Contractual Form, Retail Price and Asset Characteristics

by

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Predictions derived from a principal-agent analysis of the manufacturer-retailer relationship are derived and tested using microdata on contractual form, outlet characteristics and retail prices for gasoline stations in Eastern Massachusetts. The empirical results are consistent with upstream firms choosing contracts that have strong incentive characteristics but less direct control when asset characteristics make unobservable effort by downstream agents important. Manufacturers trade-off incentive power for more direct control when observable effort is relatively more important. Retail prices are affected by the identity of the decisionmaker and are slightly lower when the upstream firm is allowed to directly control the retail price.

1. INTRODUCTION

Vertical restraints have a long and controversial literature in the economics of antitrust policy. They have a shorter but less controversial literature in positive economic theory[1]. In this latter literature, vertical agreements are analyzed as a response to principal-agent problems. The upstream firm sells its output to self-interested downstream agents for transformation and resale. In the absence of contractual restraints, the agents' choices of price and/or quality often will not be in the best interest of the upstream principal. The purpose of the contract is to align the interests of the agent with the interests of the principal.

There is a modest empirical literature addressing this view of vertical contracts[2]. Brickley and Dark (1984) investigate the effect of monitoring costs and reputation investment on the upstream firm's decision to operate downstream units as franchises rather than company-owned outlets. They find patterns consistent with franchising to economize on monitoring costs by establishing the franchisee as a residual claimant at remote outlets and with company ownership when the downstream firm has an incentive to free-ride on the reputation of the upstream firm. Lafontaine (1988) and Norton (1988) also report results suggesting that monitoring costs and moral hazard affect the choice between franchising and company ownership. Ornstein and Hanssens (1987) find evidence that industry-wide resale price maintenance agreements increase the retail price of distilled spirits.

Although previous empirical studies have addressed the choice of price or contractual form made for each outlet, they have in general been hampered by a paucity of outlet-level data. As a result, they have relied on variation in industry or market averages to estimate a relationship between characteristics and contractual form. In general, the studies test for a relationship between the industry proportion of outlets operated under some contractual form and some set of industry characteristics. The theory invoked by these studies, however, makes no

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[1] The positive theory of vertical restraints is summarized in Tirole (1988) and Katz (1989). For a more institutional application of principal agent theory to franchising see Rubin (1978).

[2] There is a related empirical literature on the effect of asset specificity, or the potential for ex post rent extraction by some party to the agreement, on contract choices. See, for example, Joskow (1987). The contracting problem addressed in this paper does not involve relationship specific assets.

prediction about proportions. Indeed, in the absence of important (and unobserved) heterogeneity across outlets, no mix of contractual form should be observed[3].

This study is an empirical test of the implications of principal-agent theory in which outlet-specific data appropriate to the theoretical predictions are used. Data on an outlet's characteristics, its retail prices and the contract under which it is managed are used to examine the relationships among the outlet characteristics, the upstream firm's choice of contracts, and the agent's choice of retail price. One focus of the study is the upstream firm's choice of the allocation of control rights (contractual form) as a function of the characteristics of the downstream asset. Thus, the observed mix in contractual form is tied to observed heterogeneity in outlet characteristics. A second focus is the effect of contractual form on the agent's choice of retail price conditional on asset characteristics. Differences in retail prices are tied to differences in characteristics and the incentives embodied in the contractual form.

The application addressed here is gasoline retailing, and the study exploits the facts that principals (refiners) sell gasoline through variously configured stations and use several contractual forms. Variation in station characteristics lead to variation in the importance of agent effort and the extent to which the relevant effort is observable to the principal. Because an unconstrained agent generally will not choose the level of effort preferred by the principal, contractual forms with strong performance incentives will be used at stations where effort is important and unobservable. At stations where effort is observable, the refiner may choose a contractual form that allows more direct control over observable effort but offers weaker performance incentives.

Legal constraints on contracting on price make the price and effort problems asymmetric. Price is always observable, but can be directly chosen by the upstream firm only at a company-owned outlet where providing incentives for unobservable effort may be more difficult. Holding constant the quality of the product, retail prices will be affected by whether they are chosen by the upstream or downstream firm. Because agents will generally not chose the price that

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[3] Gallini and Lutz (1990) develop a signaling model in which a choice variable for the upstream firm is the proportion of company-owned stores in the distribution network, and Lafontaine (1990) presents some related empirical results. The standard principal-agent theory invoked in this paper and in the bulk of the empirical work, however, requires outlet-level heterogeneity to support a mix of contractual forms.

maximizes upstream profit, the advantage of direct control over price may offset concerns with unobservable quality.

These predictions are tested using data from a census of stations in Eastern Massachusetts that include information on over 1100 branded stations. Consistent with the theory, prices appear to be different--slightly lower--at company-owned outlets. Station configurations that imply output is sensitive to unobservable effort increase the probability that a contractual form with strong effort incentives will be chosen. Conversely, configuring stations such that output is more sensitive to observable quality increases the probability that a contractual form granting quality control to the upstream firm will be chosen.

The paper is organized as follows. Section 2 presents a model of decision-making within a vertical structure when there are institutional and informational constraints on contracting. The implications of this model for the choice of contractual form and retail price in gasoline retailing are discussed in Section 3. The empirical work is presented in Section 4, and concluding comments are offered in Section 5.

2. A MODEL OF VERTICAL DECISION-MAKING

This section outlines a model of vertical decision-making when some downstream choices cannot be covered by contract. The model is first presented in a general principal-agent framework and then, in Section 3, applied to the problem of gasoline manufacturers and retailers. The empirical work addresses only the choices of retail price and contractual form, but interpretation is facilitated by considering the context in which they are made. Thus, the model also examines asset characteristics and effort choices.

The problem facing the vertical structure can be analyzed as a three stage game. In the first stage, the upstream firm chooses the characteristics of the downstream asset that will maximize upstream profit given market conditions and subsequent play. In the second, it chooses the contract that will induce preferred behavior by the downstream firm conditional on the asset's characteristics. Finally, the downstream agent under contract to manage the asset chooses effort and retail price to maximize her utility given market conditions and the decisions of the upstream firm.

The agent's problem is to choose the effort level (e) and retail price (p) that will

maximize her utility given the market conditions she faces, the characteristics of the asset she manages and the contractual restraints on her choices. Competition in the downstream market is assumed to be imperfect. Otherwise, her price and effort choices would be market-driven with no role for contractual restraints.[4] Some of her choices may be specified by contract, but some cannot be. In particular, some dimensions of effort are assumed to be unobservable by the principal[5]. Let $e = (e^1,e^2)$, where e^1 is observable and e^2 is not. Retail price is observable, but laws against resale price maintenance will disallow contracting on price in some circumstances.

Both price and product quality are observed by the consumer, and demand for the product decreases in price and increases in quality[6]. Quality is a function of asset characteristics and agent effort; given asset characteristics, quality increases in effort. Different assets produce different products, and these products vary in the extent to which their quality is affected by effort. Let $X = (X^1,X^2)$ index asset characteristics such that an increase in X denotes an increased sensitivity of product quality to effort. Then an increase in X^1 (X^2) denotes an increase in the sensitivity of quality to observable (unobservable) effort.

The agent's utility is assumed to increase in profit and decline in effort. Letting θ represent the contract and Z represent relevant market conditions, the agent's problem can be written

$$\max_{p,e} U(e,p,\theta,X,Z),$$

where $U(\bullet)$ is the agent's utility and e is the monetary disutility of effort. Assuming the X and θ offered by the upstream firm in a take-it-or-leave-it contract allow the agent to achieve at least her reservation utility level, the solution to this problem is the utility-maximizing effort and

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[4] This assumption is consistent with the application to gasoline retailing. Gasoline stations are sufficiently differentiated by location and brand to have some discretion in price and effort. See, for example, Slade (1986).

