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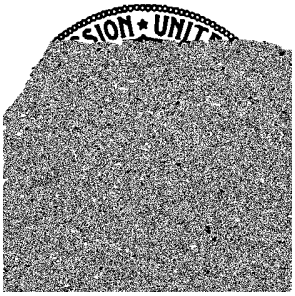

Local Market Structure and Strategic Organizational Form Choices: Evidence from Gasoline Stations

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Abstract

An extensive literature shows that agency issues and transactions costs influence vertical integration. Another mature literature indicates that market structure influences competitive behavior. However, less consideration has been given to how vertical integration and market structure may interact. I address this gap by focusing on the potential for moral hazard caused by intra-firm competition in retail gasoline markets. I argue that when multiple stations share a common brand in a market, a vertically separated station has an incentive to deviate from the cooperative strategy that the brand-owning refiner would prefer. I empirically test this prediction using rich data, and find evidence of such moral hazard. Moreover, I find that refiners behave in a way consistent with the desire to minimize it: They are more likely to employ vertically separated contracts in markets where the number of affiliated stations is small.

JEL classification: D2, L14, L22, L81
Keywords: Gasoline, moral hazard, vertical contracting, price setting

Federal Trade Commission, Bureau of Economics, 600 Pennsylvania Ave., Washington, DC, 20580. nwilson@ftc.gov. The opinions expressed here are those of the author and not necessarily those of the Federal Trade Commission or any of its Commissioners. I am grateful for comments from Itai Ater and Anne Fleischer as well as those from John Yun, Dan Hosken, Chris Taylor, Dave Balan, and other colleagues at the FTC. The usual caveat applies.

1 Introduction

A large and growing literature demonstrates theoretically and empirically that firms offering multiple differentiated products in the same market incur both costs and benefits.[1] Economists also have long devoted attention to showing how agency theory (Holmstrom and Milgrom, 1991), transactions costs (Williamson, 1975), and the property rights theory of the firm (Grossman and Hart, 1986, Hart and Moore, 1990) may explain firm boundaries, finding much support for their predictions across a variety of contexts (Lafontaine and Slade, 2007). Considering the richness of these literatures, comparatively little attention has gone to understanding how they may intersect. In particular, there is little treatment of the interrelated questions of how market structure could influence the choice of vertical contracts and how vertical contracts could lead to different product market behavior depending on the local market structure.

I address these gaps by investigating the relationship between market structure and vertical contracting in the retail gasoline industry. It is an ideal setting to consider these issues as a gasoline refiner may have multiple stations in a given market selling their gasoline. (I refer to stations sharing the same refiner brand as being "affiliated.") Moreover, refiners' affiliated stations may be operated under two different classes of contract. The first type is vertically integrated insofar as refiner employees staff the station, and the refiner remains the residual claimant. In contrast, the second class of contract makes local managers the residual claimants and allocates them extensive control rights. It is thus an example of vertical separation.

The principal-agent framework straightforwardly extends to suggest why a vertically separated station should behave differently than an integrated one in markets where there is (are) one (or more) affiliated station(s). By virtue of being the residual claimant, managers at vertically separated stations are incentivized to prioritize the performance of their station. Therefore, when choosing their profit-maximizing strategies, a vertically separated station manager will only pay attention to

[1] A benefit might be deterring entry by competitors, while the costs could include cannibalizing revenue from their existing products. See discussion in Sutton (2007).

the impact of a strategy's impact on their station's pro ts. They ignore any impact of those strategies on a liated stations. In contrast, the manager of a vertically integrated station's incentives are not so narrowly focused, and their strategy may incorporate the e ects on all a liated stations.

Left unrestrained, the tendency of vertically separated stations to ignore the competitive externalities of their product market behavior on a liated stations would cause the joint pro ts of all a liated stations in the market to be lower than the pro t-maximizing level. Therefore, the existence of a liated stations in a given market increases re ners' exposure to moral hazard if they use a vertically separated contract. Thus, market structure can be thought of in the same light as other forms of moral hazard caused by vertical separation (Klein, 1980, 1995, Brickley and Dark, 1987, Brickley, 1999, La ont and Martimort, 2002).

As noted in Winter (2009), the legal system makes it di cult for principals like re ners to contractually restrain pro-competitive behavior (like price-cutting) on the part of their agents. Therefore, economic behavior on the part of both vertically-separated station managers and re ners should vary depending on local market structure. Exploiting rich data on retail gasoline markets, I test this prediction. My chief ndings regarding the empirical importance of competition-driven moral hazard are as follows.

First, the data show that gasoline re ners are more likely to employ vertically separated contracts in markets where they have fewer a liated stations. This result is consistent with a desire to avoid the type of competition-driven moral hazard described above. However, I nd evidence of monitoring complementarities from the presence of other vertically separated outlets. Speci cally, the data show that the greater the share of nearby a liated outlets operated under vertically separated contracts, the greater the likelihood that another outlet will be vertically separated. This result suggests that the marginal cost of monitoring an additional station is lower in areas where monitoring must already take place, an idea exploited in several recent papers considering the impact of organizational form on economic behavior (Kosova et al., 2010, Wilson, 2011b).

Second, using a di erence in di erences approach to estimation, I nd that the presence of

a liated stations is correlated with di erent economic behaviors depending on whether a station is operated under a vertically separated or vertically integrated contract. For example, stations operated under vertically separated contracts are more likely to reduce prices as the a liated presence increases. This e ect is consistent with the idea that sharing a local market produces moral hazard for managers at vertically separated stations who are not incentivized to price \cooperatively." Moreover, I show that the quality of vertically separated stations' appearances are decreasing in the number of a liated outlets in the market. This result is in line with the idea that consumers are in uenced by the local reputation of a given brand in making their purchasing decisions. Thus, there is an externality to quality provision much as there is for \cooperative" pricing.

