe a measure that closely tracks the marginal cost of supplying wholesale gasoline, and we can use this measure as

⁴ Some U.S. supermarkets (Giant Eagle, Jewel-Osco, and Stop & Shop) operate their own gasoline stations, while others (BI-LO, Roundy's, Shaw's, and Winn-Dixie) do not sell gasoline themselves but offer bundled discount programs through partnerships with existing gasoline firms. For example, Shaw's supermarkets, Dunkin' Donuts, and two gasoline firms, Gulf and Irving, formed an alliance to offer a discount program. Neither Shaw's nor Dunkin' Donuts is involved in the operation of the Gulf or Irving stations. See www.override.com for details.

a control for assessing the impact on pump price. Moreover, we directly observe the changes in firms' dynamic pricing behavior before and after the new bundling programs because of the presence or absence of regular gasoline price cycles, a form of tacit pricing coordination.⁵

Before the new bundling programs took effect, the Perth market saw regular gasoline price cycles in which major oil firms were price leaders and Woolworths was a price follower. Upon bundling and operating previously oil branded gasoline sites, Coles and Woolworths cut pump prices significantly, disrupting the tacit collusion and forcing the non-bundling sites to cut pump price as well. The remaining oil firms, however, made repeated attempts to restore tacit collusion and succeeded doing so about 25 months after the start of the new bundling programs. During these 25 months, some sites exited the market, but new sites entered, and the number of small gasoline firms was not reduced. Since tacit collusion was restored, Perth market average pump price became higher than that prior to the new bundling programs; supermarket-operated gasoline sites were price followers again, but their relative pump prices remained lower than those of the same sites prior to bundling. Gasoline sites allied with but not operated by the independent supermarkets slightly increased their pump prices upon bundling.

Several non-exclusionary bundling theories are helpful for explaining the observed bundling programs. Grocery-gasoline bundled discount may be a form of advertising used to promote grocery sales. Loss leader advertising, as formalized by Lal and Matutes (1994), captures that discount is applied to gasoline price, which is easier to advertise, and that a minimum grocery purchase requirement is imposed. Temporary price promotion explains the competitive pricing behavior of supermarket-operated gasoline sites in the short run. Gans and King's (2006) bundling model, which emphasizes the pricing externality between two firms that offer a bundled discount together but are otherwise unrelated, captures the pricing behavior of the gasoline sites allied with the independent supermarkets. Price discrimination and increasing

⁵ Regular price cycles can be characterized by Edgeworth price cycles. See Wang (2009) for more details.

efficiency are also useful for explaining the observed price impact. The lack of grocery data, however, prevents us from discriminating definitely the non-exclusionary bundling theories.

This paper is partly motivated by Antitrust Modernization Commission's recent call for empirical research on bundled discounts.⁶ The recent literature on bundled discount is largely theoretical, and has focused on a setting in which a monopoly firm in one market faces competition in a second market (Nalebuff 2005, Carlton, Greenlee, and Waldman 2008, Greenlee, Reitman, and Sibley 2008).⁷ A bundled discount is thought to offer a discount on the monopoly product conditional on the purchase of the competitive product. The setting of supermarket and gasoline is different. The grocery and gasoline markets in Perth are both oligopolistic, there are multiple bundling programs, and the discount applies to the price of gasoline, the product thought to be more competitive.

This paper is also related to a literature that studies the competitive effect of traditional independent gasoline firms (Hastings 2004 and Taylor, Kreisle, and Zimmerman 2010). The research design of both papers is based on a brand conversion: gasoline sites of a large independent brand were converted into an oil brand without changes in site location or characteristics. The price data sets used in both papers cover a small sample of stations in the markets. Our research design is similar in that the location or characteristics of the stations involved in the new bundling programs were determined prior to the bundling decision. Our price data set is of much higher quality, which allows us to observe dynamic pricing behavior and site entry/exit. Our evidence suggests that supermarket-operated gasoline sites can be as competitive as the traditional large independent gasoline firms.

⁶ In its 2007 Report and Recommendations, the Antitrust Modernization Commission wrote that "The Courts, the antitrust agencies, and antitrust practitioners generally would benefit from a more thorough and empirically based understanding of the likely competitive effects of bundled discount in a variety of settings."

⁷ Much of the literature is prompted by the *LePage* case. See *LePage's, Inc. et al. v. 3M Company*, 324 F.3d 141 (3rd Cir. 2003). See also Greenlee and Reitman (2005), Kobayashi (2005a), Rubinfeld (2005), and Brennan (2008).

This paper proceeds as follows. Section 2 documents the features and timing of the bundling programs. Section 3 studies the impact of the bundling programs on competition. Section 4 examines the extent to which the existing theories of bundling capture the features and competitive impacts of the bundling programs. Section 5 concludes.

2. Market Setting and the Bundled Discount Programs

Because of a price reporting law,⁸ we observe the daily census of the (regular unleaded) retail prices of all the gasoline sites in the Perth metropolitan area for two sample periods: the 10-month period January 1 through October 31 of 2003, and the 51-month period March 17, 2004 through May 31, 2008. The focus of this paper is on the second sample period when the supermarkets and some gasoline firms formed alliances to offer bundled discount programs.

The traditional gasoline firms in the market include four oil firms (BP, Caltex, Shell, and Mobil) and two major independent gasoline firms (Gull and Peak). In October 2003, the Perth market had 313 traditional gasoline sites.⁹ In addition, Woolworths operated 15 gasoline sites under the brand of Woolworth Plus. Table 1 shows the number of gasoline sites by brand in four different months. BP operates the only refinery in Western Australia. However, BP's pricing of wholesale gasoline is constrained by potential import from Singapore,¹⁰ the major refining center in the Asian-Pacific region. Caltex and Shell buy fuel from BP through

⁸ The law, known as the 24-hour-rule, requires every gasoline station in the Perth metropolitan area to report its next day price to the government by 2:00pm each day. For more information about this law, see the Internet website (www.fuelwatch.wa.gov.au). The price data used in this paper were downloaded from this website.

⁹ In addition to these gasoline sites, 12 gasoline sites in the data set are considered outside of the Perth gasoline market because of their extremely isolated location (on an island, for example).

¹⁰ Gull buys most of its gasoline from BP, but imports some from Singapore. Mobil imports gasoline from Singapore, and it supplies Peak. Woolworths bought gasoline from an independent importer up to the end of 2003 (Australia Competition and Consumer Commission 2007, p. 63).

contracts, and the gasoline price that they pay BP is determined by what is called the import parity pricing (IPP) method, a formula that tracks the potential cost of importing gasoline from Singapore.¹¹ The IPP-based import cost closely tracks Caltex's and Shell's marginal costs of supplying wholesale gasoline. We have access to the confidential daily IPP import cost for our entire sample period.¹²

Coles and Woolworths, both vertically integrated, are the two major supermarket chains in Australia. In Western Australia (WA), Coles and Woolworths supplied, respectively, about 32% and 31% of the grocery market, and Foodland Associated supplied the rest before the end of 2005 (Australian Competition and Consumer Commission 2008). In the rest of this subsection, we document the features and the timing of the bundling programs observed in the Perth market. Our primary source of information is company press releases filed with the Australian Stock Exchange.

Since the late 1990s, Woolworths has been offering a grocery-gasoline bundled discount program in Australia by building or acquiring gasoline stations next to its supermarkets.¹³ Woolworths offers a gasoline price discount of 4 cents per liter (equal to about 15 cents per gallon) to those customers whose grocery purchase is over AU\$30. In practice, qualified customers receive a discount voucher that can be used at any Woolworths Plus sites for a fuel purchase of up to certain quantity within a period of weeks. In November 2003, Woolworths owned and operated about 300 Woolworths Plus sites in Australia. In the Perth area, there were 8 Woolworths Plus sites in January 2001, 11 in January 2003, and 15 in October 2003.

¹¹ The pricing formula is the following: IPP-based import cost = a benchmark wholesale gasoline price in Singapore + shipping cost + quality premium + wharfage + insurance and loss + tax.