[5] For simplicity, choices are characterized as simply observable or unobservable. In fact, choices may be observable but at a high cost or observable but not verifiable.

[6] Quality is either unobservable to the upstream firm or is a sufficiently noisy indicator of effort that contracting on quality cannot substitute for contracting on effort.

price:

$$e^* = e(\theta,X,Z) \tag{1}$$

$$p^* = p(\theta,X,Z). \tag{2}$$

In the second stage, the upstream firm chooses from the set of available contracts the one that induces the agent to chose the principal's preferred price and effort given X and Z. For any X and Z, there is a quality (effort level) and retail price that maximize upstream profits. It is well-known that in the absence of contractual restraints, the downstream choice of price and effort will diverge from this optimum if there are vertical or horizontal externalities[7]. In the presence of externalities, the problem for the upstream firm is to design a contract for each asset that maximizes upstream profit subject to the incentive compatibility constraints implied by equations (1) and (2). In general, a contract might specify the terms on which inputs are transferred from upstream, the level of effort required for observable dimensions, the retail price when contracting on price is lawful, lump sum transfers and monitoring rights. The problem facing the upstream firm can be written

$$\max_{\theta} \Pi(e^*,p^*,X,Z),$$

where $\Pi(\bullet)$ is upstream profit.

The contract is a function of asset characteristics because they determine the effect of agent effort. If, for example, the asset is designed to insulate quality from the agent's choice of effort (low X), the need for contractual controls for effort choice is reduced. On the other hand, if quality is very sensitive to agent effort (high X), then the contract will make some provisions for influencing the choice of effort. If an asset is characterized by output very sensitive to observable effort (high X^1), the contract will generally be more complex, specifying agent behavior. If output is very sensitive to unobservable effort (high X^2), a contract that

[7] See Tirole (1988), Chapter 4 and the references therein.

provides incentives will be preferred. The profit-maximizing contract can be denoted

$$\theta^* = \theta(X,Z). \tag{3}$$

In the first stage, asset characteristics will be chosen to maximize profit given Z, the set of available contracts and the downstream decision problem. Market conditions summarized by Z affect the optimal X. If, for example, final demand is highly sensitive to quality of a particular type, an asset that can produce that quality would be chosen. Alternatively, if demand is highly price elastic an asset that is cost efficient but perhaps limited in its quality potential might be preferred. The profit-maximization problem can be written

$$\max_X \Pi(\theta^*,e^*,p^*,Z)$$

and is solved by

$$X^* = X(Z). \tag{4}$$

3. VERTICAL RELATIONSHIPS IN GASOLINE RETAILING

In the context of gasoline retailing, the upstream firm is the wholesaler and the agent is the station operator. The wholesaler may be the refiner (e.g. Mobil or Shell) or a local distributor who is supplied by the refiner. In principle, the presence of an intermediary between refiners and operators might have some effect on observed choices and the empirical work takes this into account. For simplicity, however, this discussion treats all wholesalers as refiners.

The asset is a gasoline station at some location, and its characteristics include whether it sells non-gasoline products or services (e.g. automotive service or convenience store items), its gasoline sales capacity, and whether it sells gasoline full-service, self-service or both. Market conditions include the traffic volume at the station's location, demand elasticities (with respect to price and quality), and the number, proximity and characteristics of competing retailers.

Operator effort might include hours of operation, the level of service provided at full-service pumps, or supervision of repair service.

The contract can be conceptually decomposed into the "contractual form" and the "contractual terms" both of which are included in the θ notation. The form establishes the rights of control, while the terms set the levels for variables for which control rights have been allocated to the refiner. For example, the canonical franchise agreement reserves the choice of franchise fee and wholesale price to the upstream firm, but allows the downstream firm to choose retail price and effort. This allocation of control rights is the contractual form. The terms are the particular franchise fee and wholesale price selected by the upstream firm.

There are three contractual forms used in gasoline retailing: company-owned, lessee-dealer and open-dealer[8]. Within each category, standard form contracts that vary across dealers only in the contractual terms predominate[9]. For example, a refiner typically will reserve the right to set station hours in all lessee-dealer contracts, but may assign different hours for different stations.

Under open-dealer contracts, the land and the capital are owned by the station operator. The refiner has no investment in the station. The contractual form allocates the control of the wholesale price to the refiner. There is no rental or franchise fee. Decision rights over service quality and retail price are allocated to the station operator. The only substantive constraints on operator behavior are with respect to product purity and labeling. Operators, for example, cannot sell gasoline supplied by some other refiner in pumps identified with the contracting refiner and are required to monitor storage tanks for contamination and/or leakage. The contracts also specify a minimum volume of gasoline the open-dealer operator must purchase. However, the only penalty for failing to meet the minimum purchase requirement is termination of the supply relationship. Because a terminated open-dealer operator can sign with another supplier, this penalty is relatively mild.

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[8] The descriptions of contractual forms is based on conversations with refiners, wholesalers and industry analysts and material in Nordhaus, et al. (1983), American Petroleum Institute (1981) and Temple, Barker and Sloan (1988).

[9] There may be some interstate variation in contractual forms in response to state laws on franchising agreements.

At stations operated under lessee-dealer contracts, the land and most of the capital are owned by the refiner. The operator is responsible for buying the initial inventory of gasoline and other products[10]. As in the open-dealer contract, the contractual form allocates control over the wholesale price to the refiner. The refiner also sets an annual lease fee. In addition to minimum purchase and product purity requirements, the lessee-dealer contract allocates substantial quality control to the refiner; contracts can specify hours of operation, set cleanliness and landscaping standards, define what types of non-gasoline products or services may be sold on the premises, require the lessee to be on-site a specified amount of time and give the refiner the right to inspect the station, observe operations and audit business records. The station operator retains the right to set the retail price for all products.

The rental is station specific in the sense that it is set to reflect the volume of gasoline sales: a good location for selling gasoline will have a higher rent than a bad location. However, these rents do not extract all downstream profit. One reason for this is the return from ancillary sales. Two stations in equally good locations with respect to gasoline demand and the same capital for gasoline sales usually are charged the same rent even if one also has service bays to provide automotive service and the other does not. Refiners may also charge a flat fee for providing the capital for the ancillary service, but these fees are not station-specific. In the above example, the refiner may charge the station with auto repair service a flat fee for each service bay, but every station with repair bays will be charged the same fee[11]. The use of standardized fees of this type is a common practice in franchise contracts in many industries (Lafontaine, 1990).

Because not all rent is extracted, termination imposes a real penalty. Similarly, refusal to renew the lease--which may have a term anywhere from one to ten years--is a real penalty.

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[10] Conversations with refiners and industry analysts suggest that the cost of building a new station in the sample area was approximately 1 million dollars in 1987, and the cost of an initial inventory for a station with automotive service was less than $250,000.

[11] The transfer value of lessee dealer stations is evidence that not all the downstream profit is extracted. The Petroleum Marketing Practices Act of 1978 gives operators with lessee-dealer contracts the right to sell the lease to another party (who must be approved by the lessor). Leases have been sold for substantial sums; $100,000 to $300,000 are commonly cited as typical of the range.

This means the refiner has a mechanism for enforcing quality standards and the minimum purchase requirement. The circumstances under which a lessee-dealer operator can be terminated or not renewed are restricted by the federal Petroleum Marketing Practices Act of 1978. While refiners can refuse to renew or terminate for failure to meet the terms of the lease, they cannot refuse to renew or terminate at will. The refiner retains the right to alter the station's characteristics without the consent of the dealer.