Overall, the paper contributes to a number of literatures. First, it extends the small but growing body of work assessing how economic behavior varies across vertical contracts (Novak and Stern, 2008, Forbes and Lederman, 2010, Kosova et al., 2010, Wilson, 2011b). These papers have expanded on much of the previous vertical contracting literature by more explicitly accounting for the endogeneity of contracts. However, they concentrate on characteristics that might be thought to a ect the choice, and subsequent behavior, for traditional agency theoretic and/or transactions costs reasons, abstracting from the competition-related factors focused upon in this paper. Like previous papers within this literature focusing on the gasoline industry (Barron and Umbeck, 1984, Vita, 2000, Wilson, 2011b), I nd that vertical separation is correlated with higher prices. The present work extends the prior literature by showing that the magnitude of the vertical separation e ect is correlated with a function of local market structure.

Second, the paper contributes to a line of research focusing on intra- rm competition in franchise industries. Had eld (1991) points out that vertically separating control of multiple outlets may successfully enable an incumbent franchisor to deter entry from competing rms. However, in practice, agents are thought to fear that any potential bene ts from softer intra-brand competition will be swamped by the cannibalization e ect of customer stealing by a liated outlets. Kalnins (2004) and Wilson (2011a) present evidence that such fears of \encroachment" are justi ed in

hotel markets, while Thomadsen (2005) documents intensified competition between affiliated fast food outlets. The present paper contributes to this literature by documenting behavioral variation depending on the local market structure in the gasoline industry. Moreover, my results on quality determination are consistent with the idea that encroachment matters not just in terms of revenue cannibalization, but also in its implications for reputational free-riding.

The paper proceeds as follows. In section 2, I sketch the theoretical intuition for expecting behavior at vertically separated stations to differ in multi-product markets. Section 3 describes the institutional characteristics of the retail gasoline industry, while section 4 discusses the data used to test the hypotheses highlighted in section 2. Sections 5 and 6 present econometric analyses of how contract utilization and behavior vary with local market structure. The paper concludes in section 6.

2 Market Structure and Vertical Separation

Agency problems arise when employers cannot perfectly infer employee effort from observable information. Franchise and other vertically separated contracts address this problem by tying local agents' (i.e., franchisees) salaries to some visually observable performance metric. This helps to better align their incentives with those of the principal (i.e., franchisor). When two contracts have the same expected value for agent compensation, the contract with the higher variable component is considered "higher-powered." This is because it gives stronger incentives (i.e., higher residual claims) to the local agent to exert costly effort.[2]

While vertically separated contracts tie compensation to local performance in order to elicit higher effort, they also frequently contain provisions constraining elements of agent behavior. This is because principals' interests are rarely one dimensional. In addition to wanting to maximize static

[2] Agents' ownership of the local assets is not a prerequisite for a vertically separated contract; rather, it is such contracts' transfer of the right to residual claims and the ability of agents to influence them that are critical elements to focus upon. In practice, most vertically-separated contracts turn over control rights to the local agent, while the principal receives a portion of the outlet's total revenues in return for allowing agents the right to affiliate with their brand. The remainder of the local revenues are kept by the agent. Depending on the industry, agents' ownership of the local assets varies.

pro ts, principals frequently have dynamic concerns related to things like brand equity, which they may fear that local managers will not value. For example, Brickley and Dark (1987) note that when customers are unlikely to visit a given outlet again, an agent with a high-powered contract may shirk on those elements that go to maintaining the brand's reputation. Brickley and Dark (1987) argued that this suggests that vertically separated contracts should be less likely to be used in environments where the likelihood of non-repeat customers was high.[3]

Because of such concerns, the overall viability of vertically separated contracts depends crucially on the ability of the principal to observe and punish agents' deviations from speci ed behavior. Consistent with this, Brickley et al. (1991) show that vertically separated contracts are less likely to be used in U.S. states that have laws inhibiting the termination of franchise contracts.

desirability of separated forms in markets with more than one a liated outlets. There is no clear prediction about how such e ciencies would impact economic behavior.

Second, Blair and Lafontaine (2006) suggest that there may be economies of scale in advertising in franchising industries. If franchisees are thought to be better at advertising and other local promotions, as they are in the retail gasoline industry (Kleit, 2005), it might also lead to greater utilization of vertically separated contracts in markets with more a liated outlets. It should also lead to higher prices.

In many circumstances, both competition-driven moral hazard and externality-related bene ts to separation may simultaneously be at work. In such circumstances, the dominant in uence will be an empirical question.

3 Institutional Background

Gasoline stations can be divided into two categories. The rst set of stations are those whose marquee identi es the vertically integrated re ner (e.g., Exxon or Shell) whose gas { and only

stations engage in differentiated competition.[7] This is because retail gasoline markets vary in terms of consumer tastes and demographics. Moreover, and not unrelatedly, stations are differentiated in terms of non-gasoline "quality" (e.g., service, station cleanliness), geographic location, and the presence (or absence) of alternative services (e.g., convenience stores, repair bays).

To deal with such heterogeneity, vertically integrated gasoline refiners employ a variety of contracts that differ in their implications for local control. As has been previously recognized, these contract choices connect in a straightforward manner to principal-agent models of vertical integration and the franchising literature (see, e.g., Shepard (1993), Slade (1996)). The refiners are the principals, while individual gasoline station managers are the agents. As in other retail industries (Blair and Lafontaine, 2005), the principal (i.e., the refiner) sets the terms of the contracts, which Slade (1996) notes tend to be linear with a fixed component and a variable component connected to station sales.[8]

The first type of commonly utilized contract is one in which the station and the land on which it sits are wholly-owned by the refiners. All personnel at such "company-owned and operated" stations are salaried refiner employees, and all decision-making authority resides with the principal (i.e., the refiner). While there may be occasional intra-firm tournaments to induce extra effort from employees, the station personnel never have control over pricing, nor do they have any incentive to exert special effort to maximize local profits. As these agents' long-run career interests are tied to promotion within the firm, it is reasonable to expect them to value relatively equally profits at all affiliated stations.

