[1] The authors are economists at the Federal Trade Commission. Views and opinions expressed in this paper are solely those of the authors and should not be interpreted as reflecting the views of the Federal Trade Commission, any of its individual Commissioners, or other members of the staff. Comments by Mary Coleman, Leslie Farber, Jeff Fischer, Mark Manusazak, Paul Pautler, Louis Silvia, John Simpson, Shawn Ulrick, and participants at the Industrial Organization Society Conference and excellent research assistance by Ryan Toone are appreciated.

I. Introduction

The U.S. petroleum industry has undergone substantial restructuring since the mid 1990's. Among the major industry events were the creation of the Shell-Texaco and Marathon-Ashland joint ventures, and the BP-Amoco, Exxon-Mobil, BP-ARCO, Chevron-Texaco, and Phillips-Conoco mergers. Critics of the industry contend that the increase in concentration from these transactions has led to higher prices. Some government officials have called for a moratorium on petroleum mergers.[2] In contrast, the industry contends that these mergers have led to considerable costs savings. Before the Exxon-Mobil merger was completed the companies predicted that they would save $2.8 billion a year in costs. Two years after the merger was completed Exxon-Mobil stated they had achieved $4.6 billion dollars a year in savings.[3]

Despite the size of the petroleum industry and the controversy surrounding petroleum mergers, there have been surprisingly few attempts to examine the effect of mergers on the price of gasoline.[4] The few papers examining petroleum mergers typically either estimate the effects of a large number of mergers in a single study, or only examine one level of the industry, typically wholesale (rack) pricing.[5] The conventional approaches taken to study petroleum

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[2]"I urge Congress to enact a moratorium of at least one year on any merger or acquisitions of any major oil refiner, supplier or retailer, including cross-sector mergers and acquisitions, while Congress, the FTC and the states work together to fashion a longer term remedy that helps restore competitive forces and tempers the market dominance wielded by the few industry giants." Testimony of Connecticut Attorney General Richard Blumenthal Before the Permanent Subcommittee on Investigations of the Senate Governmental Affairs Committee, May 2, 2002.

[3]ExxonMobil Corporation, *Investor and Media Meeting*, New York, Aug. 1, 2000, pp. 36-37.

[4] There have been attempts to indirectly look at merger effects by examining changes in concentration. (GAO, 1986) Simply using concentration as a proxy for merger effects is problematic on a number of theoretical and practical levels, e.g. the difficulty of defining markets correctly and controlling for endogenous market structure. (Evans et al., 1993)

[5]The most commonly examined wholesale price for gasoline is the rack price. The rack price is the price posted at the truck rack at a terminal for trucks loading branded or unbranded gasoline. The percentage of wholesale transactions taking place at the rack prices varies by geography and by firm.

mergers are problematic for two reasons. First, examining multiple mergers in a single study is a virtually untenable task. The creation of boutique fuel specifications to comply with environmental regulations has Balkanized gasoline distribution in the U.S.[6] Each region of the U.S. is subject to different idiosyncratic sources of price variation, such as supply outages, input price fluctuations, seasonal changes in marginal supply and formulation changes. In order to ascertain how prices changed as the result of a change in market structure, the researcher must control for all of these complicating factors. Second, researchers should be careful about measuring merger affects by examining wholesale (rack) prices alone. In any gasoline market, there are multiple wholesale prices being charged to gasoline retailers, only some of which are publicly observable.[7] In addition, because petroleum mergers often affect the vertical structure of a local gasoline market, any given transaction may affect the retail markup a retail outlet earns, while having little effect on the retail price of gasoline.[8]

For these reasons, in this study we examine one transaction, the refining and marketing joint venture of Marathon and Ashland to form Marathon Ashland Petroleum (MAP). The MAP transaction proceeded with no antitrust challenge or divestiture. Testimony by various participants before the Permanent Subcommittee on Investigations of the Senate Governmental Affairs Committee, on May 2, 2002 suggested that the increased concentration from this merger, and mergers in general, have led to higher or more volatile gasoline prices in the Midwest.[9] In

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[6]Before the changes in gasoline specifications brought about by the Clean Air Act there was one gasoline specification in the country, now there are 18. Energy Information Administration, Petroleum Supply Monthly, April 1999.

[7]Also the relationship between these different wholesale prices may change, often in response to supply outages. For example, lessee dealer stations, a station owned by a major oil company leased by an independent marketer, pay a "dealer-tank-wagon" or DTW price which is typically higher than the posted rack price, but when refineries have supply problems, the DTW price is often less than the posted rack price.

[8]There are a number of theoretical models that demonstrate how mergers, both horizontal and vertical mergers may affect upstream (wholesale) but not downstream (retail) prices. For examples of these types of models see, Ordover et al., (1990) and Froeb et al., (2002).

[9]"Increased concentration in the refining and distribution segment of the industry has contributed to the exercise of market power by dominant industry actors to the detriment of

this paper we examine how the retail and wholesale prices of gasoline in arguably the most potentially problematic area, Louisville, Kentucky, changed as a result of the joint venture. We use the wholesale and retail price of gasoline in a number of cities as controls in estimating whether the retail or wholesale price of gasoline changed in Louisville as a result of the joint venture.

