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Vertical Disintegration: The Effect of Refiner Exit from Gasoline Retailing on Retail Gasoline Pricing

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The net effect of vertical integration on consumer welfare depends on the magnitude of the price reductions resulting from the elimination of double marginalization at the integrated firm and the price increases resulting from higher input prices charged to unintegrated competitors. In this paper, we estimate both of these effects in the U.S. gasoline industry by examining the change in relative retail gasoline prices after refiners exited gasoline retailing beginning in the mid-2000s. Using station-level price data from Florida and New Jersey, we find that double marginalization caused retail prices to increase by about 1.2 cents-per-gallon. Our estimates of the raising rival's cost effect, while sensitive to the choice of control group, are of a similar magnitude. On net, we find that the average retail price of gasoline was effectively unchanged as the result of vertical separation.

Keywords: Antitrust, Vertical Integration, Petroleum, Gasoline Retailing

JEL Codes: L40, L10, L81

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I. Introduction

A number of antitrust scholars have suggested that U.S. antitrust agencies have been too permissive, especially regarding vertical mergers (see, e.g., Baker et al. 2019, Salop 2018). U.S. antitrust authorities have recently taken, in fact, a number of high profile actions to address concerns that increased vertical integration may harm competition. The U.S. Department of Justice (DOJ) attempted to block the vertical merger of ATT and Time Warner in 2018, marking the first time in nearly 40 years that a federal antitrust agency sued to challenge a vertical merger.[1] In addition, to provide more clarity and transparency to the public on how they analyze vertical mergers, in January of 2020, the Federal Trade Commission (FTC) and DOJ released a revised draft Vertical Merger Guidelines that were last updated in 1984.[2]

Developing effective vertical merger competition policy is difficult because vertical integration changes a firm's pricing incentives in ways that can both enhance and harm consumer welfare. Vertical integration can generate lower final good prices by eliminating double-marginalization at the integrated firm. Simultaneously, because the integrated firm makes sales both upstream and downstream, following a vertical merger a firm may face a new incentive to take actions that harm non-integrated downstream rivals. For example, a vertically integrated firm may increase the price of inputs sold to non-integrated downstream rivals; that is, raise its rivals' costs (RRC). Increased wholesale prices cause the non-integrated downstream firms to increase their final goods prices. As a result, the distortion in wholesale price caused by vertical integration increases the sales of the integrated firm and decreases the sales of un-integrated firms (Salop and Scheffman (1983), Salinger (1991)). Ultimately, the net consumer welfare effect of a vertical merger involves balancing the efficiency gains associated with the elimination of double marginalization and the potential loss in efficiency from the merged firm raising its rivals' costs. Surprisingly, given the longstanding interest in the impact of vertical mergers on competition, there is relatively little empirical research measuring the size of these two effects.

[1] https://news.bloomberglaw.com/mergers-and-antitrust/justice-department-ftc-working-on-new-vertical-merger-guideline, last visited 12/17/2019.

2 In the press release of the guidelines Assistant Attorney General Makan Delrahim stated that "Once finalized, the Vertical Merger Guidelines will provide more clarity and transparency on how we review vertical transactions" https://www.justice.gov/opa/pr/doj-and-ftc-announce-draft-vertical-merger-guidelines-public-comment. The draft guidelines are available at: https://www.ftc.gov/public-statements/2020/01/joint-vertical-merger-guidelines-draft-released-public-comment.

In this study, we estimate the price impact of double marginalization and RRC following a dramatic change in vertical market structure in U.S. gasoline distribution: refiners' sale of virtually all of their U.S. gasoline stations beginning in the mid-2000s. The gasoline industry is especially useful to study concerning the impact of vertical integration on pricing. First, the gasoline industry has institutional features that can generate both the pro and anticompetitive effects of vertical integration. U.S. petroleum firms owned refineries that produced gasoline and then sold that branded gasoline through their own retail stations or franchisees. Further, U.S. refiners' direct presence in the retail sector was substantial. In 1997, we estimate that U.S. refiners owned about 17% of U.S. gasoline stations that accounted for 38% of U.S. gasoline sales. In addition, refiners also sold generic gasoline to independent downstream retailers that competed with refiner-owned or affiliated outlets. Second, there have been long standing concerns that U.S. refiners have taken actions to harm independently owned and operated gasoline stations. For instance, legislatures in six states have passed laws to limit, and in some cases explicitly prohibit, refiners from owning and operating gasoline stations.[3] In addition, Gilbert and Hastings (2005) found that following a vertical merger in California, the integrated refiner increased the prices charged to independent gasoline stations.

We estimate the price impact of vertical separation on retail gasoline prices in two states, Florida and New Jersey, using data from the Oil Price Information Service (OPIS). OPIS maintains a data set of the daily prices of virtually all U.S. gasoline stations derived from fleet or credit card purchases at gas station pumps. Our data consists of all of OPIS's daily station-level price data from the states of Florida and New Jersey for calendar years 2002-2015. In addition to providing price information, the OPIS data provides each station's location (street address) and identifies the brand of gasoline sold at the station. We identify gasoline station ownership, changes in ownership, and the dates of stations' sale from Florida's and New Jersey's property tax records. The State of New Jersey maintains an annual data set of property taxes that identifies property ownership for all commercial and residential properties beginning in 2009. Using this data, we identify the sale of refiner-owned gasoline stations from 2010-2015. Florida's data is not stored in a centralized dataset. To construct the Florida ownership data, we conduct an internet search of individual county property assessor's web sites to identify station

[3] Currently, Maryland, Virginia, Washington DC, Connecticut, Delaware, and Hawaii all have what are called "divorcement laws" that limit refiners' ability to control the pricing of retail stations.

ownership and changes in ownership. From these searches, we identify most, if not all, of the gasoline sales by refiners between 2004 and 2015 in Florida. Overall, we observe 675 stations sold by three refiners, British Petroleum (BP), ExxonMobil, and Motiva (the owner of the Shell brand) in Florida and New Jersey.

We first estimate the effect of double marginalization by measuring how the prices of previously refiner-owned stations changed following vertical separation. We identify this effect using a difference-in-difference estimator comparing the prices of the gasoline stations sold by the refiners to stations not owned by a refiner and were not in direct competition with a refiner-owned station. In all of our analyses, we use station-specific fixed effects to control for idiosyncratic factors that affect a station's markup, e.g., a good or poor location, and daily time effects to control for common shocks across stations, e.g., changes in wholesale gasoline prices.

Overall, we find vertical separation caused a 1.2 cents per gallon (cpg) increase in relative retail prices at previously refiner-owned stations. The estimated price impact varies both by refiner and by region. Stations located in New Jersey experienced price increases of about 2.5 cpg while those in Florida experienced price increases of about 0.8 cpg. Stations previously owned by BP or Motiva increased their prices by about 1.5 cpg less than those previously owned by ExxonMobil. We also examine how prices changed within the metropolitan areas in Florida and New Jersey that experienced a change in vertical market structure. Price changes were relatively uniform within New Jersey, however, relative prices rose by more in Southeastern Florida than in other parts of the state.

We also examine if the price changes caused by vertical separation varied depending on the amount of localized competition. We find that stations facing relatively little nearby competition (stations that had two or fewer competitors within one mile) increased their prices by 1.6 cpg more in New Jersey following vertical separation. We did not observe a significant corresponding effect in Florida.

We conduct a series of event studies that generally support our interpretation of these findings. In Florida, there is no evidence of a pre-trend in the two years prior to a station's sale. However, after a station was sold there was a price increase between 0.5 and 1 cpg. In New Jersey, we observe some evidence of a pre-trend. Prices increased by about 1 cpg in the year prior to a station's sale, and again increased by about 2 cpg seven months after the station was sold, before declining to pre-sale levels at the end of the second year post-sale. We observed a similar pattern when conducting an event study separately for BP. This graphical evidence suggests that some refiners may have begun increasing the relative prices charged by their stations in the year prior to the stations' sale.[4] As a result, our estimate of the price impact of the refiners' station sales assuming prices change at the date of sale, may be an underestimate of the full price impact of vertical separation.

We next examine whether the previous vertical integration in Florida and New Jersey may have harmed competitors. Under a traditional RRC theory, a vertically integrated refiner/retailer may find it profit maximizing to charge higher wholesale prices to independent gasoline stations than an unintegrated refiner. Under this theory, the elimination of vertical integration resulting from the sale of refiner-owned gas stations should result in a *decrease* in the relative retail price of independent gasoline stations. We test this theory by comparing how the prices of unbranded gasoline stations (those not selling refiner-branded gasolines) changed relative to refiner-branded gasoline stations when refiners were selling gasoline stations. We use two related identification strategies to conduct this test. First, we use a difference-in-difference estimator that identifies the RRC effect as the difference in the change in unbranded gasoline stations' prices and the change in branded stations prices following vertical separation within markets experiencing vertical separation. A potential weakness of this identification strategy is that other factors may be changing that affect the branded/unbranded price differential. To address this concern, we also use a triple-difference estimator that compares the change in the unbranded/branded station differential in regions experiencing a change in vertical market structure to unaffected markets.

Using the first identification approach, we find evidence supporting the RRC hypothesis: the relative retail prices charged by unbranded gas stations fell in both Florida and New Jersey by between 1.4 cpg and 1.8 cpg. Use the triple-difference estimator, we find similar results for Florida. However, for New Jersey the triple-difference estimates are inconsistent with the RRC hypothesis. In particular, unbranded/branded retail gasoline prices differential increases relative to a control market as refiners complete their sale of stations.[5]

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[4]Because some consumers are likely unaware of relative price changes in the short-run, refiners may raise prices at these stations prior to their sale. While the stations lose sales as consumers become aware of the relative price increase, the refiners do not fully internalize this loss because they will not own the stations in the near future.

[5] As discussed in detail below, we are less confident in the results of our RRC test for New Jersey than Florida because both the New Jersey control and treatment markets may be affected by changes in vertical market structure in other states that we cannot observe.

Having shown that vertical integration in the gasoline industry generated real, albeit small, pricing efficiencies (the elimination of double marginalization) and competitive harms (increased independent stations prices), we conclude by estimating the net impact of vertical separation on average consumer prices. In Florida, while the estimated average price effect is negative (vertical separation lowered consumer prices) in each case we consider, the largest price decrease was -0.45 cpg, or roughly, 0.15% of the retail price of gasoline. In New Jersey, the sign of the net effect of vertical separation depends on the estimated share of sales of different types of stations (refiner-owned, independent, and refiner franchisee). When using our preferred estimate, we find that vertical separation in New Jersey increased price (on net double marginalization increased consumer prices) however, the net effect was again very small, at most 0.08 cpg, or 0.03% of the retail price of gasoline.

Our paper adds to a substantial literature on how vertical market structure affect market prices.[6] Our research design is most similar to Gilbert and Hastings (2005) (discussed above),[7] Suzuki (2009), Gil (2015), Luco and Marshall (2019), and Hortacsu and Syverson (2006, 2007) who all examine how changes in vertical integration affect price.[8] Suzuki (2009) studies the 1996 vertical merger of Time Warner (a cable distributor) and Turner Broadcaster (an owner of cable channels), and find that the merger lowered the price of basic cable, but also resulted in the foreclosure of channels sold by unintegrated cable channel providers.[9] Gil (2015) examines U.S. movie studios forced sale of theaters following the 1948 Paramount antitrust case and finds that vertical separation resulted in higher ticket prices. Luco and Marshall (2019) examine how the increased vertical integration caused by Pepsi's and Coke's purchase of some of their bottlers affected the prices of Pepsi and Coke products and the prices of competing soft drinks distributed by their previously independent bottlers. Similar to our findings, Luco and Marshall find that vertical integration led to decreased retail prices of the products sold by the newly vertically integrated firm, of roughly 1%, and modest increases in the price of rival's products, again roughly 1%. Our results differ from Hortacsu and Syverson (2006, 2007) who examine vertical

[6] See Cooper et al. (2005), Lafontaine and Slade (2007) and Slade (2019) for reviews of this literature.

[7] Hosken, Taylor, and Silvia (2011) also study the merger analyzed by Gilbert and Hastings (2005) and find that while that merger increased the wholesale prices paid by independent gasoline stations, it did not increase the average retail price of gasoline.

[8] A related line of research uses structural models to identify the effects of double marginalization or raising rivals costs effects, for example, Chipty (2001) and Crawford et al. (2018) study the multichannel cable industry.

[9] While Time Warner had some ownership interest in cable channels prior to the merger, the merger was primarily vertical and not horizontal.

relationships in the cement and concrete industry and do not find evidence of double marginalization or that vertical integration is detrimental to rivals.

Our paper also adds to a large literature that examines gasoline pricing, see, for example, Barron, Taylor, Umbeck (2004), Hosken, McMillian, Taylor (2008), and Lewis (2008). In addition, our findings are directly relevant to a subset of this literature that focuses on divorcement in the U.S. petroleum industry. Divorcement laws in their strongest form prohibit refiners from directly operating retail stations or setting retail prices. Barron and Umbeck (1984), Vita (2000) and Blass and Carlton (2001) all find evidence that divorcement laws increased retail prices, likely as the result of causing double marginalization.

The remainder of the paper is organized as follows. Section II provides institutional detail describing vertical integration in the petroleum industry over time, and the theories used to explain the types of vertical relationships used in the industry. Section III describes our data and variable construction. Section IV presents our empirical results, and Section V concludes.

II. Institutional Detail

In this section of the paper, we describe the different types of vertical relationships between the upstream suppliers of gasoline (refiners) and downstream sellers of gasoline (stations) in the U.S., the theories developed to describe when certain vertical arrangements are used, and how those relationships have changed over time.

A refiner typically produces both a "branded" product sold through its own distribution network, and unbranded gasoline sold to independent retailers. Branded gasoline is a differentiated product. Refiners compete by offering different additive packages that can improve an engine's performance.[10] Branded gasolines are sold under the refiner's name, e.g., Shell or Exxon, typically priced at a premium relative to unbranded gasoline sold under a retailer's name.

Refiners use one of three vertical relationships with stations selling their branded fuels. First, some stations are owned and operated by the refiner, "company ops." Employees of the refiner manage these stations, and the refiner controls the retail pricing of gasoline. These

[10] See, for example, a recent Consumer Reports article discussing the benefits of Tier 1 fuels on engine performance https://www.consumerreports.org/car-maintenance/study-shows-top-tier-gasoline-worth-extra-price/.

completely vertically integrated stations do not face a markup but have an internal transfer price for their gasoline. Second, there are lessee-dealer stations. The buildings and land of the station are owned by the refiner but are leased to an independent businessperson to operate. The lessee dealer pays the refiner a rental payment and agrees to buy its gasoline at a wholesale price determined by the refiner. The wholesale price faced by lessee dealers can be highly localized, in some cases varying by station.[11] The lessee-dealer is free to set the retail price. Third, there are open dealers who are essentially franchisees of the refiners. These stations are owned and operated by independent businesspeople who enter into a contract with the refiner requiring them to sell only the refiner's brand of gasoline, and maintain the refiners overall brand image.[12] In contrast to company ops and lessee dealers, open dealers purchase their branded fuel from the refiner at a publicly observable wholesale price common to all open dealers selling that brand in a broad geographic area.[13] As of 2007, roughly 32% of gasoline stations sold branded gasoline, and accounted for about 44% of the gasoline sold in the U.S.[14]

There are also gas stations that sell gasoline not branded with a refiner's name. These stations purchase unbranded gasoline and market it under their own name. Historically, most stations selling unbranded gasoline were very small firms, often operating a single station. Over the last few decades, however, a number of very large firms operating hundreds or even thousands of stations selling retailer branded gasoline have emerged including convenience store operators such as 7-11 and Circle K, club retailers such as Costco, and a number of supermarket chains.[15] In contrast to stations selling branded gasoline, unbranded stations can purchase gasoline from any refiner selling unbranded gasoline.[16]

The vertical separation caused by refiners' exit from retailing may have different impacts on the pricing of company operated and lessee dealer stations. Stations that were formerly

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[11] The lessee dealer's wholesale price is the dealer tank wagon (DTW) price (the price the refiner charges to deliver a tank of gasoline to the station). For a more detailed discussion of the DTW pricing, see Meyer and Fischer (2004).

[12] For example, an open dealer's contract will require the station to display official dealer signs, maintain certain levels of cleanliness and service, and promote the refiners brand. For more details see: https://www.convenience.org/Topics/Fuels/How-Branded-Gasoline-Stations-Work (visited 11/18/2019).

[13] The price paid by open dealers is the "rack" price, the price paid for fuel at the refiners truck rack. In contrast to the DTW price, rack prices do not include delivery fees. For additional discussion of retail gasoline ownership, see Shepard (1993).

[14] Authors calculations using data from the 2007 Census of Retail Trade (CRT) and the U.S. Energy Information Agency's (EIA) Form EIA-782A.

[15] Some convenience store chains, such as 7-11, operate some stations selling refiner-branded gasoline. In many cases, this is the result of the chain purchasing a convenience store selling branded gasoline.

[16] Very large unbranded gasoline station chains often enter directly into supply contracts with one or a number of refiners for fuel often at prices below the posted unbranded rack price.

company operated stations should raise their prices as they begin to experience double-marginalization: prior to their sale these stations should not face a wholesale margin and following their sale they do. The situation facing lessee dealers is more complicated. As noted above, a lessee dealer pays monthly rent for the station to the refiner and a wholesale price for gasoline. If there were no demand uncertainty and/or if the lessee dealer's rent changed freely to reflect market conditions, the refiner could offer lessee dealers a contract that eliminates double-marginalization. The lessee dealer's contract would set the wholesale price equal to the refiner's marginal cost and the rental payment would be set to extract all downstream locational rents. In reality, there is uncertainty regarding a station's demand, and refiners are limited in their ability to reset a station's rent.[17] As a result, it is likely that a lessee dealer's rental payment does not extract all of the station's locational rents and that the station's wholesale price includes a margin for the refiner. Thus, following vertical separation lessee dealer stations' prices would likely increase by less than those of company operated stations. Unfortunately, in our data, we only observe a station's ownership, and do not know if a refiner-owned station is operated by the refiner or by a lessee dealer.[18] As a result, while we can measure how prices changed after a refiner-owned station became independently owned and operated, we cannot distinguish between how prices changed at lessee dealer and company operated stations.

The multiple forms of vertical integration used in the gasoline industry have evolved to solve agency problems and in response to government restrictions. While the majority of a gasoline station's sales are fuel, gasoline stations are multiproduct retailers. In addition to selling fuels, gasoline stations sometimes sell repair services, maintenance items (motor oil, wiper fluid), snacks, cigarettes, and even have on-site restaurants. Some of these services, such as fuel sales, may be efficiently sold with little monitoring by the parent company while other services, such as automotive repair, require active and ongoing monitoring to maintain quality. Hence, to avoid the reduction in profits resulting from double marginalization, one would expect stations selling mostly fuels to be owned and operated by refiners. Conversely, stations deriving significant revenues from items requiring a high service component may be more profitably

[17] Fisher and Meyer (2003) provide an excellent discussion of the factors that cause lessee dealer's pricing to differ from company operated stations.

[18] We have identified anecdotal evidence suggests that lessee dealer and company operated stations were operated in both Florida and New Jersey. For example, a contemporaneous press report describing Exxon's sale of stations in New Jersey noted that under New Jersey law lessee dealers had the right of first refusal to purchase refiner owned stations, see, https://csnews.com/exxonmobils-exit-strategy-nears-finish-line, last visited 2/2/2020.

operated as open or lessee dealers where the station's manager is the residual claimant. Shepard (1993) and Slade (1998), for example, both found empirical evidence showing that stations providing services requiring extensive monitoring (auto repair service) were less likely to be operated by the refiner and more likely to be either open or lessee dealers.

In some U.S. states, vertical separation between refiners and gasoline stations is required by divorcement laws. Divorcement laws in their strongest form prohibit refiners from operating stations and setting retail prices.[19, 20] Barron and Umbeck (1984), Vita (2000), and Blass and Carlton (2001) all find that divorcement laws raise the retail price of gasoline.

The degree of vertical integration in petroleum retailing has changed in response to changes in gasoline retailing. In the 1970's and 1980's the importance of automotive service to gasoline retailing declined, and gasoline stations switched from being full-service to self-service. This transition led to a dramatic reduction in the number of gasoline stations in the U.S. from 183,000 in 1972 to 135,000 in 1987 (Basker, Foster, and Klimek (2017). Gasoline stations became larger, and generated more of their revenues from fuel and convenience items. This change in format made it more profitable for refiners to own and operate stations, resulting in an increase in company operated and lessee dealer stations (Blass and Carlton (2001)).

Since the mid-2000s, virtually all refiners operating in the U.S. decided to sell off their gasoline stations. We document this change in market structure by plotting the fraction of stations owned by refiners and the proportion of gasoline sold by these stations in Figure 1. Figure 1 shows the fraction of refiner-owned gasoline stations fell from 23% in 1992 to 5% in 2012, and the proportion of U.S. gasoline sales made by these stations fell from 38% in 1997 to 17% in 2012.[21, 22] Refiners have continued their exit from gasoline retailing. In 2018, Sunoco

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[19]Currently, Maryland, Virginia, Washington DC, Connecticut, Delaware, and Hawaii all have gasoline divorcement laws. There is variation in the form of divorcement laws. In Virginia, refiners were allowed to operate stations they owned as of the date of the law's passage, however, refiners were prohibited from opening any new stations located within 1.5 miles of any retail outlet operated by one of their franchised stations. In Maryland, the law required refiners to either sell their stations or operate them as lessee dealers.