¹² The import cost data were provided by the Western Australia Department of Consumer and Employment Protection.

¹³ Woolworths and Caltex joint press release, "Caltex and Woolworths Open First Co-branded Petrol Stations," November 21, 2003.

Coles' bundled discount program, which first started in other Australian states in 2003,¹⁴ took effect in the Perth area on March 15, 2004.¹⁵ Coles' program also offers 4 cents per liter gasoline price discount to grocery customers whose purchase is over AU\$30.¹⁶ To implement its program, Coles purchased the right to rebrand about 600 Shell-branded gasoline sites throughout Australia into Shell-Coles Express sites, and to operate these rebranded sites by directly setting fuel prices and employing station staff. Shell still owns the stations and acts as the exclusive fuel supplier. Apparently as a response to Coles' program, Woolworths expanded its program to include about 130 Caltex sites throughout Australia.¹⁷ These 130 Caltex sites, as well as the Woolworths Plus stations, were all co-branded as Caltex-Woolworths. Caltex became the exclusive fuel supplier to Woolworths in January 2004, but "Woolworths sets fuel prices at the co-branded sites in accordance with Woolworths pricing policy."¹⁸

We know the precise timing of conversion for the Coles Express sites and the Caltex-Woolworths sites. Figure 1 shows the timeline of the discount programs. In the Perth area, 39 of the 44 Shell-branded sites were rebranded into Shell-Coles Express sites. The 5 Shell sites that were not converted into Coles Express are located in isolated areas and far away from

¹⁴ The program started in the Australia state of Victoria on July 28, 2003, and in three other states (New South Wales, the Australian Capital Territory, and Tasmania) on December 1, 2003. Coles Myer press releases, "Fuel Discounts Are Here," July 27, 2003, and "Coles-Myer Shell Alliance to Extend Fuel Discounts to NSW, ACT & Tasmania," October 30, 2003.

¹⁵ The program started on the same day in the rest of Western Australia and two other Australia states (South Australia and Northern Territory). Coles Myer press release, "WA, SA, NT Complete National Petrol Discount Roll-out," March 15, 2004.

¹⁶ Coles Myer press release, "Fact Sheet on the Coles Myer Shell Alliance," May 23, 2003.

¹⁷ Woolworths and Caltex joint press release, "Caltex and Woolworths Open First Co-branded Petrol Stations," November 21, 2003. Most of the Caltex sites in Australia (about 1780) are not involved in the discount program.

¹⁸ Woolworths and Caltex joint press release, "Caltex and Woolworths Complete Co-branded Service Station Arrangement," April 28, 2004.

Coles' supermarkets. A total of 20 Caltex sites in the Perth area were converted into Caltex-Woolworths sites on various dates between November 2003 and May 2006. All but one of these 20 sites are located in a suburb that had not already had a Woolworths Plus site. In the first 10 months of 2003, the average pump price of these 20 sites was identical to that of the Caltex sites that were never converted. The site conversions did not change any station characteristics, except that the logo of Coles Express (or Woolworths) and a sign of "Save 4 Cents Per Liter" were added to the newly converted sites. Although the Woolworths Plus sites were also rebranded into Caltex-Woolworths between January and April of 2005, we always use "Caltex-Woolworths" to refer to those sites converted from Caltex, and use "Woolworths Plus" to refer to Woolworths' own gasoline sites.

Foodland Associated started to offer a discount program in the Perth area in mid June 2004.¹⁹ The program offers customers a gasoline price discount of 4 cents per liter if they spend over AU\$25 at the Foodland-supplied independent supermarkets (but not at the Foodland-operated supermarkets).²⁰ The discount vouchers were eventually accepted at about 50 gasoline sites that carry three different brands.²¹ We do not know the precise dates on which the gasoline sites allied with Foodland started to accept fuel discount vouchers.²² However, Foodland's quarterly and annual reports and various newspaper reports allow us to identify the periods during which these sites started to accept discount vouchers. The timeline of independent supermarkets' program are also shown in Figure 1. By September 3, 2004, 6 Mobil-branded

¹⁹ "Foodland Launches Petrol Tie-up," Western Australian, June 23, 2004.

²⁰ Foodland did not operate all the supermarkets that it supplied. Foodland-operated supermarkets accounted for about one third of Foodland's grocery supply, and independent supermarkets (independently owned and operated) accounted for the rest (Foodland 2005 annual report).

²¹ The list of gasoline sites can be found at www.quickstop.com.au.

²² These stations did not change their brands. In Foodland documents, the Mobil-branded sites were referred to as Quickstop stations, but Foodland continued to advertise those stations under the Mobil brand.

sites, which were purchased by Foodland, had started to accept the discount voucher issued by the independent supermarkets.²³ Foodland gradually extended the program by purchasing 7 more Mobil sites between October 2004 and January 2005, and 3 more between February and April 2005.²⁴ Between February and April 2005, the discount program was extended to 36 additional gasoline sites, which included 20 Peak sites and 14 BP-branded sites that were owned and operated by at least two different independent gasoline firms.²⁵ These sites continued to set their standalone pump price independently, and importantly, they were reimbursed 3 cents per liter for accepting each 4-cent-per-liter discount voucher.²⁶

In November 2005, Foodland's business in WA was sold to Metcash, a large grocery wholesaler. Metcash became the wholesale supplier to all independent supermarkets in WA. The independent supermarkets continued with the fuel discount program. In December 2006, Metcash sold 15 of the Mobil-branded sites to United Petroleum, a large independent gasoline retailer in Australia.²⁷ United Petroleum continued to be part of the fuel discount program.

3. How Did Bundled Discounts Affect Competition in the Gasoline Market?

This section documents the short- and long-run impact of the new bundling programs on (1) market average pump price, (2) dynamic price competition, (3) the relative price between bundling sites and non-bundling sites and the relative price among the different brands of bundling sites, (4) and site entry and exit.

²³ We know the addresses of these 6 sites. "Foodland pumps up its fuel discount scheme," *Western Australian*, September 3, 2004.

²⁴ Foodland press release on February 11, 2005, "Fiscal 2005 Second Quarter Sales Up 7.8%," and Foodland press release on May 18, 2005, "Fiscal 2005 Third Quarter Sales."

²⁵ Foodland press release on May 18, 2005, "Fiscal 2005 Third Quarter Sales."

²⁶ This information is confirmed by the Western Australian Department of Consumer and Employment Protection.

²⁷ Western Australia Department of Consumer and Employment Protection 2007, p. 14).

3.1. Impact on Market Average Pump Price

We can identify the impact on the market average pump price because the IPP import cost is a credible benchmark. Recall that the IPP import cost is exogenous of the Perth gasoline market and closely tracks the marginal cost of supplying wholesale gasoline.

We find that the market average pump price, after controlling for the import cost, decreased significantly after Coles' entry. In the long run, the market average pump price became higher than that in 2003, but about 40% of the motorists (those who redeem a 4-cent-per-liter discount voucher) continued to pay an average retail price lower than the average pump price in 2003.

We analyze the difference between standalone pump price and the IPP import cost, and we shall use the term price-cost margin to refer to this difference. We do not attempt to separate retail margin from wholesale margin because we do not observe the wholesale price that the oil firms charge the retailers. We emphasize that BP and Caltex were involved in pricing coordination in the retail market before and after the new bundling programs, so their pricing behavior affected both retail margin and wholesale margin.