In addition to this canonical example of a low-powered contract, the retail gasoline industry uses three other contracts. Each of these is a variant of traditional high-powered, vertically separated contracts wherein the principal fully transfers incentives and local control to outside parties.

[7] See Kleit (2005) or Hosken et al. (2008) for recent surveys of retail gasoline markets.

[8] It is rare to find a firm that uses only one type of contract. In other words, most gasoline refiners are at an "interior solution" in the words of Krueger (1991). The fact that firms commonly utilize multiple contract types has the desirable econometric implication that I can control for brand-level heterogeneity in the empirical work below; the firm-level fixed effects will not be perfectly correlated with contract choices.

However, as described further below, there are modest di erences across them.[9]

The most commonly utilized of the vertically separated forms is called a \lessee dealer" arrangement. In this contract, the vertically integrated re ner still owns the land and building; however, instead of using salaried employees, the re ner leases the station to a local agent, who purchases gasoline at a price set by the re ner (see Meyer and Fischer (2004) for additional details on these arrangements). The lessee dealers then behave as entrepreneurs with respect to station operations, setting prices for gasoline and all other goods and services (including repairs if the station has service bays). Thus, local agents' incentives under lessee dealer contracts encourage them to focus only on the performance of individual stations.

The next contract closely resembles lessee dealer arrangements except that the local agent owns the land and station and, therefore, pays no rental fee to the re ner. Presumably because the local outlet is not tied through property ownership to any given re ner, the contract type is referred to as an \open dealer" arrangement.[10] Again, local managers under this contractual form are incentivized to prioritize the performance of their individual station.

The nal contract type is identical to open dealer arrangements but for the fact that the owner of the land and station owns multiple stations, a situation common in other franchising industries (Kalnins and Lafontaine, 2004). These stations are often all in the same area (see, e.g., DeBonis (2011)). The owners often are branded convenience store chains or gasoline wholesalers known as \jobbers." As a result, the contract category is referred to as \jobber/wholesaler." Because of the

their station's behavior to a liated stations unless they are owned by the same jobber/wholesaler.

Although there are important di erences across the di erent vertically separated contracts, recent research by Wilson (2011b) suggests that lessee dealer, open dealer, and jobber stations all charge higher prices, ceteris paribus, than vertically integrated stations. I attributed this to a combination of the agents' e ort-induced increases in consumer demand as well as double-marginalization. Moreover, I found that the assumption that the margin of increase in price relative to vertical integration was equal for all of these forms generally could not be rejected.[11]

In the present paper, I take advantage of this behavioral similarity to simplify the analysis, focusing on the di erence between integrated (i.e., company owned and operated) and separated (i.e., lessee dealer, open dealer, and jobber) stations. (Shepard (1993) takes a similar econometric approach in her analysis of the impact of vertical separation on pricing.) To the extent that some forms { e.g., jobber-owned { may be closer to company-ownership than others, this approach will understate di erences, and hence is a conservative one.[12]

4 Data

As in Wilson (2011b), I rely upon regional censuses of retail gasoline stations assembled by New Image Marketing, a consulting company, whose employees assessed observable station character-

The operations surveyed by New Image are in the Denver, Minneapolis, Toledo, Louisville, and Washington, DC metro areas. The data are from 1996 and 1999. Table B-1 in the Appendix

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Regular	4239	116.61	13.76	79.90	167.90
Medium	4236	126.61	13.17	86.90	186.90
Premium	4239	134.76	12.51	88.90	193.90
1(Appearance)	4612	0.15	0.36	0.00	1.00
Local Presence	4612	1.26	1.42	0.00	8.00
Share Separated	4612	0.83	0.25	0.00	1.00
Competitors	4612	9.63	6.80	0.00	36.00
1(C-Store)	4612	0.72	0.45	0.00	1.00
1(Service Bays)	4612	0.40	0.49	0.00	1.00
Nozzles	4460	18.22	9.96	2.00	60.00
Volume	4460	104.85	50.52	10.00	400.00
Pop. ('000s)	4612	620.67	295.13	40.99	1109.63
Income ('000)	4612	58.10	14.59	35.47	96.69

I believe that such problems are not likely to be acute here. Moreover, to further account for variation across markets, I obtain county-level data on population from the U.S. Census and average household income (in thousands) taken from the Statistics of Income (SOI) collected by the Internal Revenue Service to further account for market heterogeneity.[18]

station selling the same brand of gasoline as station i in the zipcode. Similarly, N_i would be equal to five if there were five stations affiliated either with different refiners or wholly independent of refiner networks in the zipcode.

To control for the possible existence of monitoring complementarities when assessing the desirability of using a vertically separated form, I use the share of other stations in a given county in a given year that are operated under vertically separated contracts.[20] It should be noted that this approach takes contemporaneous form choices of the affiliated outlets as predetermined, which could raise concerns about simultaneity. I do not dismiss these concerns; however, as shown below, checks exploiting the previous year's choices suggest that this approach does not lead to significantly biased results.[21] Therefore, to maximize my sample size, my baseline approach is to use the contemporaneous measure.