[20] The justification for divorcement laws was that open dealers selling the same brand of gasoline as the refiner company op would be subject to unfair competition because the refiner would offer its stations a lower wholesale price than the open dealer stations (Barron and Umbeck (1984)).

[21] The fraction of gasoline stations owned by refiners comes from the Energy Information Agency's Performance Profiles of Major Energy Producers from 1992, 1997, 2002, and 2007. This series of reports ended in 2009. After 2009, we determined refiner's station ownership by reviewing the financial filings of U.S. based refiners. We were unable to determine the number of stations owned by two foreign refiners (BP and Shell/Motiva) in 2012 as their filings did not identify U.S. stations owned. We infer these firms owned 1423 stations in 2009. Both Shell and BP announced they were selling their U.S. stations during this period, so we assume they sold all of their stations by 2012.

sold its company owned gasoline stations to convenience store chain 7-Eleven, and recently Marathon, the owner of the third largest convenience store/gasoline retailer announced it would spin off its convenience store chain into a separate subsidiary.[23] Assuming Marathon spins off the Speedway chain, we estimate that refiners will own fewer than 2% of gas stations in the U.S. While U.S. refiner brands of gasoline are still commonly marketed in the U.S., e.g., Exxon or Shell gasoline, virtually all of these stations are now owned and operated by third parties.

While we do not know precisely why refiners chose to exit the retailing business, we suspect a part of the reason was the major change in the retail model used to sell gasoline.[24] In the 1990s and early 2000s, most gasoline stations transitioned into convenience stores. Using data from the five most recent Censuses of Retail Trade, Figure 1 shows that the fraction of combined convenience store/gas stations nearly doubled from 44% in 1992 to 85% in 2012. As gasoline stations transformed into convenience stores, the synergy between refining and gasoline retailing likely declined. In particular, the profitability of stations today is now largely the result of the sales of convenience items rather than gasoline. For instance, according to the National Association of Convenience Stores, in 2016 gasoline sales accounted for 61% of convenience store revenues but only 38% of store profits.[25] Consistent with our conjecture, as refiners have sold their retail stores, firms specializing in the convenience store/gas station format have grown dramatically. Currently, other than Speedway, the largest owners of gasoline stations are non-refiner convenience store operators including: 7-Eleven, Alimentation Couch-Tard (owner of Circle K and other brands), Casey's General Stores, Wawa, and QuickTrip.

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[22] The fraction of gasoline sales made by refiner owned stations is reported by EIA, Form EIA-782A. This data is not available from 1992 (the series is first reported in 1994).

[23] CSP Daily News, "Marathon Petroleum Spinning of Speedway, Changing Leadership," October 31, 2019.

[24] When Exxon-Mobil announced it was exiting gasoline retailing in 2008, its spokesperson justified the decision by stating that "fuel marketing is very challenging with reduced margins and the growth of competition (becoming) significant." CSPDailynews, "ExxonMobil Exits Retail," June 13, 2008 https://www.cspdailynews.com/fuels/exxonmobil-exits-retail. Other refiners made similar announcements describing either large sales of retail stations or exiting from gasoline retailing in the U.S. and elsewhere including BP in 2007 and Chevron in 2009 (https://www.cbsnews.com/news/exit-strategy-chevron-to-pull-name-from-some-stations-out-east/), and Connoco Philips in 2008 (https://www.latimes.com/archives/la-xpm-2008-aug-28-fi-conoco28-story.html),), Shell in 2010 (https://royaldutchshellplc.com/2010/03/17/shell-to-sell-petrol-stations-around-the-world/), and Valero in 2012 (https://www.reuters.com/article/us-valero-retail-auction/valero-may-raise-3-5-billion-through-retail-arm-auction-sources-idUSBRE88Q12D20120927.

[25]See, https://www.cspdailynews.com/company-news/soi-c-stores-log-15th-straight-year-record-sales, last visited 11/20/2019.

III. Data and Variable Construction

Our empirical analysis relies on data from three different sources. Data describing a station's retail prices comes from the Oil Price Information Service (OPIS). OPIS maintains a dataset containing daily gasoline prices of U.S. gasoline stations. Their data is derived from gasoline purchases made by the holders of fleet cards or credit cards, and the reported price corresponds to the last transaction made by a fleet or credit card holder at a station on a given day.[26] The coverage of OPIS's data has expanded substantially over time, and it currently contains pricing information from virtually all U.S. gasoline stations. In our data, the number of stations reporting data in Florida and New Jersey has increased from about 1,400 and 3,000, respectively, in 2002 to approximately 3,000 and 7,300 by 2009. OPIS's station-level price data is not a balanced panel (all stations do not report prices every day), however, the panel has become much more balanced over time. In 2002, the median station in Florida and New Jersey reported 219 and 235 daily price observations. By 2015, the median station reported prices nearly every day: 350 days in New Jersey and 360 days in Florida. From the OPIS data, we observe a station's daily price, the brand of gasoline sold (e.g., Exxon or Shell), and the street address. We obtained OPIS data from January 1, 2002 through December 31, 2015.

We use public property tax records to identify gasoline stations in New Jersey owned by refiners and subsequently sold. Beginning in 2009, the State of New Jersey released a downloadable dataset identifying all commercial and residential property in the state.[27] The property tax data contains variables on the property's address, the owner of the property, the type of property, and the date the current owner purchased the property. To identify gasoline stations owned by refiners, we identified all properties categorized as potentially being a gas station that were owned by a refiner (Exxon/Mobil, BP, or Motiva).[28] We then combined the property tax data with the OPIS data. For those stations we could match, we were confident that the properties were gas stations owned by the refiners. For those properties in the state tax data that did not match with the OPIS data, we conducted further analysis to determine the type of

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[26] Every day OPIS captures station-specific retail gasoline prices for up to 130,000 service stations in the U.S. OPIS uses relationships with credit card companies, direct feeds and other survey methods to collect daily station prices.
[27] The data can be found at https://www.state.nj.us/treasury/taxation/lpt/TaxListSearchPublicWebpage.shtml.
[28] We examined properties that had a "property use code" of either "GARAGE - SERVICE / GAS" or "GAS / STORAGE TANK", or a property that had a text in the "building description" field that indicated a facility was a gas station, e.g., the field identified the name of a brand of gasoline, or included words such as "service station".

property. In that vast majority of cases, the properties were related to the production or storage of gasoline, e.g., gasoline storage tanks, pipelines, or undeveloped land. We identified stations sold by refiners when the property tax records indicated that the owner had changed from a refiner to another entity. Because New Jersey's property tax data first became available in 2009, it was not possible to identify sales that took place before 2010.[29]

Identifying the ownership of stations in Florida was more difficult although the time period covered was not as limited. The State of Florida does not maintain a single data source identifying the owner of properties. Instead, each Florida County maintains a website to identify the ownership history of a given station. Unfortunately, given the manner in which the information is stored in the counties' web sites, we were required to examine each station separately.[30] To reduce the number of properties we needed to search, we used an additional data set to identify gasoline stations that were likely sold during our sample period. The State of Florida maintains a data set identifying all underground gasoline storage tanks. Each record in this data set identifies a given tank's location (street address) the date that the station was entered into the data set, and a field that tracks the "account owner".[31] When the account owner changes, a new record is created with the date of the change. We used the information on a change in the account owner field as an indicator that a station may have been sold. We then searched the property records of the 2,008 gasoline stations in the OPIS data that were ever associated with the brands Exxon, Mobil, BP and Shell that experienced a change in the account owner field during our sample period.[32]

In our empirical analysis, we require two years of pre- and post-sale data to measure pre- and post-sale pricing. Because our first and last year of available pricing data are 2002 and 2015, we restrict ourselves to studying the price impact of refiner-owned gas station sales between 2004 and 2013 in Florida. In New Jersey, where we can first observe station sales in

[29] Prior to 2009, there is no readily accessible data on the ownership of gasoline stations in New Jersey.

[30] In Florida, each county property appraiser's office maintains a website that identifies the value and sale date of every property. The different counties' websites, however, do not store information describing the changes in ownership using a common template. For example, rather than simply listing the transfer date of property and the buyer and seller associated with a given transaction, the typical county's property appraiser's web site contains links to legal documents in PDFs that describe the real estate transaction.

[31] The account owner in many cases is different from the actual owner of the station. For example, in the underground storage tank data set Exxon/Mobil is listed as the account owner for 42 stations while our review of property records identified 162 Exxon/Mobil owned stations that were sold during our sample period.

[32] This limitation allowed us to reduce the number of internet searches we needed to conduct from the 3,347 stations that ever sold Exxon, Shell, BP, or Mobil gasoline data in Florida during our sample period.

2010, we study station sales that took place between 2010 and 2013. Overall, we identified 675 station sales where we observe pre and post-sale gasoline prices in the OPIS data: 412 in Florida and 263 in New Jersey. We plot the locations of all stations and highlight those stations sold in Figures 2 and 3**,** for Florida and New Jersey, respectively. In Figure 2, we see that Florida station sales were concentrated in three areas: Southeastern Florida (including the Miami/Ft. Lauderdale metropolitan areas), Southwestern Florida (including the Tampa, Sarasota, and Ft. Meyers metropolitan areas), and Central Florida (including the Orlando area). During our sample, there were no station sales by BP, Motiva, or Exxon/Mobil in the Florida panhandle or Northern Florida. In Figure 3, we see the majority of the station sales in New Jersey took place in the suburbs of New York City; however, some stations sales were in western or central New Jersey, or in counties along the Atlantic Ocean. None of the stations sold in New Jersey were located in the suburbs of Philadelphia or in the southern part of the state. Not surprisingly, in both Florida and New Jersey, the overwhelming number of the oil company owned stations were located in urban or suburban markets. This finding is consistent with earlier research that found that stations are more likely to be company owned and operated if they are located close to a national or regional headquarters for a firm to facilitate monitoring, see, e.g., Brinkley and Dark (1987), Lafontaine and Slade (2007), and Wilson (2015).

Using the OPIS data and the information on refiner ownership of stations, we have measured the proportion of stations of each type: refiner-owned, refiner-franchisee, or independent separately for Florida and New Jersey in Table 1.[33] In both the Florida and New Jersey, we see that that most gasoline stations were operated by open dealers selling refiner branded gasoline (Refiner Franchisee), and that refiner-owned stations were the least frequently observed stations. The proportions calculated based on stations counts, however, likely underestimate the competitive significance of refiner-owned stations. Company operated stations, on average, sell much more gasoline than either refiner franchisee or independent stations. While there is no publicly available data to measure the sales by the different types of stations in Florida and New Jersey, we can use national estimates from EIA and the CRT to

[33] In constructing these estimates, we limit our attention to the Florida and New Jersey regions experiencing a change in vertical market structure: Central, Southeastern, and Southwestern Florida and the suburbs of New York and the rest of New Jersey.

estimate the average sales made by each type of station.[34] Using these estimates, we calculate the sales weighted proportions of sales, also shown in Table 1. When weighted by estimated sales, we see that the sales made by independent gasoline stations is of roughly the same magnitude of those made by refiner-owned stations.

Gasoline stations receive their supply from wholesale distribution points referred to in the petroleum industry as "racks" (the truck racks where tanker trucks are filled) located at refineries, pipelines, or ports. Racks are typically located near major population centers, and mostly serve stations located within 50-75 miles.[35] This distance effectively defines the size of the region having a common source of gasoline supply. In Florida, there are three different wholesale regions corresponding to the regions we have identified: Southwestern Florida, Southeastern Florida, and Central Florida.[36] While all of these regions ultimately receive their gasoline by barge shipments from the U.S. Gulf Coast refining region, wholesale prices may vary slightly between these regions due to shipping costs or transitory supply or demand shocks.[37] Gasoline stations in the New Jersey suburbs of New York City receive gasoline from the Port of New York.[38] New Jersey stations outside of the New York Metro area may receive their gasoline from the Port of New York or from distribution points near Philadelphia.[39]

Table 2 provides some statistics describing the timing of station sales by refiner and region. In Florida (Panel A), Exxon/Mobil and Motiva both sold 162 stations while BP sold 88. The table shows the timing of sales across firms. Exxon/Mobil sold almost all of its stations in

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[34] EIA's *Performance Profiles of Major Energy Producers* (published annually through 2009) provides an estimate of the monthly sales and total number of refiner owned and operated stations and franchisee stations. Using the estimates from the *Performance Profiles* and the Census of Retail Trade's count of the number of U.S. gasoline stations, we can also calculate the implied sales of independent gasoline stations. Using these data, we estimate in 2007 the average refiner operated station, refiner franchisee station, and independent gasoline station sold 196.3, 92, and 65.7 thousand gallons of gasoline per month, respectively.

[35] Federal Trade Commission Bureau of Economics (2004), "The Petroleum Industry: Mergers Structural Change, and Antitrust Enforcement," page 219. Available at: https://www.ftc.gov/reports/petroleum-industry-mergers-structural-change-antitrust-enforcement-report-staff-federal.

[36] Central Florida includes Brevard, Orange, Osceola, Seminole, and Volusia counties, Southeast Florida includes Broward, Martin, Miami-Dade, Palm Beach, and St. Lucie counties, and Southwest Florida includes Charlotte, Collier, Hernando, Hillsborough, Manatee, Lee, Pinellas, Pasco, and Sarasota counties.

[37] Gasoline supplied to Western Florida is shipped into the Port of Tampa, and then distributed by truck. Stations in Central Florida (including Orlando) can obtain their gasoline by trucks from Port Canaveral or via a pipeline connected to the Port of Tampa. Finally, Southeastern Florida stations receive their supply from a port near Miami. See https://www.eia.gov/todayinenergy/detail.php?id=15651, last visited 1/17/2020.

[38] Gasoline imported into the Port of New York or shipped on the Colonial Pipeline to Newark are distributed at the Newark Rack, which refers to a number of distribution points close to New York City.

[39] The New York City Suburbs include Bergen, Essex, Hudson, Middlesex, Morris, Passaic, Union, and Somerset counties, and "Rest of New Jersey" includes Hunterdon, Mercer, Monmouth, Ocean, Sussex, and Warren counties.

2011. By contrast, Motiva had relatively large sales of stations in different regions in different years: 61 stations in the Southwest in 2006, and 56 stations in the Southeast in 2009. Statistics describing the New Jersey stations sales are shown in Panel B.[40] In contrast to Florida, a single refiner, ExxonMobil, owned most of the refiner-owned stations in New Jersey during our sample period. In addition, the vast majority of these stations (75%) were located in the New Jersey suburbs of New York City. Both ExxonMobil's and Motiva's sales were concentrated in a single year, 2012 and 2011, respectively.

IV. Empirical Model and Results

In this section, we conduct two empirical analyses to examine how the change in vertical market structure resulting from gasoline refiners selling their stations affected the relative prices charged by different types of gasoline stations. First, we examine the prices charged by newly vertically separated stations. In particular, we are interested in determining if vertical separation resulted in an increase in retail prices consistent with double marginalization. Next, we determine how the change in vertical market structure affected the relative retail prices charged by stations selling unbranded gasoline; that is, stations unaffiliated with a refiner. Under a RRC theory, a vertically integrated refiner may find it profitable to raise the wholesale fuel price charged to unintegrated retail stations. As a result, the price of unaffiliated gasoline stations would rise relative to the price at stations selling refiner-branded gasoline. If the RRC described refiner behavior, vertical separation should result in a decrease in the relative retail price charged by unbranded stations. Finally, we conclude by conducting an estimate of the net impact of vertical separation on retail prices.

In each analysis, our goal is to measure the causal effect of the change in vertical market structure on the pricing of previously refiner-owned stations and non-refiner affiliated stations. The difficulty in measuring this price effect is that we do not observe the prices these stations would have charged in the post-sale period if the refiners counterfactually had not sold the stations. The research design we use closely follows the merger retrospective literature that

[40] In New Jersey, where we could observe the ownership of all stations, we know that only three refiners owned stations: Exxon/Mobil, Motiva/Shell, and BP. During our sample period, BP only sold three stations and maintained ownership of 23 stations at the end of our sample period. Because so few BP stations were sold during our sample period, we dropped them from our analysis of station sales in New Jersey and the sales are not reported in Table 1. In addition, at the end of our sample period Exxon/Mobil still owned six stations in New Jersey.

exploits geographic variation in changes in local market structure to determine how mergers affect pricing decisions.[41] For each analysis, we use difference-in-difference estimators that identify the price impact of refiner's exit from retailing as the change in the price at the affected station post-sale relative to other stations that were not directly affected by the change in vertical market structure. The key assumption underlying the difference-in-difference estimator is that prices in the control group would have changed post-sale in a similar manner as those that were sold. It is not possible to test directly this assumption, as the counterfactual is not observed. Instead, we provide graphical evidence showing how prices of stations that were sold changed relative to the control group in the pre-sale period. In addition, we test the robustness of our results relative to different control groups.

a. Double Marginalization: Price Changes at Refiner Owned Stations

We first estimate the price impact of a station's sale on its price using equation (1) below where we regress station i's price on day t on a station fixed-effect (α_i) that controls for persistent factors such as a good location that can allow a gasoline to charge higher prices (see, e.g., Hosken, McMillan, and Taylor (2008) and Lewis (2008)), a time fixed-effect (γ_{jt}) to control for shocks to gasoline prices that may be time (t) and region (j) specific, and an indicator equal to one for the post-sale period for those stations that have been sold.

$$(1) \qquad p_{it} = \alpha_i + \gamma_{jt} + \theta * \text{Post Sale}_{it} + e_{it}$$

Because we have both a large number of gasoline stations and time periods in the regression, we cluster standard errors by both time and station using Cameron, Gelbach, and Miller's (2011) multiway clustering procedure. Finally, as noted above, we require at least two-years of pre- and post-sale data to measure the price change following a station's sale. In analyzing station sales for Florida, we use data from January 2002-December 2015. For New Jersey, when we can only

[41] Examples include Gilbert and Hastings (2005) and Hortasu and Syverson (2007) who study vertical mergers in petroleum and cement, and studies of horizontal mergers in petroleum markets (Taylor and Hosken (2007) and Houde (2012)), airlines (Kim and Singal (1993) and Carlton et al. (2019), banking (Prager and Hannan (1998) and Allen, Clark, and Houde (2013)), and healthcare (Dafny (2009) and Cooper et al. (2019)).

begin consistently observing station sales in 2010, we limit our data set to two years prior to the first station sales (January 2008) through the end of the sample period.

We next describe stations included in the control group focusing first on geographic restrictions. Ideally, we would like to include all stations experiencing similar supply and demand conditions to those stations that are sold, but not those stations that may be indirectly affected by the sale of refiner-owned stations. First, we exclude those stations from the control group that may be potentially engaged in direct price competition with the refiner-owned stations that were sold. The literature finds that gasoline pricing is localized; that is, pricing at a station is primarily affected by stations that are operating relatively close by.[42] To avoid including potentially competing stations in the control group, we exclude all gasoline stations operating within 1.5 miles of a station that will be sold from the control group. Second, we limit the control group to those stations operating in the counties of the refiner-owned stations. This restriction excludes regions in Florida and New Jersey in which refiners choose not to operate retail outlets. Finally, we exclude stations more than 10 miles from any refiner-owned stations to ensure only the parts of counties that contain refiner-owned stations are in the control group.

We next consider restrictions on the types of gasoline stations in the control group. The change in vertical market structure may change the relative wholesale prices facing two types of gasoline stations causing these stations to be potentially poor controls. Prior to vertical separation, BP, ExxonMobil, and Motiva may have increased the prices charged to independent gasoline stations as part of a RRC strategy. As a result, following vertical separation, independent gasoline stations relative prices may fall as a result of vertical separation. For this reason, prices at these stations may not provide a valid counterfactual price. It is also possible that following vertical separation the refiners selling gasoline stations (BP, ExxonMobil, and Motiva) may choose to change the relative wholesale prices charged to their franchisee stations. In particular, following vertical separation, the previously BP, Motiva, and ExxonMobil owned stations became franchisee stations. This results in a change in the composition of franchisee stations that may cause the refiners to the change the wholesale price charged to its franchisee dealers. As a result, prices at these stations may be invalid controls.[43] For these reasons, our

[42] Barron, Taylor and Umbeck (2004) and Hosken, McMillian, and Taylor (2008), for example, both focus on localized competition within 1.5 miles of stations in urban and suburban areas like those we study.
[43] Recall that refiners charge a single wholesale price (a branded rack price) to all franchisee stations operating in a region. If, for example, the previously refiner owned stations had, on average, particularly valuable locations, then

preferred control group consists of the refiner franchisee stations not affiliated with the refiners selling gasoline stations; that is, those not affiliated with BP, ExxonMobil, or Motiva.[44] These stations are supplied by refiners not experiencing a change in vertical market structure in the affected markets, and it seems unlikely that their suppliers would face an incentive to change their wholesale prices. However, as a robustness check, we also estimate the effect of double marginalization using control groups containing independent stations and BP, ExxonMobil, and Motiva franchisees.

In the first two columns of Table 3, we present the mean prices and margins of refiner owned stations and those in our primary comparison group.[45] Prices and margins are reported in 2010 cents-per-gallon (cpg) net of taxes, and are reported for 2003 (the year directly preceding the refiner station sales).[46] While in four of the five regions we study, the refiner-owned stations had higher prices than those in the control group, the difference was small, never more than three cpg. Moreover, the difference in average prices within the control and treatment groups was much larger, the standard deviation of prices was more than 11 cpg in each region. This large variation is the result of idiosyncratic features of different gasoline stations that affect price levels, particularly location. The most striking difference in the table is the much higher prices charged and margins earned by New Jersey stations. This difference is the result of the continuing ban on self-service gasoline in New Jersey (Johnson and Romeo (2000)).