At stations operated under company-owned contracts, all capital investment is made by the refiner, and the operator is employed by the refiner. All the control allocated to the employer in standard employer-employee relationships is allocated to the refiner. In particular, the refiner maintains ownership of the gasoline until it is sold to the consumer and therefore has the right to set the retail price. This is the only contractual form under which the refiner can directly set the retail price[12]. The operator is a salaried employee whose compensation package may include an incentive scheme typically tied to the volume of sales.

The model assumes that the refiner chooses station characteristics, a reasonable assumption at company-owned and lessee-dealer stations where the capital is owned by the refiner and the contractual form allocates to the refiner substantial quality control rights. At open-dealer stations this modeling approach is less immediately appealing. It can be supported, however, by arguing that a refiner choosing to sign an open-dealer contract at a particular station could have constructed an alternative station and supplied it as a company-owned or a lessee-dealer operation. Given this option, the refiner will enter an open-dealer contract only if the station characteristics are those he prefers given market conditions, *and* the station characteristics are such that an open-dealer contract is preferred.

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[12] There is a long history of litigation with respect to resale price maintenance in gasoline retailing. The courts have consistently held that refiners cannot set the retail price at any station not operated by an employee. In particular, the courts have ruled that using a commission contractual form under which legal title to the gasoline is retained by the refiner until sold to the consumer but the operator is not an employee does not give the refiner the right to set the retail price. See, for example, *Simpson v. Union Oil Company*, 377 U.S. 13, 17-18. It may not be coincidental that the commission contractual form has virtually disappeared from gasoline retailing subsequent to this ruling.

3.1 Contractual Form and Effort

Among the three contractual forms there are clear differences in the potential for directly controlling effort and for providing performance incentives. The amount of direct effort control allocated to the refiner is greatest with company-owned contracts and smallest with open-dealer contracts. So for stations at which the more important effort dimensions are observable, the company-owned contract should be attractive.

For unobservable effort, however, what matters is performance incentives. In this dimension company-owned contracts are inferior to open and lessee-dealer contracts. When greater operator effort increases the demand for gasoline, operators with lessee-dealer and open-dealer contracts gain the mark-up over wholesale price for each additional gallon sold. Further, for some non-gasoline products or services, these operators are true residual claimants.

In contrast, if the operator receives only a fixed salary at company-owned stations, there is no mechanism for affecting unobserved effort. Some refiners, however, include an incentive scheme in the compensation package for salaried operators. The extent to which this approach is a good substitute for residual claimancy depends on what observable indicators of effort are available. If a station sells only gasoline, an incentive scheme based only on gasoline volume can be a good substitute for directly contracting on effort. Indeed, any readily metered product or service can be easily incorporated into an incentive scheme. But then it is not correct to claim these outputs involve unobservable effort, because there is some observable indicator that is highly correlated with effort. Some services, however, are difficult to meter because the output is hard to define or can be easily disguised by the operator. In this case, effort is unobservable.

The relationship between optimal contractual form and station characteristics is summarized in the diagram. When both observable and unobservable effort are important (high X^1 and high X^2, respectively), lessee-dealer (LD) contracts will be preferred because this form allows both control over observable quality and incentives for unobservable effort. With high X^1 and low X^2, the refiner should be indifferent between the lessee-dealer and company-owned (CO) forms, both of which allow control of observable effort. In the opposing case (low X^1 and high X^2) the company-owned form is dominated, but the refiner will be indifferent between the lessee and open-dealer (OD) forms. Finally, when effort has little effect on quality, the refiner

will be indifferent among the three forms.

	HIGH X^2	LOW X^2
HIGH X^1	LD	LD = CO
LOW X^1	LD = OD	LD = CO = OD

A good example of a service that is highly sensitive to unobservable effort is auto repair. The quality of repair work is notoriously difficult to monitor; without on-site supervision by a manager with strong incentives to produce high quality, shirking is unavoidable. For the same reason, it is relatively easy for an operator to under-report auto repair profit. An incentive scheme based on output or profit is not feasible. Residual claimancy through an open-dealer or lessee-dealer contract is a superior mechanism for inducing optimal downstream choices. Evidence supporting this argument is reported by Brickley and Dark, who find that among those firms offering automotive repair, 96 percent of the outlets were operated as franchises rather than as company-owned outlets.

Some non-gasoline output is less affected by unobservable dealer effort. Convenience stores can be run in ways that remove those quality dimensions sensitive to unobservable effort from the control of the operator. Inventory can be centrally planned, purchased, priced and distributed. As a result, the effect of effort is reduced. Further, it is fairly easy to monitor the quality dimensions her effort can influence: cleanliness, spoilage and stocking shelves, for example. With many observable quality dimensions, refiners should prefer company-owned or lessee-dealer contracts to open-dealer contracts for stations with convenience stores. With little unobservable effort input by the operator, refiners may be indifferent between company-owned and lessee-dealer contracts for convenience store stations. Finally, there may be some stations at which operator effort has little effect on demand. A station that sells only self-service gasoline, for example, requires only minimal operator input. At these stations, there is no reason to suppose that one contractual form will be preferred to another on the basis of quality control.

3.2 Contractual Form and Price

Contractual form will affect price as well as effort, and the ability to set price directly at company-owned outlets may make this form attractive to refiners . Because a refiner's only instrument for extracting downstream profit at open-dealer stations is the wholesale price, he will set the wholesale price for those stations above his marginal cost. But because a refiner cannot lawfully set station-specific wholesale prices, he must then charge a wholesale price above marginal cost at all his stations. Even without this constraint, if extraction of downstream profit through rental or other fixed fees is imperfect, charging a wholesale price above marginal cost might maximize upstream profit. In either case, if downstream competition is imperfect, the retail price decision of downstream agents will be affected by double marginalization: holding effort constant, the price chosen by the downstream agent will be too high from the refiner's point of view because the operator's marginal return to reducing retail price is less than the total benefit of price minus unit production and retailing cost. When the agent chooses both effort and price, it is clear that the price she chooses and the price the refiner would choose will not be the same, but it is not possible to sign the difference without further information about final demand and downstream competition. Here, however, the use of minimum purchase requirements implies that the price chosen by the operator tends to be too high. In the absence of quantity forcing, then, prices at company-owned outlets would be lower than prices at other outlets.

Minimum purchase requirements will limit the pricing discretion of lessee-dealer operators, and are commonly believed to be used for that purpose. They are not a substitute, however, for setting price. Minimum purchase requirements are in effect over relatively long periods of time and are not adjusted for minor changes in demand or supply conditions. As a result they are set low enough to ensure the dealer will be able to meet them under a range of conditions. Observed prices, therefore, could be higher at lessee-dealer and open-dealer outlets than company-owned outlets despite the quantity forcing. This prediction is consistent with claims made by open-dealer and lessee-dealer operators that company-owned stations charge lower prices (USDOE, 1980). Barron and Umbeck (1984) also find that a small sample of stations converted from company-owned contracts to some other contractual form charged prices that were lower, relative to nearby stations, before the change in form. If the absence of a

strong enforcement mechanism reduces the effectiveness of quantity forcing at open dealerships, prices at these outlets may be higher than prices at lessee-dealer outlets.