Besides each station's brand affiliation, the New Image data provide information on a large number of station features. These include the presence of a convenience store, the presence of service bays, and the number of fuel pump nozzles.[22] I include all these variables as controls in my analyses. I show descriptive statistics for all station-year observations in Table 1.

Table 2 shows summary statistics for all of the different outcome and explanatory variables for vertically integrated and separated stations. Consistent with Wilson (2011b), it shows that prices are consistently higher at vertically separated stations. Similarly, it shows that the \quality" (as

[20] I use the number of affiliated outlets in the county as opposed to the zipcode for several reasons. Primarily, this reflects the fact that I believe that conditional on traveling from their headquarters to a given county, it costs principals relatively little to travel between zipcodes to monitor different stations. In addition, because brands frequently do not have more than one outlet in a zipcode, it is hard to precisely identify the impact of contracting complementarities, though Wilson (2011b) reports that using zipcode-level shares did not qualitatively change the results of the analysis.

One might also worry that this model of monitoring costs misses important details such as differences across counties with different total numbers of stations. Therefore, I experimented with specifications that included both

Table 2: Descriptive Statistics across Vertically Integrated and Separated Stations

	Integrated			Separated			
Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	T-Test
Regular	657	106.63	16.37	3642	118.53	12.36	-70.74
Medium	657	117.86	14.70	3639	128.29	12.19	-65.06
Premium	657	127.03	14.11	3642	136.28	11.66	-58.88
1(Appearance)	823	0.25	0.43	3864	0.13	0.33	4.81
Local Presence	823	1.37	1.57	3864	1.22	1.38	3.08
Share Separated	823	0.47	0.36	3864	0.89	0.17	-19.13
Competitors	823	10.40	7.85	3864	9.48	6.53	8.74
1(C-Store)	823	0.67	0.47	3864	0.73	0.45	-2.34
1(Service Bays)	823	0.06	0.24	3864	0.46	0.50	-19.71
Nozzles	671	20.13	10.91	3864	17.79	9.73	17.07
Volume	671	138.63	51.25	3864	99.15	47.81	132.53
Pop. ('000s)	823	545.48	274.94	3864	634.68	295.96	-139.20
Income ('000)	823	59.21	14.55	3864	57.59	14.59	11.07

proxied for by appearance) of vertically integrated stations is consistently higher. This is in line with the ndings of Michael (2000) and Jin and Leslie (2009) in other industries, and consistent with the prediction of Brickley and Dark (1987) that franchisees may not have the same incentives to exert e ort on activities that bene t the entire brand.

Intuition about the strategic deployment of di erent contractual forms depending on local market structure can be gained by examining Table 3, which shows the breakdown of station-year

Table 3: A liated Presence and Contract Utilization

	Integrated	Separated	Total
Zero A liated	308	1,519	1,827
	16.86	*83.14*	*100*
One A liated	217	1,029	1,246
	17.42	*82.58*	*100*
Two A liated	155	703	858
	18.07	*81.93*	*100*
> Two A liated	143	613	756
	18.92	81.08	100
Total	823	3,864	4,687
	17.56	*82.44*	*100*

Rows in *italics* indicate percentages of observations within row.

in Table 4. The Table shows how the means of all station-year observations of prices and appearance quality vary depending on both contractual form and the number of a liated outlets in the zipcode. The results do not indicate di erent trends for the prices charged by integrated and separated stations as the number of local a liates increases. For both types of contract, there is a slight downward trend.

Table 4 shows less ambiguity, however, in the relationship between vertical separation, market structure, and the quality of stations' appearance. The Table shows a clear positive correlation between the presence of a liated stations and the provision of quality for vertically integrated stores. This is consistent with the idea that there are positive local reputational spillovers that the principal is incentivized to internalize. By contrast, there is no trend for vertically separated outlets, which is in line with the comparative absence of any such incentive for their local managers.

Overall, the aggregate data patterns presented in Tables 3 and 4 suggest di erences in both economic behavior across forms and the utilization of organizational forms that are consistent with competition-related moral hazard. However, the di erences in Table 2 also suggest systematic selection of di erent contract types in di erent environments. This makes it impossible to conclude anything with con dence about the empirical relevance of competition-driven moral hazard at this

Table 4: Variation in Economic Behavior across Market Structure and Contract Forms

stage. To obtain a more precise understanding, I therefore move to econometric frameworks that exploit within and between station variation in the data.

5 Strategic Form Choice

5.1 Identification and Inference

In this section, I assess whether gasoline refiners respond to the potential for competition-driven moral hazard by varying their utilization of vertically separated contracts. As noted above in section 2, there also are reasons to believe that there are contracting complementarities that affect the relative desirability of vertically separated forms. Therefore, it is possible that the presence of local affiliates under different contracts have different effects on the desirability of using a vertically separated form at a specific outlet.

I accommodate the possibility of both competition-driven moral hazard and monitoring efficiencies in the following estimating equation of vertically integrated refiners' decision to utilize a vertically separated contract:

$$F_{it} = A_{it} + S_{it} + N_{it} + X_{it} + Z_i + u_{it}; \quad (1)$$

where i and t index stations and time of observation, respectively. (For the sake of concision, I suppress market subscripts.) F is a binary variable taking the value of one if station i is vertically separated at time t; A indicates the local market presence of the principal affiliated with station i at that time; S indicates the share of affiliated outlets in the county that are operated under vertically separated contracts; and N is the number of other competitors in the zipcode.[23] X_{it} and Z_i continute to represent time-varying and time invariant station characteristics, respectively, while u_{it} is information unobservable to the econometrician.