To provide evidence on the validity of the parallel trends assumption underlying the difference-in-difference estimator, we first estimate a series of event studies examining how prices changed at the stores that were sold relative to all other stations. We estimate the event study using equation (2) below where station i's price on day t (p_{it}) is a function of a station fixed-effect (α_i), a region-time effect (different for each of the three Florida and two New Jersey regions) (γ_{jt}), and a series of 48 indicator variables whose estimated coefficients will

the refiner may increase the wholesale prices changed to all franchisees to extract some of these location specific rents.

[44] The control group consists of franchisee station of the refiners Chevron, Citgo, Conoco, Getty, Gulf, Hess, Phillips 66, Sunoco, and Valero

[45] Margins are defined as the difference between retail price and the wholesale price net of taxes. We have OPIS's average rack price for Newark, New Jersey and Miami, Florida to measure New Jersey and Florida station's wholesale prices. Most of the gasoline stations in New Jersey probably receive their gasoline from the Newark rack. All of the Florida regions receive gasoline shipments from ocean going barges from refiners in Texas and Louisiana. In the long run, rack prices in Southwest Florida and Central Florida vary by a few cpg from Miami as the result of difference in shipping costs.

[46] Prices are deflated using the CPI for urban consumers.

measure how prices differ at the stations that are sold in the 24 months prior to sale and 24 months post sale.

$$(2) \quad p_{it} = \alpha_i + \gamma_{jt} + \sum_{k=-24}^{-1} \beta_k (\text{k Months Pre Sale})_{ik} {*} (\text{If Sold})_i + \sum_{k=1}^{24} \beta_k (\text{k Months Post Sale})_{ik} {*} (\text{If Sold})_i + \varepsilon_{it}$$

The event study is constructed by plotting the β_k's against the number of months prior to (or following) the sale of a station (the coefficient corresponding to the month a station is sold is normalized to zero). The event study allows us to see how closely the control group stations' prices track the prices of the stations sold in the pre-period, and allows us to observe the timing of any price change post-sale. Because the stations are sold at very different times (between 2004 and 2013), we only include data for the stations that were sold during the four years around the station's sale (24 months preceding and following the station's sale). Standard errors are estimated using two way clustering by date/region and station.

We begin by estimating equation (2) using data from all of the 675 station sales, and plot the coefficients corresponding to the month indicators in Figure 4. Figure 4 shows evidence of a slight pre-trend in the two years prior to a station's sale. Prices at the stations sold increase about 0.5 cpg two years prior to a store's sale and an additional 0.5 cpg in the year before a station's sale. However, just after a store is sold, there is a clear jump in the relative price charged by stores that were sold by a refiner, with prices carrying between 0.5 to 1.3 cpg higher post sale.

We next explore how the event study varies across states and by refiner. Figures 5 and 6 show the event studies estimated separately for gasoline stations operating in Florida and New Jersey, respectively. For Florida, there appears to be no evidence of a pre-trend in the two years prior to a station's sale. However, after the station sold, there is a clear increase in price varying between 0.5 and 1 cpg. In New Jersey, there appears to be two different pricing regimes prior to a station's sale. Prices seem to be centered around -1.75 cpg 24 to 13 months prior to a station's sale, and then prices increase about a cent per gallon in the year prior to a station's sale. However, after a station is sold its prices increase by about 2 cpg seven months after the station was sold, before declining to pre-sale levels at the end of the second post-sale year. Finally, Figures 7, 8, and 9 estimate the event studies separately by refiner. The event studies for both BP and Exxon stations show some evidence of a pre-trend. For BP, prices appear to begin increasing about eight months before a station's sale, and then increase again about seven months following the sale, by about 1 cpg. The Exxon/Mobil stations' prices increase by about 1 cpg in the two years prior to the station's sale, and then increase their prices by about 2 cpg about seven months after the station's sale. Relative prices then fall to about 1 cpg higher than their pre-sale level by the end of the sample period. By contrast, the stations formerly owned by Motiva show a high level of volatility in the event study with no clear break in pricing following their sale.

The event studies for Florida, BP, and Exxon provide graphical evidence suggesting that the refiners may have begun increasing the relative prices charged by their stations in the year prior to the stations' sale. The choice of refiners to increase retail prices at their stations may seem surprising. In a static model, refiners do not face an incentive to raise retail prices before selling their stations. However, if some consumers are inattentive to relative price changes in the short run, refiners might have an incentive to raise prices at their stations in the months prior to their sale.[47] This could occur because the refiner does not internalize the effect of permanently losing consumers who switch to lower priced stations, as many consumers may be unaware of the change in relative price until after the station is sold. As a result, when we estimate the price impact of the refiners' station sales assuming prices change at the date of sale, we may be underestimating the full price impact of vertical separation.

We quantify the magnitude of the price changes associated with station sales by estimating equation (1). We begin by estimating the average price impact of a station's sale by a refiner by pooling data from Florida and New Jersey and the three refiners selling stations that we study, BP, Shell, and Exxon/Mobil. The results are shown in Table 4. The first three columns of Table 4, explore the sensitivity of the estimated price changes to different methods of controlling for shocks to daily gasoline prices. In column 1, we control for a daily price common to all stations and regions (such as crude oil price shocks). In columns 2 and 3, we allowing daily price changes to vary by state or within a state by region to allow for localized supply or demand shocks that could affect gasoline pricing. The results show that the choice of time

[47] There is an extensive literature examining the importance of incomplete consumer information in generating both cross-sectional and intertemporal price variation within gasoline markets. For example, in understanding the role of consumer search as an explanation for asymmetric price adjustment: the finding that retail prices change more quickly in response to wholesale price increases than decreases. Lewis and Marvel (2011) document that consumer's search more in response to price increases than decreases, and Tappata (2009) builds an equilibrium model to explain this phenomenon.

control is important. Retail prices increase by about 2.5 cpg when using a simple common time control, but are estimated to increase by only 1.2 cpg when using a regional price control corresponding to a local wholesale market. For this reason, we use region/day time controls in all of the empirical analysis that follows, and we cluster our standard errors by region/time and station. In the remaining columns of Table 4, we add controls for both the state and the refiner selling the station. In column 4, we see that prices increase by about 2.5 cpg in New Jersey and 0.8 cpg in Florida. Price increases also appear to be largest for Exxon (the omitted group) and lower for Motiva and BP (column 5). In column 6, we control for both region and brand, and find prices increase most in New Jersey and for Exxon.

In Table 5, we explore in more detail how price changes vary by region and by refiner. The first two columns of the table estimate how the prices changed in Florida. Overall, prices increased by 1.4 cpg in Southeast Florida and were largely unchanged in the Central Florida or Southwest Florida. However, these overall price changes mask significant variation by refiner. Stations previously owned by Exxon/Mobil experienced significant price increases following vertical separation in all Florida regions: increasing by 2.3, 1.2, and 2.3 cpg in Southeast Florida, Central Florida, and Southwest Florida respectively. Similarly, BP's prices increased by about 0.8 cpg in the two regions it sold stations. The findings for Motiva are mixed, with prices increasing in Southeast Florida and falling in Southwest Florida and Central Florida. The price changes following vertical separation in New Jersey are more uniform than in Florida. Overall, prices are estimated to increase by 3 cpg in the suburbs of New York City and about 2.3 cpg in the rest of New Jersey (column 3). When we estimate price changes separately by refiner, we find larger price increases for Exxon/Mobil than for Motiva, although the differences in price across refiners are not statistically significant.

We next examine whether the price change varied by local market structure. For example, it may be more difficult for a station to pass through a price increase resulting from an increase in wholesale price following vertical separation from the refiner in more competitive markets than in less competitive markets. We define a station as facing little nearby competition if it faces two or fewer rivals within one mile of its station.[48] The results are shown in Table 6.

[48] Roughly 42% of stations in New Jersey and 30% of the refiner sold stations operated in markets with fewer than two rivals within one mile. We have analyzed the differential impact of vertical disintegration in highly concentrated local markets using different market definitions (two or fewer rivals within ½, ¾, and 1.5 miles) and found qualitatively similar results to those shown here. Results shown in Appendix Table 1.

In column 1, we see that following their sale, stations in less competitive markets increased their relative prices by about 1 cpg more than those operating in more competitive markets. This price differential declines when we control for the state the station operates in, and the refiner that previously owned the station (columns 2-4). Interestingly, the effect of localized competition on post-sale pricing appears to be much more important in New Jersey (increasing the post-sale price increase by about 1.7 cpg) than in Florida where the estimated effect is positive but not statistically significant.

We have performed a number of additional robustness checks on our estimates described in Appendix 1. Most of these analyses examine how our estimates are affected by changes in the composition of the control group. For example, limiting the control group to independent stations, or modifying the geographic restrictions placed on the control group, e.g., excluding stations located within 3 miles of a refiner owned station. In most cases, we found that our findings are both qualitatively and quantitatively similar to those reported in Tables 4-6. The one significant exception was when we limited the control group to consist of franchisee stations of the refiners that were vertically separating (BP, Shell, Exxon, and Mobil stations owned and operated by franchisees). Using this control group, we found that the estimated price increases were smaller in New Jersey and Southeastern Florida. The results from this analysis suggest that refiners may have increased the wholesale prices charged to all of their stations following vertical separation: both previously franchisee and previously refiner owned stations.[49]

b. Evidence of RRC: Relative Price Changes at Unbranded Gasoline Stations

We next test if the previous vertical integration of refiners and stations caused higher retail prices at unbranded gasoline stations (those not affiliated with a refiner) as suggested under a RRC theory (Salop and Scheffman (1983), Salinger (1991)). Under the RRC theory, the vertical integration of a refiner and retailer causes the integrated firm to increase the wholesale price charged to independent gas stations. If vertical integration caused refiners to increase the wholesale price charged to unbranded gasoline stations resulting in higher retail prices, then vertical separation should cause unbranded gasoline stations' relative retail price to fall.

[49] We also examined how prices changed at stations located near the refiner sold stations. In most cases, we did not observe these competing stations change their prices in response to a rival station becoming vertically separated. The one exception is in New Jersey in regions where a refiner owned station faced two or fewer competitors within one mile. These rival stations increase their prices by about 2 cpg after the refiner sells its station. These results are presented in Appendix 2.

The incentive for refiners to engage in a RRC strategy is directly related to the substitutability of refiner branded and unbranded gasoline stations, and the importance of branded refiners as a source of supply to unbranded stations. For example, if unbranded and branded gasoline stations were distant substitutes, then refiners would have little incentive to raise the wholesale price to unbranded gasoline stations. Ideally, we would directly measure the diversion between branded and unbranded stations and the quantities sold by refiners to unbranded gas stations to evaluate the RRC theory in the markets we study. Unfortunately, we do not have access to disaggregated retail or wholesale gasoline quantity data to conduct such an analysis.[50] However, two institutional factors limit refiners' ability to engage in a RRC strategy in the states we study. First, the refiners supplying their own affiliated stations with fuel within a region are not the only firms that can supply unbranded gasoline. In most areas, unbranded gasoline is supplied (or could be supplied) by arbitragers. To enter a region's unbranded wholesale gasoline market, an arbitrager needs to purchase gasoline, identify a method to ship it, and obtain access to a wholesale distribution point in that region where it can supply the trucks that will transport gasoline to unbranded gas stations. Because the marginal supply of gasoline (if not all gasoline) consumed in Florida and New Jersey is shipped into the region from distant refining centers, arbitragers should not face a substantial shipping cost disadvantage relative to refiners in supplying unbranded gasoline. Moreover, in major metropolitan areas like those we study, wholesale distribution points (racks) contain third party terminal owners that can rent rack space to arbitragers.[51] For these reasons, the threat of arbitrage limits the amount by which vertically integrated refiners can increase unbranded wholesale prices.

A second constraint affecting a refiner's ability to raise rivals' costs is that the wholesale prices paid by refiner-franchised stations and independent gasoline stations are set at the regional (rack) level. All stations obtaining a given type (or brand) of gasoline pay the same price at a given rack.[52] In particular, refiners cannot price discriminate by charging higher wholesale

[50] While EIA collects detailed refiner-specific sales data, this information is highly proprietary and not available to researchers. While a handful of researchers have had access to the retail prices and quantities of specific refiner's stations, e.g., Barron, Umbeck, and Waddell (2008), or have access to survey data for a small number of days, e.g., Wilson (2015), we have been unable to identify similar data for Florida or New Jersey during our period.
[51] In New Jersey, Buckeye, Kinder Morgan and NuStar all operate independent terminals. In Florida, all three of those firms as well as TransMontaigne have independent terminals. OPIS/Stalsby, 28th Edition, Petroleum Terminal Encyclopedia, 2017. These terminal operators provide services to refiners and potentially to arbitragers.
[52] Some very large retailers may purchase unbranded gasoline at a discount from the publicly posted unbranded rack price. However, retailer specific discounts are not tied to the location of a station.

prices to independent stations directly competing with their company owned outlets than those that are not, which is what they would like to do under a RRC theory. This inability to target its price increase at competing independent retailers should lessen the size of any relative wholesale price increase caused by a RRC strategy.

We use two related identification approaches to test the RRC theory. First, we examine how the branded/unbranded retail price differential changes as refiners become less vertically integrated within a region. Under the RRC theory, as the refiners sell more of their stations, they should lower the wholesale price charged to unbranded stations. In turn, this reduction in wholesale prices should result in a decline in the relative retail price charged by unbranded stations. In this analysis, we use a difference-in-difference estimator where we identify the RRC effect as the difference between the change in unbranded retail prices and the change in branded retail prices following vertical separation.

A potential weakness of this approach is that it assumes that no other factors caused the branded/unbranded differential to change over time. To control for this possibility, we also estimate the RRC effect by examining how the branded/unbranded price differential changed *across* markets: comparing the change in unbranded and branded stations' prices in regions experiencing a change in vertical market structure to the change in unbranded and branded stations' prices in markets not experiencing such a change; i.e., a triple-difference estimator. This second analysis controls for common factors that may affect the branded/unbranded station price differential unrelated to the change in vertical market structure.

The tests we describe are more informative if the markets affected by the change in vertical market structure are unaffected by other contemporaneous changes that could affect wholesale pricing. We believe this is the case for the three Florida regions we study. Each of these regions is a separate wholesale market for retail stations, and we observe the pricing and changes in vertical integration for all stations located within the wholesale market. Unfortunately, this is not true for the New Jersey markets we study. The New Jersey regions affected by vertical separation are likely supplied by the Newark rack.[53] The Newark rack also supplies stations in the state of New York. From contemporaneous press reports, we know that

[53] In most cases, gasoline stations obtain their supply from the closest wholesale distribution point (rack). The stations located in the New Jersey suburbs of New York City are supplied by the Newark rack. Most of the refiner-owned stations in Western and Coastal New Jersey are closer to the Newark rack than the Philadelphia rack, and are thus likely supplied by the Newark rack.

refiners were also selling gasoline stations located in the New York during our sample period.[54] Hence, it is possible that changes in the unbranded wholesale gasoline prices paid by New Jersey gasoline stations could also be affected by changes in vertical market structure in New York that we do not observe.

We face a similar issue in identifying control regions for the triple-difference analysis. In Florida, we have identified two wholesale regions that did not experience a change in vertical market structure: the Panhandle region located in Northwest Florida that includes the cities of Pensacola and Tallahassee, and Northeastern Florida that includes the greater Jacksonville area.[55] Because we can observe all of the gasoline stations supplied in these wholesale markets, stations operating in these Florida regions should provide a valid control for the triple difference analysis in Florida. None of the stations in the New Jersey suburbs of Philadelphia were owned by refiners, and these stations obtained their gasoline from a different wholesale distribution point (the Philadelphia rack) than those experiencing a change in vertical market structure.[56] Thus, the New Jersey stations in the Philadelphia suburbs provide a potential control for the triple difference analysis. However, prices at the Philadelphia rack were also determined by conditions faced by stations in Pennsylvania. In particular, if the level of vertical integration in Pennsylvania changed during our sample period causing wholesale prices to change, then these stations would not be a valid control group.[57]

Determining when a refiner may have changed its wholesale pricing decision as a result of the change in the level of vertical integration was complicated because the changes in vertical integration varied over time and by region. In Florida, for example, refiner station sales took place over nine years and the timing of station sales varied by region (see Table 2). As a result, there was no easily identifiable discrete date when refiners' had an incentive to change relative wholesale prices. Rather than focusing how pricing changes following a specific date as we did in estimating the price changes at refiner sold stations, we instead exploit the fact that station

[54] We attempted to study vertical separation in New York State as well, but could not identify the ownership of stations overtime. We identified press reports indicating that ExxonMobil was selling stations in New York during our sample period. https://csnews.com/nearly-300-exxonmobil-stations-sold-q3, last visited 5/11/2020.

[55] The Panhandle region includes Bay, Calhoun, Escambia, Franklin, Gadsden, Gulf, Holmes, Jackson, Jefferson, Leon, Liberty, Okaloosa, Santa Rosa, Wakulla, Walton, and Washington counties. The Jacksonville region includes Baker, Clay, Duval, Nassau, Putnam, and St. Johns counties.

[56] The New Jersey control group consists of New Jersey stations located in the Philadelphia suburban counties of Burlington, Camden, Gloucester, and Salem.

[57] We have not identified any press accounts describing sales of refiner-owned stations in the Philadelphia area, however, given the national changes in vertical market structure it is a possibility.

sales in Florida and New Jersey were concentrated in a relatively small number of years. In particular, we look for evidence of the RRC strategy by examining how the relative price of unbranded stations' prices changed relative to branded station prices in the years immediately following large sales of stations.

We begin by estimating how the branded/unbranded relative price changes within a market. Specifically, we construct a set of variables that are the interaction of an indicator for whether a station sells unbranded gasoline (If Unbranded$_i$) and an indicator corresponding to the period following the major sales of stations in Florida in either 2006, 2009, or 2011 or in New Jersey in 2011 or 2012. The estimating equations are shown below, (3) and (3'), for Florida and New Jersey, respectively.

$$(3) \quad p_{it} = \alpha_i + \gamma_{jt} + \beta_1^{FL}\text{If Unbranded}_i\text{*(If 2007-2009)}_t + \beta_2^{FL}\text{If Unbranded}_i\text{*(If 2010-2011)}_t \; \beta_3\text{If Unbranded}_3^{FL}\text{*(If 2012-2015)}_t + \varepsilon_{it}$$

$$(3') \quad p_{it} = \alpha_i + \gamma_{jt} + \beta_1^{NJ}\text{If Unbranded}_i\text{*(If 2012)}_t + \beta_2^{NJ}\text{If Unbranded}_i\text{*(If 2013-2015)}_t + \varepsilon_{it}$$

In equations (3) and (3'), the $\beta's$ measure the change in the relative price of unbranded stations over time. For example, the coefficient β_1^{FL} measures how the relative retail price charged by unbranded stations changed in the period immediately following the first major round of Florida stations sales relative to the pre-sale period.[58] Because the various post-sale periods are mutually exclusive, if the lessening of vertical integration causes unbranded relative prices to fall, we should observe prices generally falling over time, e.g., $\left|\beta_1^{FL}\right| \le \left|\beta_2^{FL}\right| \le \left|\beta_3^{FL}\right|$.[59]

The sample used in estimating (3) and (3') is slightly different from what was used in estimating the effect of vertical separation on previously refiner owned stations. We excluded the previously refiner-owned stations from the estimation sample, because we have shown that these stations (all branded) increased their relative retail prices as the result of becoming vertically separated. As a result, the estimation sample includes all of the unbranded and branded

[58] Gasoline stations rarely change brand. The station fixed-effect controls for any level effect associated with a station being branded or unbranded. The region-time fixed-effect measures how the price level of all stations changes. As a result, the coefficient on the interactions of the unbranded indicator with the time-period indicators measures how unbranded gas stations' prices changed differentially to branded stations during these periods.
[59] Our post-sale periods are mutually exclusive and completely exhaustive to allow the reader to test easily the null hypothesis that the pricing post-sale in each of the three periods is statistically different from the pre-period.

stations that were never owned by refiners during our sample period.[60] In Table 3, we show the average price levels and margins of branded and unbranded gasoline stations in 2003, the year prior to the station sales we observe (columns 3&4). Not surprisingly, as branded gasoline was perceived as a superior product, the average price of branded gasoline was higher than unbranded gasoline in all regions. However, this difference was relatively small, no more than 3 cpg, especially when compared to the price variation among branded and unbranded stations.

As before, to evaluate the credibility of the estimator, we begin by conducting a pair of event studies for Florida and New Jersey to examine the change in the relative retail price of unbranded gasoline stations to branded stations over time. We estimate equation (4) separately for Florida and New Jersey, where station i's price on day t (p_{it}) is a function of a station fixed-effect (α_i), a region-time effect (γ_{jt}), and a series of monthly indicator variables interacted with an unbranded indicator to capture how prices differ at unbranded stations relative to branded stations each month using the estimation sample described above. We normalized the coefficient corresponding to the first period to be zero (January, 2002 for Florida and January 2008 for New Jersey).

$$(4) \qquad p_{it} = \alpha_i + \gamma_{jt} + \sum_k \varphi_k (\text{Month}_\text{k})_\text{ik} * (\text{If Unbranded})_i + \varepsilon_{it}$$

The event study is constructed by plotting the φ_k's from equation (4) corresponding to each month in Figure 10 (for Florida) and Figure 11 (for New Jersey). In neither figure do we observe a sharp break in relative pricing in either Florida or New Jersey. Instead, in both states we see that the branded/unbranded differential is relatively constant prior to the period when refiners began selling large numbers of stations. In both Figures 10 and 11, the relative price charged by unbranded stations gradually begins to fall as the refiners began to sell large numbers of stations, which is consistent with the raising rival's cost theory.