Retail gasoline prices in Louisville do not appear to increase as a result of the joint venture. These findings are robust when comparing the retail price in Louisville to three control markets. The wholesale (rack) prices of reformulated gasoline (RFG) increased 3-5 cents per gallon approximately 15 months after the transaction. This wholesale price (rack) effect, however, seem to be the result of a supply shock caused by St. Louis's switch to RFG rather than the joint venture. The difference in the retail and wholesale (rack) price changes demonstrates that it is crucial to examine both retail and wholesale pricing when measuring the price effects of a merger affecting gasoline markets. The finding that the wholesale price increase is not passed through at retail is somewhat surprising. In this market, it appears that retailers directly supplied by refiners, representing 30% of gasoline sales, did not experience a wholesale price increase in 1999. Apparently those stations facing the higher wholesale (rack price) were not able to pass through enough of the price increase to affect the average market price because of competition with stations directly supplied by refiners.[10]

The paper is organized as follows. The second section provides industry background and then describes the structure of the MAP joint venture. Section three reviews the methodologies used in merger retrospectives for various industries and those research papers that focus on

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consumers." and "Although not as large as the mergers referenced above on a national scale, the most significant transactions in Michigan petroleum markets involve the merger of Marathon and Ashland Petroleum and then later Marathon Ashland Petroleum's acquisition of all the Ultramar Diamond Shamrock assets in the State." Testimony of the Michigan Attorney General Jennifer Granholm before the Permanent Subcommittee on Investigations of the Senate Governmental Affairs Committee, May 2, 2002.

[10]Competition from stations selling conventional gasoline which did not experience a wholesale price increase directly across the Ohio River in Indiana or in Kentucky, outside the RFG area, may also have limited the ability of rack supplied stations to pass thru the wholesale price increase.

(refineries in Texas and Louisiana) produces much more gasoline than it consumes, and ships gasoline to the Midwest and East Coast. The eastern region of the U.S. is a net importer of gasoline, with marginal supply coming from the Gulf via pipeline and from Canada, Europe and the Caribbean via ports around New York City. Most of the gasoline consumed in the upper Midwest, e.g., Illinois or Minnesota, is refined locally, but the region receives marginal supply from the Gulf.

Not only does the method of supply vary by geography, but vertical integration among levels of the petroleum industry- crude exploration, refining, wholesaling and marketing- vary by firm and geography as well. Some firms, such as Exxon-Mobil, are vertically integrated from the exploration and production of crude oil through refining, wholesaling and marketing. Other firms, such as Tesoro, concentrate on refining and marketing, and other firms concentrate on simply refining, such as Koch, or marketing, such as Sheetz or Racetrac.

Further complicating the vertical market structure in the industry, there are also different vertical relationships between the wholesale and retail levels of the industry.[11] A branded gasoline station, e.g. Exxon or Shell, may be owned and operated by an oil company (company op), owned by the oil company and leased to an independent operator (lessee dealer), or owned and operated by an independent operator (open dealer). It is important to note that each of these retail/wholesale vertical relationships results in a potentially different wholesale price. The company owned and operated station pays an unobserved transfer price for gasoline, the lessee dealer typically pays a dealer tank wagon price which can vary by station and which is difficult to observe, and the open dealer typically pays the rack price plus delivery and possibly a markup to the delivery firm which is somewhat observable. The percentage of branded stations of each

[11]The vertical market structure is impacted in a number of states by divorcement regulations, restrictions on petroleum companies owning gasoline stations. See, Vita (2000) and Blass and Carlton (2001) for a description, and the estimated economic impact, of divorcement.

[12]For a more detailed description of the wholesale gasoline markets and DTW and rack pricing see Borenstein and Shepard (1994).

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over 250 points to 1500 to 1600 range. These retail market shares are based on sales of gasoline

[15]See Figure II for a map of the Louisville MSA and the gasoline station locations.

[16]We also analyzed conventional gasoline prices at the Louisville rack and at retail in the area surrounding the RFG area in Louisville relative to the control cities. There was no change in the price of conventional gasoline at the Louisville rack or in the surrounding retail areas. Figure VII shows the price of conventional gasoline at the Louisville rack relative the Chicago rack. There is no change in the price of conventional gasoline.

health care, and airlines.[17] Most merger event studies that examine product prices before and after a merger use one of three types of reduced form regressions.

In the first type of regression (*see* Barton 0 Tsee

[17]For a review of the literature on the multitude of methodologies used in examining the effects of mergers, including those papers that attempt to directly estimate the price effects see, Pautler (2003).

[18]In addition to the recent working papers discussed in the text, a government report by the U.S. General Accounting Office (GAO, 1986) examined gasoline prices from the time period

surrounding Texaco's purchase of Getty and Chevron's purchase of Gulf. Having only limited post-merger data, GAO did not directly estimate the price effects of the two mergers. Instead it estimated a wholesale price- concentration relationship and inferred a price increase resulting from a change in concentration. Since the FTC-required divestitures prevented concentration increases where the merger guidelines thresholds would have been exceeded and because the correlation between HHI and wholesale price appeared small, the GAO concluded that the two mergers "would have had only a small effect on wholesale gasoline prices." The report concluded that supply changes other than the mergers were primarily responsible for the observed increase in prices in 1985.

[19] Other research papers have found that company operated stations have, on average, lower prices than lessee dealers. See Shepard (1993) and Barron and Umbeck (1984).

[20]In the paper there is also a price-concentration regression looking at the relationship between both vertical and horizontal market structure and the wholesale price of unbranded gasoline in metropolitan areas in the Western United States. The authors find that the difference between

California refineries along with 1,100 gasoline stations and related terminals and transportation assets from Unocal. Tosco owned two refineries on the West Coast, one in California and one in Washington, but had a limited retail presence in California. Their analysis examines whether Tosco raised rivals' costs by increasing the price of unbranded gasoline after it acquired Unocal's West Coast assets. The statistical results show a positive relationship between Tosco's price of unbranded gasoline and the increase in vertical integration caused by the purchase of Unocal assets by Tosco. The size of the estimated effect depends on the change in vertical integration caused by the merger. For example, if in a given city 20 percent of the acquired (Unocal) retail outlets were within a mile of the an independent (unbranded) competitor, Tosco raised its unbranded wholesale price in that city by 0.7 cents per gallon. While the paper shows that Tosco/Unocal raised the wholesale price of unbranded gasoline, the paper does not examine what happened to retail prices. Thus, while this paper provides evidence that the change in market structure affected Tosco's wholesale prices, it is unclear that consumers were made worse off as a result of the transaction.