The coefficients of interest are and . Respectively, these account for the direct impact of

[23] See footnote [20] above for details on the usage of county vs. zipcode level data.

the number of a liated outlets in the zipcode and the impact of the share of outlets in the county that are contemporaneously organized as separated on the likelihood of using a vertically separated contractual form. By including S as well as A, I am able to separately consider the in uence of competition-driven moral hazard and monitoring complementarities on form choice. The stories outlined above in section 2 predicts a negatively signed and a positive .

In terms of the market competition variables, Equation (3) implies linear e ects from the di erent types of competitors, as in Davis (2006). (However, the inclusion of S allows for the possibility of non-linearity from the type of contracts at comparatively proximate stations.) As described further below, I check the importance of the linearity assumptions, and nd that the paper's results are qualitatively robust to non-linear alternatives.

In addition to the observable explanatory variables discussed in the previous section, I include brand and state-date indicator variables in all regressions.[24]

In general, I assume that the unobserved information is a composite term, i.e., $u_{it} = \ _i + \ _{it}$, where $\ _i$ represents time-invariant station-speci c heterogeneity and $\ _{it}$ is the idiosyncratic error. Depending on 's correlation with the explanatory variables and the dependent variable, Equation 3 should be estimated in di erent ways.

First, I make the strong assumption that the station-speci c heterogeneity is uncorrelated with the other explanatory variables. This implies that I can estimate equation (3) using ordinary least squares (OLS), accounting for the possible correlations over time at the station-level by clustering or the use of random e ects (RE). Insofar as clustering allows for more general correlation structures than RE, it is a more conservative approach.

When the assumption of independence between the unobserved and observed factors does not hold, the cross-sectional estimates su er from omitted variable bias. Therefore, in my second approach to identi cation, I include the station-level means of the time-varying regressors to capture the correlation between and the observables. This approach stems from Mundlak (1978), who noted that the results from standard linear xed e ects (FE) models can be obtained in a RE model if the means of time-varying regressors are included. Thus, my second approach involves assuming that:

$$\ _i = X_i \ + \ _i; \tag{2}$$

where X_i

at least predetermined) at the time the decision-maker chooses forms. While including the lagged terms (and their means) helps control for unobserved heterogeneity, it requires that all stations in MN, OH, and CO are dropped since only one year of data is available for those areas. As with the cross-sectional models, I assume that correlations introduced by the remaining unobservable station-specific heterogeneity can be addressed by clustering the standard errors at the station level. My results are qualitatively robust to the exclusion of the lagged terms.

Third, both of the previous approaches implicitly assume that the refiners can update their contract choices each year. This assumption is quite strong insofar as Blair and Lafontaine (2005) state that franchising contracts are usually many years long. Therefore, I relax the implicit assumption and utilize only the first observation in the data for each station. When taking this approach, I utilize the entire pool of stations in the sample and do not include the Mundlak controls.

Finally, it is worth considering what it would mean if the approaches described above failed to appropriately control for the possible interrelatedness of choices and unobservables. Suppose there were shocks that increased the expected profits from locating multiple stations in a given zipcode. In order to produce systematically biased results, these shocks would have to be correlated with the payoffs to choosing different contracts. To a large extent, therefore, I believe controlling for the share of local outlets organized under vertically separated contracts should capture any systematic correlation.

I estimate all models as probits, allowing for heteroskedastic standard errors, which are clustered at the station-level when there are multiple periods of data per station. Coefficients and standard errors are for numerically calculated marginal effects.

5.2 Empirical Results

Table 5 shows the results of the models of contract choice. Column 1 represents the baseline approach, exploiting observations from all states. Column 2 employs the same estimating approach

Table 5: Market Structure and Form Choice

	All	All, Lag	All, Panel	Initial
	Probit mfx/se	Probit mfx/se	Probit mfx/se	Probit mfx/se
Local Presence	-0.011**	-0.010+	-0.013+	-0.015**
	0	0.01	0.01	0.01
Share Separated	0.197***	0.153**	0.177**	0.287***
	0.04	0.07	0.07	0.06
Competitors	0.001	0.004**	0.001	-0.001

lag. Column 3 is the Mundlak model, which increases the degree to which time invariant station heterogeneity is controlled for. Column 4 uses only the first observation for each station to control for the possibility that there are frictions impeding the regular updating of form choices.

The results across all four models are similar in the economic and statistical significance of their estimates. Moreover, they are consistent with the theory of competition-driven moral hazard laid out above. In all four models, I find that an increase in the number of affiliated outlets in the vicinity leads to a economically significant lower likelihood of utilizing vertically separated contracts. The impact is not overwhelmingly large as the estimates imply that the presence of one additional affiliated outlet reduces the likelihood of vertical separation by 1.1 to 2 percent. However, insofar as the unconditional likelihood of company-ownership is only 13 percent, the results indicate that the presence of just one affiliated outlet leads to a 10-15 percent increase in the likelihood that the form is utilized.

In addition to supporting the idea that competition can lead to incentive conflicts with vertically separated managers, the Table provides robust evidence in support of the idea that there are scale monitoring efficiencies. This can be seen in the fact that an increase in the share of outlets in the surrounding county operated under a vertically separated form leads to an increase in the likelihood that a specific outlet is also operated at arms length from the principal. Column 2 suggests that this effect is not driven by possible simultaneity of form choices.

The other explanatory variables have coefficients in broad alignment with past research. In general, the presence of other competitors has no economically or statistically significant influence on form choice. There is no influence to having a convenience store on vertical separation. This finding may reflect the influence of aggregating all of the different vertically separated forms as Shepard (1993) found this factor to differentially affect the likelihood of different vertically separated contracts.[25] By contrast, the presence of a service bay significantly increases the likelihood that the refiner uses an arms length arrangement. Broadly consistent with the past literature considering

[25] The results of the multinomial logit model presented in Table B-4 support this possibility.

the effect of outlet size on the boundaries of the firm as surveyed in Lafontaine and Slade (2007), I find that the number of nozzles has a negative impact on the likelihood of vertical separation. Finally, I find that neither population nor income is an economically significant factor.