Figure 2 shows the monthly average market wide price-cost margin for our two sample periods. The market average price-cost margin exhibits considerable volatility. For example, it dived in March 2004, rebounded sharply between August and December 2004, and then dived again in January 2005. However, the price-cost margin was generally smaller from March 2004 through August 2005 than in 2003. Since September 2005, which is right after Hurricane Katrina, the price-cost margin became on average higher than the 2003 level. To be sure, consider the following regression:

$$(1) \quad margin_{it} = c + Post_{1,t} + Post_{2,t} + \epsilon_{it},$$

where $margin_{it}$ is the difference between the pump price of station i on date t and the import cost for date t . Dummy variable $Post_1$ equals 1 for the period March 17, 2004 through August 31, 2005, and 0 otherwise. Dummy $Post_2$ is 1 for the period since September 1, 2005, and 0 otherwise. The constant term c is the market average price-cost margin in 2003, and its estimate is 7.86 cents per liter. The estimated coefficients for $Post_1$ and $Post_2$ are, respectively, -2.02 and 1.23. Both are highly statistically significant. These estimates indicate that the market average price-cost margin from March 2004 through August 2005 was 2.02 cents per liter lower than that in 2003, but since September 2005, it was 1.23 cents higher. This finding is robust to the specification of the two time periods. For example, we shall see that gasoline pricing behavior exhibited a structural break in May 2006. Thus, we may let $Post_1$ end in August 2005, but let $Post_2$ start in June 2006, and drop from consideration the time period in between. In this case, the estimated coefficient for $Post_2$ is 1.61 cents per liter.

It is important to note that many consumers since March 2004 enjoy a 4-cent-per-liter discount off the pump price. The volume share of supermarket-operated gasoline sites was 65% in 2005 (Western Australia Department of Consumer and Employment Protection 2007, p. 10), and about 60% of fuel transactions at these sites involve a discount voucher (Australian Competition and Consumer Commission 2007, p.181). We do not know the volume share of the 50 or so gasoline sites allied with the independent supermarkets. Nonetheless, it is conservative to say that about 40% of the gasoline sales in the Perth market since 2005 involve a discount voucher. These consumers, even in the long run, pay an average retail price that is about 2.39 cents per liter lower than the pump price in 2003, after controlling for the import cost.

3.2. Impact on Dynamic Pricing Behavior

A unique feature of this study is that we directly observe how bundling affected dynamic price competition. Because of this feature, we observe the mechanism underlying the findings

in the previous section. That is, we observe why the market average pump price decreased significantly after Coles' entry and why it became higher in the long run.

Appendix A shows the daily Perth market average pump price and the daily IPP import cost from July 1, 2003 through May 31, 2008. In 2003, the Perth market average pump price exhibited regular cycles, a form of tacit collusion. Figure 3(a) shows a sample of cycles, using the daily brand average pump prices of five firms. Gasoline firms hike price sequentially and then decrease price gradually. There were 35 price cycles during the first 10 months of 2003, and it was always the case that one or more of the three largest gasoline firms (BP, Caltex, and Shell) were the first to hike price. In particular, Shell was among the first to hike price for 9 cycles, and if it did not lead a price cycle, it always hiked price on the second day. Mobil never led, and almost always hiked price on the second day of a cycle. Woolworths Plus, Gull, and Peak hiked prices on the second or third day of a cycle.

The Shell sites' conversion into Coles Express disrupted the gasoline price cycle dynamics. Figure 3(b) indicates that price cycles lost regularity in April 2004. This is because Coles Express, unlike Shell in 2003, stopped acting as a price leader. (So did the Caltex-Woolworths sites.) That is, these supermarket-operated gasoline sites stopped being the first to hike price and stopped following on the second day. This is the reason why the market-average price-cost margin became smaller after Coles' entry.

BP and Caltex, however, did not stop initiating price hikes for long. They started to hike price regularly in late August 2004, and regular price cycles returned by late October. This is why the price-cost margin rebounded significantly between September and December 2004. However, in late December 2004, the supermarket-operated gasoline sites became unwilling to follow the lead price hikes again, thus causing the price cycles to be less successful again even though BP and/or Caltex continued to initiate price hikes on a weekly basis. This is why the market average price-cost margin became much lower than its 2003 level again.

Hurricane Katrina caused the IPP import cost to rise sharply in late August and early September of 2005. As a result, price cycles disappeared in the last three months of 2005 again. Starting in January 2006, BP started to initiate price hikes again, and a new pattern of price cycles emerged in May 2006, which remains in effect until April 2008. During this period, the gasoline firms were more successful at pricing coordination, which explains why the market average price-cost margin became higher than the 2003 level. BP was almost always the first to hike price, and Caltex was occasionally a co-leader. Importantly, Coles Express appeared to be more willing to hike price than it was before. This can be seen from Figure 3(b), which shows 6 price cycles in late 2006. Woolworths continued to be among the last to hike price for nearly all cycles, but even its price hikes were of significant sizes now. Note that in May 2008, the end of our sample period, price cycles disappeared again.

The independent supermarkets' bundling program did not have a notable effect on pricing dynamics. The pricing behavior of Mobil, Peak and the 14 independently owned BP-branded sites did not experience a noticeable change upon bundling.²⁸ This suggests that bundling gasoline sites not operated by supermarkets have little impact on competition.

3.3. Impact on Relative Prices

This subsection documents the impact on the relative price (or the price differential) between the bundling sites and non-bundling sites and the relative price among the different groups of bundling sites. The main findings of this subsection are the following:

First, the pump prices of the supermarket-operated gasoline sites, in absolute level or relative to the non-bundling sites, were more competitive in the short run than in the long run.

Second, even in the long run, supermarket-operated gasoline sites' relative pump prices remained lower than those of the same sites prior to bundling.

²⁸ Note that the 14 independent BP-branded sites were never price leaders, even before bundling.

Third, the pump prices of the new supermarket gasoline sites (Coles Express and Caltex-Woolworths) were higher than those of the original Woolworths Plus sites by a smaller amount in the short run than in the long run.

Fourth, the gasoline sites allied with the independent supermarkets, upon bundling, did not decrease their pump prices to match those of the supermarket-operated gasoline sites.

Since firms' relative price reflects their differential dynamic pricing behavior, these findings are consistent with the findings in the previous subsection. We focus on 124 bundling gasoline sites that belong to 6 bundling groups (39 Coles Express sites, 20 Caltex-Woolworths sites, 15 original Woolworth Plus sites, 16 Mobil-branded sites, 20 Peak sites, and 14 independently owned BP-branded sites), 21 non-bundling sites that were at least 3 miles away from any bundling sites by May 2008,²⁹ and 120 non-bundling sites that were within 3 miles of a bundling site by May 2008.³⁰ All of the 265 sites appeared in the vast majority of our sample period. The first 21 non-bundling sites, which are referred to as the baseline non-bundling sites, might be considered not directly competing with any bundling sites.

The four observations on relative prices can be seen from two figures. Figure 4(a) compares the quarterly average price-cost margins of the three groups of supermarket-operated gasoline sites and the two groups of non-bundling sites. Figure 4(b) compares the quarterly average price-cost margins of the three groups of gasoline sites allied with the independent supermarkets, the 21 baseline non-bundling sites, and the Woolworths Plus sites. We focus on price-cost margin since the price differential between any two sites is the same as their

²⁹ These 21 sites include 6 BP-branded sites, 7 Caltex-branded sites, 5 Gull-branded sites, and 3 unbranded sites. These 21 sites do not include those sites that were in the data set but were extremely isolated. Distance between two gasoline sites is measured along the major roads.

³⁰ These 120 non-bundling sites include 43 BP-branded sites, 36 Caltex-branded sites, 20 Gull sites, and 21 sites that carry various small independent brands or no brands at all.

difference in price-cost margin. It is evident that all gasoline sites in the Perth market were affected by the two major supermarket chains' new bundling programs.