3.3 Open-Dealer Contracts Revisited

The preceding discussion implies that open-dealer contracts should never dominate both company-owned and lessee-dealer contracts. If effort matters and any dimension is observable, lessee-dealer contracts will strictly dominate open-dealer contracts. If effort is unimportant, the superior price control available with company-owned contracts will lead refiners to prefer strictly company-owned contracts to open-dealer contracts. Only in the unlikely circumstance that effort matters but no dimension is observable will an open-dealer contract not be dominated by another form. Even in this case, the refiner should be indifferent between the lessee and open-dealer forms. Nonetheless, open-dealer contracts are common.

This apparent inconsistency arises from the assumption that the most profitable contract for the refiner results in a non-negative refiner profit. This need not be the case. There will be some locations at which even the best contract will not produce a normal return on the refiner's investment in land and capital. If the investment is made by the operator, however, it will be profitable for the refiner to supply gasoline to that station as long as his wholesale mark-up on the quantity sold is higher than his cost of delivering the gas. This arrangement can be profitable for the operator if there are downstream rents that cannot be extracted by the refiner under any contract. Then the total profit at the station may be high enough to cover the investment in land and capital even though the refiner's share under an alternative arrangement would not be.

This situation will arise most commonly when a substantial share of the profits generated at the station come not from gasoline sales but from sale of some ancillary product or service. At a station of this type, the refiner's profit from gasoline sales (through the wholesale mark-up plus the rent) will be relatively small. If rent extraction is imperfect for the ancillary service, this additional income might not be sufficient to bring the total return to a normal level. The operator, however, may find the ancillary service extremely profitable, especially when she gets to retain the entire profit stream. Thus, stations that have a small gasoline sales capacity and some ancillary service are more likely to be open-dealer stations.

Nearly all the stations in this country are built by gasoline suppliers rather than station operators. Since refiners would not build stations that could not be run profitably under the best contractual arrangement, these stations must have been profitable (at least in expectation) for the refiner under lessee-dealer or company-owned contracts when they were built[13]. Changes in market conditions can subsequently make these stations unprofitable as a refiner investment, leading him to sell to an open dealer[14]. Because these changes are more likely the longer the station exists, open-dealer stations are also more likely to be older stations.

3.4 Summary of Predictions

If the primary concern of the refiner is controlling the downstream price, company-owned stations would be the dominant form. When unobservable effort is important, however, the refiner may trade control over price for effort incentives producing the mix in contractual form actually observed. Within a mixed distribution system, the price at company-owned stores will be different--and probably lower. If quantity forcing is more successful under lessee-dealer contracts, prices at open-dealer stations will higher than prices at lessee-dealer stations.

The company-owned contract should be associated with stations designed to insulate quality from unobservable effort thereby making the price advantage of this form relatively more important. Stations selling gasoline self-service only and stations where the ancillary service is a convenience store rather than automotive service should be good candidates for the company-owned form. In contrast, the lessee-dealer form will be associated with stations where unobservable effort is important. Stations with automotive service will be run more profitably under a lessee-dealer contract than a company-owned contract.

Finally, if open-dealer stations are those at which refiner ownership is no longer

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[13] In principle, a refiner could build stations he intends to sell immediately to an open dealer. If refiner and operator have the same risk attitude and beliefs, the refiner could extract all future profit through the sale price. This would be particularly attractive if the refiner has some advantage in land acquisition and station construction. In fact, however, this is not a common practice.

[14] The federal Petroleum Marketing Practices Act of 1978 requires that a refiner wishing to cease operation of a lessee-dealer station offer to sell the station to the current lessee. The refiner is not, however, obligated to supply the station after the sale.

profitable, these stations should be older on average than the stations owned by refiners. They also may earn a substantial share of income from an ancillary service for which rent extraction is imperfect, suggesting that the proportion of the station's capacity devoted to gasoline sales will be lower at open-dealer stations.

4. THE EMPIRICAL MODEL AND RESULTS

Testing these predictions requires an econometric model that is responsive to the nature of the decision problem and the limitations of the available data. The empirical work estimates equations (2) and (3) taking into account the discrete nature of the observed contractual form variable. Because the estimation strategy is affected by data availability, this section begins with a description of the data and then specifies the empirical model and reports the results.

4.1 Data and Sample Characteristics

The data are from a cross-sectional census of all the gasoline stations in a four county area in Eastern Massachusetts that includes the Boston metropolitan area[15]. Data on station location, ancillary services, gasoline brand, station capacity, service level (full or self) and contract type are included for each. No relevant information on effort or demand characteristics are available. Some information on market conditions can be constructed using the data on station location. Although reported as a cross-section, data collection occurred over a twelve week period in the first quarter of 1987, during which the wholesale prices of refined petroleum products were slowly rising. To adjust for wholesale price changes, the retail prices have been indexed using weekly fob wholesale price data for the Bc ɔn area[16]. Retail prices observed in any given week are indexed by the average wholesale price reported at the end of the preceding week. The analysis is restricted to branded stations: Shell, Exxon, Amoco, Gulf, Mobil, Citgo, Texaco and Chevron in this sample. Descriptive statistics for the branded stations

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[15] There are a total of 1527 stations in the four county area. The analysis omits stations in a subset of the outlying areas, reducing the sample to 1489 stations of which 1130 are branded stations.

[16] The station-level data were collected by Lundberg Surveys, Incorporated. The wholesale price data are from Oil Price Information Service.

are reported in Table 1.

Approximately 43 percent of the branded stations are operated as lessee-dealer outlets and about five percent are operated as company-owned outlets. This area has a lower proportion of company-owned stations than the national average. Nationally, major refiners were selling over fourteen percent of their product through company-owned outlets in 1987; in the sample area company-owned outlets were selling less than eight percent of the branded output (USDOE, 1987). This sample also contains a higher proportion of full-service only stations and a lower proportion of self-service only stations than the national average. By the late 1980s, less than one fifth of all branded U.S. stations were full-service only, down from more than two thirds in the late 1970s. Yet in 1987, two-thirds of the branded stations in the Boston area were full-service only. Over forty percent of U.S. stations were self-service only by the late 1980s, up from less than five percent in the early 1980s, while only about twelve percent of the sampled stations are self-service only (*National Petroleum News*, various issues).[17]

The data are generally consistent with the predicted relationships between station characteristics and contractual form. A much higher proportion of company-owned stations are self-service only. When company-owned stations provide non-gasoline services they are less likely to provide auto repair ("Repair") and more likely to have convenience stores ("Cstore") than other stations. Company-owned stations also tend to be located in outlying areas more often. Eighty-seven percent of the company-owned stations are located more than ten miles from the center of Boston ("Outlying Location"). These locations may have lower land costs and--since they have been developed more recently--probably have a newer station stock. Perhaps because they are more often located in geographically outlying areas, the average company-owned station faces less competition from nearby stations. The "nearby capacity" variable sums the number of cars that can be served simultaneously at other stations located within a one mile radius of the station.

The data on open-dealer stations are consistent with the view that they are small capacity, older stations not intensively involved in gasoline sales. The average open-dealer station has less

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[17] A few of the many towns in the sample area have ordinances restricting self-service gasoline. If these ordinances are more common in this area than they are nationwide, they may explain some of the divergence from the national averages.

gasoline sales capacity; it is large enough to serve only 3.5 cars at the same time ("Capacity"), compared to five cars at the other stations. In fact, nearly three quarters of the open-dealer stations have only one gasoline island while no more than thirty percent of the other stations are single island. In large part because of this capacity difference, open-dealer stations have a smaller proportion of their available space devoted to gasoline sales: the intensity variable is the ratio of capacity to lot size and is lowest at open-dealer stations. These stations sell approximately half the volume sold by lessee-dealer and company-owned outlets. The data on investment indicate little recent activity at open-dealer stations. Less than forty percent of the open-dealer stations have been remodeled within the three years preceding data collection compared to over two thirds of the other stations ("Remodel")[18].