Overall, the results of the form choice models offer strong additional support for the idea that there is competition-driven moral hazard and that it is an empirically significant factor in this industry. The data show that refiners vary their utilization of vertically separated contracts to minimize its likelihood. In addition, as noted above, the key implication regarding the impact of nearby outlets holds when all contract possibilities are endogenized in a multinomial logit setting. Moreover, the results also were robust to the inclusion of controls for the relative presence of independents and controlling for brand-state-date heterogeneity. Finally, as might have been expected given the discussion of possible endogeneity bias above, the results are robust to instrumenting for the number of affiliated outlets with its one period (station-level) lag.[26] Details on all models not included in the paper are available upon request.

6 Economic Behavior Analysis

6.1 Identification and Inference

The previous section demonstrated that refiners hesitate to employ vertically separated contracts when there are affiliated present in the zipcode. While consistent with concerns about competition-driven moral hazard, one might nevertheless wonder if firms were reacting to other incentives. Alternatively, one might fear that the results were systematically biased as a result of not satisfactorily addressing the simultaneous determination of form and local market structure. To partially check that this is not leading to inappropriate support for the idea that market structure can produce moral hazard, this section tests for behavioral differences across vertically separated and integrated stations in different market structures conditional on the refiners' choices of contracts.

In order to infer the empirical significance of competition-induced moral hazard on these en-

[26] In this regression, however, the monitoring efficiency variable is no longer statistically significant.

dogenous variables, I estimate variations on the following linear general form:

$$Y_{it} = F_{it} + A_{it} + F \quad A_{it} + N_{it} + X_{it} + Z_i + u_{it}; \tag{3}$$

where i and t again index stations and time of observation, respectively. Y is the economic outcome of interest (i.e., price or quality), and will be the price of regular, super, and premium gasoline or the provision of quality as proxied for by a binary station appearance variable. As before, F indicates whether a given station operates under a vertically separated contract,while A captures the number of a liated outlets in the market. $F \quad A$ the interaction between F and A. Once more, N represents the sum of all other gasoline stations in the zipcode; X_{it} are time-varying station and market characteristics; Z_i are time-invariant station characteristics; and u_{it} is information unobservable to the econometrician.

Equation (3) takes a di erence in di erences approach to trying to identify the impact of moral hazard by high-powered agents on station behavior in multi-product markets. The coe cient of interest is , which captures the systematic impact of an additional a liated station on the behavior of stations operated under vertically separated contracts relative to vertically integrated stations in otherwise similarly structured markets. Any direct impact of vertical separation upon behavior is picked up by , while reveals the direct in uence of an additional a liated outlet on a station's behavior, regardless of whether or not it is operated under a vertically separated contract.

As in Vita (2000) and Hosken et al. (2008), I estimate the pricing models in levels; however, the results are qualitatively identical when I employ a log-linear speci cation. For the quality of station appearance regressions, I estimate the likelihood of having high quality using probit models, reporting the numerically calculated marginal e ects of the explanatory variables. In estimating the pricing models, I exploit only the pooled (with clustering) and Mundlak estimating approaches insofar as there is no reason to fear that gasoline prices are sticky. However, as noted above, there is reason to think that appearance quality is likely to be more durable. Therefore, when exploring the

Table 6: Form, Market Structure, and Pricing Behavior

	Regular Unleaded		Super Unleaded		Premium Unleaded	
	OLS b/se	Mundlak b/se	OLS b/se	Mundlak b/se	OLS b/se	Mundlak b/se
Separated	0.662*	1.625***	0.625+	2.654***	0.656+	2.423***
	0.34	0.45	0.42	0.63	0.43	0.71
Sep X Local	-0.230*	-0.272*	-0.295*	-0.398*	-0.328**	-0.215
	0.13	0.15	0.15	0.22	0.16	0.25
Local Presence	0.172+	0.102	0.18	0.290+	0.14	0.165
	0.12	0.15	0.14	0.22	0.15	0.25
Competitors	-0.078***	-0.071	-0.051***	0.017	-0.058***	0.048
	0.01	0.07	0.02	0.09	0.02	0.1
C-Store	-0.697***	-0.3	0.042	-0.156	-0.402+	-0.243
	0.21	0.25	0.29	0.31	0.29	0.37
Service Bays	0.677***	0.499**	1.070***	0.571*	1.173***	0.727**
	0.2	0.25	0.27	0.32	0.26	0.34
Appearance	-0.295*	-0.864***	0.258	-0.892**	-0.107	-0.796*
	0.18	0.3	0.22	0.41	0.25	0.48
Population	0	-0.011	0	-0.041	0	0.034
	0	0.03	0	0.03	0	0.04
Income	0.098***	0.025	0.138***	0.185*	0.156***	0.061
	0.01	0.09	0.01	0.1	0.01	0.11
Brand E ects	Yes	Yes	Yes	Yes	Yes	Yes
State-Date E ects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4299	1616	4296	1616	4299	1616

* p<0.10, ** p<0.05, *** p<0.01 in two-sided tests. + p<0.10 in one-sided test. All standard errors clustered at station-level. Mundlak models include one year lagged volume of sales as well as station-level means of lagged volumes, the number of stations in the zipcode, population, and income data.

models. Columns 2, 4, and 6 show the results of the Mundlak models when I more extensively control for unobserved heterogeneity.