3.3.1. Regression Estimates

In this subsection, we use the following difference-in-difference model to estimate the effect of the new bundling programs on relative pump price:

$$(2) \quad \text{margin}_{it} = c + \alpha_0 \text{Within3miles}_i + \sum_{j=1}^6 \alpha_j \text{BundleGroup}_{j,i} + \beta \text{Post}_t + \gamma_0 \times \text{Within3miles}_i \times \text{Post}_t + \sum_{j=1}^6 \gamma_j \text{BundleGroup}_{j,i} \times \text{Post}_t + \epsilon_{it},$$

where the dependent variable *margin* is as defined in equation (1). The dummy variable *Within3miles* is 1 for the 120 non-bundling sites that were within 3 miles of a bundling site by May 2008, and 0 otherwise. The variable *BundleGroup_j* equals 1 if site *i* belongs to bundling group *j*, and 0 otherwise. Recall that there are 6 bundling groups. The variable *Post* equals 1 for a post-bundling period and 0 for a pre-bundling period. Hence, the constant *c* is the average price-cost margin of the 21 baseline non-bundling sites in the pre-bundling period, and the α coefficients are the price differential between these baseline non-bundling sites and the other groups of sites in the pre-bundling period. The coefficient β is the change in the price-cost margin of the 21 non-bundling sites from a pre-bundling period to a post-bundling period. The γ coefficients measure how a bundling event differentially affected the pump prices of various groups of gasoline sites relative to those of the 21 baseline non-bundling sites.

To estimate the short-run effect of the two major supermarkets' new bundling programs on relative prices, we set the pre-bundling period³¹ to be the first 10 months of 2003 and the post-bundling period to be March 17, 2004 through September 30, 2004 when the scale of the

³¹ For the 7 Caltex-Woolworths sites converted between June and August, 2004, the corresponding *BundleGroup_j* variable is set to be missing for the period from March 17, 2004 through the day just before the site's conversion.

independent supermarkets' discount program remained negligible. To estimate the short-run effect of the independent supermarkets' bundling program on relative prices, we set the pre-bundling period to be March 17, 2004 through January 31, 2005 and the post-bundling period to be May 1, 2005 through August 30, 2005.³² To estimate the long-run effect of all three bundling programs on relative prices, we set the pre-bundling period to be the first 10 months of 2003 and the post-bundling period to be June 1, 2006 through May 31, 2008. The results are reported in Table 2. The reported standard errors are robust to serial correlations.

The results quantify how competitive the pump prices of the supermarket-operated gasoline sites were in the short run and in the long run. In 2003, the average prices of the pre-conversion Shell and Caltex sites were not statistically different from those of the two groups of non-bundling sites, but from March 17, 2004 through September 30, 2004, they were 2.30 and 2.79 cents per liter respectively lower than that of the 21 baseline non-bundling sites.³³ Since the price-cost margin of the 21 baseline sites decreased by 1.92 cents per liter, those of the Coles Express and Caltex-Woolworths sites decreased by 4.22 and 4.71 cents per liter, or by 54.15% ($= 4.22/(8.036-0.243)$) and 58.62%. During the same period, the average price-cost margin of the Woolworths Plus sites decreased by 3.34 ($= 1.421 + 1.918$) cents per liter, or by 51.02%. These are very large decreases in profit margins. From March through September 2004, the average price-cost margins of Coles Express, Caltex-Woolworths, and Woolworths Plus are 3.58 ($= 8.036 - 0.243 - 1.918 - 2.295$), 3.42, and 3.21 cents per liter, respectively, and that of the 21 non-bundling sites was 6.02 cents per liter. From June 2006 through May 2008, the price-cost

³² The period in between is treated as missing. For the Mobil sites that bundled before September 3, 2004, the corresponding *BundleGroup_j* variable is set to be missing from September 4, 2004 through January 31, 2005 as well. For the other Mobil sites, the bundle group variable is set to be missing from October 1, 2004 through January 31, 2005 as well.

³³ The average pump price of the non-bundling sites within 3 miles of a bundling site was 0.47 cents per liter than that of the 21 baseline non-bundling site during this period.

margins of these three groups of bundling sites increased to 9.02, 8.29, and 7.69 cents per liter, respectively, and those of the 21 baseline non-bundling sites increased to 10.03 cents per liter.

The price differential between Coles Express (Caltex-Woolworths) and the 21 non-bundling sites since June 2006 was 0.78 (1.84) cents per liter larger than that between the pre-conversion Shell (Caltex) sites and the 21 non-bundling sites. The price differential between Woolworths Plus and the 21 non-bundling sites since June 2006 was 0.85 cents per liter larger than that between them in 2003. These results quantify the second observation on relative price.

In 2003, the average prices of the pre-conversion Shell and Caltex sites were about 1.25 (= 1.492-0.243) and 1.59 cents per liter, respectively, higher than that of the Woolworths Plus sites, but from March 17, 2004 through September 30, 2004 they were only about 0.38 (= 1.25 – 2.295 + 1.421) and 0.21 cents per liter higher, and since June 1, 2006 they became 1.33 and 0.60 cents per liter higher. Hence, the price differential between Coles Express and Woolworth Plus since June 2006 is essentially the same as the price differential between Shell and Woolworths Plus in 2003. These results quantify the third observation on relative prices.

The regression results also confirm the observation that the gasoline sites allied with the independent supermarkets did not cut their prices to match those of the supermarket-operated gasoline sites upon bundling. In fact, the estimates suggest that the pump prices of the Peak sites, the 14 BP-branded sites, and the Mobil-branded sites all increased slightly relative to those of the 39 Coles Express sites or those of the two groups of non-bundling sites. In the long run, bundling had little effect on the relative price of Peak, but increased the relative price level of the 14 BP-branded sites.

Note that the relative price of the initially Mobil-branded gasoline sites became smaller since the first quarter of 2006 and particularly so in 2007. These changes in relative prices appear to be related in timing to Metcash's purchase of these gasoline sites in November 2005 and to the subsequent sale of these sites to United in December 2006.

3.4. Impact on Site Entry and Exit

Another important feature of this study is that we observe gasoline sites' entry and exit in the Perth market. Consider Table 1 again, which contains the entry and exit statistics. Consider first the changes in the total number of gasoline sites in the market. From March 2004 through May 2006, there was a net loss of 16 gasoline sites: 38 sites were closed, and 22 new sites were opened. From June 2006 (when tacit collusion was restored) to the end of our sample period, there was an additional net loss of 20 gasoline sites: 31 sites were closed, and 11 new sites were opened. The new bundling programs were probably an important factor in explaining the net losses of gasoline sites, considering that during the first 10 months of 2003, a total of 18 sites were opened and no sites were closed. Consider next brand-specific changes. From March 2004 to the end of our sample period, every non-supermarket gasoline brand experienced a net loss of sites due to two possible reasons. First, the number of sites converted into another brand is bigger than the number of sites converted into this brand. Second, the number of sites closed is bigger than the number of sites opened. Shell, due almost entirely to the first reason, and Caltex, due to both reasons, experienced the largest decreases. The number of sites carrying small independent brands or no brands at all increased by 2 from March 2004 to May 2006, and decreased by 5 since tacit collusion was restored.

3.5 A Summary of the Competitive Impact

The two major supermarket chains' new bundling programs are, unless predatory, pro-competitive in the short run: supermarket-operated gasoline sites cut pump price significantly upon bundling, disrupted tacit collusion, and caused the market average pump price to be lower. We shall argue in the next section that supermarket-operated gasoline sites' pricing behavior is consistent with advertising, and inconsistent with predation. We characterize supermarket-operated gasoline sites as competition neutral in the long run. They are not pro-competitive in

the long run because they are participants (price followers) in tacit collusion. They are not anticompetitive either because their relative pump prices remain lower than those of the same sites prior to bundling and, due to the 4-cent-per-liter discount, about 40% of the motorists pay an average retail gasoline price that is about 2.39 cents per liter lower than that before the new bundling programs. Bundling gasoline sites allied with but not operated by supermarkets had little impact on competition.

4. Why Grocery-Gasoline Bundled Discount?

In this section, we examine the extent to which the existing bundling theories capture the salient features of the grocery-gasoline bundling programs documented in section 2 and explain the impact on competition documented in section 3. We consider two closely related advertising strategies in subsection 4.1, Gans and King's (2006) bundling model in subsection 4.2, price discrimination and increasing efficiency in subsection 4.3, and predation in subsection 4.4.

4.1. Advertising

In this subsection, we evaluate two forms of closely related price advertising strategies: loss leader advertising and temporary price promotion. Loss leader advertising captures key features of the grocery-gasoline bundled discounts, and temporary price promotion provides an explanation for the particularly aggressive pricing behavior of the supermarket-operated gasoline sites in the short run.