The price data do not reveal a clear relationship between price levels and contractual form. Prices are reported by gasoline grade (regular leaded, regular unleaded and premium unleaded) and service level (full-service and self-service). Some stations offer cash discounts. The prices used in the analysis are the lowest prices for the specified grade and service level offered by the station. Not all stations carry all grades.

4.2 Estimation and Results: Price Equation

The retail price equation defines the operator's choice of price given the contractual form, the asset characteristics and the relevant market conditions. Because all the variables affecting her choice are exogenous, the equation can be estimated by ordinary least squares. The estimating equation for the price at the jth station is

$$p_j = \beta_0 + \beta_1'X_j + \delta_1\theta_{1j} + \delta_2\theta_{2j} + \gamma_1'Z_{1j} + \gamma_2'Z_{2j} + \sum_{h=1}^{m-1} \iota_h D_{hj} + \epsilon_j. \qquad (5)$$

where θ_1 is a dummy variable for a company-owned station, θ_2 is a dummy variable for an open-dealer station and D_h, h=1,..,m, are dummy variables for the m refiners supplying the

[18] The data record whether or not the station was remodeled within the specified time period, not what was done. Remodeling can include anything from rebuilding the station to adding a canopy over the pumps.

stations in this sample. The θ variable in equation (2) includes both the contractual form and the contractual terms. Price will be affected by both, but only form is observed[19] by the econometrician. One of the most important terms affecting the choice of retail price is the wholesale price. However, since the wholesale price cannot vary across stations of the same brand, unobserved variation in transfer pricing will be captured by the refiner fixed effects and therefore will not bias the coefficient estimates in equation (5). The Z_1 vector includes observed market conditions: nearby rival capacity and outlying location. Unobserved market conditions, Z_2, are part of the error term, and may bias the least square estimates of the contractual form effects. This problem is addressed following the presentation of the least squares results.

Equation (5) is a reduced form, and the coefficients will reflect the total effect of the exogenous variables on price: the direct effect and the indirect effect through changes in effort. By construction, the coefficient on θ_1 (θ_2) is an estimate of the increment to price observed at company-owned (open-dealer) stations compared to the price at lessee-dealer stations. If there were no feedback from effort to price, the double marginalization effect would imply the company-owned coefficient would be negative ($\delta_1 < 0$) and the open-dealer coefficient will be non-negative ($\delta_2 \geq 0$). If there are significant indirect effects, however, the signs of the coefficients cannot be predicted. In this case, the coefficient provides information on the total effect of contractual form on price, but it is incorrect to interpret it as an estimate of only the direct effect. The coefficients of interest are those on the contractual form variables, but the same argument applies to the other exogenous variables: station and market characteristics will have a direct effect on price and an indirect effect through changes in effort.

The ordinary least squares estimates reported in Table 2 display substantial variation across gasoline grades and service types. For leaded products, there are no clear contractual form effects. The estimated coefficients are quite small (less than a cent), but imprecisely measured. For unleaded products, the coefficients are consistently negative for the company-owned variable, indicating that prices are one to three and a half cents lower. The coefficient

[19] "Observable" is a term reserved for distinguishing those things that can be contracted on; "observed" is used to distinguish what the econometrician can measure given the data.

estimates, however, can be statistically distinguished from zero[20] only for premium unleaded, full-service gasoline. The pattern for open-dealer stations is less clear. The magnitude of the effect for full-service gasoline is small and cannot be bounded from zero. The only large effect is for premium, unleaded self-service where the coefficient implies that open-dealer stations charge over a cent more than lessee dealers, but all open-dealer coefficients have relatively large standard errors.

The estimates in Table 2 may be affected by the mix of supplier types in the sample. The discussion has treated all suppliers as refiners, but nearly twenty percent of the stations are supplied by local wholesalers. The data do not identify individual local suppliers, but industry sources report that wholesalers in New England may supply from less than ten to more than one hundred stations. These wholesalers use the same contractual forms as refiners and the larger ones may behave very much like refiners. There may be variation in contracts across wholesalers, however, that cannot be removed with refiner fixed effects. In addition, wholesalers may supply stations carrying different brands.

Table 3 reports the results from restricting the sample to stations that are supplied directly by refiners. The contractual form results of Table 2 are reinforced. The estimates of the company-owned coefficients for unleaded products remain negative and are larger in absolute value. The average company-owned effect is -2.75 here, compared to -1.72 when all suppliers are included. In addition, the coefficient on regular unleaded self-service can now also be statistically bounded away from zero. Nonetheless, the estimates are still imprecise on average: the standard error of the average company-owned effect is 1.42. The absolute magnitude of the coefficients for open-dealer stations tend to be smaller here and no coefficient can be bounded from zero.

Among the other coefficients, the most interesting is the estimated effect of rival capacity. Increasing nearby capacity to serve an additional car reduces price by less than one tenth of a cent, but the effect is persistent and precisely estimated. If the number of nearby stations is substituted for the nearby capacity variable, the (unreported) estimates suggest that price also decreases in the number of nearby rivals. These results are consistent with the pricing prediction of simple spatial competition models: as the number of firms in a given market

[20] All references to statistical significance are assessed at the .05 level or better.

increase, the average price will decline.

The coefficients on the remaining variables change across grades and service levels. In general, station characteristics appear to affect full-service prices more than self-service prices. This may be because the quality of full-service has more unobserved variation than the quality of self-service. Full-service prices increase when the station offers both full and self-service gasoline ("Split Island")[21]. Recent remodeling and offering automotive repair tend to decrease full-service prices. At some "self-service" pumps, a station worker pumps the gas but will not provide any other service usually associated with full-service. These "Mini- service" sales are priced higher than real self-service.

The estimates in Tables 2 and 3 are unbiased if the unobserved market characteristics (Z_2) in the error term are uncorrelated with the observed station characteristics. This assumption is rather strong, however. Consider, for example, variations in consumer income that lead to high demand for service and unwillingness to search for low prices. The service demand will lead refiners to choose full-service through equation (4). Income will also have a direct effect on prices through the search component: holding service constant, higher income implies higher prices. Income, then, will be in the vector Z_2. Because it is correlated with full-service, the coefficient estimates will be biased.

While the market characteristic data necessary to avoid bias in the estimates is unavailable, another approach to controlling for market characteristics is possible. Any group of stations within a small geographic area should face similar market characteristics. Because station locations are known, it is possible to use this information to estimate contractual form effects within small areas. To implement this approach, station addresses are converted to cartesian coordinates. Each company-owned station becomes the center for a geographic area, and each station within one cartesian mile of that station is identified. For the kth group of stations, there are two price equations (for each grade and service level): one for the station that is company-owned and one for the nearby stations that are not. A within area average is constructed for the non-company-owned stations and subtracted from the company-owned equation. The result are k=1,..,r equations

[21] The effect of offering both full and self service gasoline on full service prices is investigated in Shepard (1990) where it is attributed to second degree price discrimination.

$$(p_{k1} - \bar{p}_{k2}) = \lambda_0 + \lambda_1'(X_{k1} - \bar{X}_{k2}) + \mu_k,$$

where r is the number of company-owned stations, p_{k1} is the price at the kth company-owned station and $\bar{p}_{k2}$ ($\bar{X}_{k2}$) is the average price (station characteristic) for the non-company-owned stations. The common market characteristics (Z) are removed by differencing. Then if company-owned stations charge different prices, the constant term will reflect that difference. Notice that refiner fixed effects are not well-defined in this context and are not in the estimating equation. Unreported results show that this omission does not substantively change the reported coefficient estimates in Tables 2 and 3.