We next estimate the magnitude of the change in the relative unbranded retail price by estimating equations (3) and (3'). For both states, we first estimate the equation pooling data across regions, and then estimate the equation separately by region to allow for the possibility that refiners changed the wholesale prices faced by unbranded gas stations differently in different regions. The results appear in Table 7. For Florida, we find the relative retail price charged by

[60] We obtain similar result to those shown in Table 10 if we also exclude all stations located close to the previously refiner owned stations.

unbranded stations fell by 0.7 cpg following the first round of stations sales, decreased by 1.1 cpg relative to the pre-sale period after the second round of station sales, and then fell to about 1.6 cpg relative to the pre-period following the final major sale of stations in 2011. We also see heterogeneity in the estimated effects across Florida regions. Independent prices decreased most in Southeast Florida (where the effects of double-marginalization were largest), and effects were smallest in Central Florida (where the effects of double-marginalization were smallest). In New Jersey, we also find that the relative price of gasoline sold by unbranded gasoline stations fell, and the overall decline in relative price in the suburbs of New York and the rest of New Jersey are similar, around 1.8 cpg. The difference between the two regions is in the timing of the price decline. Stations in the suburbs of New York prices decrease in the year following the first round of stations sales (2012), which is also the year that the second round of station sales were taking place. For the New Jersey stations located outside of metropolitan New York, most of the reduction in price comes after all station sales were completed (2013-2015).

There may be some concern that part of what was measured in equation (3) and (3') is the result of a pre-existing trend in the branded/unbranded gasoline station differential; that is, unbranded stations' relative prices may have been falling prior to vertical separation. To address this concern, we re-estimated all of the models shown in Table 7 including a monthly time-trend. Qualitatively, our findings are robust to the inclusion of the time trend (see Appendix Table 12). The estimated price impact of vertical integration is essentially unchanged for Florida overall, and for Southwest and Central Florida. There was, however, an upward trend in the unbranded/branded price differential in Southeastern Florida that caused the estimated effect of vertical integration to increase in absolute value by about 0.8 cpg. In New Jersey, there was a slight negative trend in the branded/unbranded differential that caused the estimated effect of vertical integration to fall in absolute value by about 0.7 cpg.

We next use pricing data from other Florida and New Jersey regions not experiencing a change in vertical market structure during our sample period as additional controls using equations (5) and (5') for Florida and New Jersey, respectively. In the estimating equation, we now include two sets of variables to measure how unbranded stations relative prices changed over time. First, we construct a set of variables that are the interaction of an indicator for whether a station sells unbranded gasoline (If Unbranded_i) and an indicator corresponding to the period following the major sales of stations that took place in Florida in either 2006, 2009, or

2011 or in New Jersey in 2011 or 2012. In addition, we create a similar set of variables that are interacted with an indicator for whether the station is in a region that experienced a change in vertical market structure $\left(\Delta\text{Vertical}_{\text{it}}\right)$ to capture how the prices of unbranded stations in these markets changed differentially.

$$
\begin{aligned}
(5)\quad p_{it} = {} & \alpha_i + \gamma_{jt} + \lambda_1^{FL}\text{If Unbranded}_i\text{*(If 2007-2009)}_\text{t} + \lambda_2^{FL}\text{If Unbranded}_\text{i}\text{*(If 2010-2011)}_\text{t} \\
& \lambda_3^{FL}\text{If Unbranded}_i\text{*(If 2012-2015)}_\text{t} + \delta_1^{FL}\text{If Unbranded}_i\text{*(If 2007-2009)}_\text{t}\text{*}(\Delta\text{Vertical})_\text{i} + \\
& \delta_2^{FL}\text{If Unbranded}_\text{i}\text{*(If 2010-2011)}_\text{t}\text{*}(\Delta\text{Vertical})_\text{i} + \delta_3^{FL}\text{If Unbranded}_i\text{*(If 2012-2015)}_\text{t}\text{*}(\Delta\text{Vertical})_\text{i} \\
& + \varepsilon_{it}
\end{aligned}
$$

$$
\begin{aligned}
(5')\quad p_{it} = {} & \alpha_i + \gamma_{jt} + \lambda_1^{NJ}\text{If Unbranded}_\text{i}\text{*(If 2012)}_\text{t} + \lambda_2^{NJ}\text{If Unbranded}_\text{i}\text{*(If 2013-2015)}_\text{t} + \\
& + \delta_1^{NJ}\text{If Unbranded}_\text{i}\text{*(If 2012)}_\text{t}\text{*}(\Delta\text{Vertical})_\text{i} + \delta_2^{NJ}\text{If Unbranded}_\text{i}\text{*(If 2013-2015)}_\text{t}\text{*}(\Delta\text{Vertical})_\text{i} \\
& + \varepsilon_{it}
\end{aligned}
$$

In equation (5) and (5') the λ coefficients measure how unbranded stations' prices changed relative to branded stations prices in *all markets* in the respective time periods. The $\delta's$ are the coefficients of interest that measure how unbranded stations' prices change relative to branded stations' prices in those regions experiencing a change in vertical market structure. As before, because the various post-sale periods are mutually exclusive, if the lessening of vertical integration causes unbranded relative prices to fall, we should observe prices falling (or at least not increasing) over time, e.g., $\left|\delta_1^{FL}\right| \le \left|\delta_2^{FL}\right| \le \left|\delta_3^{FL}\right|$. The estimation sample includes the same gasoline stations used in estimating equations (3), (3'), and (4), and also includes stations from Florida's Panhandle and Jacksonville regions, and New Jersey's Philadelphia suburbs.

Before presenting the estimates of (5) and (5'), we conduct event studies for Florida and New Jersey to examine how the relative retail price of unbranded gasoline stations changed relative to branded stations in regions experiencing a change in vertical market structure relative to those in regions not experiencing such a change over time. We estimate equation (6) separately for Florida and New Jersey, where station i's price on day t is (p_{it}) is a function of a station fixed-effect (α_i), a region-time effect $\left(\gamma_{jt}\right)$, a series of monthly indicator variables interacted with an unbranded indicator, and a series of monthly indicator variables interacted with an unbranded indicator and an indicator for whether the station is located in a region that experienced a change in vertical market structure $\left(\Delta\text{Vertical}_{\text{it}}\right)$. We normalized the coefficient corresponding to the first period to be zero (January, 2002 for Florida and January 2008 for New Jersey).

$$(6) \quad p_{it} = \alpha_i + \gamma_{jt} + \sum_k \varphi_k (\text{Month}_\text{k})_{\text{ik}} * (\text{If Unbranded})_i + \sum_k \nu_k (\text{Month}_\text{k})_{\text{ik}} * (\text{If Unbranded})_i * \Delta\text{Vertical}_\text{i} + \varepsilon_{it}$$

In the event studies, we plot the estimated ν_k coefficients that measure the differential change in unbranded and branded gasoline prices in regions experiencing a change in vertical market structure relative to those regions that did not. For Florida (Figure 12), we see a very similar pattern as shown in the event studies using only within region variation (Figure 10). Prior to the sale of refiner-owned stations, the unbranded/branded differential is relatively flat. After refiner sales of stations begin, the relative price of unbranded stations begins to fall in those regions, and prices continue falling throughout the sample period. By contrast, in New Jersey, Figure 13, there is some evidence of a pre-trend in pricing. The relative price of unbranded gasoline stations in the pre-period increases by roughly 2 cpg about two years before the first major set of station sales take place. After stations sales begin in 2011, unbranded gasoline stations' relative prices begin to decline, and fall substantially after the beginning of the second round of stations sales in 2012. However, in contrast to the within market event study (Figure 11), the relative price of unbranded stations increases back to pre-sale levels by the end of the sample period.

In Table 8, we present the estimates from equations (5) and (5'). For Florida, the results are very similar to the within region estimates (Table 7). The relative retail price of unbranded gasoline stations declines over time monotonically by about 0.5 cpg following each of the major sales of stations. The regional heterogeneity is quite similar to that seen in Table 7. Price decreases were largest in Southeastern Florida, and essentially zero in Central Florida. Not surprisingly given the results from the event study, the findings for New Jersey are very different when using the triple-difference estimator. While we find that relative unbranded retail prices fall following the first round of stations sales (by roughly 2 cpg), relative unbranded retail prices *increased* following the second round of sales. The estimated pattern in New Jersey is inconsistent with the RRC hypothesis.

Overall, the results of these analyses suggest that the ownership of gasoline stations by refiners lead refiners to increase the wholesale prices charged to unbranded stations. In Florida, where our test is most powerful because we observe all of the stations in each wholesale market, the price of unbranded gasoline stations fell relative to branded stations as refiners began selling their stations. We find this result when exploiting only price variation within regions experiencing a change in vertical market structure, and when examining the change in relative prices to regions not experiencing such a change. The evidence for New Jersey is mixed. As noted earlier, our tests are weaker for the New Jersey markets because we do not observe all of the gasoline stations in the wholesale markets. Within the regions experiencing a change in vertical market structure, we observe the relative price of unbranded gasoline stations falling after refiners sold their stations. However, when comparing the relative price change in these regions to a New Jersey region that did not experience a change in vertical market structure (stations in the Philadelphia suburbs), we do not observe a pricing pattern consistent with the RRC hypothesis.

c. Discussion

Having shown that that vertical integration in the gasoline industry generated real, albeit small, pricing efficiencies (the elimination of double marginalization) and competitive harms (increased independent stations' prices), we now estimate the net impact of vertical separation on gasoline prices in Florida and New Jersey. In calculating this average, we account for the two price changes resulting from vertical separation: the price increases at previously refiner-owned stations and price decreases at independent gasoline stations.[61]

We calculate the average price change caused by vertical separation as the quantity weighted average price change of three types of stations (i) operating in these markets: company-owned and operated stations, franchisee stations, and independent gasoline stations, where the weights (s_i^1) correspond to the proportion of fuel sales made by each station type following vertical separation (denoted by the superscript 1) as shown in equation (7) below.[62]

[61] While it is true a small number of non-refiner owned stations increased their prices in response to refiner-owned stations in concentrated local markets, these stations accounted for a very small fraction of stations overall and price increases were only economically and statistically significant in New Jersey. For this reason, we ignore the price changes at these stations in this calculation.

[62] In this calculation, we assume that franchisee stations do not experience a change in price as the result of vertical separation. Independent gas stations experience a price reduction relative to franchisee stations, and previously refiner-owned gasoline stations raise their prices relative to franchisee stations.

$$(7) \quad \Delta P = \sum_{i=1}^{3} \Delta p_i * s_i^1$$

To conduct this calculation, we need the change in price (which we have estimated) and the share of each type of station (shown in Table 1). As noted earlier, there is no publicly available data to directly measure the share of sales made by each type of gasoline station in Florida or New Jersey. Instead, we estimate these shares of sales made by each type of station using counts of stations, and by weighting each station type by its estimated relative sales. Because we do not know how indicative the national estimates of relative station sales are for Florida and New Jersey, we calculate the estimated state price changes using both the weighted and unweighted station shares.

We also need to address how the change in relative price caused by vertical separation affects the sales of stations of different types. Clearly, we should expect the sales of refiner-owned stations to fall given their relative price increase, and that the sales of independent gasoline stations should increase as their relative price falls. We account for this change in sales by modifying the pre-vertical separation shares shown in Table 1 using equation (8) below.

$$(8) \quad s_i^1 = s_i^o * \left(1 + \frac{\Delta p_i}{p_i} * \varepsilon_{ii}\right)$$

Specifically, we assume each station's sales change only as the result of its own-price elasticity; that is, we only account for first-order effects.[63] To construct our estimates, we use station specific own-price elasticities of 0, -2 and -8.[64]

We calculate the overall estimated price changes for each state using data from 2007, shown in Table 9.[65] We use the estimated effect of double marginalization for Florida and New Jersey from Table 4 column (4), and use the RRC estimates from Table 7 columns (1) and (5). Overall, we find that the estimated net price impact of vertical separation was very small. In Florida, while the estimated price effect is negative (vertical separation lowered consumer

[63] Because the estimated quantity responses resulting from vertical separation are so small, accounting for rival's reactions will not result in any material difference in the estimated price changes.

[64] Barron, Umbeck and Waddell (2008) estimate gasoline station own-price elasticities using data from an experiment where gasoline stations randomly changed their prices. They found that stations facing relatively few competitors had an own-price elasticity of about 2 and that stations facing a large number of competitors had own-price elasticities of about 8. We use the upper and lower bounds of Barron, Umbeck, and Waddell's estimated elasticities to examine the sensitivity of our findings to different levels of downstream competition.

[65] In 2007, the average pump price of gasoline was \$2.93 and \$2.77 per gallon in Florida and New Jersey, respectively measured in January 2010 dollars.

prices), the largest price decrease was only -0.45 cpg, or roughly 0.15% of the retail price of gasoline. In New Jersey, the sign of the net effect of vertical separation depends on the share measure. When using our preferred measure (weighting by estimated station sales), we find that vertical separation in New Jersey increased price (on net double marginalization increased consumer prices) however, the net effect was again very small, at most 0.08 cpg, or 0.03% of the retail price of gasoline.

V. Conclusion

Antitrust scholars have recently expressed concern that increased vertical integration may be harming competition (Baker et al. (2019)). Determining how increases in vertical integration affect competition is complicated because vertical integration changes a firm's pricing incentives in ways that can both increase or decrease consumer welfare. Vertical integration eliminates the double markup facing the integrated firm resulting in lower retail prices and increased sales. Simultaneously, increased vertical integration increases the integrated firm's incentive to increase the input prices charged to downstream rivals. By increasing its rivals' costs, rivals are forced to increase their downstream prices. While it is long been understood how vertical integration changes a firm's pricing incentives, there is relatively limited evidence regarding the economic magnitudes of these different effects.

Directly measuring the importance of vertical integration is difficult because large changes in vertical market structure occur infrequently. In this paper, we exploit the large change in vertical market structure resulting from most U.S. refiners' decisions to exit gasoline retailing beginning in the mid-2000s. We examine how retail prices charged by different types of gas stations in the states of Florida and New Jersey changed following the sale of 675 refiner-owned gasoline stations. We first estimate the size of the double marginalization effect by estimating how the prices charged by previously refiner-owned stations changed following their sale by refiners. Overall, we find that prices increased modestly, by about 1.7 cents per gallon (cpg). The estimated effect varied by region and refiner. Stations in New Jersey increased prices by more than those in Florida, and stations owned by ExxonMobil increasing price by more than those owned by Motiva or BP. In addition, stations facing fewer nearby competitors increased their prices more following vertical separation than those facing more localized competition.

We next estimated how the change in vertical market structure affected the prices charged by stations unaffiliated with refiners. We used two related identification approaches to measure how unbranded gasoline stations relative prices changed following vertical separation. First, we examined how the unbranded/branded station price differential within a region changed following vertical separation. Second, we compared how the unbranded/branded station price differential in regions experiencing a change in vertical market structure changed relative to the unbranded/branded station differential in similar regions not experiencing such a change. For Florida, using both identification approaches we found that unbranded gasoline stations' prices fell relative to branded stations, consistent with the raising rivals' costs hypothesis. For New Jersey, we found that unbranded stations' relative prices fell within the regions where refiners sold their stations. However, we also found that unbranded station relative prices also fell in a region not experiencing such a change.[66]

Overall, we find that both double-marginalization and a supplier's incentive to raise rival's costs have real impacts on consumer prices. However, these effects in the gasoline markets we study are small. Both the double marginalization effect and raising rival's cost effect are roughly 1 to 2 cpg, or roughly 0.76%-1.5% of the price of gasoline.[67] The net effect of vertical separation on retail gasoline prices was essentially zero: we estimate that Florida prices fell by 0.13% and New Jersey prices rose by 0.07%. While more research must be done before drawing general conclusions about the economic importance of these effects, we note that Luco and Marshall's (2019) recent study of vertical integration soft drink syrup makers and bottlers also found small and similarly sized (roughly 1%) effects of double marginalization and raising rivals costs.

[66] As noted in the discussion of these findings, we are less confident in our raising rivals' costs' findings for New Jersey. In particular, in Florida we can observe all of the changes in vertical market structure that may affect wholesale prices in a wholesale market. Unfortunately, while we can observe all changes in vertical market structure in New Jersey, it is possible that New Jersey wholesale prices are affected by changes in vertical market structure in neighboring states (Pennsylvania and New York) that we cannot observe.
[67] The average retail price of gasoline in Florida and New Jersey in 2003 was about $1.32 per gallon in 2010 dollars (see Table 2), implying a price change of roughly 0.76%-1.5% per gallon from the double-marginalization and raising rivals' costs effects.

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Appendix 1

Robustness of the Estimates of Double Marginalization

In this appendix, we describe the robustness of our estimates of double marginalization. We begin by examining how our results change when we change the composition of gasoline stations included in the control group. We first re-estimated all of the specification shown in Tables 4-6 using the independent and own brand control groups. The estimated magnitude of the price increases following the sale of refiner-owned gasoline stations are qualitatively similar to those reported in Table 4-6 when using the independent control group (see Appendix Tables 2-4). The primary difference is that the price changes are a generally larger. For example, the overall estimated price impact of the elimination of double marginalization when using our preferred control group is 1.2 cpg (Table 4, column 3) and 2.2 cpg when using the independent control group (Appendix Table 2, column 3).

The results estimated using the own brand control group (consisting of BP, Shell, Exxon, and Mobil stations owned and operated by franchisees during the entire sample period) are different than those estimated with our preferred control group in some regions. This can be seen most clearly by comparing Table 5 and Appendix Table 6 that show the estimated price changes by region and brand using our preferred and the own brand control groups. Comparing the results in column 2 between the two tables, we see that the estimated price increase in Southeastern Florida is lower when using the own brand control group. Similarly, comparing the results in column 4 between the two tables, we see that the estimated price changes for New Jersey are smaller when using the BP, Shell, Exxon, and Mobil control group. These results are consistent with the refiners raising the wholesale prices to *all* of their stations following vertical separation; that is, both the stations that were independent franchisees of the refiner's selling stations and the previously refiner-owned stations experienced an increase in wholesale price. This pattern is not seen in all Florida regions. The estimated change in the price of Central Florida stations is larger when using the own brand comparison group, and Southwest Florida price changes are more similar. The same pattern holds for the other empirical analyses shown in Tables 4 and 6: estimated price changes are lower when using the Own Brand control group for New Jersey and Southeast Florida, are larger for Central Florida, and mostly similar for Southwest Florida (see Appendix Tables 5 and 7).

We also examine the robustness of our estimates to the geographic restrictions placed on the control group. To control for the possibility that stations farther than 1.5 miles from a station that was sold could also be affected by a station's post-sale pricing, we have re-estimated the specifications in Tables 4-6 limiting the control group to stations at least 3 miles from a station that was sold. These results are again similar to those in Tables 4-6, and shown in Appendix Tables 8-10.

Appendix 2

Effect of Vertical Separation on Nearby Rivals to Refiner-Owned Stations

Having demonstrated that refiner sales of stations caused prices charged by those stations to increase in some regions, it is natural to ask how nearby rivals responded. To answer this question, we estimated a variant of equation (1) where the variable Post $Sale_{it}$ is defined to be 1 for those stations we defined as being potential competitors of the previously refiner-owned stations (located within 1.5 miles) in the time periods following the refiner's station's sale.[1] We then repeated the analyses shown in Tables 4-6 using the comparison group of all stations located at least 1.5 miles from the refiner stations that were sold. These results are summarized in Appendix Table 11. We do not find an economically or statistically significant effect on pricing using the pooled sample of competing stations in Florida and New Jersey (columns 1 and 2), or when estimating separate effects for competing stations located in specific Florida and New Jersey regions (columns 3 and 4). We do find, however, evidence of an economically and statistically significant increase in price of competing station in local markets with a small number of competitors. Overall, prices at these stations increase by about 1 cpg (columns 5 and 6). This estimated price increase is much larger in New Jersey (1.9 cpg) than in Florida (0.6 cpg), and is only statistically significant in New Jersey. This pattern of results closely follows our earlier finding that price changes in markets with fewer competitors were larger in New Jersey than in Florida.

Overall, we think these rival responses are consistent with our interpretation of these price changes being caused by vertical separation. Rival responses are second-order effects. In most markets, we estimated that the price impact of vertical separation on previously refiner-owned stations were modest, about 1-2 cpg. Hence, it is not surprising that rival gas stations may not change their prices much in response to this change in relative price. However, in markets with few competitors where prices increased substantially, roughly 3-4 cpg in New Jersey, we saw rivals increase their price by roughly 50% of that amount.

[1] If a competing station is located near more than one station that is sold, we use the earliest sale date to define the post-sale period.