The basic idea of loss leader advertising is that retailers can advertise the price of a good (the loss leader) at a discount and attract buyers into their stores to buy unadvertised goods. This theory captures why the grocery-gasoline bundled discount is applied specifically to gasoline price but not to grocery price: gasoline price is much easier and cheaper to advertise than grocery price. Perhaps unique among all consumer products, the price of gasoline is posted

on highly visible price boards at a minimum cost. This theory also suggests a reason why the 4-cent per liter price discount is conditional on grocery purchase. For loss leader advertising to be effective, consumers must buy some amount of unadvertised goods as well. Absent a grocery purchase requirement, many consumers may buy the discounted gasoline only, especially so if supermarkets and gasoline sites are not located next to each other.

Consider the Lal and Matutes (1994) loss leader advertising model.³⁴ Two stores are located at the ends of a unit line, and each store sells two products. Consumers are uninformed about product prices, and they anticipate that once they are in a store the retailer can charge them high prices because their travel cost is sunk. Loss leader advertising is thus a commitment device; it guarantees consumers a positive surplus so that they travel to the store. Since price advertising is costly, stores do not advertise the prices of all products. It is straightforward to show that both firms in the model use the product with a lower advertising cost as the loss leader. In this model, bundling is not imposed *ex ante*. Rather, it is achieved *ex post* through economy of scale in shopping—all consumers in equilibrium buy a bundle to save transportation cost. Economy of scale in shopping, in reality, may not be strong enough for consumers to buy unadvertised goods, thus the need for grocery purchase requirement.

A discrepancy between the Lal and Matutes model and the grocery-gasoline bundled discount programs is the way in which price discount is advertised. In gasoline markets, we observe a standalone price for gasoline and a fixed discount. In the model, however, firms do not advertise a fixed discount. Instead, they advertise a single discounted price for the loss leader. Because of this discrepancy, the Lal and Matutes model does not make direct predictions regarding standalone gasoline price. However, the basic idea of bundled discount as advertising does help understand the price impacts of the new bundling programs.

³⁴ There are other models of loss leader pricing (see, for example, DeGraba 2006).

First, loss leader advertising lends itself immediately to another price advertising strategy, temporary price promotion, which explains the particularly aggressive pricing behavior of the supermarket-operated gasoline sites in the short run. Upon entering a new market, firms often offer temporary price promotions to market their products. If grocery-gasoline bundled discount is indeed an effective advertising strategy for promoting the sales of groceries, it would be natural for Coles and Woolworths to engage in temporary price promotions by setting their standalone pump prices particularly low in the short run (since the 4-cent-per-liter discount is fixed). In addition, the fact that Coles Express roughly matched the pump price of Woolworths Plus in the short run (but not in the long run) is also consistent with temporary price promotion.

Second, the idea of bundled discount as advertising is consistent with the fact that the Perth market average price-cost margin became higher in the long run. After the short-run price promotion, the two major supermarket chains are happy to set higher pump prices, as long as they are price followers and their pump prices are relatively lower.

Third, the logic of loss leader advertising also appears to capture that the pump prices of the Coles Express and Caltex-Woolworths sites were higher than those of the Woolworths Plus sites, especially in the long run. The idea is that the Woolworths Plus sites enjoy a location advantage over the Coles Express sites or the Caltex-Woolworths sites. Cutting the pump price of a Woolworths Plus site affects two types of marginal consumers' choice of supermarkets: those whose grocery purchase is over \$30 and, because of economy of scale in shopping, those whose grocery purchase is under \$30 as well. Since the new supermarket-operated gasoline sites are not located right next to a supermarket, their pump price, on the other hand, only affects the supermarket decision of those consumers whose grocery purchase is over \$30. In other words, gasoline sold at a Woolworth Plus site is a loss leader to all customers of the adjacent Woolworths supermarket, but gasoline sold at the new supermarket-operated sites is a loss leader only to those supermarket consumers whose grocery purchase is over \$30. This location

advantage of the Woolworth Plus sites provides an explanation for why their pump prices are lower than those of the Coles Express or Caltex-Woolworths sites, especially in the long run when the effect of temporary price promotion disappears.

The Lal and Matutes model does not capture the way the independent supermarkets offered their bundling program. In the model, a single firm sells two products. The independent supermarkets, however, did not buy or operate the gasoline sites involved in their program. Hence, it is not surprising that the gasoline firms allied with the independent supermarkets did not cut their standalone pump prices upon bundling; they do not have the incentive to cut pump price to promote the sales of supermarket grocery. However, the fact that the independent supermarkets reimburse 3 cents per liter to the otherwise unrelated gasoline firms for accepting each 4-cent- per-liter discount voucher is still consistent with loss leader advertising.

4.2. The Gans and King Model

Gans and King (2006) present a theory of bundled discount in an oligopoly setting.³⁵ They consider two pairs of firms and two completely unrelated products. They study what happens if pairs of firms, prior to setting standalone product prices, can commit to a bundled discount to those consumers who buy both goods from the pair. They presume that the two products are interchangeable and the discount is off the price of the bundle, so they do not attempt to explain why discount is applied specifically to gasoline price. Their key prediction is that if two firms offer a bundled discount, they would increase their standalone prices of both products. The intuition is simple. The size of the market is fixed in the model. Hence, if those who buy both goods from the pair are given a discount, those who buy a single product from the pair must pay a higher standalone price. Otherwise, bundled discount would not be profit

³⁵ See Gans (2007) for further elaborations of the model.

maximizing. Hence, this theory captures that the gasoline sites allied with the independent supermarkets increased their standalone pump prices upon bundling.

A virtue of the Gans and King model is that it has clear predictions as to the conditions under which bundled discount may arise. In the model, consumers are arrayed on a unit square. Absent bundling, the equilibrium price for either product is that of the standard Hotelling model. With bundling, new equilibria may arise, depending critically on how standalone prices are set. Gans and King emphasize that once a bundled discount is offered, the standalone prices of two otherwise unrelated products become related, thus generating a pricing externality between the two products. The externality is internalized if two firms are integrated in that a single entity sets the standalone prices of both products. Assume that neither pair of firms is integrated, and that for some reasons, one pair cannot offer a bundled discount. Then, the other pair has the incentive to offer one to price discriminate between these “loyal” consumers who buy both goods from the pair and those who buy only one product. If both pairs are non-integrated and free to offer a bundled discount, both pairs do so in equilibrium. If only one pair is integrated, the integrated pair offers a bundled discount, but the non-integrated pair does not. If both pairs are integrated, neither pair offers one. In the Perth market, the independent supermarkets (non-integrated) responded with a bundled discount program after Coles and Woolworths (both integrated) offered their bundled discount programs. This is inconsistent with the prediction of the Gans and King model. However, the pricing externality emphasized by their model applies to those gasoline stations that are allied with the independent supermarkets.

4.3. Price Discrimination and Increasing Efficiency

Price discrimination is often cited as a reason for bundling.³⁶ The minimum grocery purchase requirement may be interpreted as a form of quantity discount. Gasoline price discount

³⁶ See the literature that follows Stigler’s (1968) seminal paper.

vouchers may also play a role similar to that played by mail rebates. The grocery-gasoline bundling may also segment the gasoline market. Consumers who buy from the bundling sites and use the 4-cent-per-liter discount voucher should, on average, be more price sensitive than those who buy from the non-bundling sites or those who buy from the bundling sites but do not use the discount voucher. This may help explain why the average pump price, after controlling for the import cost, was higher in the long run than the pump price in 2003, but the average price paid by those who redeem a discount voucher was still lower.

Increasing efficiency is perhaps the most common reason for bundling (Evans and Salinger 2005). The grocery-gasoline bundling certainly allows a bundling gasoline site to sell more gasoline. Supermarkets operated about 25% of the Perth gasoline sites in 2005, but they accounted for 65% of the gasoline sales. Since Woolworths' original discount program involves its own gasoline sites located next to its supermarkets, economy of scope in selling may arise, and consumers can enjoy economy of scale in shopping. However, economy of scope/scale in selling cannot explain the independent supermarkets' discount program because the gasoline firms involved in this program were otherwise unrelated to each other or to the independent supermarkets. In addition, economy of scale in shopping cannot explain the new bundled discount programs since they involve gasoline sites that are not located next to supermarkets.