These within area estimates are presented in Table 4 for all branded stations and lend some support to the impression from the earlier estimation that company-owned stores charge somewhat lower prices for unleaded products[22]. While these estimates are no longer consistently negative, the only large effects--those for full-service--are negative. The only coefficient large enough to be statistically distinguished from zero is, again, the effect on prices for premium unleaded gas sold full-service. For this product, prices at company-owned stores are at least eight cents per gallon lower. The magnitude of the contractual form results appear to be sensitive to excluding other explanatory variables. In particular, if "Repair" and "Cstore" are omitted, the magnitudes of the coefficient estimates and standard errors are smaller for the full-service prices. The basic pattern, however, is preserved: the larger effects are negative and the implied reduction in price for full-service premium is at least six cents.

Notice that the test here is particularly stringent. Suppose company-owned outlets do choose lower prices in response to any given market situation. These lower prices will induce lower prices at nearby stations. Thus, the measured effect is not the amount by which company-owned stations reduce their prices from the equilibrium price that would prevail in their absence, but the difference in price that survives the competitive response by rivals. The row of Table

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[22] The estimation is weighted least squares where the weights reflect the number of observations underlying the averages. The resulting covariance matrix is homoskedastic. Because any given station can appear in more than one area, the errors also can be correlated across markets. Fortunately, duplicate observations can be identified and used to construct appropriate weights to generate correct standard errors. It is the corrected standard errors that appear in Table 4.

4 labeled "No. Areas" reports the number of company-owned stations on which the estimates are based and the row labeled "No. Stations" reports the total number of stations on which the estimates are based. For example, of the 38 company-owned stations selling regular unleaded gas self-service, 25 have at least one non-company owned station within one mile also selling regular unleaded gas self-service. Across all twenty-five areas, there are 87 stations selling unleaded gas self-service. But this means that most of the 314 stations selling this grade self-service do not have a company-owned store nearby. The average differences reported in Tables 2 and 3, therefore, are based primarily on a comparison of company-owned stations with other stations that do not compete with these hypothetically low-priced stations. One might expect, then, to find the estimated effects more pronounced in Table 2. The fact that the within area effects are not smaller suggests that controlling for local effects eliminates important sources of variation in retail pricing.

4.3 Estimation and Results: The Contract Equation

In equation (3) the contract is treated as a continuous variable representing both the contractual form and the contractual terms. But only contractual form is observed, and observed form choices are discrete. A standard approach to estimation based on observed, discrete choices is to model a latent variable, $\Pi(\theta(X,Z)_i)$ in this case: the profit earned by the refiner at a station with characteristics X and market conditions Z when the ith contractual form is chosen, i=1,2,3, and terms are set optimally. Then the observed variables θ_i can be defined

$$\begin{aligned} \theta_i &= 1 \text{ if } \Pi(\theta_i) = \max(\Pi(\theta_1),\Pi(\theta_2),\Pi(\theta_3)) \\ \theta_i &= 0 \text{ otherwise.} \end{aligned} \tag{6}$$

Let

$$\Pi(\theta)_{i)_j} = \alpha_0 + \alpha_1'X_j + \phi_1'Z_{1j} + \phi_2'Z_{2j} + \sum_{h=1}^{m-1} \eta_h D_{hj} + \nu_j \tag{7}$$

be the profit at station j when contractual form i is chosen. Then if ν has an extreme value

distribution, the relationship between choice probabilities and asset characteristics and market conditions can be estimated using a multinomial logit specification.

Equation (4), defining the optimal station characteristics, is not estimated, but its presence clarifies the assumptions necessary to identify the contractual form equation. Since Z_2 is unobserved and X is a function of Z, the way equation (4) is written implies that X will be correlated with the composite error: $\phi_2'Z_2 + \nu$. The identifying restriction, then, is that contractual form is not a function of market conditions: $\phi_1 = \phi_2 = 0$. This is clearly an untenable assumption for contract terms. The level of a fixed fee in a franchise contract, for example, will be a function of demand parameters. Here, however, the estimated contract equation involves only contractual form and the identifying restriction applies only to the choice of form.

The decision-making process implicit in the identifying restriction is as follows: the refiner chooses station characteristics to maximize profit given market conditions and the available contracts. He then chooses the contractual form that will, when terms are set optimally, induce the profit-maximizing effort and price choices for a station with those characteristics. Finally he chooses the contract terms that, given the station's characteristics, market conditions and the allocation of control rights established by the contractual form, will induce the preferred downstream behavior. The critical step in this argument is that market conditions affect the choice of contractual terms but not the choice of contractual form.

The multinomial logit specification implies a particularly simple form for the probability ratios. Let the arbitrarily chosen normalization category be lessee-dealer contracts and k = 1,2 denote the other categories. Then the ratio of the probability that the kth form is chosen to the probability that the lessee-dealer form is chosen at station j is simply

$$e^{(\alpha_{0k} + \alpha_{1k}'X_j + \nu_{kj})}.$$

The estimated coefficients can therefore be interpreted as the percentage change in the log of this odds ratio. These estimates are reported in Table 5. In columns one and two the estimated coefficients are reported for the ratio of company-owned (co) to lessee-dealer (ld) and the ratio of open-dealer (od) to lessee-dealer, respectively. The implicit estimates of the coefficients for

the ratio of company-owned to open-dealer are reported in column three. The estimates reported in the first three columns use observations on all the branded stations. Estimates for observations restricted to stations directly supplied by refiners appear in columns four through six.

The results for the primary ancillary services are consistent with the model's predictions. The coefficients for repair imply a reduction in the probability that the station will be company-owned relative to both other forms when auto service is provided. This result fits the prediction that the company-owned form will not be optimal when the ancillary service involves substantial unobserved effort. In contrast, the presence of a convenience store increases the probability that the station will be operated as a company-owned outlet. Convenience stores have a much higher ratio of observable to unobservable effort, making them better candidates for company-owned contracting. The model has no prediction with respect to the relationship between auto repair and the refiner's relative preference for open-dealer versus lessee-dealer contracts, but both coefficients are negative--significantly so for the sample including all branded stations. Thus, auto repair may increase the relative probability that the station will be operated under a lessee-dealer contract. If refiners choose a contractual form that allows for explicit control of observable quality when it is important, cstores should also increase the probability of operation as a lessee-dealer rather than open-dealer station. The empirical support for this hypothesis is somewhat less strong: The coefficients have the expected sign but are not sufficiently precise to be statistically distinguished from zero.

As predicted, an increase in the intensity with which station capacity is used for gasoline sales reduces the probability that the station is operated under an open-dealer contract. When the portion of the lot devoted to ancillary services increases, the revenue the refiner can extract from gasoline sales declines, making the station a less attractive investment. The data not clearly support the argument that stations selling only self-service gasoline are more likely to be run under company-owned contracts. No full service does reduce the probability that the station is operated as an open-dealer outlet, but the effect on the probability of company-owned versus lessee-dealer is not clear cut. In both cases the coefficients have the predicted signs, but the magnitude is too small to distinguish from zero.

The predictive power of the model is reasonably good. The percent of stations for which

the estimates imply a probability of 50% or more for the actual contractual form is slightly more than seventy percent for both sample definitions. In contrast, predictions from randomizing based only on the observed proportions of each contractual form would be correct for only 47 percent of the stations. Simply assigning each station to the most commonly observed category would increase the number of correct predictions to only 52 percent.