Figure 1: Change in Composition of U.S. Gasoline Stations

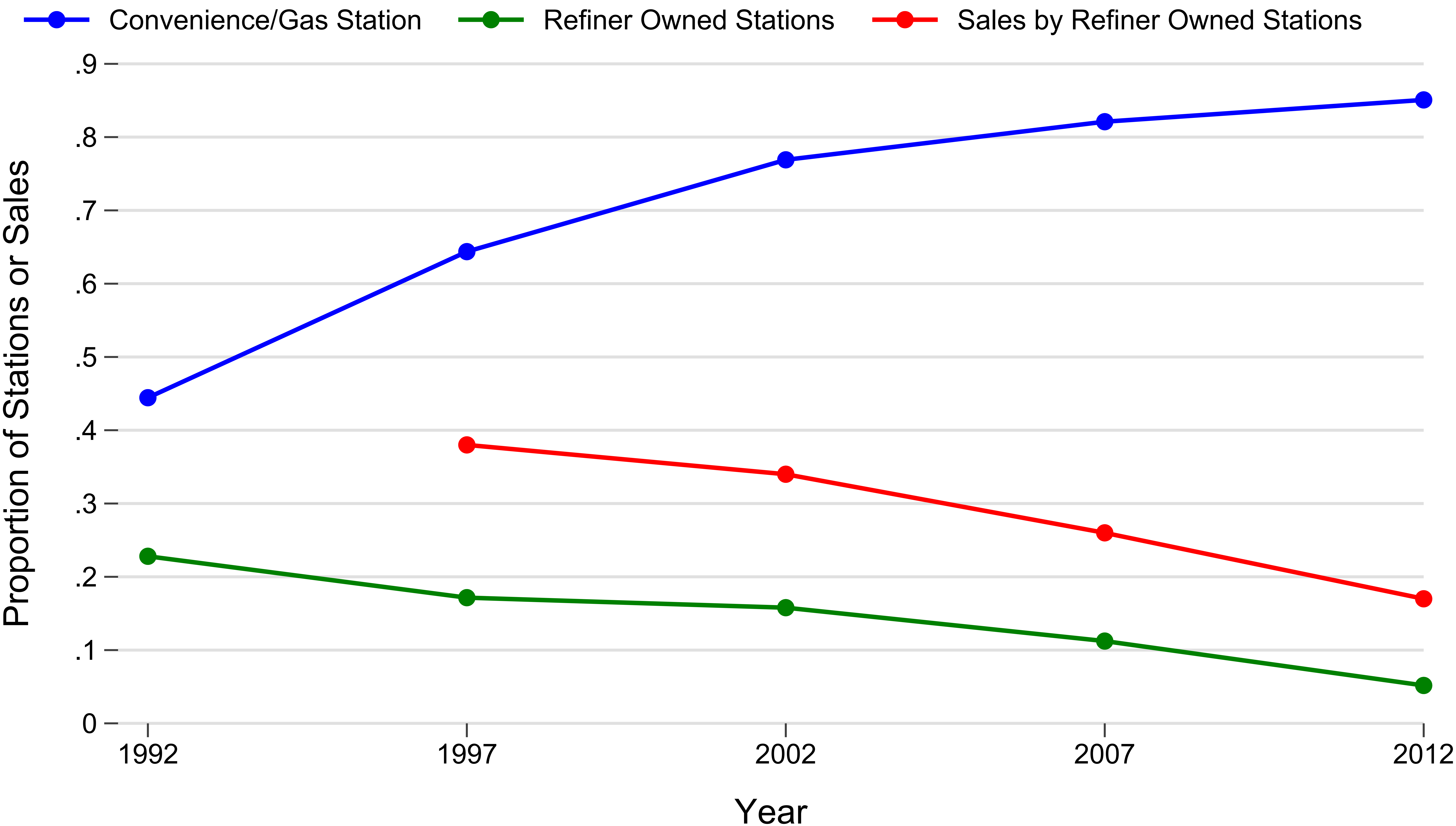


Figure 2: Florida Gasoline Stations

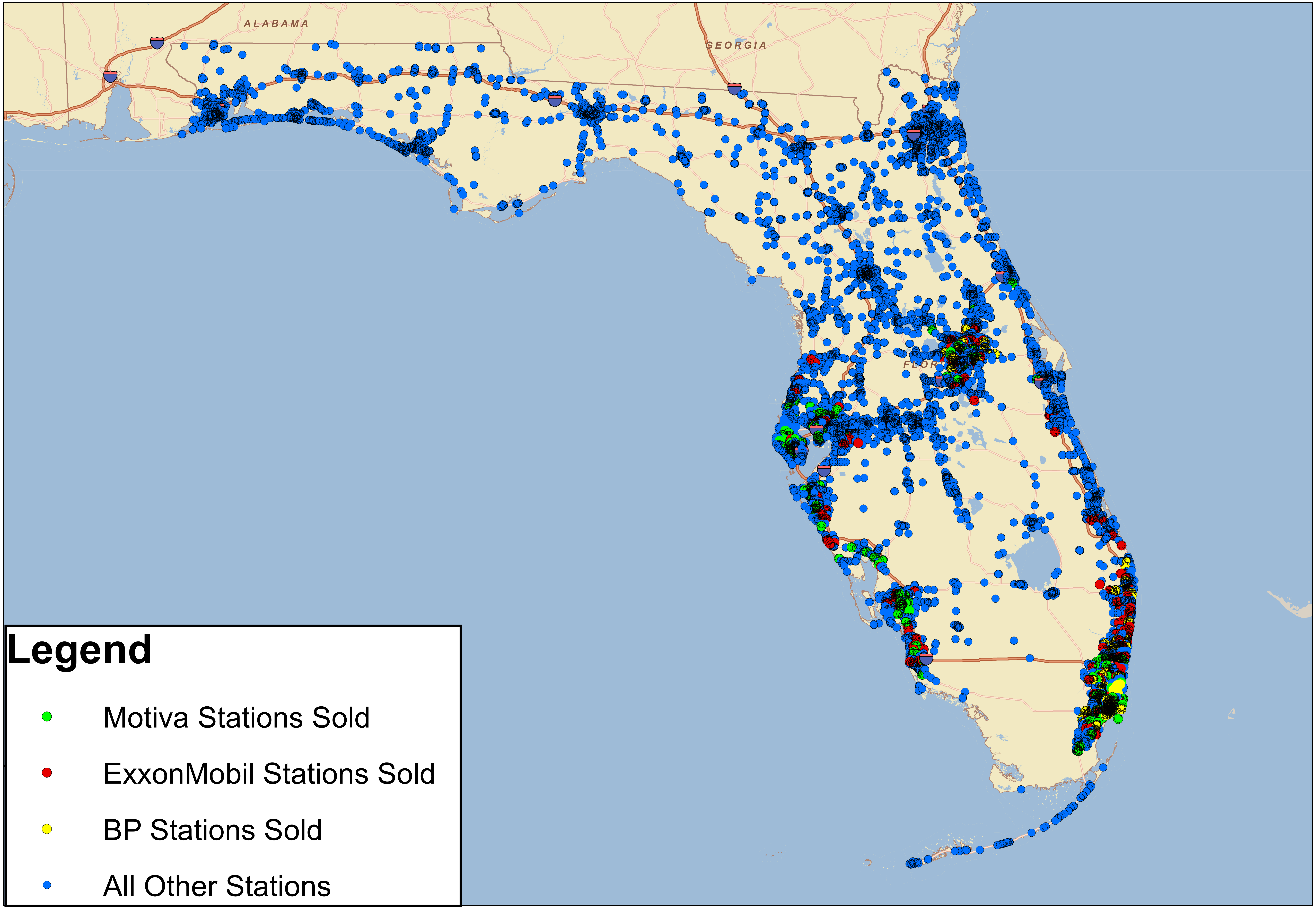


Figure 3: New Jersey Gasoline Stations

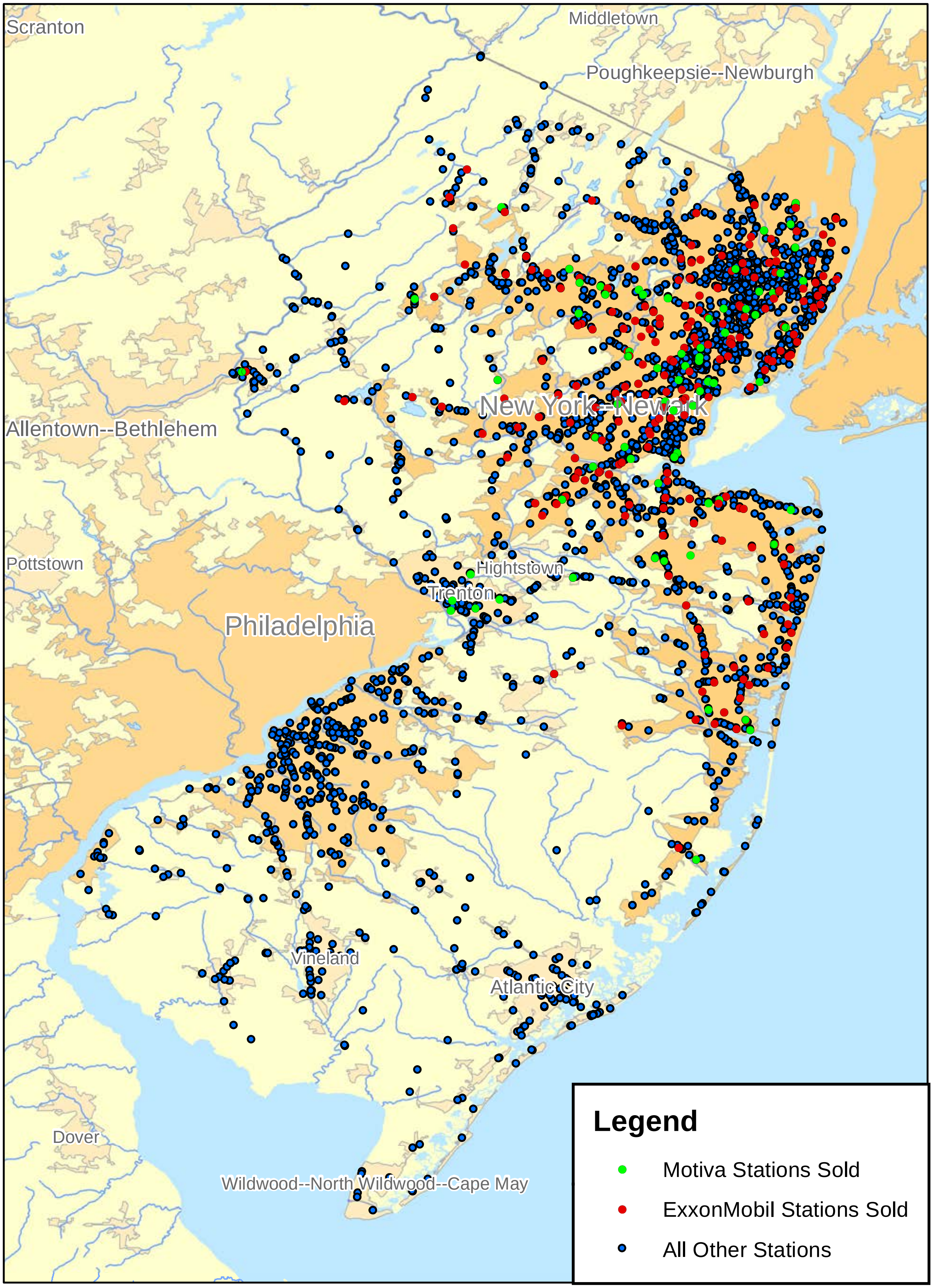
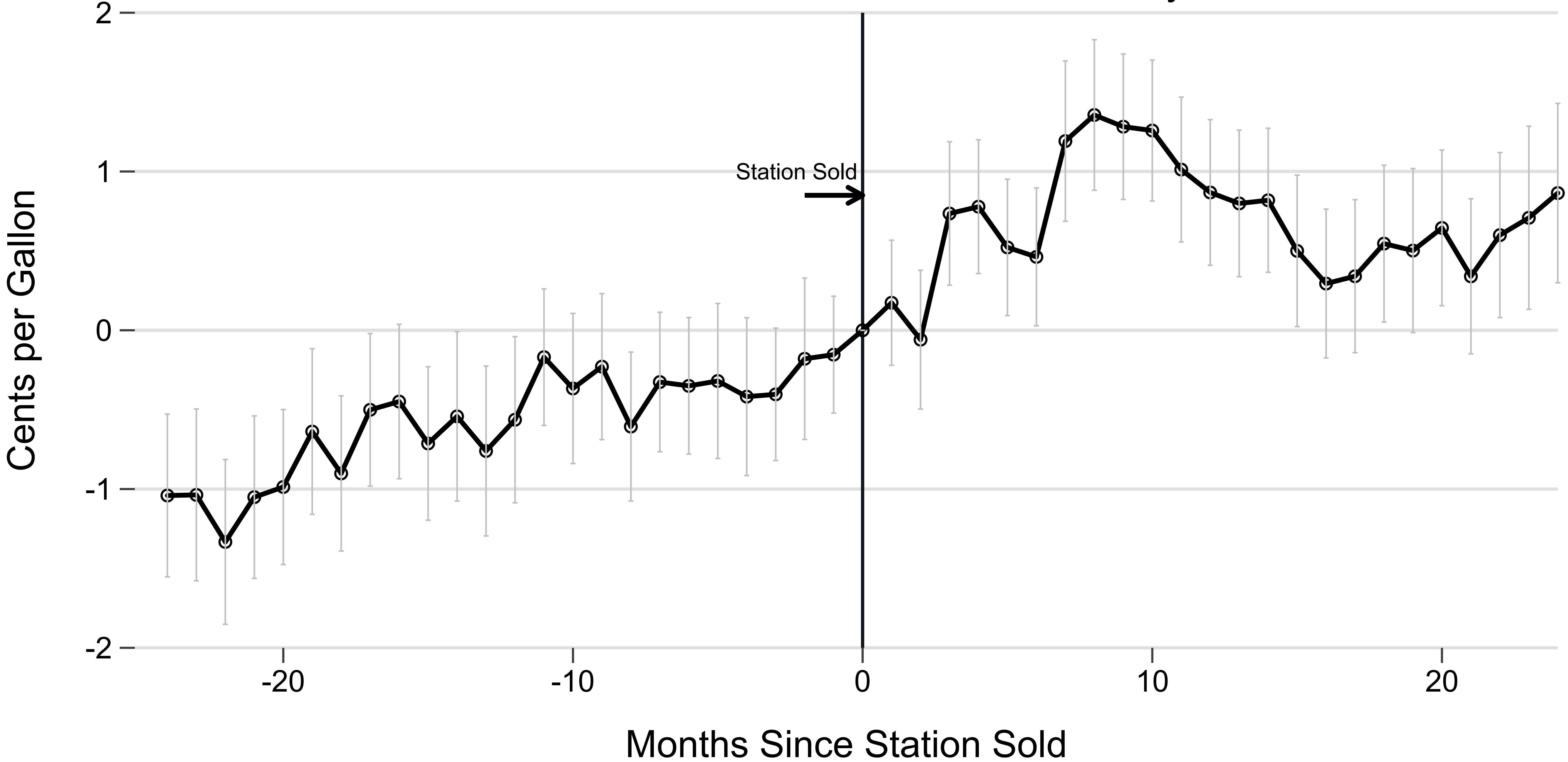


Figure 4: Event Study

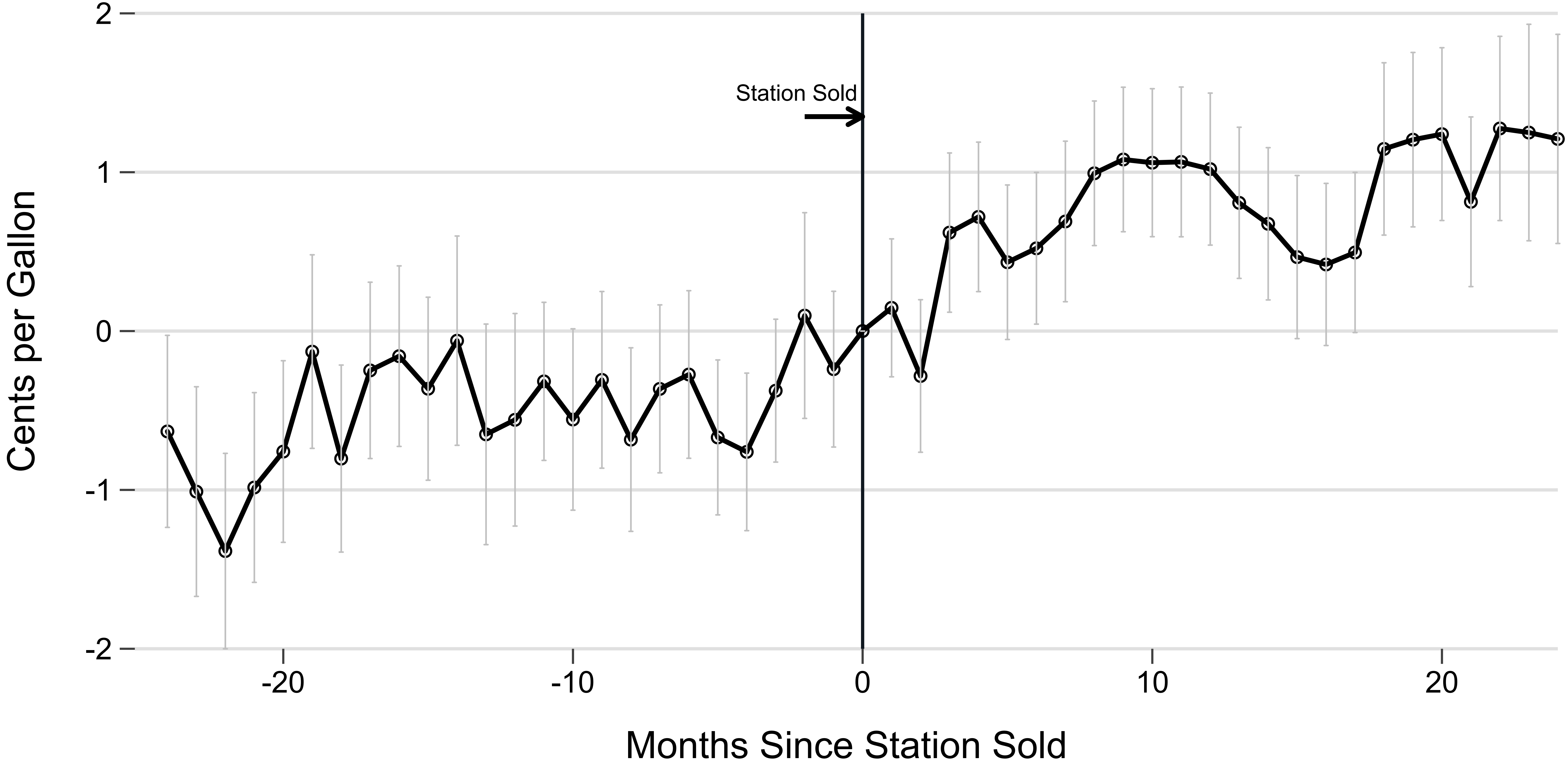
All Brands in Florida and New Jersey



Notes: A station's daily price of gasoline net of taxes was regressed on a station fixed-effect,a day-region fixed-effect, and indicators corresponding to the number of months before (or after) a station was sold interacted with a dummy for those refiner-owned stations that were sold. The graph plots the estimated coefficients of the months before (or after) station sale interactions and their corresponding 95% confidence intervals. The coefficient corresponding to the month of sale is normalized to zero. Prices are measured in 2010 cents-per-gallon deflated using the urban CPI.

