

**A Theory of Contract Choices with Reference to
Petrol Retailing: Risk, Incentives, and Competition**

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Cristina Caffarra joined the Oxford Institute for Energy Studies (O.I.E.S.) as a Researcher in 1988, working mainly on issues concerning the upstream oil industry. This paper is a revised version of a Chapter from her on-going D.Phil. thesis at Oxford University ("Strategic vs. Agency Considerations in Vertical Contracting: The Case of Petrol Retailing"), undertaken with support from the O.I.E.S., the ENI-Enrico Mattei Foundation (Italy), and the Institute of Petroleum (London).

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ABSTRACT

In UK petrol retailing, the vertical relationship between manufacturer (refiner/wholesaler) and retailer is governed by a menu of possible contracts, characterized by different typical unit margins. In 'agency' terms, each contract type thus incorporates an implicit risk/incentives trade-off, with higher margins providing higher-powered incentives for retailer's effort, but also increasing his share of the risk. At the same time, the difference in the margins also suggests a possible 'strategic' function of contracts: in an oligopolistic context, manufacturers might choose a particular contract type with the objective of indirectly influencing the final price set by the retailer, and possibly reduce the intensity of competition in the market game. This paper addresses the issue of contract-assignment, proposing a model where both 'agency' and 'strategic' considerations are featured in contract design. Agency considerations are explicitly incorporated in a simple duopoly, with manufacturers delegating the retail function to risk-averse retailers, and retailers competing against one another in prices. The manufacturers' profits (payoffs) are thus obtained as the net result of two distinct influences: the agency costs of delegation, which are higher the more risk-averse (or less able) the retailer; and the strategic benefits from delegating to such a retailer, in the form of higher wholesale and retail prices. The key result of the model is that the net effect of these costs and benefits depends crucially on the intensity of local competition. Where competition is slack, the agency cost borne by the delegating manufacturer is not offset by the benefit to be gained by signalling his commitment to a less aggressive pricing strategy. The outcome is different, however, where competitive conditions are locally tight, i.e. final demand for each retailer is very sensitive to the other retailer's price. In that case, the agency cost of employing a more risk-averse retailer is outweighed for the manufacturer by the strategic benefit from being able to commit to a higher retail price. This generates a series of testable propositions in the context of petrol retailing.

1 INTRODUCTION

In the UK petrol retailing industry, oil companies have a variety of contracts from which to choose when structuring the organization of their retail networks. Such contracts range from exclusive supply agreements with independent dealers, to various forms of agreement for the operation of company-owned sites: tenancies, licences, commission agencies, direct management by company employees; franchising has been recently added to this list.¹ The purpose of this paper is to formulate a (possible) interpretation for the assignment of such contracts (i.e. to explain the fact that a filling station is operated under one contract-type, rather than another).

Explaining the firm's choice of organizational form (e.g. integration and delegation) is a long-standing issue in the theory of the firm and in industrial economics. Particular attention has been directed in the literature to the determinants of the firm's delegation decision, i.e. the decision to vertically separate consecutive stages of operations (such as manufacturing/retailing) by contracting them to outside agents (as opposed to vertical integration). The theoretical literature on incomplete contracts (Grossman and Hart 1986, Hart and Moore 1990, Moore 1992) has emphasized a view of the firm as a collection of physical assets, over which some agents have property rights. The incentives for an agent's choice of action are affected by the distribution of such property rights; and the costs and benefits of the integration vs. delegation decision must be understood primarily in terms of changes in the distribution of property rights, and their effect on agents' incentives.

A separate literature on vertical restraints (Mathewson and Winter 1984, 1986, Waterson 1986) has focused instead on how it is possible to eliminate, by judicious combination of vertical restrictions, the classical externalities associated with delegation; to the effect that many apparently restrictive trade practices could in fact have welfare-enhancing properties. More recently, the choice of organizational form has come to be more explicitly linked to incentive theory, and attention has been focused on the principal/agent nature of the relationship between various levels of hierarchy within the firm. The large literature on optimal contract design explores how to ensure incentive compatibility in various settings, under conditions of moral hazard and/or adverse selection.

Finally, the potential implications of the firm's organizational choices also for industry conduct/performance have been recognized by the literature on strategic behaviour in oligopoly (Vickers 1985, Fershtman and Judd 1986, 1987, Bonanno and Vickers 1988). When the delegating firm is set in a context of oligopolistic rivalry, with every price/quantity decision interdependent on rivals' decisions, the choice of organizational structure may be very significant. These works suggest, in particular, that in some circumstances there may be an ulterior motive for delegating a task to an agent, in that delegation can be effectively used to signal a credible commitment to a strategy by competing firms in oligopolistic structures.

¹ Independent dealers own and operate just under two-thirds of UK filling stations, but their relative importance is far less in throughput terms – around 35 per cent of total UK fuel sales, excluding hypermarkets. Even in the context of a shrinking total number of stations, their share of the total has been declining over time, while company-owned sites have grown both in relative numbers and volumes.

A (rather more sparse) empirical literature also exists on delegation, focusing mainly on the incentive-compatibility aspect. Franchising is the favourite testing ground for various predictions on the incidence of delegation, because franchised firms can offer valuable empirical evidence on how agency costs may affect organizational choice. The fundamental feature of franchising is identified in the coincidence of management and ownership in the person of the franchisee ("bundling of entrepreneurship and capital", Norton 1988), which implies residual risk bearing is restricted to the important decision-maker. The expectation is therefore that franchising as a contractual arrangement should be used more in the presence of factors that make the separation of management and risk bearing inefficient. This empirical literature (Brickley and Dark 1987, Brickley, Dark and Weisbach 1991, Martin 1988, Krueger 1987, Norton 1988, Lafontaine 1992) tends to formulate a number of intuitive predictions on what specific economic/market parameters can make such separation inefficient, and then tests these intuitions (either on data from a particular industry, or on a cross-industry sample – i.e. trying to relate different proportions of franchised stores in different industries to some industry characteristics).