Although the results reported in Table 5 are generally consistent with the theory invoked in Section 2, they support reduced form predictions that might also be consistent with other theories. In particular, one competing explanation of the observed patterns might be that ownership reflects only station age. Refiners report that they sometimes operate a new (or newly rebuilt) station as a company-owned outlet initially and then convert to lessee-dealer. This practice might allow the refiner to get information on the true profitability of the station so that lease terms could be set optimally. As an artifact of the historical development of gasoline retailing, new stations are more likely to have convenience stores than are older stations. Similarly, recently opened station are more likely to be self-service only and less likely to have service bays. In conjunction with the age-related arguments made for open-dealer stations, this explanation is consistent with the pattern observed in Table 5. Some support for this view also comes from Table 1, where it is clear that company-owned stations are more likely to be in outlying areas where the station stock is probably newer on average. The remodel variable was included in the Table 5 regressions to control for newly rebuilt stations, but the variable is far from an ideal indicator of station age[23].

There is no measure of station age in the data set, but there is a way to develop a rough categorization for a subsample of the data. The company that conducted the 1987 survey has conducted previous surveys in the Boston area and has maintained consistent station identification numbers over successive surveys. This identifier includes the year the station was first observed. There are two problems with this as an indicator of age. First, the earliest survey was in 1972 and surveys have been performed only irregularly since that time. So a first observation at the next sample period, 1975, does not allow precise dating of the station. In

[23] If a station has been recently rebuilt--to convert service bays to a convenience store, for example--this activity will be reflected in remodel. However, stations are remodeled--without changing their basic character--when they are old. Remodel may, in fact, indicate that the station is old, not new.

addition, not all areas in the current sample were included in each survey. Indeed, the area surveyed appears to have changed somewhat with each survey. However, towns appear to be a common unit of observation. That is, if some stations in a town are surveyed, all stations in the town are typically surveyed.

To test for age effects, an indicator variable for older stations was constructed. First, all towns that had no station first observed before 1979 was dropped from the sample. All remaining stations, then, are presumably in towns where they would have been observed had they existed prior to 1980. Among these, stations are classified as "Old" if they existed in the 1970s[24]. The regressions reported in Table 5 were then rerun for this subsample with the additional dummy variable for old stations. The results are in Table 6.

Although the coefficients change somewhat compared to the full-sample results in Table 5, controlling for age does not substantively change the results, except perhaps for the convenience store coefficients. It is no longer true that convenience stores significantly separate company-owned from lessee-dealer outlets. However, it remains the case that, unlike repair service, convenience stores do not increase the probability that the outlet will be managed under a lessee-dealer contract relative to a company-owned contract. These results make a stronger statement about the apparent misfit between open-dealer forms and convenience stores and the tendency for stations that are less intensively used for gasoline sales to be operated under open-dealer contracts. Any changes in the results compared to Table 5, however, are not the result of the age variable. Old does a poor job of discriminating among contractual forms and omitting it from the equation has almost no effect on the other coefficients.

5. CONCLUSIONS

The empirical results generally confirm the well-known theoretical result that the nature of the vertical contract matters even when there are no relationship specific assets. Upstream firms offer contracts that allocate control in ways that best align the incentives and opportunities of downstream agents with upstream interests. Contractual forms well-suited to providing

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[24] While the choice of 1980 was dictated by data availability, it also coincides with the end of price and allocation controls in place during the 1970s. It is commonly believed that these controls inhibited the rationalization of the retail distribution system observed in the 1980s.

incentives are used when the downstream production process is importantly affected by unobservable agent choices. Conversely, forms well-suited to detailed, direct control are chosen when important downstream choices are observable and contractible. Further the data provide some support for the hypothesis that contractual form affects pricing, particularly that prices will be lower when the upstream firm can directly control price.

While the insights provided by general principal-agent models have been confirmed, the analysis has also rested on a fairly detailed analysis of the contractual and institutional framework particular to gasoline retailing. This level of specificity may raise the usual issues about how broadly the results can be applied. But the specificity is also appropriate to the theory. Contracts are written when the relationship is sufficiently complex to warrant imposing rights different from those of the spot market. These complexities involve the nature of the relationship and the institutional context within which the firms operate.

One of the contracting issues of considerable theoretic and empirical interest not addressed is identifying the determinants of the set of contractual forms. This paper has taken this set as given, but it is not obvious that these three forms include the optimal contract for any given station. Indeed, it is easy to imagine alternative forms that might better protect the principal's interests. For example, it is possible in principle to have separate contracts for managing auto repair and gasoline sales at the same station thereby unbundling services with very different control issues. A limited set of observed contracts are nonetheless common in many industries. It is difficult to provide a consistent theoretical justification for restricting the feasible set of contracts. Perhaps these limitations are a response to transaction costs or legal concerns involving equity that mitigate against otherwise optimal contract customization. In any case, further empirical investigation is warranted.

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TABLE 1: DESCRIPTIVE STATISTICS

	Company Owned	Lessee Dealer	Open Dealer	Total
Some Full Service (%)	45.45	84.60	96.26	88.76
Full Service Only (%)	29.09	48.46	89.12	68.67
Repair (%)	25.45	84.80	86.73	82.92
Cstore (%)	45.45	9.03	3.91	8.14
Remodel (%)	80.00	68.38	38.27	53.27
Outlying Location (%)	87.27	57.91	58.84	59.82
Capacity	5.44	4.97	3.50	4.23
	(2.19)	(1.95)	(1.67)	(1.97)
Monthly Gas Vol.	97.96	81.83	43.98	62.92
(x 1000 gal)	(47.92)	(39.34)	(27.35)	(39.57)
Intensity	0.45	0.39	0.32	0.36
	(0.27)	(0.17)	(0.19)	(0.19)
Nearby Capacity	22.42	29.72	31.11	30.09
	(16.88)	(22.18)	(26.02)	(24.10)
Price Reg. Leaded	76.28	74.89	76.11	75.26
Self	(2.58)	(4.05)	(5.05)	(4.16)
Price Reg. Leaded	82.94	84.86	81.59	83.02
Full	(10.61)	(9.47)	(7.97)	(8.85)
Price Reg. Unleaded	80.11	80.84	83.24	81.19
Self	(3.75)	(4.71)	(5.32)	(4.83)
Price Reg. Unleaded	90.65	92.69	88.97	90.55
Full	(11.65)	(10.35)	(9.13)	(9.86)
Price Prem. Unleaded	93.52	94.57	98.33	95.13
Self	(5.34)	(5.91)	(5.76)	(6.02)
Price Prem. Unleaded	101.24	106.27	103.47	104.59
Full	(7.67)	(9.77)	(9.48)	(9.70)
Number of Stations	55	487	588	1130

Standard deviations in parentheses

TABLE 2: PRICE EQUATION ESTIMATES
(All Branded Stations)

	Regular Leaded		Regular Unleaded		Premium Unleaded	
	Self	Full	Self	Full	Self	Full
Company Owned	0.34	-0.19	-1.37	-0.86	-1.12	-3.54
	(0.82)	(1.55)	(0.81)	(1.72)	(0.93)	(1.72)
Open Dealer	0.48	0.60	0.42	-0.44	1.35	0.08
	(0.61)	(0.59)	(0.63)	(0.62)	(0.73)	(0.62)
Split Island	-0.13	11.86	-0.48	12.17	0.40	10.73
	(0.63)	(0.69)	(0.62)	(0.74)	(0.72)	(0.74)
Repair	0.97	2.99	-0.26	1.26	-0.64	1.08
	(0.62)	(0.83)	(0.63)	(0.92)	(0.72)	(0.94)
Cstore	1.93	1.38	0.79	0.60	0.53	-0.64
	(0.67)	(1.34)	(0.67)	(1.43)	(0.59)	(1.44)
Capacity	-0.27	-0.55	-0.19	-0.42	-0.35	-0.41
	(0.12)	(0.15)	(0.12)	(0.16)	(0.14)	(0.16)
Remodel	-0.83	-1.88	-0.98	-2.48	-0.52	-2.37
	(0.51)	(0.53)	(0.51)	(0.56)	(0.59)	(0.56)
Nearby Capacity	-0.05	-0.05	-0.05	-0.04	-0.04	-0.03
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Outlying Location	0.07	1.56	-0.86	0.60	-1.79	0.34
	(0.57)	(0.59)	(0.57)	(0.62)	(0.67)	(0.62)
Mini-service	0.96		1.67		1.82	
	(0.61)		(0.64)		(0.74)	
N	320	821	353	994	351	974
Rsquare	0.193	0.408	0.316	0.353	0.410	0.340