Figure 5: Event Study

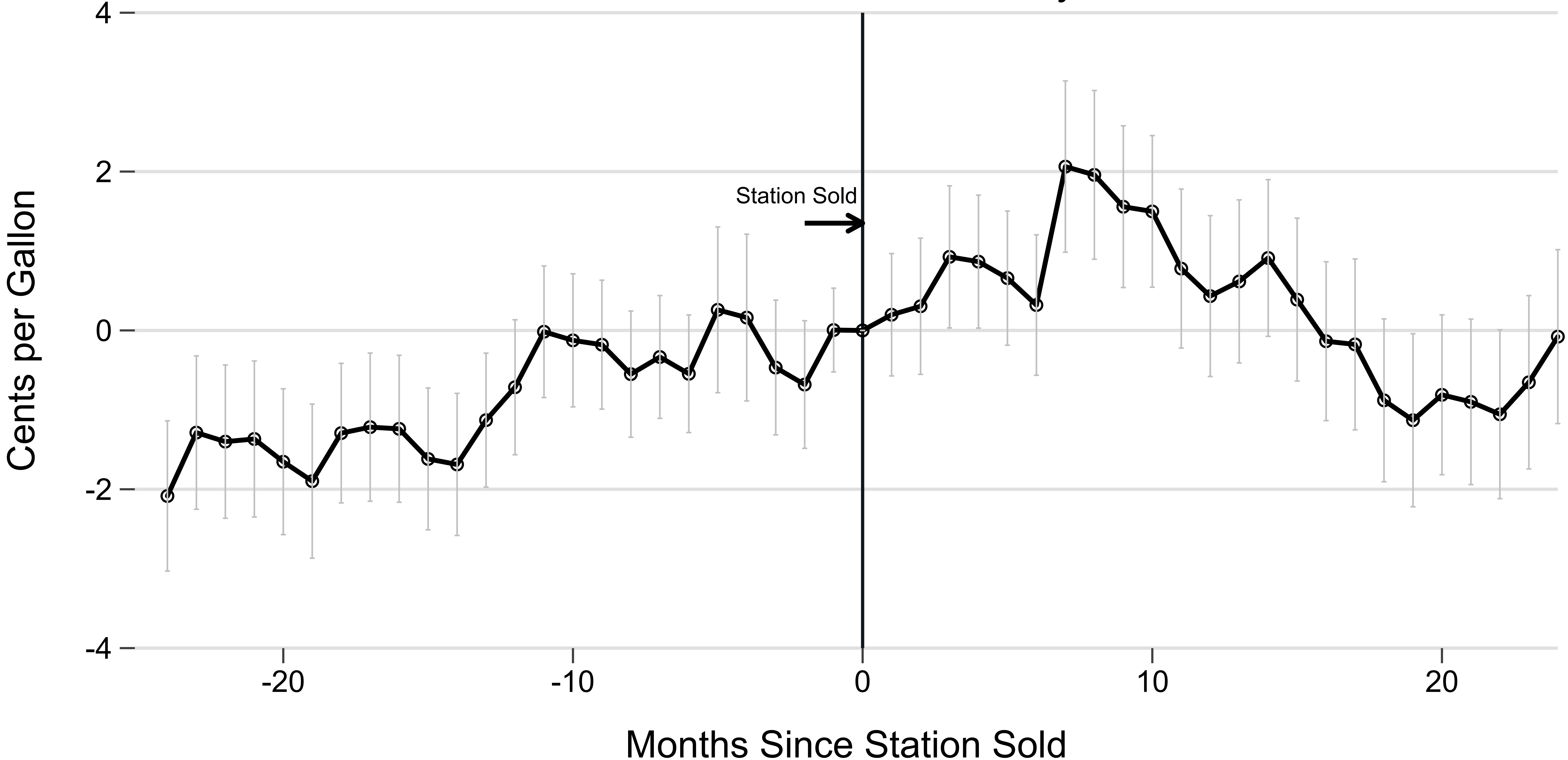
All Brands in Florida



Notes: A station's daily price of gasoline net of taxes was regressed on a station fixed-effect,a day-region fixed-effect, and indicators corresponding to the number of months before (or after) a station was sold interacted with a dummy for those refiner-owned stations that were sold. The graph plots the estimated coefficients of the months before (or after) station sale interactions and their corresponding 95% confidence intervals. The coefficient corresponding to the month of sale is normalized to zero. Prices are measured in 2010 cents-per-gallon deflated using the urban CPI.

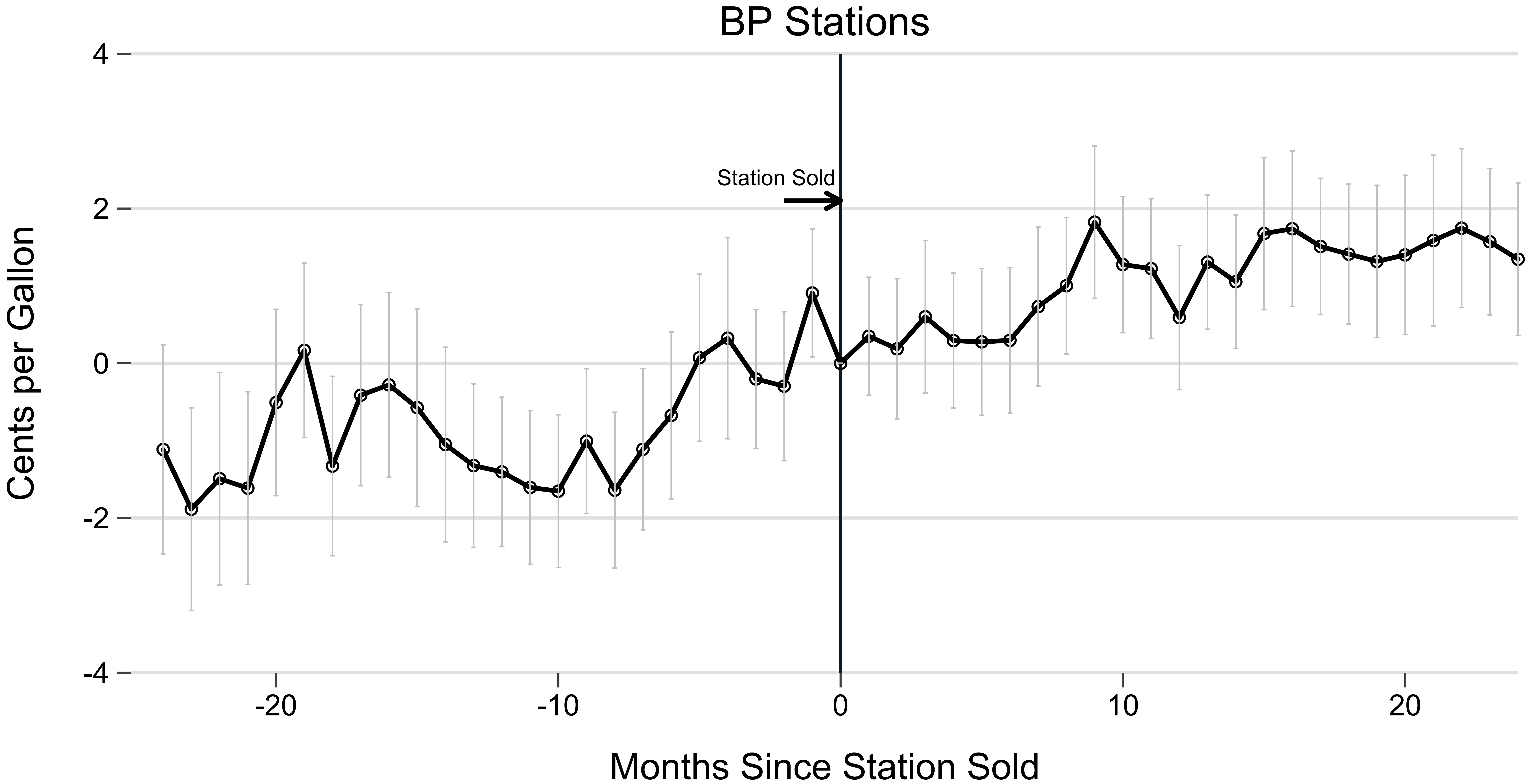
Figure 6: Event Study

All Brands in New Jersey



Notes: A station's daily price of gasoline net of taxes was regressed on a station fixed-effect,a day-region fixed-effect, and indicators corresponding to the number of months before (or after) a station was sold interacted with a dummy for those refiner-owned stations that were sold. The graph plots the estimated coefficients of the months before (or after) station sale interactions and their corresponding 95% confidence intervals. The coefficient corresponding to the month of sale is normalized to zero. Prices are measured in 2010 cents-per-gallon deflated using the urban CPI.

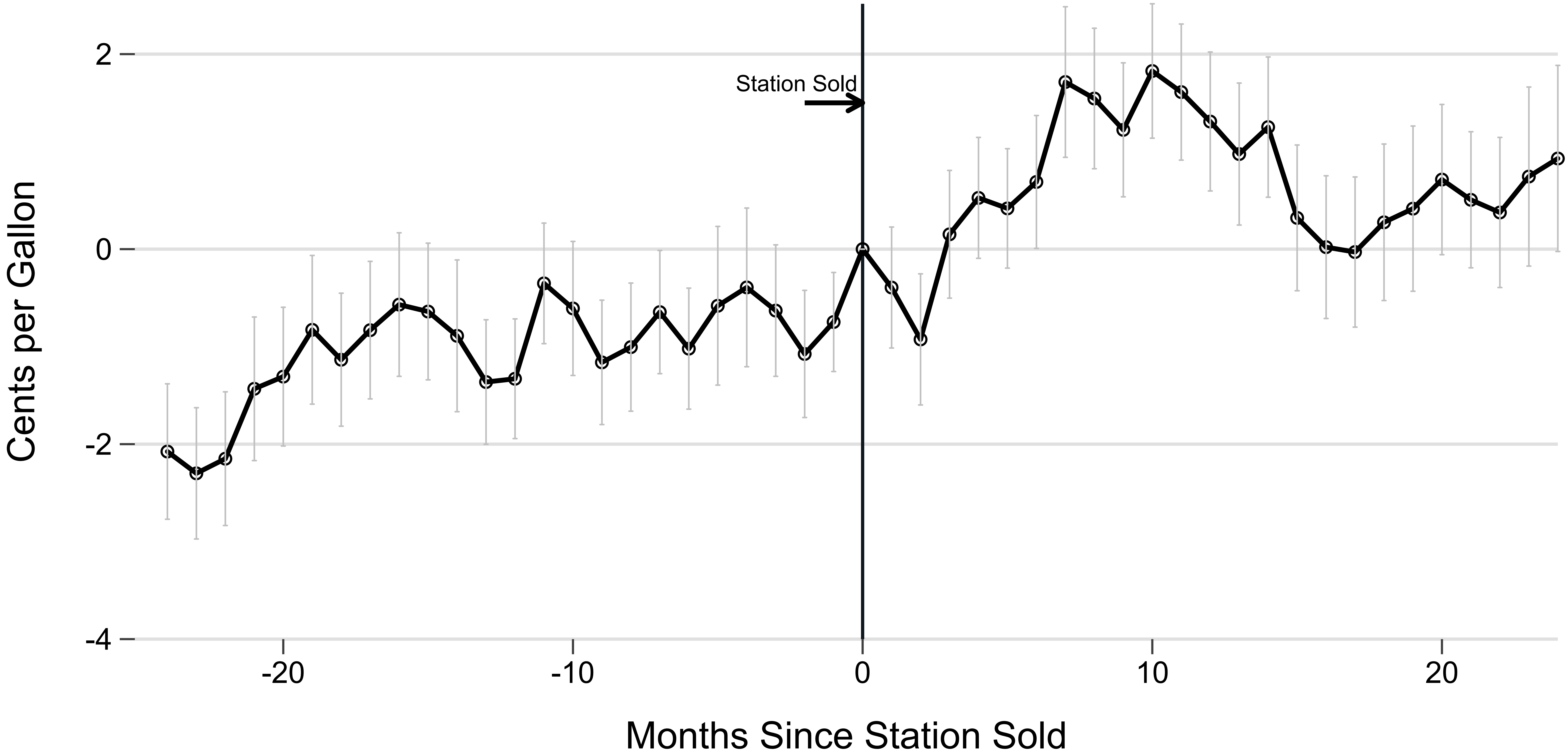
Figure 7: Event Study



Notes: A station's daily price of gasoline net of taxes was regressed on a station fixed-effect,a day-region fixed-effect, and indicators corresponding to the number of months before (or after) a station was sold interacted with a dummy for those refiner-owned stations that were sold. The graph plots the estimated coefficients of the months before (or after) station sale interactions and their corresponding 95% confidence intervals. The coefficient corresponding to the month of sale is normalized to zero. Prices are measured in 2010 cents-per-gallon deflated using the urban CPI.

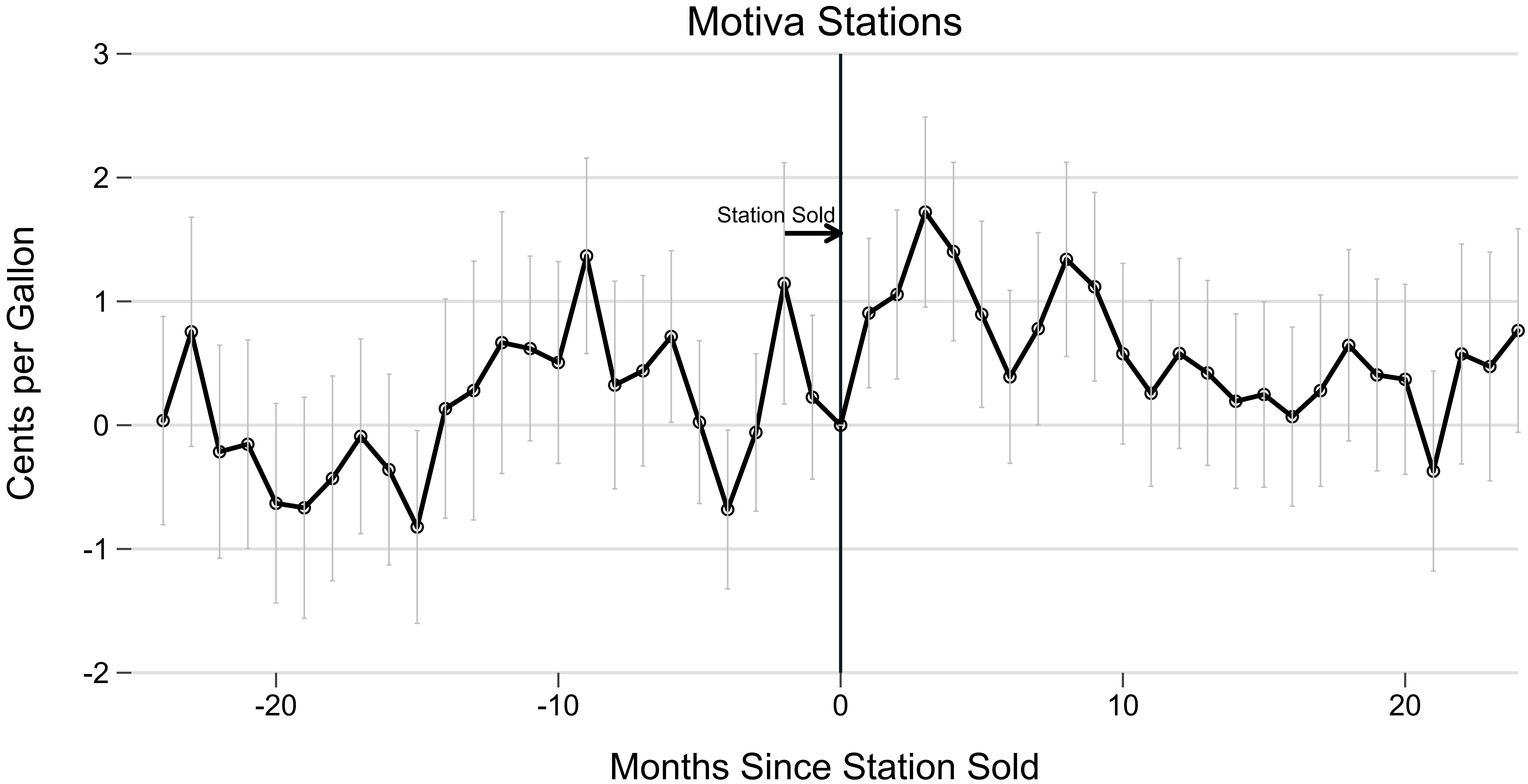
Figure 8: Event Study

ExxonMobil Stations



Notes: A station's daily price of gasoline net of taxes was regressed on a station fixed-effect,a day-region fixed-effect, and indicators corresponding to the number of months before (or after) a station was sold interacted with a dummy for those refiner-owned stations that were sold. The graph plots the estimated coefficients of the months before (or after) station sale interactions and their corresponding 95% confidence intervals. The coefficient corresponding to the month of sale is normalized to zero. Prices are measured in 2010 cents-per-gallon deflated using the urban CPI.

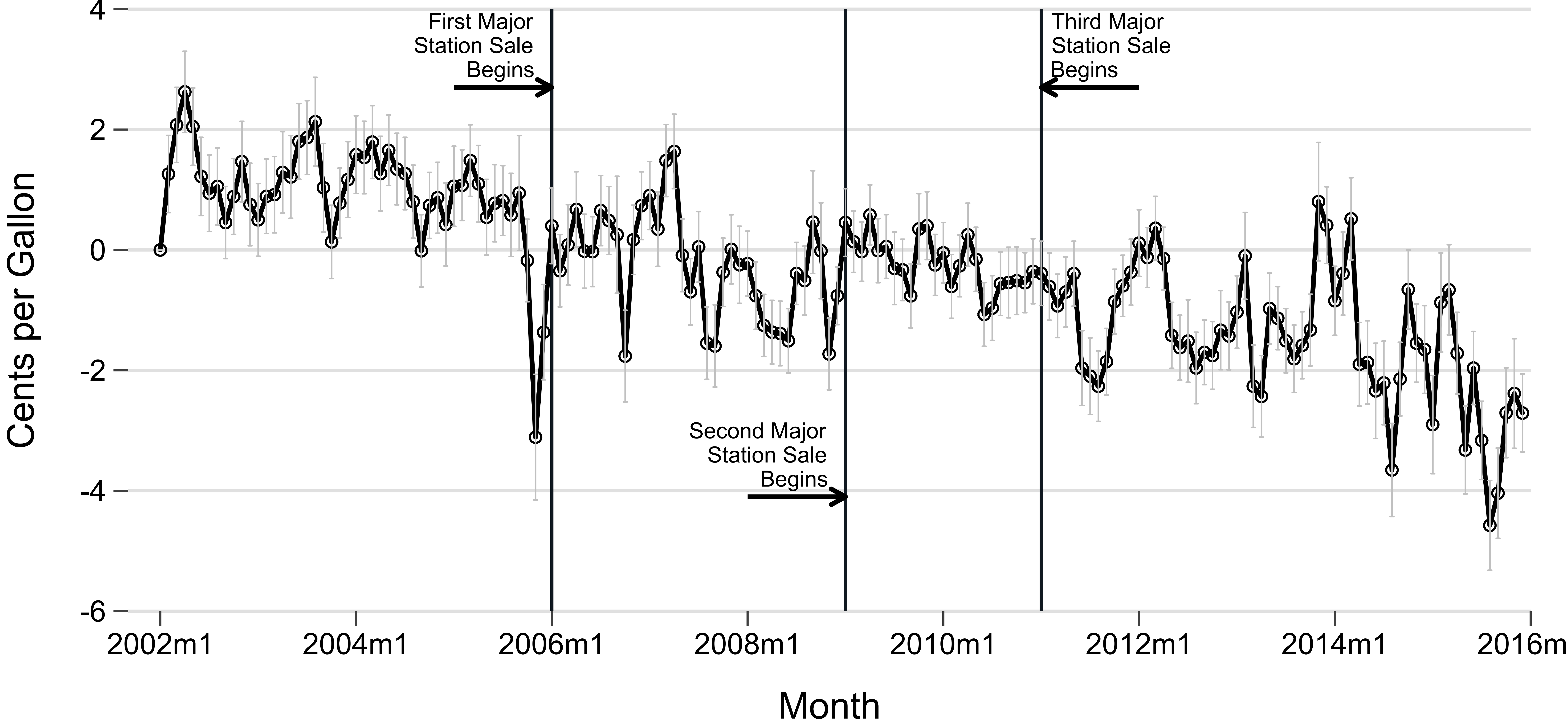
Figure 9: Event Study



Notes: A station's daily price of gasoline net of taxes was regressed on a station fixed-effect,a day-region fixed-effect, and indicators corresponding to the number of months before (or after) a station was sold interacted with a dummy for those refiner-owned stations that were sold. The graph plots the estimated coefficients of the months before (or after) station sale interactions and their corresponding 95% confidence intervals. The coefficient corresponding to the month of sale is normalized to zero. Prices are measured in 2010 cents-per-gallon deflated using the urban CPI.

Figure 10: Change in Relative Price

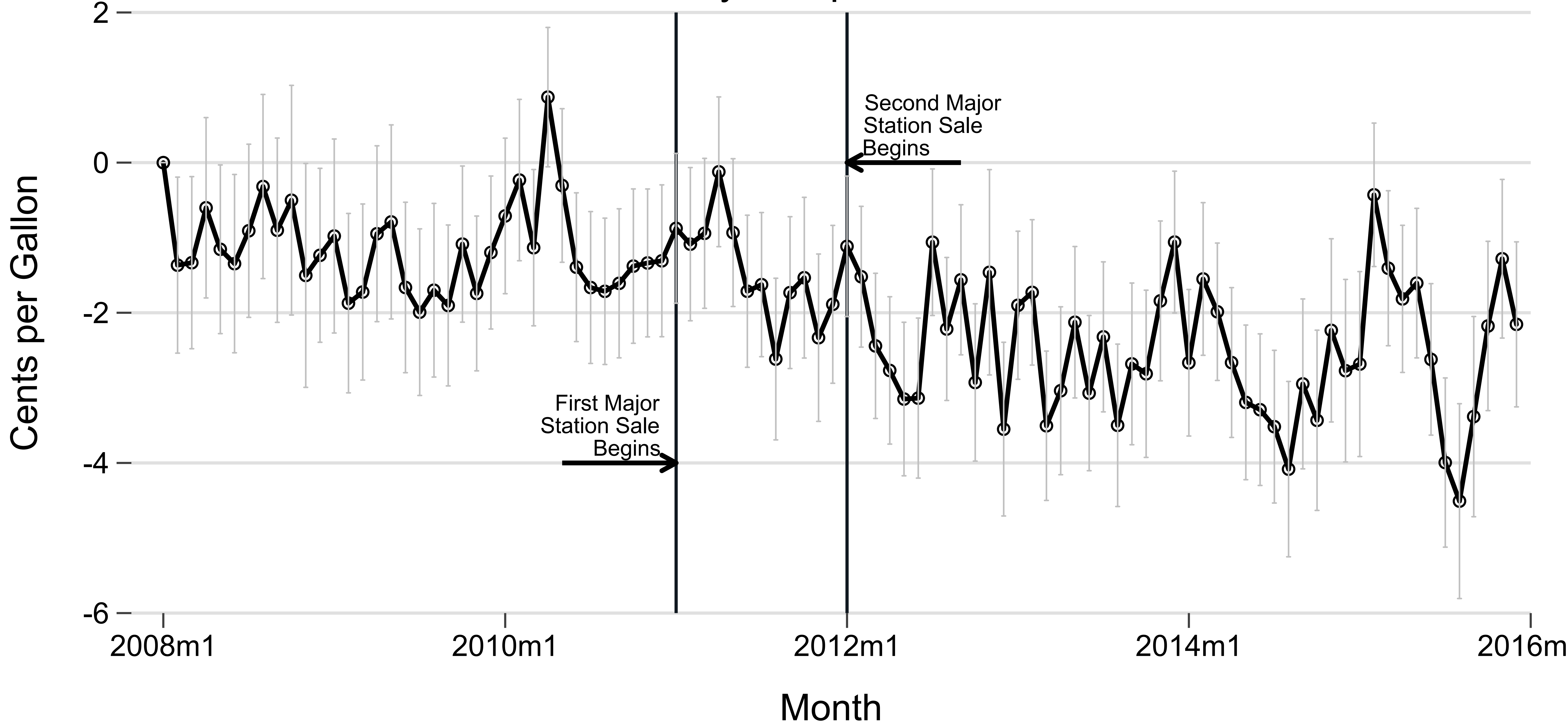
Florida Independent Stations



Notes: A station's daily price of gasoline (net of taxes) was regressed on a station fixed-effect, a day-region fixed-effect, and indicators corresponding to a month interacted with a dummy for gasoline stations unaffiliated with any refiner selling unbranded gasoline. The graph plots the estimated coefficients corresponding to the month unaffiliated station interactions and their corresponding 95% confidence intervals. The sample consists of refiner-franchised stations and independent stations selling unbranded gasoline located at least 1.5 miles from refiner-sold stations. The coefficient corresponding to the January 2002 is normalized to zero. Prices are measured in 2010 cents-per-gallon deflated using the urban CPI.