Chouinard and Perloff (2001) examine gasoline price changes over time and differences in prices among geographic areas using monthly state-level retail and wholesale (rack) prices for the period between January 1989 and June 1997. They estimate separate regressions for the determinants of retail prices and wholesale prices. Their analysis uses a state level fixed-effect specification. To isolate the effect of horizontal mergers and divestitures, Chouinard and Perloff include dummy variables for the presence of a refinery or retail merger among their explanatory variables in their wholesale and retail price regressions. A merger is assumed to affect state retail and wholesale prices from the date it is completed to the end of the data set in June 1997. A total of 35 mergers were included in the analysis with 27 at the retail level and eight at the refinery level. Most mergers yielded statistically insignificant impacts. Nine of 27 retail mergers and three of the eight refinery mergers showed a statistically significant retail price effect; only

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unbranded wholesale gasoline prices and crude prices is positively correlated with a measure of vertical integration. The authors point out that a positive statistical correlation between vertical integration and price should not be interpreted as necessarily demonstrating causality.

and Shell marketing assets in the state. Manuszak finds that there would have been anticompetitive effects if this joint venture had been completed as originally proposed. In fact, the FTC required Texaco to divest its Hawaiian assets before allowing the joint venture to proceed. The author concludes the FTC concerns were warranted but that the dead weight loss would have been relatively small due to the inelastic demand for gasoline. The simulated price effect of any two firms on Maui merging was between 2 and 3 cents per gallon.

Each of these studies has used a slightly different methodology but ultimately all examine the possible price effects of mergers comparing a pre- and post-merger period either through an event study or simulation. The effects found in these studies run the gamut from small price decreases to sizeable price increases. These studies do point out a number of issues that must be addressed in a merger retrospective. It is important to examine both wholesale and retail pricing post merger since the vertical and horizontal competition may have been affected. The event study, dummy variable approach, without control prices, is problematic because few market-specific high-frequency supply and demand variables for gasoline are available. In addition, examining multiple mergers using a panel data approach can be difficult without carefully controlling for each region's supply situation. Given these issues, we focus our attention on a measuring the price effect of a single petroleum merger affecting one market at both the wholesale and retail level and compare prices in the affected market with other markets that face similar supply and demand conditions but should be unaffected by the merger.

IV. Data and Methodology

The goal of this study is to determine how, if at all, prices changed in the Louisville wholesale and retail gasoline markets as a result of the MAP joint venture. While it is relatively

Louisville relative to other markets unaffected by the merger facing similar supply and demand conditions.

Many factors specific to gasoline markets complicate this approach. First, the specification of gasoline used in Louisville is different from that used in other nearby markets. This factor limits our comparison of Louisville gasoline markets to three regions using RFG (Chicago, Houston, and stations in the Northern Virginia suburbs of Washington, D.C.). However, even within these three regions there are differences in the fuel specification. Second,

self-sufficient in RFG with ethanol production during this period. (Bulow et al. (2003)) Hence, broad costs shocks should be passed through in a similar manner. Marathon also owned a refinery (in Robinson, Illinois) that was connected to both Chicago and Louisville via a pipeline. Through this pipeline Marathon could have shifted supply from Louisville (where it may have gained market power following the joint venture) to Chicago where it could have likely sold excess supply while having little impact on price.

There were two key drawbacks to using Chicago as a control city. The first was that Chicago only used RFG with ethanol. Louisville used both RFG made with ethanol and MTBE. In our data, we were able to consistently observe only the wholesale price for RFG in Louisville sold with MTBE. For this reason, our empirical analysis uses the wholesale price of RFG with MTBE in Louisville. Thus, comparisons between wholesale gasoline prices in Chicago and Louisville compared slightly different types of gasoline.[22] The wholesale prices of RFG made with MTBE and ethanol sold in Louisville appear to have a virtually constant differential (with one exception) during our time period; that is, the relative price of the two types of RFG in Louisville do not appear to change over time. For this reason, we do not believe our results would change if we had a complete wholesale price series on wholesale RFG made with ethanol. At retail, it was not possible to determine which stations in Louisville sold RFG made with MTBE or ethanol. Thus, when examining relative differences in *retail* prices we compared an (unknown) mix of ethanol and MTBE RFG prices in Louisville to ethanol prices in Chicago. Second, while the marginal supply to both Chicago and Louisville was the Gulf, the method of shipment was different. If, for some reason, either the pipeline serving Chicago were out of service or something affected the shipment of gasoline into Louisville by barge, then the relative price between the two cities might have diverged.[23]

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[22]While the gasoline differs between the two cities, the distinction between conventional gasoline and RFG is much greater; that is, RFG made with ethanol is a much closer supply-side substitute than conventional gasoline.

[23]With the exception of a major barge accident that limited shipments into Louisville for a few days in August 1999, we are unaware of any shocks to the pipeline that served Chicago or the barges that served Louisville during our time period.

[24]Houston and Northern Virginia use the “southern” specification of RFG made with MTBE. Louisville and Chicago use the “northern” specification.

empirical analysis, we calculate price effects separately cefioniolate pricexanalp,uo6vus24, we cals3202 -152(.g.

[27] These shocks were the result of unanticipated refinery outages and difficulty in changing gasoline specifications. For this reason, it is difficult to view gasoline pricing in the Midwestern U.S. (including Louisville and Chicago) as being in equilibrium in 2000 and 2001. These problems in the gasoline markets have been well documented. See, e.g., Bulow et al. (2003).

[28]These wholesale prices are those paid by independently owned gas stations, either branded (e.g., Exxon or BP) or unbranded (not affiliated with a refiner). The wholesale price of gasoline paid by refiner owned stations is not publicly available.