The results of the di erent models are consistent with the theory outlined above. In all six regressions, the interaction term's coe cient is negative. Moreover, in ve of the models, the coe - cient is statistically signi cant at conventional levels. The negative coe cients indicate that as the number of nearby a liated stations increases, vertically separated stations cut their prices more than vertically integrated outlets. Although the magnitude of the coe cient on the interaction ef- fect appears small { between 0.2 and 0.4 cents per a liated station { these e ects are of non-trivial economic signi cance because retail margins in gasoline retailing are very low. Hosken et al. (2008) and Kleit (2005) report that retail margins average 20 cents or less. Thus, a one standard deviation in the number of a liated stations in a zipcode leads to a price change equal to 1-3 percent or

o ering products that complement gasoline sales should have lower gasoline prices. This is consistent with the nding that the presence of a convenience store is negatively correlated with gasoline price. I also nd that service capabilities are associated with higher prices, which is consistent with the ndings of Slade (1996). Interestingly, I nd that stations with higher quality appearances tend to have lower prices, which may suggest cost complementarities between the provision of quality and other desired services. Finally, the results show higher household incomes are associated with higher prices; however, population's impact is negligible and inconsistently signed.

Overall, these results o er signi cant support for the importance of competition-driven moral hazard. They are consistent with the idea that vertically separated stations engage in tougher price competition in the presence of a liated outlets than would vertically integrated stations in otherwise equivalent situations. Such behavior is in line with the idea that the high-powered local managers at vertically separated outlets do not internalize the impact of their competitive decisions on overall brand performance. As noted above, the results represent particularly conservative estimates insofar as they represent net e ects, and there may be some demand advantages to using vertically separated contracts in markets with a liated outlets.

Furthermore, although not shown here, the price results are robust to a host of alternative speci cations including controling for the relative presence of independent stations, adding brand-speci c state-year dummies to reduce concern that the results are driven by brand-speci c variation across geographic areas, and using non-linear logarithmic formulations of the market structure variables as in Berry (1992). Moreover, the price regression results are qualitatively robust to instrumenting for the choice of vertical contract and the interaction term with the share of a liates in the county that are operated under vertically separated forms, the number of gasoline nozzles at the station, and the one year lag of a liated stations in the zipcode. However, it must be noted that while instrumenting leads to coe cients of the same signs but signi cantly larger magnitudes (as in Wilson (2011b)) as the OLS and Mundlak models, the results are not precisely identi ed. This is not surprising given the high degree of correlation between the endogenous variables and

the dramatic reduction in the sample size that instrumenting with lags leads to. Consistent with such problems, F tests of the explanatory power of the instruments in the first stage are somewhat marginal, and C tests of the exogeneity of the instruments cannot reject their endogeneity. Because of these things, I do not place great weight on the IV point estimates and do not report them here.

6.2.2 Quality of Station Appearance

Table 7 shows the results of models of the determinants of high quality station appearances. Column 1 uses observations from all states, while Column 2 represents the discrete choice analogue to the linear Mundlak models estimated for prices. Finally, Column 3 uses only the first observation for each station to control for the possibility that appearance is \sticky" in some way. If this were the case, it would be inappropriate to treat multiple observations for a station as equivalent.

As with the price models, the estimation results are generally consistent with the theory outlined above, and are qualitatively similar across models and data samples. In all three models, the interaction term is negative as predicted. However, the term is only statistically significant in the first and third models. Moreover, the economic magnitude of the coefficient on the interaction term is also markedly larger in these models. Indeed, for almost all of the explanatory variables, the Mundlak model recovers coefficients that are statistically and economically less significant than in the other models. These findings may reflect the comparative stickiness of the appearance variable,

market structure variables. Vertical separation is associated with lower likelihood of a high quality appearance, which is consistent with the simple comparisons of means shown above. In addition, the presence of competitors appears to put upward pressure on the provision of quality though this e ect is of small magnitude. This result is supportive of the idea that stations attract customers in part by o ering them a more pleasing experience than competitors. By contrast, there is no economically or statistically signi cant separate e ect for the additional presence of a liated outlets.

The coe cients on the other controls also are broadly intuitive. The presence of both convenience stores and service bays reduces the likelihood that a station has a high quality appearance. This is consistent with the necessity of allocating nite e ort across a variety of tasks. If revenues are generated from two separate activities for which demand is inversely correlated, then the incentive to devote resources to an activity that only bene ts one of them is reduced, especially if it is lower margin. This may explain why service bays have a larger and more statistically signi cant e ect (Slade, 1996). Population and income have economically insigni cant impacts.

Overall, the ndings for the connection between local market structure, vertical separation, and the provision of quality o er signi cant additional support for the empirical relevance of competition-driven moral hazard. As before, these results were robust to controlling for the relative presence of independent competitors and the possibility of brand-state-date heterogeneity. In addition, as noted above in footnote [15], robustness checks exploiting the full range of quality grades returned qualitatively similar results when estimated as ordered probit models.

7 Conclusion

This article advances the idea that market structure di erentially in uences the strategic incentives of outlets operated under di erent types of vertical contracts. As a result, market structure should also in uence the choice of contractual form. Investigating the empirical importance of these factors in the context of the retail gasoline industry, I nd that gasoline stations operated under vertically separated contracts charge lower prices, while neglecting to maintain high quality appearances,

Lafontaine, F. and M. Slade, \Vertical integration and rm boundaries: the evidence," *Journal of Economic Literature*, 2007, *45* (3), 629{685.

_ , R. Perrigot, and N.E. Wilson, \Institutional Quality and Organizational Form Decisions: Evidence from Within the Firm," *working paper*, 2011.

Mazzeo, M.J., \Product choice and oligopoly market structure," *The RAND Journal of Economics*, 2002, pp. 221{242.