Figure 11: Change in Relative Price

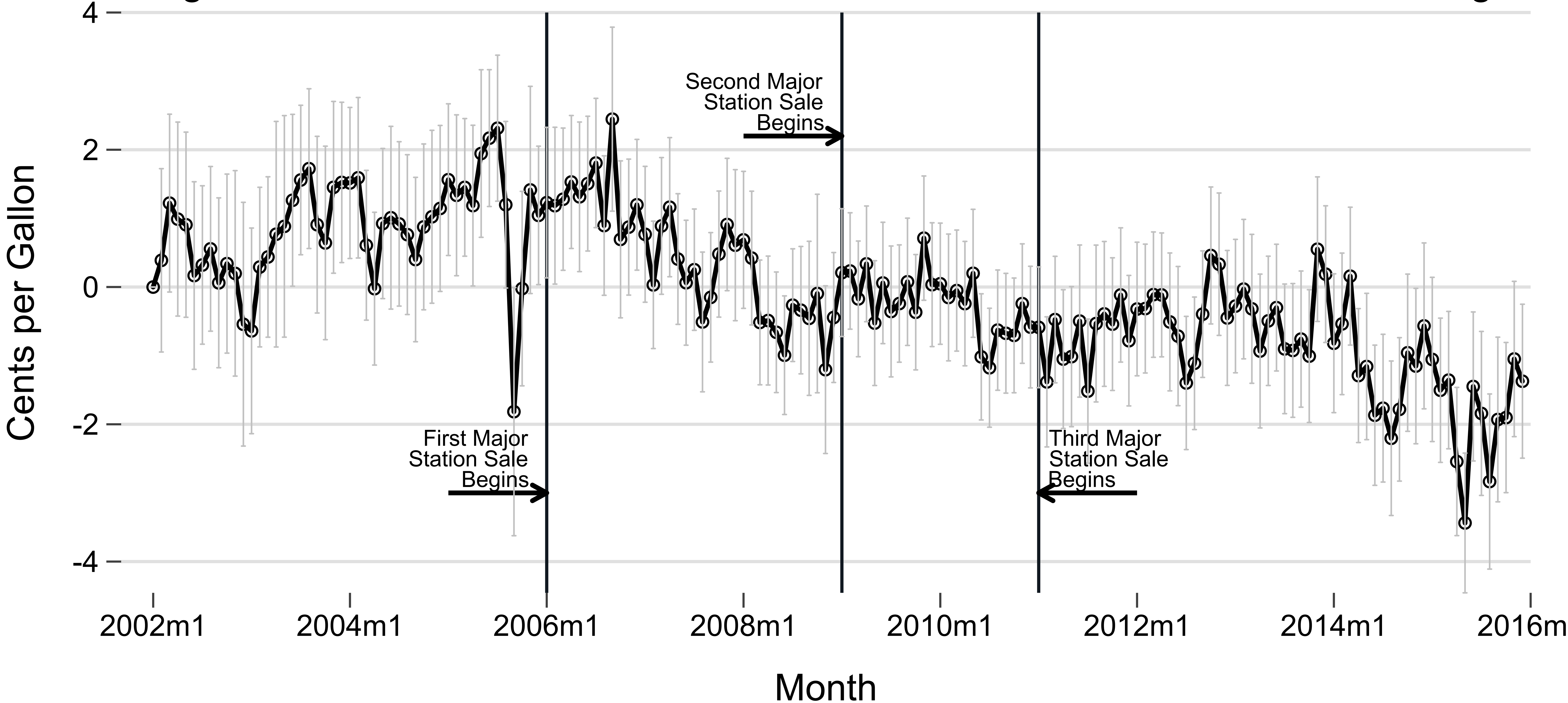
New Jersey Independent Stations



Notes: A station's daily price of gasoline (net of taxes) was regressed on a station fixed-effect, a day-region fixed-effect, and indicators corresponding to a month interacted with a dummy for gasoline stations unaffiliated with any refiner selling unbranded gasoline. The graph plots the estimated coefficients corresponding to the month unaffiliated station interactions and their corresponding 95% confidence intervals. The sample consists of refiner-franchised stations and independent stations selling unbranded gasoline located at least 1.5 miles from refiner-sold stations. The coefficient corresponding to the January 2008 is normalized to zero. Prices are measured in 2010 cents-per-gallon deflated using the urban CPI.

Figure 12: Florida Triple Difference

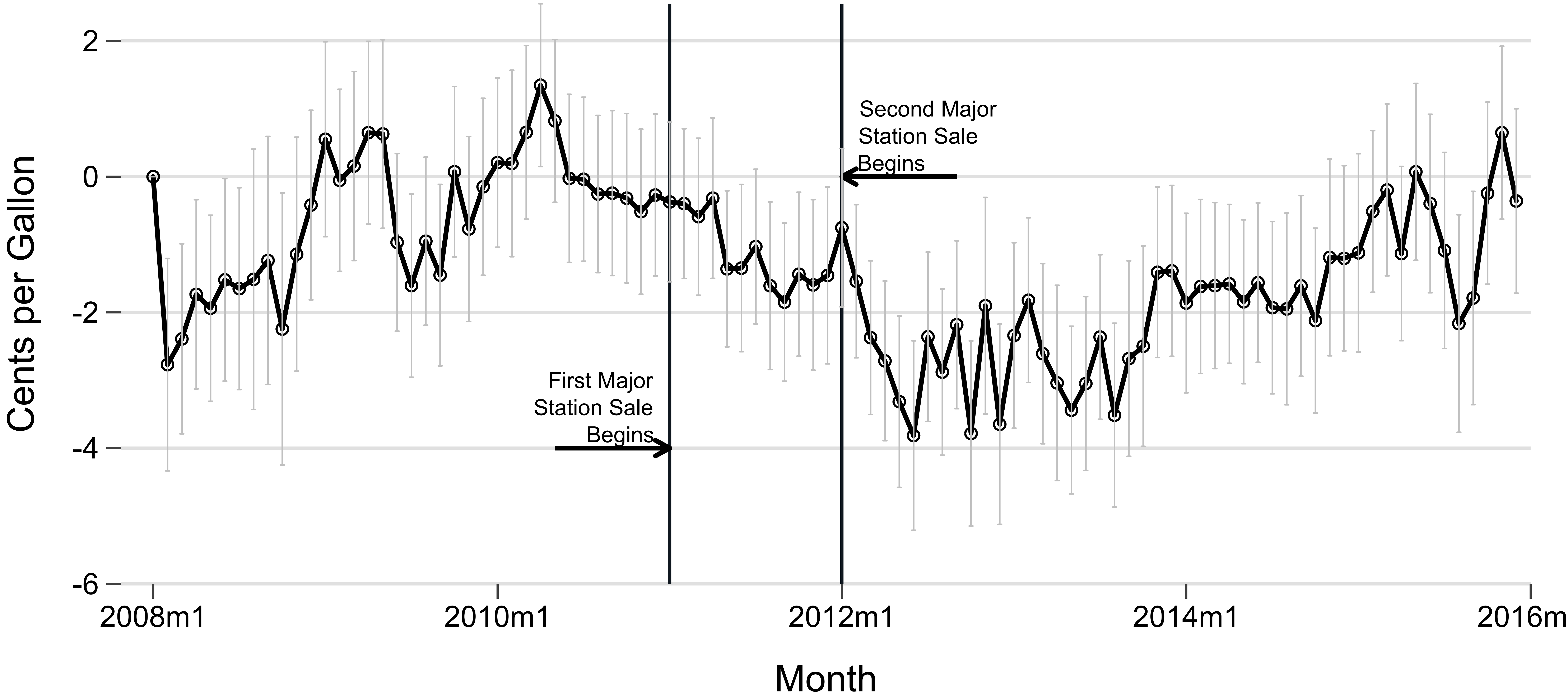
Change in Unbranded/Branded Differential Between Affected and Control Regions



Notes: A station's daily price of gasoline (net of taxes) was regressed on a station fixed-effect, a day-region fixed-effect, a month-unbranded fixed-effect, and indicators corresponding to a month interacted with a dummy for gasoline stations unaffiliated with any refiner selling unbranded gasoline in a region experiencing a change in vertical market structure. The graph plots the estimated coefficients corresponding to the month/unaffiliated station/affected markets interactions and their corresponding 95% confidence intervals. The sample consists of refiner-franchised stations and independent stations selling unbranded gasoline. The coefficient corresponding to January 2002 is normalized to zero. Affected Regions include Southeast, Southwest, and Central Florida. Control Regions include Northeast and the Panhandle of Florida. Prices are measured in 2010 cents-per-gallon deflated using the urban CPI.

Figure 13: New Jersey Triple Difference

Change in Unbranded/Branded Differential Between Affected and Control Regions



Notes: A station's daily price of gasoline (net of taxes) was regressed on a station fixed-effect, a day-region fixed-effect, a month-unbranded fixed-effect, and indicators corresponding to a month interacted with a dummy for gasoline stations unaffiliated with any refiner selling unbranded gasoline in a region experiencing a change in vertical market structure. The graph plots the estimated coefficients corresponding to the month/unaffiliated station/affected markets interactions and their corresponding 95% confidence intervals. The sample consists of refiner-franchised stations and independent stations selling unbranded gasoline. The coefficient corresponding to January 2008 is normalized to zero. Affected regions included the New Jersey suburbs of New York City and other regions in New Jersey. The control region is the New Jersey suburbs of Philadelphia. Prices are measured in 2010 cents-per-gallon deflated using the urban CPI.

Table 1: Estimated Proportion of Station Types by State

	Florida		New Jersey	
Station Type	Proportion Of Stations	Proportion of Stations Weighted by Estimated Sales	Proportion Of Stations	Proportion of Stations Weighted by Estimated Sales
Refiner-Owned	0.08	0.17	0.10	0.21
Refiner Franchisee	0.61	0.61	0.57	0.55
Independent	0.31	0.22	0.33	0.23

Notes: This table reports the proportion of stations of a different ownership type for the regions affected by vertical separation. In Florida, this regions include Central Florida, Southeastern Florida, and Southwestern Florida. In New Jersey, these regions include the New Jersey suburbs of New York City, coastal areas, and areas in north and central New Jersey. In calculating the proportion of stations, all stations are weighted equally. In calculating the proportion weighting by sales, we use EIA reports that estimate the U.S. average sales made by independent, refiner franchisee, and refiner-owned stations.

Table 2: Description of Station Sales by State

Panel A: Florida

	Exxon			Motiva/Shell			BP		
	Central	Southeast	Southwest	Central	Southeast	Southwest	Central	Southeast	Total
2004	2	1	3	1		3			10
2005			1		1				2
2006				13		61		9	83
2007	1		1	1				10	13
2008	2		19		3			5	29
2009	3	3			56		1	49	112
2010					13		14		27
2011	24	81	21		6				132
2012					4				4
Total	32	85	45	15	83	64	15	73	412
Refiner Total		162			162		88		

Panel B: New Jersey

	Exxon		Motiva/Shell		
	New York City Suburbs	Rest of New Jersey	New York City Suburbs	Rest of New Jersey	Total
2010		3	3		6
2011	4		40	16	60
2012	142	44	5	2	193
2013	4				4
Total	150	47	48	18	263
Refiner Total	197		66		

Table 3: Mean Prices and Retail Margins in 2003 for Double Marginalization and Raising-Rivals' Costs Analyses (Year Prior To Station Sales)

Region	Double Marginalization				Raising Rivals' Costs			
	Price		Margin		Price		Margin	
	Control	Refiner Sold Stations	Control	Refiner Sold Stations	Control	Unbranded Stations	Control	Unbranded Stations
Florida								
Central	123.06	121.90	12.55	11.96	124.39	122.84	13.93	12.44
	(11.12)	(11.07)	(9.26)	(9.38)	(11.74)	(11.11)	(10.01)	(9.17)
Southeast	127.59	129.09	17.01	18.45	128.06	125.49	17.46	14.95
	(11.48)	(12.37)	(10.39)	(10.85)	(11.97)	(11.19)	(10.72)	(9.94)
Southwest	122.00	124.84	11.85	14.46	123.22	121.84	12.97	11.65
	(11.19)	(11.09)	(9.77)	(9.54)	(11.29)	(10.85)	(9.80)	(9.49)
New Jersey								
Suburbs of New York City	140.24	143.31	26.28	29.33	140.38	139.51	26.40	25.60
	(12.64)	(12.40)	(12.25)	(11.94)	(12.52)	(13.00)	(12.11)	(12.59)
Rest of New Jersey	137.46	139.80	23.63	25.72	138.31	134.78	24.42	20.80
	(12.19)	(13.13)	(11.67)	(11.93)	(12.16)	(12.68)	(11.53)	(11.87)

Notes: Mean prices and margins are calculated separetely by region and reported in cents-per-gallon. Margins are defined as the average difference betweeen a station's price (net of taxes) and the rack price. Margins for Florida are calculate using the average branded rack price for Miami. Margins for New Jersey are calculated using the branded rack price for Newark. All prices are reported in January 2010 dollars deflated by the Urban CPI. Means are calculated using data from 2003, the year prior to the refiner station sales being studied.

Table 4: Difference-in-Difference Estimates of Refiner Sales of Stations on Retail Price

	(1)	(2)	(3)	(4)	(5)	(6)
Post Sale	2.510***	2.068***	1.225***	2.509***	2.200***	2.763***
	(0.244)	(0.233)	(0.224)	(0.418)	(0.254)	(0.470)
Post Sale * Florida				-1.681***		-0.809
				(0.493)		(0.551)
Post Sale * If Motiva					-1.679***	-0.753
					(0.444)	(0.808)
Post Sale* If Motiva* Florida						-1.069
						(0.960)
Post Sale * If BP					-1.543***	-1.387***
					(0.486)	(0.490)
Observations	6,330,802	6,330,802	6,330,802	6,330,802	6,330,802	6,330,802
R-squared	0.988	0.991	0.992	0.992	0.992	0.992
Station and Time Fixed Effects	x					
Station and Time* State Fixed Effects		x				
Station and Time*Region Fixed Effects			x	x	x	x
Control Group	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Differences in Price Impact by Region and Refiner

	(1)	(2)	(3)	(4)
	Florida	Florida	New Jersey	New Jersey
Post Sale* Southeast Florida	1.436***			
	(0.425)			
Post Sale*Central Florida	0.225			
	(0.500)			
Post Sale* Southwest Florida	0.107			
	(0.334)			
Post Sale* Southeast Florida* If Motiva		1.452**		
		(0.727)		
Post Sale* Southeast Florida* If Exxon		2.256***		
		(0.516)		
Post Sale* Southeast Florida* If BP		0.767		
		(0.562)		
Post Sale*Central Florida*If Motiva		-2.104		
		(1.557)		
Post Sale*Central Florida*If Exxon		1.226***		
		(0.353)		
Post Sale*Central Florida*If BP		0.887**		
		(0.436)		
Post Sale* Southwest Florida* If Motiva		-1.091***		
		(0.397)		
Post Sale* Southwest Florida* If Exxon		2.264***		
		(0.403)		
Post Sale* Rest of New Jersey			3.041***	
			(0.771)	
Post Sale* New York City Suburbs			2.296***	
			(0.498)	
Post Sale* New York City Suburbs*If Motiva				1.808**
				(0.889)
Post Sale* New York City Suburbs*If Exxon				2.527***
				(0.547)
Post Sale* Rest of New Jersey* If Motiva				2.460**
				(1.200)
Post Sale* Rest of New Jersey* If Exxon				3.392***
				(0.922)
Observations	4,987,970	4,987,970	1,342,832	1,342,832
R-squared	0.992	0.992	0.989	0.989
Station and Time*Region Fixed Effects	x	x	x	x
Control Group	Other Branded	Other Branded	Other Branded	Other Branded

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Effect of Refiner Sales of Gasoline Stations in Regions with Different Levels of Localized Competition

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Pooled	Pooled	Pooled	Pooled	Florida	New Jersey	Florida	New Jersey
Post Sale	0.918***	2.163***	1.906***	2.456***				
	(0.265)	(0.459)	(0.313)	(0.515)				
Post Sale* If Fewer than two rival gas stations within 1 mile of the station being sold	0.937**	0.841**	0.689*	0.657	0.574	1.689**	0.330	1.614**
	(0.406)	(0.405)	(0.411)	(0.409)	(0.483)	(0.717)	(0.491)	(0.727)
Post Sale * Florida		-1.589***		-0.768				
		(0.496)		(0.552)				
Post Sale * If Motiva			-1.566***	-0.644			-1.817***	-0.506
			(0.454)	(0.807)			(0.549)	(0.815)
Post Sale* If Motiva* Florida				-1.078				
				(0.956)				
Post Sale * If BP			-1.424***	-1.286***			-1.665***	
			(0.488)	(0.491)			(0.518)	
Post Sale* Southeast Florida					1.284***		2.620***	
					(0.459)		(0.511)	
Post Sale*Central Florida					0.0496		1.124**	
					(0.482)		(0.467)	
Post Sale* Southwest Florida					-0.104		1.154**	
					(0.376)		(0.518)	
Post Sale* Rest of New Jersey						2.243**		2.469**
						(0.913)		(0.985)
Post Sale* New York City Suburl						1.643***		1.835***
						(0.570)		(0.616)
Observations	6,330,802	6,330,802	6,330,802	6,330,802	4,987,970	1,342,832	4,987,970	1,342,832
R-squared	0.992	0.992	0.992	0.992	0.992	0.989	0.992	0.989
Station and Time*Region Fixed Effects	x	x	x	x	x	x	x	x
Control Group	Other Brandec	Other Brandec	Other Brandec	Other Brandec	Other Brandec	Other Brandec	Other Brandec	Other Branded

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7: Change in Relative Price Between Independent and Refiner Affiliated Gasoline Stations Within Affected Markets

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Florida	South East Florida	Southwest Florida	Central Florida	New Jersey	New York City Suburbs	Rest of New Jersey
Independent*If(2007-2009)	-0.710***	-0.827***	-0.999***	-0.161			
	(0.0960)	(0.213)	(0.130)	(0.173)			
Independent*If(2010-2011)	-1.138***	-2.310***	-1.304***	0.0234			
	(0.124)	(0.254)	(0.161)	(0.236)			
Independent*If(2012-2015)	-1.621***	-3.198***	-1.237***	-0.688***			
	(0.141)	(0.316)	(0.165)	(0.259)			
Independent*If(2012)					-1.551***	-2.020***	-0.458
					(0.228)	(0.288)	(0.344)
Independent*If(2013-2015)					-1.942***	-2.153***	-1.433***
					(0.265)	(0.327)	(0.440)
Constant	224.6***	229.6***	222.2***	221.5***	255.1***	255.3***	254.6***
	(0.0226)	(0.0331)	(0.0294)	(0.0546)	(0.0616)	(0.0761)	(0.102)
Observations	14,762,592	5,150,637	5,399,090	4,212,865	4,271,006	3,018,287	1,252,719
R-squared	0.992	0.991	0.993	0.994	0.989	0.988	0.990
Station and Time*Region Fixed Effects	x	x	x	x	x	x	x
Control Group	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Triple Difference: Change in Relative Price Between Independent and Refiner Affiliated Gasoline Stations In Affected Markets Relative to Unaffected Markets

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Florida	South East Florida	Southwest Florida	Central Florida	New Jersey	New York City Suburbs	Rest of New Jersey
Independent*If(2007-2009)	-0.482***	-0.599**	-0.772***	0.0662			
	(0.178)	(0.260)	(0.198)	(0.229)			
Independent*If(2010-2011)	-1.100***	-2.272***	-1.266***	0.0615			
	(0.246)	(0.331)	(0.267)	(0.317)			
Independent*If(2012-2015)	-1.459***	-3.036***	-1.076***	-0.527			
	(0.267)	(0.388)	(0.280)	(0.344)			
Independent*If(2012)					-2.064***	-2.533***	-0.970**
					(0.409)	(0.445)	(0.484)
Independent*If(2013-2015)					-1.140**	-1.350***	-0.630
					(0.447)	(0.487)	(0.568)
Constant	224.5***	227.1***	223.1***	222.9***	254.2***	254.1***	252.8***
	(0.0198)	(0.0260)	(0.0245)	(0.0336)	(0.0510)	(0.0587)	(0.0631)
Observations	19,362,332	9,750,377	9,998,830	8,812,605	5,383,949	4,131,230	2,365,662
R-squared	0.993	0.992	0.993	0.993	0.989	0.989	0.991
Station and Time*Region Fixed Effects	x	x	x	x	x	x	x
Control Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations
Control Regions	Northeast Florida, Panhandle of Florida	Northeast Florida, Panhandle of Florida	Northeast Florida, Panhandle of Florida	Northeast Florida, Panhandle of Florida	New Jersey Suburbs of Philadelphia	New Jersey Suburbs of Philadelphia	New Jersey Suburbs of Philadelphia

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9: Estimated Net Price Price Effect of Vertical Separation by State

	Assumed Station Own-Price Demand Elasticity					
State	0	0	2	2	8	8
Florida	-0.43	-0.21	-0.43	-0.21	-0.45	-0.23
New Jersey	-0.39	0.08	-0.41	0.06	-0.41	0.01
Assume Equal Sales at All Stations	x		x		x	
Weight Station's by Estimated Sales Volume		x		x		x

Note: The net price effects are calculated using coefficient estimates from Table 4 (column 1) in calculating the EDM effect, and Table 7 (column (1) for Florida and (5) for New Jersey) in calculating the RRC effect. The estimated proportion of retail sales by station type reported in Table 8. All prices effects are reported in 2010 cents per gallon.