[29]Fleet cards are often used by firms whose employees drive a lot for business purposes, e.g., salesman or insurance claims adjusters. Fleet cards are often used to closely monitor what items employees charge to the firm, e.g., to ensure that an employee only bills fuel and not food when visiting a filling station.

uses corresponds to a quantity weighted pricing scheme.[30] Second, branded gasoline stations (which tend to charge higher prices) are more likely to accept fleet cards. Thus, on any given day the average price reported by OPIS is likely higher than the (unobserved) average gasoline price in a market. For the purposes of this study, however, this should not be a problem because we are measuring changes in price levels across markets; that is, as long as the differential between branded and unbranded gasoline does not change as a result of the joint venture, this data should allow us to determine how the prices change following the joint venture.[31]

OPIS sells two types of retail price data (both types are used in this study). The first type of data consists of the daily prices by individual stations. OPIS also creates aggregate measures of prices for each of more than 360 metropolitan areas throughout the U.S. While OPIS reports daily price data, we have chosen to conduct our analysis using data aggregated to the weekly level. The composition of stations reporting price data on any day in the OPIS data changes from day to day. Thus, using daily data, it is not clear if prices in a market change from day to day because the composition of the sample changed (e.g., prices increased because a larger proportion of high priced stations report prices on a given day) or because the price distribution changed. By aggregating prices over a longer time period, changes in the composition of the sample are less of an issue.

For our two key regions, the Louisville and Chicago areas, we used OPIS's daily station-specific retail price data and OPIS's daily retailer-specific branded and unbranded wholesale prices. We constructed the average weekly retail price by taking the average of all station days reporting in a given week in the city of Louisville (Chicago). We focused on a region narrower than the metropolitan area for two reasons. First, all of our prices are measured before taxes. Taxes often vary by jurisdiction, e.g., taxes are different in the city of Chicago than elsewhere in Cook County, Illinois. By focusing on a specific jurisdiction, we can correctly measure a region's pre-tax price. Second, within the broad metropolitan area, different gasoline stations

[30]High frequency quantity data, e.g., daily or weekly, corresponding to gasoline station pricing data are not available.

[31]There is no discernable change in the branded/unbranded wholesale gasoline spread following the joint venture (results not shown, available on request from the authors).

[32]Retail margins are calculated as the difference between the average retail price and the

be relatively lower in Louisville at the end of the year, and wholesale prices tended to increase at the end of the year.

Following the MAP joint venture (January 1, 1998), there did not appear to be a systematic change in Louisville's retail prices relative to Chicago. Louisville's relative retail price appeared to have decreased in late 1998 and early 1999, but returned to 1997 levels by the end of 1999. In contrast, Louisville's wholesale price increased somewhat in 1998 (relative to 1997) and increased substantially roughly 15 months following the creation of MAP, and appeared to stay at this higher level for the remainder of the time period. These two findings suggest that the relative retail margin earned by gas stations in Louisville decreased substantially following the joint venture (the implied relative margin, (Retail Price_L - Wholesale Price_L) - (Retail Price_C - Wholesale Price_C) is plotted in Figure III).

To check the robustness of the pattern seen in Figure III, we plotted the wholesale and retail prices of gasoline in Louisville (and retail margins) relative to the three control regions: Chicago, Houston, and Northern Virginia.[36] Figure IV shows the difference between Louisville's branded wholesale gasoline prices and those of Chicago, Houston, and Northern Virginia in 1997, 1998, and 1999. While the average differential between Louisville and Houston, Northern Virginia, and Chicago were clearly different (Chicago has higher prices than Northern Virginia, which has higher prices than Houston), the changes in the differential overtime were very similar. The data clearly show that Louisville's relative wholesale price increased dramatically roughly 15 months after the merger. Figure V (for retail prices) and Figure VI (for retail margins) showed that the pattern for changes in retail prices and retail margins was quite similar when measured relative to Northern Virginia, Houston, or Chicago. Specifically, there did not appear to be any significant change in retail prices, but retail margins fell.

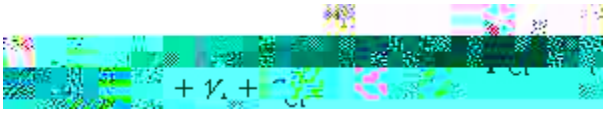
This pattern can be also be seen in the average annual differentials between Louisville and the control cities in Table 2. The mean difference between Louisville's rack price and Chicago's, Houston's , and Northern Virginia's rack priced increased by 5.4, 2.7, and 3.5 cents a gallon, respectively between 1997 and 1999. Similarly, between 1997 and 1999 relative retail

[36]Retail and wholesale prices for Northern Virginia and Houston are the OPIS calculated average prices.

margins in Louisville fell by about 5.7, 6.7, and 1.2 cents a gallon relative to Houston, Chicago, and Northern Virginia. In contrast, there is no systematic change in Louisville's relative gasoline prices following the merger.

Our next step is to determine if the empirical pattern seen in the plots (increased wholesale prices and decreased retail margins) is robust to controlling for seasonal effects. We do this using a simple difference-in-difference estimator. We assume that Louisville's retail prices, rack prices, and retail margins at a point in time are explained by expected crude oil prices (F_t),[37] changes induced by the joint venture (estimated separately for 1998 and 1999), seasonal effects (proxied by month dummies, D_{mt}), and time-specific supply and demand shocks ($_t$) as described by equation (1) below.

The prices (margins) in the control cities are explained by a similar relationship described by equation (2) below (the key difference being no systematic change induced by the joint venture).



[37]The crude oil futures price used is the New York Mercantile Exchange (NYMEX) contract for crude delivery at Cushing Oklahoma in the next month.

[38] There are persistent regional difference in seasonal changes in gasoline prices. For instance, different regions begin burning "summer" blends of gasoline at different times.

To estimate the price effects of the joint-venture we take the difference of equations (1) and (2) and estimate equation (3) below which eliminates the time-specific shocks to price ( ).