Meyer, D. and J. Fischer, \The Economics of Price Zones and Territorial Restrictions in Gasoline Marketing," *Federal Trade Commission Bureau of Economics Working Paper*, 2004, *271.*

Michael, S.C., \The e ect of organizational form on quality: the case of franchising," *Journal of Economic Behavior & Organization*, 2000, *43* (3), 295{318.

MSNBC, \Exxon to sell all of companys gas stations," *MSNBC.com*, 2008.

Mundlak, Y., \On the pooling of time series and cross section data," *Econometrica*, 1978, pp. 69{85.

Novak, S. and S. Stern, \How does outsourcing a ect performance dynamics? Evidence from the automobile industry," *Management Science*, 2008, *54* (12), 1963{1979.

Shepard, A., \Contractual form, retail price, and asset characteristics in gasoline retailing," *RAND Journal of Economics*, 1993, *24* (1), 58{77.

Slade, M.E., \Multitask agency and contract choice: an empirical exploration," *International Economic Review*, 1996, *37* (2), 465{486.

Sutton, J., \Market structure: theory and evidence," *Handbook of Industrial Organization*, 2007, *3*, 2301{2368.

Thomadsen, R., \The e ect of ownership structure on prices in geographically di erentiated industries," *The RAND Journal of Economics*, 2005, *36* (4), 908{929.

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Appendix A: New Image Data Description

Below, I provide the name and description provided by New Image of those variables used in the analysis and the method by which they were transformed (if appropriate).

Organizational Form: Categorical variable corresponding to the answer to the following question. TYPE OF OPERATION)(TOO) - Overall status of operation, ask respondent to identify:
0) - No building or doesn't sell gasoline
1) - Lessee dealer building and facility owned by major/non major oil company, business owned by dealer. [I reordered this as Type 2.]
2) - Salary operation building and facility owned by major/non major oil company. Personnel paid by company. [I reordered this as Type 1, so that salaried operations represented the baseline.]
3) - Open Dealer - Land and operation owned by individual who is supplied product by major/non major oil company.
4) - Jobber/Wholesaler Operation owned by a local company that owns several operations in the area. (EXP distributor) or a franchise/chain organization (EXP a convenience store chain)

Regular Unleaded Price: Numerical variable corresponding to non-constrained answer to the following question. OCT REGULAR UNLEADED)(UO) - Price Reg Unleaded)(RUP)

Super Unleaded Price: Numerical variable corresponding to non-constrained answer to the following question. OCT MIDGRADE UNLEADED)(MO) - Price mid Unleaded)(MUP)

Premium Unleaded Price: Numerical variable corresponding to non-constrained answer to the following question. OCT SUPER)(SO) - Price Super Unleaded)(PUP)

Appendix B: Additional Tables

Table B-1: Contract Variation Across States

	1996	1997	1998	1999	2000	Total
CO	0	0	0	630	0	630
	0	*0*	*0*	*100*	*0*	*100*
DC	0	117	0	109	0	226
	0	*51.77*	*0*	*48.23*	*0*	*100*
KY	239	237	0	244	0	720
	33.19	*32.92*	*0*	*33.89*	*0*	*100*
MD	0	437	0	444	0	881
	0	*49.6*	*0*	*50.4*	*0*	*100*
MN	0	0	0	600	0	600
	0	*0*	*0*	*100*	*0*	*100*
OH	0	0	0	0	185	185
	0	*0*	*0*	*0*	*100*	*100*
VA	0	478	482	485	0	1,445
	0	*33.08*	*33.36*	*33.56*	*0*	*100*
Total	239	1,269	482	2,512	185	4,687
	5.1	*27.07*	*10.28*	*53.6*	*3.95*	*100*

Rows in *italics* represent percentages.

Table B-2: Station-Period Observations by State and Form

State	Company Owned	Lessee Dealer	Open Dealer	Jobber	Total
CO	290	57	99	184	630
	46.03	*9.05*	*15.71*	*29.21*	*100*
DC	0	154	43	2	199
	0	*77.39*	*21.61*	*1.01*	*100*
KY	49	74	233	364	720
	6.81	*10.28*	*32.36*	*50.56*	*100*
MD	14	619	157	44	834
	1.68	*74.22*	*18.82*	*5.28*	*100*
MN	57	95	198	250	600
	9.5	*15.83*	*33*	*41.67*	*100*
OH	70	15	45	55	185
	37.84	*8.11*	*24.32*	*29.73*	*100*
VA	191	749	307	120	1,367
	13.97	*54.79*	*22.46*	*8.78*	*100*
Total	671	1,763	1,082	1,019	4,535
	14.8	*38.88*	*23.86*	*22.47*	*100*

Rows in *italics* represent percentages.

Table B-4: Multinomial Logit Model of Contract Choice

	Lessee b/se	Open b/se	Jobber b/se
Local Presence	-0.114	-0.161+	-0.122
	0.09	0.1	0.11
Share Separated	1.743**	2.580***	4.661***
	0.77	0.76	0.84
Competitors	0.032*	0.01	0.007
	0.02	0.02	0.02
C-Store	0.089	-0.650**	0.217
	0.23	0.26	0.32
Service Bays	1.977***	2.518***	0.3
	0.27	0.29	0.32
Nozzles	-0.021+	-0.125***	-0.063***
	0.01	0.02	0.01
Population	0	-0.001**	-0.002***
	0	0	0
Income	-0.004	-0.009	0.01
	0.01	0.01	0.01
Brand E ects		Yes	
State E ects		Yes	
Year E ects		Yes	
Observations		3113	

* p<0.10, ** p<0.05, *** p<0.01 in two-sided tests. + p<0.10 in one-sided test. Regression utilizes all observations from all states; convergence problems occurred when state-date e ects