4.4. Predation

Various groups argue that supermarkets offer grocery-gasoline bundled discount for the purpose of predation: supermarkets sell gasoline at a discount in the short run to drive small competitors out of the gasoline market so that supermarkets can charge a high gasoline price in the long run.³⁷ Proponents of this argument may see some of our findings as supporting

³⁷ In an older version of the argument, major oil firms were argued to be the predators. This older version was examined and refuted by Barron, Loewenstein, and Umbeck (1985) and Blass and Carlton (2001).

evidence. The Perth market average price-cost margin became lower immediately after Coles' entry, but became higher in the long run. In particular, during most months between March 2004 and May 2005, the pump prices of the supermarket-operated gasoline sites were, after the 4-cent-per-liter discount, lower than the IPP import cost. Recall that the IPP import cost tracks the wholesale price at which Caltex and Shell buy gasoline from BP, and that Coles and Woolworths buy gasoline from Caltex and Shell. Thus, after the bundled discount, the pump prices of the supermarket gasoline sites were probably below some measures of marginal cost of supplying retail gasoline for a considerable period of time.

However, there are serious issues with the predation argument. First, the predation argument is inconsistent with the fact the independent supermarkets also offer a bundled discount program. The independent supermarkets do not own or operate the gasoline sites that participate in their bundled discount program. Therefore, the independent supermarkets cannot benefit from predation in the gasoline market; any potential gasoline price increase in the long run due to predation would benefit the gasoline firms but not the independent supermarkets.

Second, the predation argument cannot explain why Woolworths had been offering a small-scale bundling program for at least 3 years in the Perth area before Coles' bundling program in March 2004. During that period, the Perth gasoline market was characterized by regular price cycles (tacit collusion), and Woolworths was a price follower (Wang 2009).

Third, the new bundling programs did not reduce the number of small gasoline firms in the market before tacit collusion was restored in June 2006. Peak, Gull, and Woolworths Plus posted the most competitive pump prices in 2003, and they were the last to hike gasoline price each cycle.³⁸ Thus, Peak and Gull may be candidates for predation. Yet, from March 2004

³⁸ The average pump prices of Peak, Gull, and Woolworths Plus were 89.9, 90.6, and 90.5 cents per liter in the first 10 months of 2003. During the same period, the average pump prices of BP, Caltex, and Shell were 92.4, 92.3, and

through May 2006, the number of Peak sites increased by 1 and the number of Gull sites only decreased by 6. The gasoline sites carrying small independent brands or no brands at all increased slightly. In addition, during this competitive period, entry was still occurring: 22 new gasoline sites were opened between March 2004 and May 2006.

Fourth, the two major oil firms (BP and Caltex) were important players in this market, yet the vast majority of the gasoline sites under their control were not involved in bundling. The supermarket-operated gasoline sites cut pump price upon bundling and disrupted tacit collusion, but BP and/or Caltex initiated numerous price hikes to restore regular price cycles. If the price cuts by the supermarket-operated gasoline sites were anticompetitive, shouldn't the price hikes by BP and/or Caltex be pro-competitive?

Lastly, the logic of single-product predation may be inappropriate for a multi-product setting (Carlton, Greenlee, and Waldman 2008). Even if gasoline is priced below marginal cost, supermarkets may not incur any losses in the short run. Increased grocery sales may recoup immediately any losses in gasoline sales. Thus, the need for recoupment in the long run may not exist. Hence, the more appropriate antitrust question is whether the grocery-gasoline bundled discount is a harmful exclusionary device. The setting of supermarket and gasoline does not fit into the standard model in which bundling is thought to be potentially anticompetitive. In the standard model, a monopoly firm in one market faces competition in a second market. Bundling or tying two products can help the monopoly firm monopolize the competitive product (Whinston 1990) or maintain its monopoly status (Carlton and Waldman 2002).³⁹

91.9 cents per liter. The average pump price of the gasoline sites carrying small independent brands or no brands at all was among the highest during the same period, at 92.6 cents per liter.

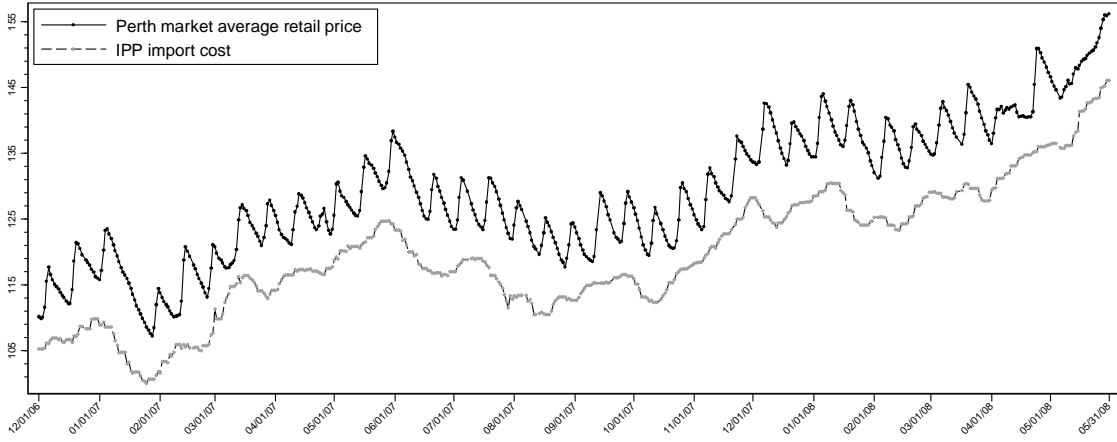
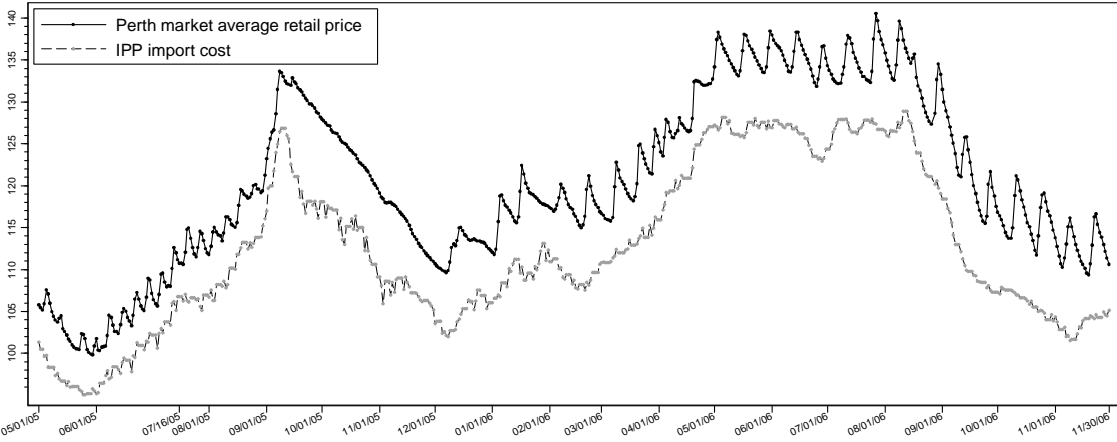
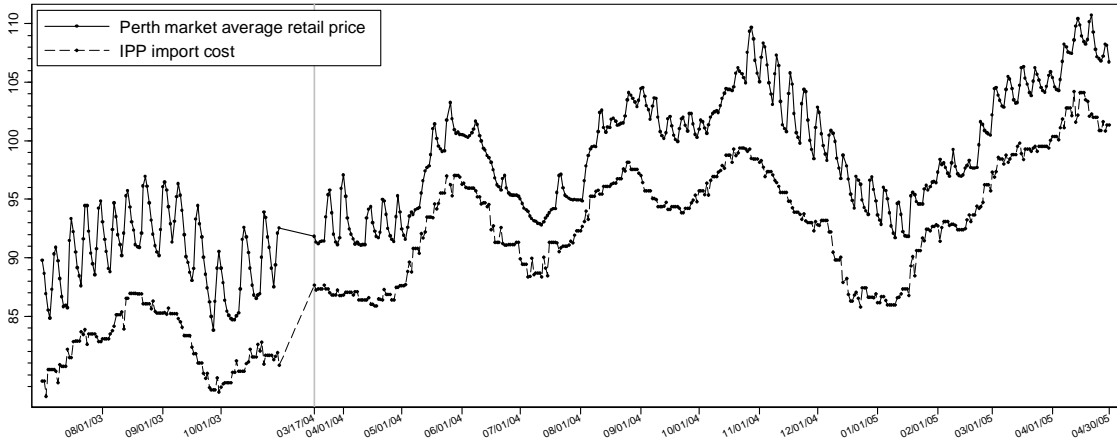
³⁹ See also Nalebuff (2004).