Because the error term of equation (3) is autoregressive, we estimate it using an ar(1) correction.[39] The parameter estimates of equation (3) for retail prices, rack prices, and retail margins are presented in Tables 3a, 3b, and 3c, respectively.

The general pattern of results seen in Figures IV, V, and VI is seen in the estimated price effects for 1998 and 1999. There is no consistent evidence showing a change in relative retail prices in Louisville. Louisville's retail price is essentially unchanged relative to Chicago, down two cents in 1999 relative to Houston, but up two cents relative to Northern Virginia. None of these price changes are statistically significant at conventional levels. In contrast, Louisville's rack prices may have increased slightly in 1998 (between 1.75 and 3.75 cents) and increased substantially in 1999 (between 3.25 and 6.75 cents).[40, 41] There is some difference across control cities in the change in relative retail margins. Relative to Chicago and Houston, retail margins in Louisville appear to have fallen about six cents in 1999. The relative decrease in Houston is much smaller, about 1.7 cents, and is not significant at conventional levels. In addition, a cursory view of the estimated coefficients on the month dummies shows that there are systematic

[39]We use the Prais-Winsten correction for autocorrelation.

[40]The wholesale price increase in 1998 is not, however, robust to changes in the measure of the price of gasoline, see Table 3.

[41]The data appear to be stationary in the retail price and retail margin regressions. However, the error terms in the rack price regressions may be non-stationary. The autocorrelation coefficients are very large in these regressions: .98 for Chicago, .90 for Houston, and .86 for Virginia, and the null hypothesis of non-stationarity cannot be rejected for these regressions. Thus, the estimated standard errors must be viewed with caution. However, the pattern seen from these regressions is consistent with the figures and average differences shown in Table 2.

[42]For example, in gasoline markets branded gasoline (sold through stations affiliated with major oil companies) typically sells at a premium relative to gasoline sold through unaffiliated stations (e.g., a local convenience stores). However, even within the branded gasolines there are

branded gasoline. Table 4 presents the estimated year effects from the regression of the Louisville measure on the control city measure, month dummies, and a futures price for oil which also corrects for autocorrelation; that is, the analogue to Tables 3a, 3b, and 3c. For brevity, we only report the coefficients and corresponding t-statistics for the year dummies. [46] The patterns for premium gasoline (both branded and unbranded) and unbranded regular gasoline are the same as in Tables 3a, 3b, and 3c. Rack prices for premium gasoline and unleaded gasoline increased by three to seven cents per gallon in 1999 relative to 1997 (depending on the control city).[47] Retail prices did not exhibit any systematic price change, and retail margins fell by two to seven cents per gallon, depending on the choice of control city.

VI. Interpreting the Results

The primary goal of this study is to determine if consumer prices increased as a result of

[46]To facilitate comparison of the results, the estimates from Table 3a, 3b, and 3c are reproduced in Table 5.

[47]While the estimated year effect for wholesale gasoline in1998 (relative to 1997) is positive in all of the estimated specifications of equation 2, the year effect is not statistically significant for unbranded gasoline sold in Houston or Northern Virginia.

[48]The U.S. Midwest experienced multiple supply shocks in 2000 and 2001 that caused large movements in gasoline prices both within and between Midwestern cities. In particular, the differences between wholesale prices in Louisville and the control cities changed dramatically and frequently as gasoline markets responded to these supply shocks. For this reason, it is very

and 2001). The primary question is whether the change in wholesale pricing was related to the merger. A secondary question is why was there no overall change in retail pricing given the increase in wholesale prices. This section discusses there two issues.

The increase in relative rack prices in Louisville was not likely the result of the joint venture. Instead, rack prices appear to have increased because of a large increase in demand for the RFG in the Midwest that may not have been completely anticipated by refiners. This increase in demand was caused by St. Louis entering the RFG program.

Specifically, in the summer of 1999, the St. Louis MSA began using RFG. Prior to 1999, the St. Louis area used a low Reid vapor pressure conventional gasoline in an attempt to satisfy air quality requirements without using RFG. In 1998, after failing to meet federal clean air requirements and facing the possibility of losing federal highway funds, the Missouri legislature passed a bill removing the ban on RFG sales in the state and authorized the state to opt into the federal RFG program. The Missouri Governor then sent a letter to the EPA in the Summer of 1998 asking to opt into the RFG program. The EPA issued a proposed rule in September of 1998 and a final rule in February of 1999 which required refiners to supply RFG at wholesale by May 1, 1999 and retail by June 1, 1999. Industry articles suggest that the industry met the May 1 and June 1 deadlines. (Platt's Oilgram News, various issues)

There are a number of reasons to argue that St. Louis's switch to RFG was the source of the Louisville price spike. First, when St. Louis began using RFG, it was consuming essentially the same type of RFG as Louisville.[49] Second, both cities had the same source of marginal supply, gasoline imported from the Gulf area refineries either by barge or pipeline. Third, the increased demand for RFG resulting from St. Louis's entry into the federal reformulated program was substantial. While quantities of gasoline sold are not readily available at the MSA level, the state level data in this case is useful. The average monthly amount of RFG sold in Missouri

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difficult to isolate any relatively small(three to five cent per gallon) permanent change in relative gasoline prices during this time period.

[49]Most of the gasoline consumed in St. Louis and Louisville was made with MTBE rather than ethanol. In contrast, all of the RFG consumed in Chicago was made with ethanol and produced locally by the Chicago area refiners.