Standard errors in parentheses
Refiner fixed effects included

TABLE 3: PRICE EQUATION ESTIMATES
(Direct Supply Stations)

	Regular Leaded		Regular Unleaded		Premium Unleaded	
	Self	Full	Self	Full	Self	Full
Company Owned	0.56	-0.35	-1.87	-1.61	-1.71	-5.82
	(0.91)	(1.86)	(0.89)	(2.02)	(1.03)	(2.08)
Open Dealer	-0.17	0.35	0.06	-0.76	1.04	-0.40
	(0.67)	(0.67)	(0.68)	(0.68)	(0.80)	(0.69)
Split Island	-0.09	12.08	-0.35	12.20	0.56	11.16
	(0.65)	(0.74)	(0.65)	(0.78)	(0.76)	(0.78)
Repair	0.88	3.63	-0.40	2.82	-0.61	2.77
	(0.65)	(1.02)	(0.72)	(1.10)	(0.77)	(1.15)
Cstore	1.82	1.98	0.44	1.06	0.22	-0.20
	(0.71)	(1.52)	(0.72)	(1.59)	(0.84)	(1.64)
Capacity	-0.24	-0.58	-0.16	-0.33	-0.30	-0.36
	(0.13)	(0.17)	(0.13)	(0.18)	(0.15)	(0.18)
Remodel	-0.88	-1.98	-1.10	-2.36	-0.71	-2.56
	(0.54)	(0.61)	(0.54)	(0.62)	(0.62)	(0.63)
Nearby Capacity	-0.05	-0.06	-0.05	-0.05	-0.04	-0.05
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Outlying Location	-0.06	1.54	-0.99	0.37	-1.81	0.14
	(0.59)	(0.65)	(0.59)	(0.67)	(0.68)	(0.68)
Mini-service	0.31		1.81		2.04	
	(0.64)		(0.67)		(0.77)	
N	297	667	327	810	325	800
Rsquare	0.178	0.442	0.321	0.400	0.415	0.372

Standard errors in parentheses
Refiner fixed effects included

TABLE 4: AREA ESTIMATES OF PRICE EQUATION
(ALL BRANDED STATIONS)

	Regular Leaded		Regular Unleaded		Premium Unleaded	
	Self	Full	Self	Full	Self	Full
Constant	0.15 (0.90)	-2.97 (3.30)	0.09 (1.05)	-3.54 (1.36)	0.09 (0.55)	-9.03 (1.18)
Split Island	-0.13 (1.17)	1.01 (2.64)	-0.65 (0.82)	2.17 (1.58)	-1.36 (0.85)	5.03 (0.82)
Capacity	-0.38 (0.30)	-1.38 (0.92)	0.13 (0.33)	1.60 (0.89)	0.57 (0.34)	0.81 (0.41)
Remodel	4.58 (2.26)	-6.03 (4.93)	4.21 (1.69)	-2.29 (4.47)	7.63 (1.76)	-5.50 (2.14)
Mini-service	-0.30 (1.62)		2.43 (2.72)		5.13 (2.82)	
Repair	0.30 (1.18)	1.19 (5.29)	1.83 (1.29)	5.36 (4.53)	1.48 (1.34)	1.26 (2.16)
Cstore	1.99 (1.17)	1.20 (6.48)	1.37 (1.18)	3.64 (5.22)	1.23 (1.23)	1.22 (2.42)
No. Areas	19	22	25	25	25	22
No. Stations	62	75	87	104	87	94
Rsquare	0.544	0.326	0.426	0.187	0.690	0.758

Standard errors in parentheses

TABLE 5: CONTRACT EQUATION ESTIMATES

	All Branded Stations			Direct Supply Only		
	$\ln\frac{pr(co)}{pr(ld)}$	$\ln\frac{pr(od)}{pr(ld)}$	$\ln\frac{pr(co)}{pr(od)}$	$\ln\frac{pr(co)}{pr(ld)}$	$\ln\frac{pr(od)}{pr(ld)}$	$\ln\frac{pr(co)}{pr(od)}$
No Full Service	0.61	-1.25	1.86	0.86	-1.13	1.99
	(0.40)	(0.33)	(0.44)	(0.47)	(0.38)	(0.55)
Repair	-2.22	-0.58	-1.64	-1.60	-0.50	-1.10
	(0.41)	(0.25)	(0.42)	(0.47)	(0.30)	(0.51)
Cstore	0.82	-0.67	1.48	1.01	-0.69	1.70
	(0.40)	(0.35)	(0.44)	(0.46)	(0.41)	(0.55)
Intensity	0.15	-1.48	1.64	0.55	-1.85	2.40
	(0.68)	(0.42)	(0.73)	(0.76)	(0.49)	(0.85)
Remodel	0.76	-1.00	1.75	0.83	-1.38	1.96
	(0.40)	(0.15)	(0.40)	(0.51)	(0.16)	(0.51)
N		1130			924	
Chi square*		462.87			401.34	
Loglikelihood		-728.83			-571.75	
Rsquare**		0.241			0.269	

*LR test statistic (22 df)
**McFadden's pseudo rsquare
Standard errors in parentheses
Includes refiner fixed effects

TABLE 6: CONTRACT EQUATION ESTIMATES
(AGE SUBSAMPLE)

	All Branded Stations			Direct Supply Only		
	$\ln\frac{pr(co)}{pr(ld)}$	$\ln\frac{pr(od)}{pr(ld)}$	$\ln\frac{pr(co)}{pr(od)}$	$\ln\frac{pr(co)}{pr(ld)}$	$\ln\frac{pr(od)}{pr(ld)}$	$\ln\frac{pr(co)}{pr(od)}$
No Full Service	0.61	-1.52	2.13	0.93	-1.33	2.27
	(0.43)	(0.37)	(0.48)	(0.50)	(0.40)	(0.58)
Repair	-1.99	-0.57	-1.42	-1.42	-0.47	-0.95
	(0.44)	(0.29)	(0.45)	(0.50)	(0.34)	(0.55)
Cstore	0.77	-0.92	1.69	0.91	-0.72	1.62
	(0.45)	(0.41)	(0.52)	(0.52)	(0.46)	(0.62)
Intensity	1.06	-2.19	3.25	1.61	-2.81	4.41
	(0.80)	(0.50)	(0.86)	(0.88)	(0.58)	(0.99)
Old	-0.44	-0.14	-0.30	-0.65	0.21	-0.44
	(0.38)	(0.18)	(0.39)	(0.43)	(0.20)	(0.44)
N		869			739	
Chi Square*		337.62			299.97	
Loglikelihood		-577.49			-471.80	
Rsquare**		0.264			0.334	

*LR test statistic (22 df)
**McFadden's pseudo rsquare
Standard errors in parentheses
Includes refiner fixed effects