5. Conclusion

Supermarkets' entry into gasoline retailing and their grocery-gasoline bundled discounts are an important new development in the retail gasoline industry. In this paper, we have taken a first look at this new development. We have documented carefully the impact of multiple grocery-gasoline bundled discount programs on competition in an Australian market. Our findings suggest that bundling gasoline sites operated by supermarkets are best characterized as pro-competitive in the short run and competition-neutral in the long run, and that bundling gasoline sites not operated by supermarkets have little impact on competition. Overall, our evidence suggests that supermarkets offer grocery-gasoline bundled discounts for non-exclusionary purposes.

There is a large theoretical literature on bundling, but very few papers have studied empirically the competitive effects of bundling. Indeed, a comprehensive survey of the bundling literature (Kobayashi 2005b) identifies only two empirical papers (Haas-Wilson 1987 and Hausman and Sidak 2005) that have examined the competitive effects of bundling. This lack of empirical studies reflects the difficulty of collecting data and identifying market settings suitable for empirical analysis. In this paper, we identify such a setting, and we have access to nearly ideal gasoline price data. This allows us to identify the impact of bundling not only on the market average price-cost margin and the relative price between brands, but also on dynamic pricing behaviour and site entry and exit. However, we do not have access to grocery data or gasoline quantity data, which prevents us from offering direct evidence for advertising or providing a definite assessment of the other non-exclusionary theories of bundling. Future research on grocery-gasoline bundled discount would certainly benefit by collecting grocery data and gasoline quantity data.

Appendix A: Daily Perth Market Average Retail Price and Import Cost



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Table 1: Site Opening, Closing, and Distribution by Brand and Period

	Site Distribution				Number of sites newly opened or permanently closed							
	Oct.	Mar.	June	May	01/01/03-		11/01/03-		03/17/04-		06/01/06-	
	2003	2004	2006	2008	open	close	open	close	open	close	open	close
Entire market	328	328	312	292	18	0	5	5	22	38	11	31
BP	67	70	68	65	2	0	0	1	2	5	1	2
Caltex	87	80	53	45	1	0	1	1	1	11	2	9
Shell	44	5	3	1	0	0	0	0	0	1	0	2
Coles Express	0	41	45	49	0	0	2	0	3	0	3	0
Woolworths	15	22	39	40	3	0	0	0	4	0	1	1
Mobil/United	21	20	17	15	0	0	0	0	1	3	1	2
Gull	37	37	31	29	2	0	1	1	1	7	3	5
Peak	20	22	23	20	4	0	1	0	2	4	0	3
Small brands	37	31	33	28	4	0	0	2	8	7	0	7

Note: Small brands include those sites that do not carry any brands. The number of gasoline sites of a brand may change between two periods because some sites may be closed, opened, converted into another brand or converted into this brand from another brand. This table does not separately list the number of sites experienced brand changes.

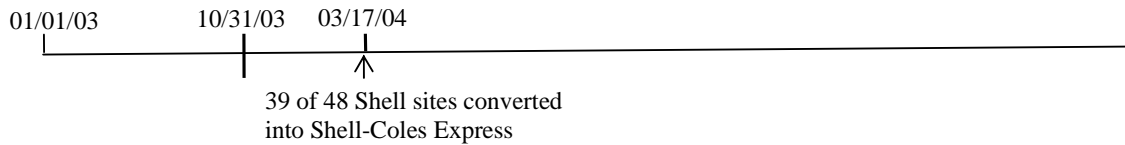
Table 2: The Impact of Bundling on Relative Prices

	Pre-bundling period	2003	03/17/04-01/31/05	2003
	Post-bundling period	03/17/04- 09/30/04	05/01/05- 08/31/05	06/01/06- 05/31/08
		(1)	(2)	(3)
	Constant	8.036*** (0.364)	6.861*** (0.423)	8.036*** (0.364)
	Within 3 miles	-0.014 (0.384)	-0.308 (0.457)	-0.014 (0.384)
	39 initially Shell-branded sites	-0.243 (0.371)	-2.639*** (0.440)	-0.243 (0.371)
	14 (20) initially Caltex-branded sites	0.099 (0.375)	-2.581*** (0.438)	0.103 (0.376)
	Original Woolworths Plus sites	-1.492*** (0.434)	-3.082*** (0.430)	-1.492*** (0.434)
	Peak sites	-2.083*** (0.378)	-2.310*** (0.435)	-2.083*** (0.378)
	14 independently owned BP-branded sites	0.550 (0.458)	0.624 (0.470)	0.550 (0.458)
	Initially Mobil-branded sites	-0.553 (0.375)	-0.619 (0.441)	-0.553 (0.375)
	Post	-1.918*** (0.246)	-0.443*** (0.098)	1.997*** (0.194)
	Within 3 miles × Post	-0.469* (0.271)	0.151 (0.119)	0.035 (0.234)
	39 initially Shell-branded sites × Post	-2.295*** (0.268)	0.094 (0.124)	-0.771*** (0.233)
	14 (20) initially Caltex-branded sites × Post	-2.793*** (0.270)	0.324** (0.147)	-1.844*** (0.221)
	Original Woolworths Plus sites × Post	-1.421*** (0.334)	0.312* (0.170)	-0.852*** (0.298)
	Peak sites × Post	-0.123 (0.272)	0.576*** (0.115)	-0.069 (0.206)
	14 independently owned BP-branded sites × Post	0.118 (0.306)	0.488*** (0.108)	1.140*** (0.249)
	Initially Mobil-branded sites × Post	0.208 (0.264)	0.704*** (0.142)	-0.687*** (0.263)
	United			-1.580*** (0.200)
	Observations	121,164	109,432	255,665
	R-squared	0.181	0.126	0.082

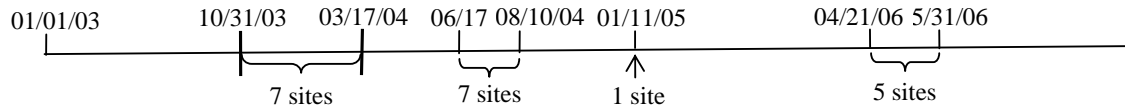
Notes: In parentheses are robust standard errors adjusted for clustering at the station level. * indicates $p < 0.10$, ** indicates $p < 0.05$, and *** indicates $p < 0.01$.