(which is only consumed in St. Louis) for 1999 was 1.04 million gallons a day while the average amount of RFG sold in Kentucky (which is only sold in the Louisville area and Kentucky suburbs of Cincinnati) was 1.08 million gallons a day.[50] Thus, Midwest demand for RFG with MTBE essentially doubled in the spring/summer of 1999.[51]

The timing of Louisville's relative wholesale price increase for RFG is consistent with St. Louis entering the reformulated program. In order to meet the EPA requirement to have RFG available at wholesale by May 1, 1999, wholesalers in St. Louis would have to begin building inventories of RFG in late March or early April. This is when Louisville's relative RFG prices began to increase. Figure VII shows the difference in the rack prices between Louisville and Chicago for both conventional gasoline and RFG. Not only does this graph show the timing of the change in RFG pricing in April of 1999 but also shows that the relationship between Chicago and Louisville in conventional was unchanged during the three years as mentioned earlier.

In order to double the amount of RFG made with MTBE needed to supply the Midwest, refiners needed to change their output mix to less conventional gasoline (which had been consumed in St. Louis) to RFG. Recent studies, see Bulow et al (2003) and Taylor and Fischer (2003), suggest that modifying refineries to produce new specifications of gasoline is complicated and can lead to unexpected output reductions. For example, a change in the RFG specifications in 2000 substantially reduced local refining capacity in the upper Midwest that increased the price of gasoline in the Chicago/Milwaukee area.

An additional fact consistent with there being a supply shock in Louisville is the change in the difference between the rack and the DTW prices in 1999. In other markets experiencing supply disruptions (the Midwest in 2000, California in 1999 and 2000), stations supplied directly by refiners (DTW stations) experience less of a wholesale price increase than those stations that

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[50]Department of Energy, Energy Information Administration, Petroleum Marketing Annual, 1998 and 1998.

[51]In addition, the average amount of RFG sold in Louisville in 1999, 1.08 million gallons a day, was over 14 percent higher than in 1998, 947.5 thousand gallons a day. While it is not clear what caused the increased demand in Louisville, it is hard to argue that there was an anticompetitive effect from this merger with an increase in sales of 14 percent.

purchase their gasoline in at the rack.[52] Normally the rack price is less than the DTW price because the rack price does not include delivery or additional services.

The pricing pattern in Louisville in mid to late 1999 is similar to that observed in other regions experiencing supply disruptions. A comparison of the rack and DTW prices for RFG gasoline in Kentucky shows that there was a change in relative prices in 1999. The difference between the DTW price and the rack price in Kentucky, shown in Figure VIII, averaged 4-5 cents per gallon in 1997 and 1998. In 1999 the difference between DTW and rack prices was historically low and was *negative*

[52]Department of Energy, Energy Information Administration, Petroleum Marketing Annual, 1999 and 2000.

that the price of gasoline at rack supplied stations increased from 1998 to 1999 relative to the direct supplied stations by about 0.5 cents per gallon.

Additionally, as shown in Figure II, the reformulated area in Louisville is not particularly large, a little over 20 by 20 miles, and is surrounded on all sides by stations selling conventional gasoline. Thus stations paying the rack price for gasoline are competing with direct served stations, which also did not experience the relative wholesale price increase, and are also competing with stations across the Indiana border and further out in Kentucky that sell conventional gasoline, which did not experience a relative price increase. Apparently these factors kept stations supplied by the rack in Louisville from passing through enough of the price increase to affect average retail prices.

VII. Conclusions

This study uses retail gasoline prices and wholesale (rack) gasoline prices for Louisville and a number of control cities to examine the price effects of the Marathon-Ashland joint venture. We find no effect of this transaction on the retail price of RFG or conventional gasoline in Louisville. Wholesale (rack) RFG prices increased significantly 15 months after the transaction. This increase coincided with a major industry event which affected the Midwestern gasoline area, the introduction of RFG in St. Louis. The available evidence suggests that St. Louis's decision to switch to RFG may have resulted in the increase in Louisville's rack price for RFG. In particular, the demand in the Midwest for RFG made with MTBE (the RFG used in St. Louis and Louisville but not Chicago) nearly doubled with St. Louis's entry into the RFG program. Further, the inversion in rack and DTW wholesale prices for RFG is consistent what has been observed in other markets that have experienced supply shocks.

The results of the this study reveal the importance of examining both retail and wholesale pricing in measuring the competitive effects of mergers. Had we analyzed rack prices without examining retail pricing, we would have concluded that the transaction led to higher prices. Further, the observation that the rack price increased and did not seem to be passed through by retailers caused us to do additional research into what shocks would have affected rack but not

retail prices.[53] Our results suggest that researchers should be very careful in using rack prices as a measure of the wholesale price of gasoline, particularly in markets experiencing supply shocks, e.g., the Midwest or California. The wholesale price that different types of gasoline retailers (e.g., DTW or rack-supplied) pay may vary significantly during a supply shock.

The results of this study suggest that this merger in a moderately/highly concentrated market did not raise consumer prices. Given the large changes in market structure in petroleum markets, additional research into the competitive effects of mergers would be beneficial. Because of the idosyncratic nature of oil markets, e.g. different sources of marginal supply, different fuel specifications, etc., the results of any one study need to be qualified. Only when a sufficient number of merger retrospectives are complete will it be possible to generalize the results to inform antitrust policy.

[53]To our knowledge, no article in the trade press noted a relative increase in Louisville's rack price, and no article described how St. Louis's entry into the RFG program might affect gasoline pricing in the Midwest.

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Appendix - The Impact on Retail Prices of a Rack Price Increase

In this section of the paper we provide some explanation for why the relative rack price increase Louisville experienced in mid-to-late 1999 did not manifest itself in a significant increase in retail price. As described in the industry background section, different gas stations face different wholesale prices depending on their source of supply. In particular, aggregate gasoline pricing data from H0 0 >>BDC 0b -4

seasonality) and station specific fixed effects (see equation 1 below). Second, we examine the average residuals in 1998 and 1999 separately for direct and rack supplied stations to determine if relative prices changed for direct supplied and rack supplied stations.

(1) Retail Prices

The retail prices used in the regression were the price charged by a given station on a given day (all observed days are weekdays). The rack price was the average branded rack price observed on that day in Louisville. There were 368 gasoline stations in the sample, 81 were rack supplied.