Appendix Table 1: Robustness of Localized Competition Findings to Alternative Local Market Sizes

VARIABLES	(5) Pooled	(6) Pooled	(7) Florida	(8) New Jersey	(9) Pooled	(10) Pooled	(11) Florida	(12) New Jersey
Post Sale	0.655**	2.205***			1.129***	2.681***		
	(0.316)	(0.546)			(0.239)	(0.476)		
Post Sale* If Fewer than two rival gas stations within 0.5 miles of the station being sold								
Post Sale* If Fewer than two rival gas stations within 0.75 miles of the station being sold	1.080***	0.881**	0.570	1.828**				
	(0.396)	(0.396)	(0.464)	(0.755)				
Post Sale* If Fewer than two rival gas stations within 1.5 miles of the station being sold					0.778	0.440	0.335	0.946
					(0.572)	(0.560)	(0.619)	(1.115)
Post Sale * Florida		-0.776				-0.798		
		(0.551)				(0.550)		
Post Sale * If Motiva		-0.653	-1.789***	-0.568		-0.744	-1.838***	-0.754
		(0.800)	(0.539)	(0.796)		(0.807)	(0.540)	(0.810)
Post Sale* If Motiva* Florida		-1.056				-1.039		
		(0.954)				(0.959)		
Post Sale * If BP		-1.270**	-1.642***			-1.356***	-1.693***	
		(0.493)	(0.523)			(0.490)	(0.515)	
Post Sale* Southeast Florida			2.406***				2.704***	
			(0.562)				(0.461)	
Post Sale*Central Florida			0.954*				1.197**	
			(0.509)				(0.508)	
Post Sale* Southwest Florida			0.933*				1.232***	
			(0.521)				(0.469)	
Post Sale* Rest of New Jersey				2.130**				3.061***
				(1.029)				(0.915)
Post Sale* New York City Suburbs				1.407*				2.406***
				(0.736)				(0.529)
Observations	6,330,802	6,330,802	4,987,970	1,342,832	6,330,802	6,330,802	4,987,970	1,342,832
R-squared	0.992	0.992	0.992	0.989	0.992	0.992	0.992	0.989
Station and Time*Region Fixed Effects	x	x	x	x	x	x	x	x
Included Stations	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded

Appendix Table 2: Difference-in-Difference Estimates of Refiner Sales of Stations on Retail Price: Independent Control Group

	(1)	(2)	(3)	(4)	(5)	(6)
Post Sale	3.794***	3.349***	2.204***	3.212***	2.964***	3.493***
	(0.233)	(0.223)	(0.208)	(0.473)	(0.263)	(0.521)
Post Sale * Florida				-1.381***		-0.796
				(0.523)		(0.591)
Post Sale * If Motiva					-1.408***	-0.847
					(0.438)	(0.810)
Post Sale* If Motiva* Florida						-0.618
						(0.958)
Post Sale * If BP					-1.218**	-1.088**
					(0.493)	(0.491)
Observations	5,251,602	5,251,602	5,251,602	5,251,602	5,251,602	5,251,602
R-squared	0.989	0.992	0.993	0.993	0.993	0.993
Station and Time Fixed Effects	x					
Station and Time* State Fixed Effects		x				
Station and Time*Region Fixed Effects			x	x	x	x
Included Stations	Independent	Independent	Independent	Independent	Independent	Independent

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 3: Differences in Price Impact by Region and Refiner: Independent Control Group

	(1)	(2)	(3)	(4)
	Florida	Florida	New Jersey	New Jersey
Post Sale* Southeast Florida	2.977***			
	(0.355)			
Post Sale*Central Florida	0.881*			
	(0.492)			
Post Sale* Southwest Florida	1.160***			
	(0.317)			
Post Sale* Southeast Florida* If Motiva		3.121***		
		(0.662)		
Post Sale* Southeast Florida* If Exxon		3.399***		
		(0.510)		
Post Sale* Southeast Florida* If BP		2.434***		
		(0.529)		
Post Sale*Central Florida*If Motiva		-1.532		
		(1.557)		
Post Sale*Central Florida*If Exxon		1.960***		
		(0.338)		
Post Sale*Central Florida*If BP		1.530***		
		(0.419)		
Post Sale* Southwest Florida* If Motiva		0.0925		
		(0.390)		
Post Sale* Southwest Florida* If Exxon		3.024***		
		(0.396)		
Post Sale* Rest of New Jersey			3.734***	
			(0.730)	
Post Sale* New York City Suburbs			2.994***	
			(0.596)	
Post Sale* New York City Suburbs*If Motiva				2.390**
				(0.951)
Post Sale* New York City Suburbs*If Exxon				3.273***
				(0.637)
Post Sale* Rest of New Jersey* If Motiva				3.208***
				(1.170)
Post Sale* Rest of New Jersey* If Exxon				4.046***
				(0.888)
Observations	3,979,513	3,979,513	1,272,089	1,272,089
R-squared	0.994	0.994	0.988	0.988
Station and Time*Region Fixed Effects	x	x	x	x
Included Stations	Independent	Independent	Independent	Independent

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 4: Effect of Refiner Sales of Gasoline Stations in Regions with Different Levels of Localized Competition: Independent Control Group

	(1) Pooled	(2) Pooled	(3) Pooled	(4) Pooled	(5) Florida	(6) New Jersey	(7) Florida	(8) New Jersey
Post Sale	1.908***	2.878***	2.670***	3.185***				
	(0.242)	(0.510)	(0.316)	(0.563)				
Post Sale* If Fewer than two rival gas stations within 1 mile of the station being sold	0.872**	0.809**	0.683*	0.660	0.514	1.718**	0.325	1.628**
	(0.403)	(0.404)	(0.411)	(0.410)	(0.482)	(0.716)	(0.491)	(0.726)
Post Sale * Florida		-1.300**		-0.758				
		(0.528)		(0.593)				
Post Sale * If Motiva			-1.298***	-0.738			-1.453***	-0.597
			(0.448)	(0.809)			(0.544)	(0.817)
Post Sale* If Motiva* Florida				-0.629				
				(0.954)				
Post Sale * If BP			-1.105**	-0.989**			-1.321**	
			(0.496)	(0.495)			(0.522)	
Post Sale* Southeast Florida					2.839***		3.853***	
					(0.393)		(0.482)	
Post Sale*Central Florida					0.724		1.581***	
					(0.472)		(0.454)	
Post Sale* Southwest Florida					0.970***		1.964***	
					(0.362)		(0.508)	
Post Sale* Rest of New Jersey						2.921***		3.186***
						(0.877)		(0.952)
Post Sale* New York City Suburbs						2.328***		2.551***
						(0.659)		(0.698)
Observations	5,251,602	5,251,602	5,251,602	5,251,602	3,979,513	1,272,089	3,979,513	1,272,089
R-squared	0.993	0.993	0.993	0.993	0.994	0.988	0.994	0.988
Station and Time*Region Fixed Effects	x	x	x	x	x	x	x	x
Included Stations	Independent	Independent	Independent	Independent	Independent	Independent	Independent	Independent

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 5: Difference-in-Difference Estimates of Refiner Sales of Stations on Retail Price: Own-Brand Control Group

	(1)	(2)	(3)	(4)	(5)	(6)
Post Sale	2.787***	2.041***	1.037***	1.554***	2.021***	1.876***
	(0.263)	(0.256)	(0.245)	(0.496)	(0.277)	(0.546)
Post Sale * Florida				-0.664		0.294
				(0.570)		(0.626)
Post Sale * If Motiva					-1.746***	-0.940
					(0.448)	(0.817)
Post Sale* If Motiva* Florida						-1.145
						(0.971)
Post Sale * If BP					-1.521***	-1.701***
					(0.505)	(0.504)
Observations	4,580,951	4,580,951	4,580,951	4,580,951	4,580,951	4,580,951
R-squared	0.987	0.990	0.991	0.991	0.991	0.991
Station and Time Fixed Effects	x					
Station and Time* State Fixed Effects		x				
Station and Time*Region Fixed Effects			x	x	x	x
Included Stations	Own-Brand	Own-Brand	Own-Brand	Own-Brand	Own-Brand	Own-Brand

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 6: Differences in Price Impact by Region and Refiner: Own-Brand Control Group

	(1) Florida	(2) Florida	(3) New Jersey	(4) New Jersey
Post Sale* Southeast Florida	0.959**			
	(0.458)			
Post Sale*Central Florida	1.233**			
	(0.552)			
Post Sale* Southwest Florida	0.541			
	(0.377)			
Post Sale* Southeast Florida* If Motiva		0.907		
		(0.749)		
Post Sale* Southeast Florida* If Exxon		1.843***		
		(0.542)		
Post Sale* Southeast Florida* If BP		0.267		
		(0.597)		
Post Sale*Central Florida*If Motiva		-1.425		
		(1.571)		
Post Sale*Central Florida*If Exxon		2.356***		
		(0.428)		
Post Sale*Central Florida*If BP		1.988***		
		(0.522)		
Post Sale* Southwest Florida* If Motiva		-0.863*		
		(0.443)		
Post Sale* Southwest Florida* If Exxon		2.761***		
		(0.424)		
Post Sale* Rest of New Jersey			0.813	
			(0.913)	
Post Sale* New York City Suburbs			1.850***	
			(0.589)	
Post Sale* New York City Suburbs*If Motiva				1.219
				(0.941)
Post Sale* New York City Suburbs*If Exxon				2.156***
				(0.636)
Post Sale* Rest of New Jersey* If Motiva				0.277
				(1.286)
Post Sale* Rest of New Jersey* If Exxon				1.140
				(1.058)
Constant	229.8***	229.8***	257.3***	257.3***
	(0.0694)	(0.0687)	(0.148)	(0.148)
Observations	3,649,706	3,649,706	931,245	931,245
R-squared	0.992	0.992	0.988	0.988
Station and Time*Region Fixed Effects	x	x	x	x
Control Group	Own-Brand Stations	Own-Brand Stations	Own-Brand Stations	Own-Brand Stations

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 7: Effect of Refiner Sales of Gasoline Stations in Regions with Different Levels of Localized Competition: Own-Brand Control Group

	(1) Pooled	(2) Pooled	(3) Pooled	(4) Pooled	(5) Florida	(6) New Jersey	(7) Florida	(8) New Jersey
Post Sale	0.740***	1.195**	1.740***	1.567***				
	(0.283)	(0.530)	(0.331)	(0.584)				
Post Sale* If Fewer than two rival gas stations within 1 mile of the station being sold	0.903**	0.877**	0.661	0.660	0.579	1.715**	0.319	1.620**
	(0.403)	(0.404)	(0.407)	(0.407)	(0.487)	(0.718)	(0.493)	(0.728)
Post Sale * Florida		-0.573		0.335				
		(0.572)		(0.627)				
Post Sale * If Motiva			-1.639***	-0.830			-2.011***	-0.645
			(0.457)	(0.815)			(0.555)	(0.821)
Post Sale* If Motiva* Florida				-1.155				
				(0.968)				
Post Sale * If BP			-1.411***	-1.601***			-1.762***	
			(0.506)	(0.505)			(0.524)	
Post Sale* Southeast Florida					0.804		2.226***	
					(0.489)		(0.534)	
Post Sale*Central Florida					1.055**		2.209***	
					(0.537)		(0.526)	
Post Sale* Southwest Florida					0.324		1.654***	
					(0.417)		(0.535)	
Post Sale* Rest of New Jersey						0.00269		0.292
						(1.035)		(1.104)
Post Sale* New York City Suburbs						1.189*		1.437**
						(0.653)		(0.698)
Observations	4,580,951	4,580,951	4,580,951	4,580,951	3,649,706	931,245	3,649,706	931,245
R-squared	0.991	0.991	0.991	0.991	0.992	0.988	0.992	0.988
Station and Time*Region Fixed Effects	x	x	x	x	x	x	x	x
Included Stations	Own-Brand	Own-Brand	Own-Brand	Own-Brand	Own-Brand	Own-Brand	Own-Brand	Own-Brand

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 8: Difference-in-Difference Estimates of Refiner Sales of Stations on Retail Price: Control Stations 3 Miles or More Distant From Sold Stations

	(1)	(2)	(3)	(4)	(5)	(6)
Post Sale	2.964***	2.441***	1.130***	2.592***	2.101***	2.912***
	(0.253)	(0.246)	(0.247)	(0.503)	(0.282)	(0.552)
Post Sale * Florida				-1.866***		-1.057*
				(0.576)		(0.638)
Post Sale * If Motiva					-1.689***	-0.910
					(0.445)	(0.816)
Post Sale* If Motiva* Florida						-0.945
						(0.968)
Post Sale * If BP					-1.657***	-1.577***
					(0.506)	(0.502)
Observations	3,946,679	3,946,679	3,946,679	3,946,679	3,946,679	3,946,679
R-squared	0.988	0.991	0.992	0.992	0.992	0.992
Station and Time Fixed Effects	x					
Station and Time* State Fixed Effects		x				
Station and Time*Region Fixed Effects			x	x	x	x
Control Group	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 9: Differences in Price Impact by Region and Refiner: Control Stations 3 Miles or More Distant From Sold Stations

	(1) Florida	(2) Florida	(3) New Jersey	(4) New Jersey
Post Sale* Southeast Florida	1.004*			
	(0.528)			
Post Sale*Central Florida	0.556			
	(0.510)			
Post Sale* Southwest Florida	0.488			
	(0.346)			
Post Sale* Southeast Florida* If Motiva		0.963		
		(0.786)		
Post Sale* Southeast Florida* If Exxon		1.779***		
		(0.620)		
Post Sale* Southeast Florida* If BP		0.339		
		(0.656)		
Post Sale*Central Florida*If Motiva		-1.737		
		(1.558)		
Post Sale*Central Florida*If Exxon		1.523***		
		(0.386)		
Post Sale*Central Florida*If BP		1.260***		
		(0.466)		
Post Sale* Southwest Florida* If Motiva		-0.812*		
		(0.416)		
Post Sale* Southwest Florida* If Exxon		2.591***		
		(0.424)		
Post Sale* Rest of New Jersey			3.215***	
			(0.850)	
Post Sale* New York City Suburbs			2.241***	
			(0.624)	
Post Sale* New York City Suburbs*If Motiva				1.626*
				(0.962)
Post Sale* New York City Suburbs*If Exxon				2.550***
				(0.667)
Post Sale* Rest of New Jersey* If Motiva				2.631**
				(1.252)
Post Sale* Rest of New Jersey* If Exxon				3.573***
				(0.993)
Observations	3,104,803	3,104,803	841,876	841,876
R-squared	0.993	0.993	0.988	0.988
Station and Time*Region Fixed Effects	x	x	x	x
Control Group	Other Branded	Other Branded	Other Branded	Other Branded

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 10: Effect of Refiner Sales of Gasoline Stations in Regions with Different Levels of Localized Competition: Control Stations 3 Miles or More Distant From Sold Stations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Pooled	Pooled	Pooled	Pooled	Florida	New Jersey	Florida	New Jersey
Post Sale	0.813***	2.227***	1.794***	2.585***				
	(0.281)	(0.541)	(0.333)	(0.596)				
Post Sale* If Fewer than two rival gas stations within 1 mile of the station being sold	0.948**	0.881**	0.717*	0.690*	0.557	1.714**	0.325	1.617**
	(0.401)	(0.402)	(0.407)	(0.406)	(0.484)	(0.718)	(0.491)	(0.728)
Post Sale * Florida		-1.776***		-1.012				
		(0.581)		(0.640)				
Post Sale * If Motiva			-1.573***	-0.795			-1.817***	-0.658
			(0.454)	(0.814)			(0.553)	(0.822)
Post Sale* If Motiva* Florida				-0.956				
				(0.965)				
Post Sale * If BP			-1.540***	-1.474***			-1.623***	
			(0.508)	(0.504)			(0.524)	
Post Sale* Southeast Florida					0.855		2.113***	
					(0.553)		(0.603)	
Post Sale*Central Florida					0.385		1.444***	
					(0.493)		(0.482)	
Post Sale* Southwest Florida					0.280		1.490***	
					(0.387)		(0.520)	
Post Sale* Rest of New Jersey						2.406**		2.702**
						(0.980)		(1.049)
Post Sale* New York City Suburbs						1.584**		1.842**
						(0.690)		(0.732)
Observations	3,946,679	3,946,679	3,946,679	3,946,679	3,104,803	841,876	3,104,803	841,876
R-squared	0.992	0.992	0.992	0.992	0.993	0.988	0.993	0.988
Station and Time*Region Fixed Effects	x	x	x	x	x	x	x	x
Control Group	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 11: Effect of Refiner Sales of Gasoline Stations on Rivals Located within 1.5 Miles of a Sold Station

	(1) Pooled	(2) Pooled	(3) Florida	(4) New Jersey	(5) Pooled	(6) Pooled	(7) Florida	(8) New Jersey
Post Sale	-0.112	0.0104			-0.310*	-0.246		
	(0.161)	(0.309)			(0.168)	(0.321)		
Post Sale* If Fewer than two rival gas stations within 1 mile of the station being sold					1.100***	1.096***	0.589	1.890***
					(0.397)	(0.399)	(0.499)	(0.655)
Post Sale * Florida		-0.162				-0.0827		
		(0.362)				(0.364)		
Post Sale* Southeast Florida			-0.215				-0.279	
			(0.331)				(0.336)	
Post Sale*Central Florida			-0.0882				-0.219	
			(0.373)				(0.339)	
Post Sale* Southwest Florida			-0.100				-0.219	
			(0.208)				(0.231)	
Post Sale* Rest of New Jersey				-0.263				-0.602*
				(0.350)				(0.359)
Post Sale* New York City Suburbs				0.766				0.0369
				(0.646)				(0.719)
Observations	8,984,048	8,984,048	6,832,342	2,151,706	8,984,048	8,984,048	6,832,342	2,151,706
R-squared	0.992	0.992	0.992	0.989	0.992	0.992	0.992	0.989
Station and Time*Region Fixed Effects	x	x	x	x	x	x	x	x
Control Group	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded	Other Branded

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 12: Change in Relative Price Between Independent and Refiner Affiliated Gasoline Stations: Include Price Trend

VARIABLES	(1) Florida	(2) South East Florida	(3) Southwest Florida	(4) Central Florida	(5) New Jersey	(6) New York City Suburbs	(7) Rest of New Jersey
Independent*If(2007-2009)	-0.718***	-1.339***	-0.937***	-0.159			
	(0.117)	(0.241)	(0.163)	(0.215)			
Independent*If(2010-2011)	-1.147***	-2.910***	-1.231***	0.0262			
	(0.158)	(0.335)	(0.206)	(0.296)			
Independent*If(2012-2015)	-1.632***	-3.936***	-1.150***	-0.685**			
	(0.187)	(0.447)	(0.225)	(0.340)			
Independent*If(2012)					-0.965***	-1.342***	-0.0928
					(0.249)	(0.315)	(0.384)
Independent*If(2013-2015)					-1.211***	-1.307***	-0.980**
					(0.306)	(0.384)	(0.497)
Monthly Time Trend	3.27e-05	0.00178**	-0.000231	-1.15e-05	-0.00240***	-0.00268***	-0.00163**
	(0.000334)	(0.000795)	(0.000345)	(0.000786)	(0.000495)	(0.000629)	(0.000741)
Constant	224.6***	229.5***	222.2***	221.5***	255.5***	255.8***	254.9***
	(0.0438)	(0.0602)	(0.0476)	(0.141)	(0.106)	(0.129)	(0.172)
Observations	14,762,592	5,150,637	5,399,090	4,212,865	4,271,006	3,018,287	1,252,719
R-squared	0.992	0.991	0.993	0.994	0.989	0.988	0.990
Station and Time*Region Fixed Effects	x	x	x	x	x	x	x
Control Group	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations	Refiner Branded Stations

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1