Figure 1: Timeline of the New Bundled Discount Programs

39 Shell sites converted into Shell-Coles Express on 03/15/04:



20 Caltex sites converted into Caltex-Woolworths on various dates:



The independent supermarkets' bundled discount program:

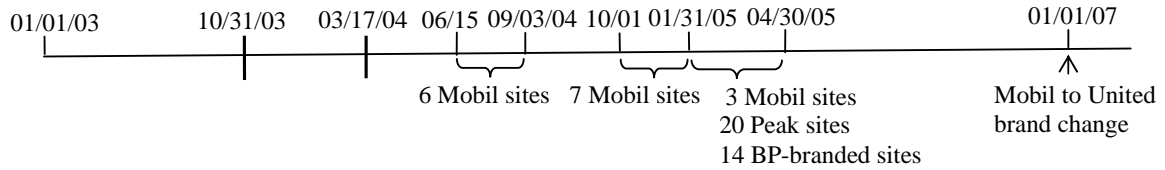


Figure 2: Monthly Perth Market Average Price-Cost Margin, January 2003 – May 2008

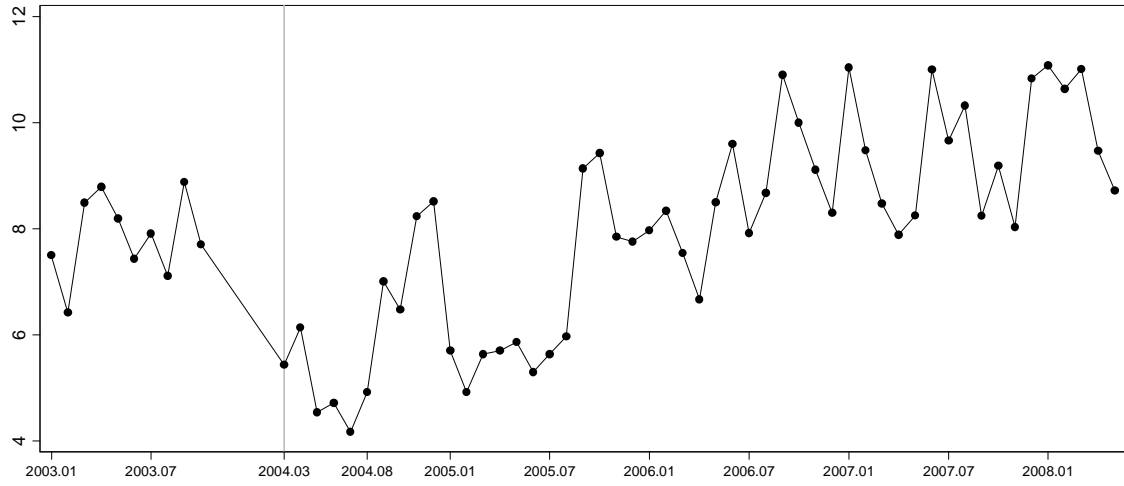
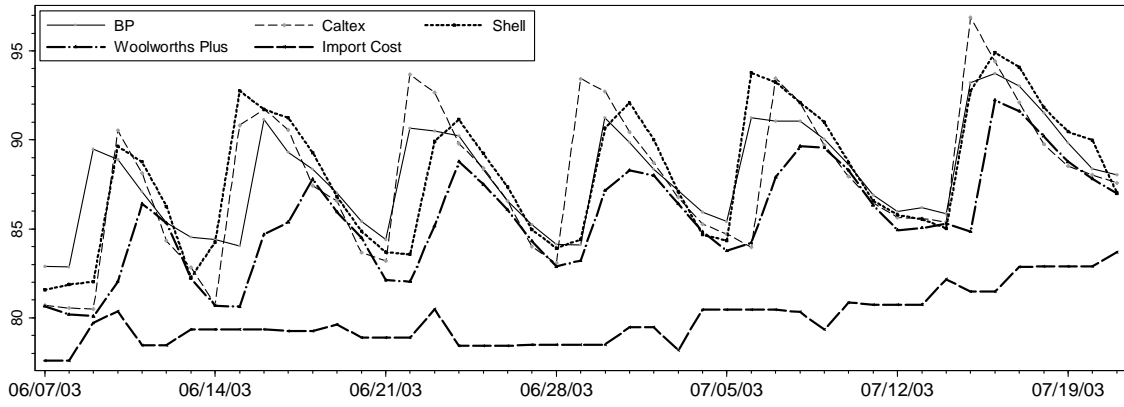
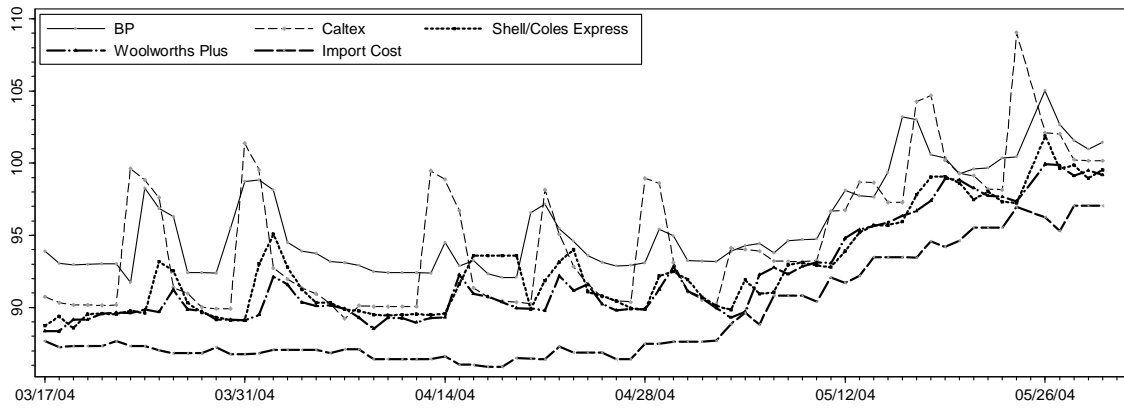


Figure 3: Daily Brand Average Retail Price of Four Firms and IPP Import Cost

(a) 06/07/03 – 07/21/03



(b) 03/17/04 – 05/13/04



(c) 10/05/06 – 12/25/06



Figure 4(a): Quarterly Average Price-Cost Margin of Five Groups of Gasoline Sites

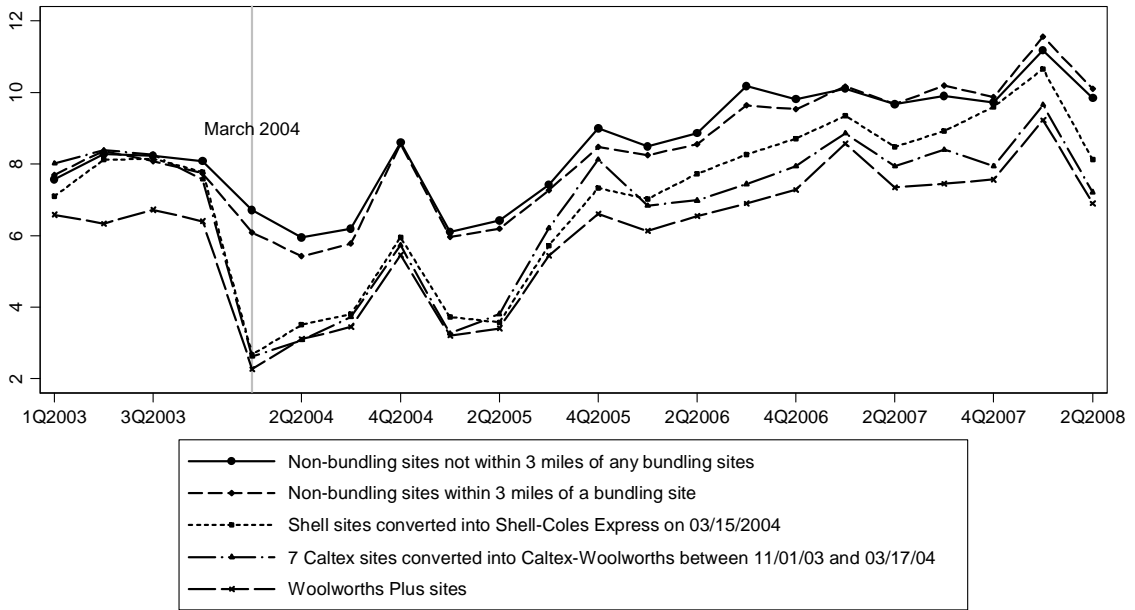


Figure 4(b): Quarterly Average Price-Cost Margin of Five More Groups of Gasoline Sites