The explanatory variables in equation 1explain 82 percent of the variation in the retail prices. Figure A-1 shows the average residuals for the direct supplied and the rack supplied stations. The figure shows that the residuals of rack supplied stations increased relative to direct

Table 1: Descriptive Statistics For Gasoline Prices and Margins
(Prices exclude all taxes)

Variable Name	City	Branded/Unbranded	Weeks	Mean	Standard Deviation	Min	Max
Premium Retail Margin	Chicago	Branded	155	16.39	3.93	5.25	27.37
Premium Retail Margin	Houston	Branded	155	17.23	3.31	8.85	24.73
Premium Retail Margin	Louisville	Branded	155	18.41	4.56	7.13	28.19
Premium Retail Margin	Virginia	Branded	155	15.12	4.41	3.82	23.80
Regular Retail Margin	Chicago	Branded	154	22.92	4.01	12.25	33.47
Regular Retail Margin	Houston	Branded	155	13.19	3.30	6.50	21.81
Regular Retail Margin	Louisville	Branded	154	14.84	4.07	3.54	23.97
Regular Retail Margin	Virginia	Branded	155	13.08	4.03	4.09	20.40
Retail Price Premium Gas	Chicago	n/a	155	89.65	10.46	65.66	105.95
Retail Price Premium Gas	Houston	n/a	155	82.98	10.18	63.49	101.21
Retail Price Premium Gas	Louisville	n/a	155	89.93	13.11	59.73	113.84
Retail Price Premium Gas	Virginia	n/a	155	85.23	11.77	61.61	102.49
Retail Price Regular Gas	Chicago	n/a	154	86.18	8.97	66.25	99.75
Retail Price Regular Gas	Houston	n/a	155	69.07	9.29	51.28	85.70
Retail Price Regular Gas	Louisville	n/a	154	76.85	11.63	49.17	97.17
Retail Price Regular Gas	Virginia	n/a	155	72.24	10.59	50.98	87.78
Rack Price Premium Gas	Chicago	Branded	156	73.35	9.91	50.17	90.11
Rack Price Premium Gas	Houston	Branded	156	65.86	10.30	44.50	84.40
Rack Price Premium Gas	Louisville	Branded	156	71.66	12.15	44.96	94.44
Rack Price Premium Gas	Virginia	Branded	156	70.23	10.74	48.83	88.49
Rack Price Premium Gas	Chicago	Unbranded	156	70.51	10.11	46.28	89.02
Rack Price Premium Gas	Houston	Unbranded	156	63.75	11.10	39.84	81.53
Rack Price Premium Gas	Louisville	Unbranded	156	70.03	12.25	41.73	93.83
Rack Price Premium Gas	Virginia	Unbranded	156	64.32	11.53	39.15	82.50
Rack Price Regular Gas	Chicago	Branded	156	63.46	10.21	39.69	81.38

Table 3a: Regression of Difference in Louisville and Control City Retail Price on Futures Price and Month Indicators

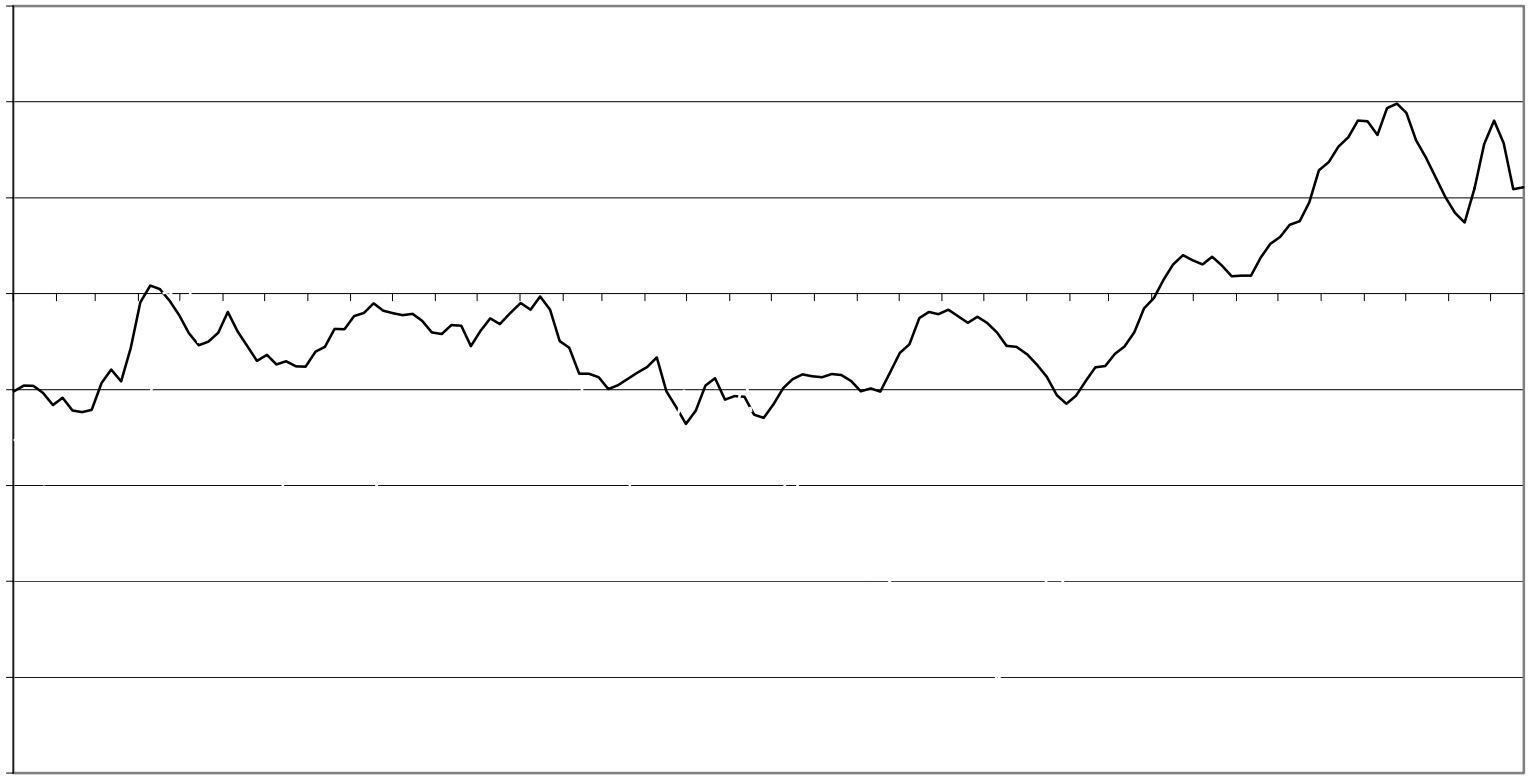
Table 3b: Regression of Difference in Louisville and Control City
Rack Price on Futures Price and Month Indicators

Error Coefficient StaicardcError Toefficientcf-268lStdicardcError1998Tj /T

Table 3c: Regression of Difference in Louisville and Control City
Retail Margin on Futures Price and Month Indicators

	Chicago Coefficient	Chicago Standard Error	Houston Coefficient	Houston Standard Error	Virginia Coefficient	Virginia Standard Error
1998 Indicator	-1.61	1.37	-2.33	1.34	-0.73	1.48
1999 Indicator	-6.27	1.33	-5.81	1.22	-1.69	1.45
January	3.11	1.26	2.88	1.30	0.92	1.37
February	5.08	1.46	4.55	1.50	2.71	1.59
March	5.49	1.54	5.23	1.56	3.34	1.67
April	5.38	1.57	3.86	1.57	2.38	1.70
May	4.83	1.60	3.55	1.61	3.36	1.74
June	4.78	1.61	4.73	1.61	4.51	1.75
July	2.32	1.57	2.99	1.57	3.22	1.70
August	0.79	1.56	1.84	1.57	2.59	1.69
September	-0.80	1.49	-0.23	1.52	0.51	1.62
October	-0.81	1.36	-0.31	1.40	0.14	1.47
November	0.20	1.09	-0.01	1.16	0.16	1.18
Futures Price	0.28	0.15	0.08	0.15	-0.04	0.16
Constant						

Table 4: Year Effects from Regression of Difference in Louisville and Control City



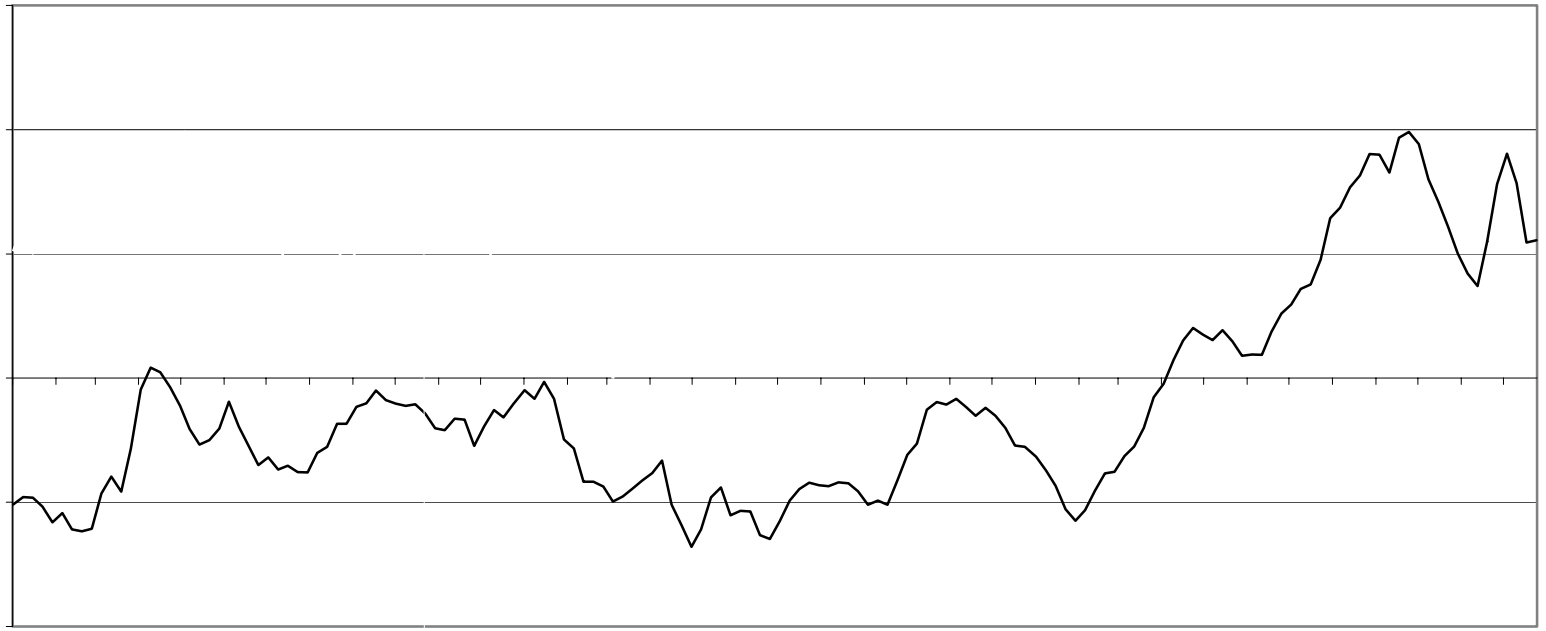


Figure VIII
Difference Between Kentucky Dealer Tank Wagon and Rack Prices(1997-1999)