In petrol retailing, as in a few other industries, the firm's choice of organizational form is more complex than the simple decision "delegate vs. non-delegate", or "separate vs. integrate". There is a whole "menu" of contract types (supply agreements with independent dealers, tenancy, licence, franchise, commission agency, direct management (by company employees), differing from one another essentially in terms of their legal status; duration and tenure security; typical structure of the retailer's compensation. The latter refers to: (a) typical size of the unit margin recognized to the retailer (it is possible to identify a rather typical range of values for each contract type, taken across companies; this increases discretely from commission agency through to licence, tenancy and independent dealership); (b) size/sign of the fixed fee (retailers tend to pay a fixed fee which varies across contracts in inverse relation to the margin; and where the margin is very low, the fee may consist of a transfer from the company to the retailer); and (c) the retail costs for which the retailer is directly responsible (see Appendix for a summary of the main differences across contracts).

While it is possible to identify broad historical trends in the pattern of contract choice by UK petrol companies (licences often replaced tenancies in the 1970s; commission agencies emerged in the 1980s), companies tend to operate their sites under a mixture of contract types. A preference may be shown by a company for one contract type (and then a majority of its sites will be operated under that type), but some variety is always preserved. In addition, adjustments are continually made by individual companies, switching from one contract type to another in the menu of established options; or introducing a new contract altogether. This strongly indicates that the question of contractual arrangements and their implications remains very high on the companies' agenda.

The issue of what determines the choice of contract type was also (briefly) considered in the Monopolies and Mergers Commission (MMC) Report on *The Supply of Petrol* (1990). In the course of the investigation, the oil companies themselves suggested that contracts perform a very significant role in brand competition: when asked whether they thought lesser variety and greater standardization

of contracts would not be preferable, the companies pointed out that

the choice of incentive structure represents the companies' commercial judgement as to the optimal (most efficient) method of operating in retailing. It is not surprising that different companies take different views on the matter. *The choice of incentive structure is one of the dimensions within which competition takes place* (my italics); companies would be rewarded or penalized according to their success or failure relative to rivals. Enforced standardization of contracts would therefore be anti-competitive. (MMC,1990).

The Report's conclusion was simply that

The wholesaler's choice of agreement is determined by many factors, of which security of tenure is one. This depends in turn on a number of things such as the nature of the site in question, the retailer's preference, the wholesaler's own policy on these matters (Ibid.).

Further insight into the possible role of contracts can be gained from individual companies' statements on the reasons for their specific choices: tenancies were often replaced by licences because companies felt "very successful in improving facilities and standards at licensed sites, whereas tenants were obstructive"; some companies explicitly emphasized the undesirable effects of the greater security of tenure enjoyed by tenants:

the benefits provided to a tenant under the terms of a lease, often of 21 years' duration, largely prevent the company from implementing its strategies in the short-medium term, and the tenant's rights to renewal can effectively deny the company the opportunity to realize the potential of its property in the longer term. Although the lease may specify standards of operation, an unsatisfactory lessee may nevertheless remain in possession of the premises. In contrast, a licence . . . affords an effective control over the capital invested in the company-owned forecourt facilities.

Of the companies with a large proportion of tenants, some spoke of their concern to "find a mechanism which balanced [their] readier access to capital markets and ability to bear risk, against the need to motivate and provide incentives for those responsible for day-to-day site management". "The best mechanism varies according to the nature of the site", but "for many sites a tenancy is the most suitable form of agreement . . . because the security of tenure attracts a better quality of operator who feels that he has a stake in the business and would build it up." As for direct management and commission agency, the emphasis was very much on control issues. Directly managed sites were said to offer the opportunity "to gain first-hand experience of petrol and related retailing activities, and develop new marketing policies which could be applied across the network as a whole"; while "commission agency combines the required entrepreneurial activity on the part of the operator with the control [needed] over flagship sites" (MMC, 1990).

The clear message is that in this vertical relationship (as in any other), the features of the contract are a critical decision variable for the delegating party (the "principal"), because of their influence on the agent's behaviour. The terms of the delegating contract are crucial for the profitability of delegation, because they implicitly affect the retailer's choices – and define the most appropriate "type" of retailer to sign up. Whether the manufacturer's objective is just to solve the fundamental agency

problem posed by delegation (risk/incentives trade-off, i.e. to efficiently share risk while at the same time motivating hard work); or to efficiently allocate the agent's attention among his various duties (multi-task agency); or even to behave strategically in interbrand competition; in all cases it is by setting the terms of the contract that this is pursued.

Petrol retailing appears especially suitable for an empirical exploration of these issues, as it is quite plausible that companies may be pursuing any of these three objectives:

- (a) The sale of petrol at a retailer-operated filling station indeed falls within the boundaries of a standard agency problem: the (exogenous) demand uncertainty raises a risk-sharing question, while the positive effect of retailer's effort on sales points to the need for providing incentives. How these opposing influences are optimally traded off is the domain proper of agency theory, and the contract offered by the manufacturer (hence the shape of the retailer's compensation) will implicitly incorporate such trade-off;
- (b) Further, if the retailer's activity at the station is seen as a combination of different tasks (selling fuel, managing the station's shop, operating the garage/car sales business), each with a separate compensation structure for the retailer (but with mutual spillovers, both on the cost and the demand side), then the features of the contract should be set to reflect this;
- (c) Finally, if we also consider the competitive dimension (i.e. the fact that each filling station is likely to be in competition with at least one other site), then the terms of the contract should be optimally set taking into account the oligopolistic interaction among sites, and its effects on the retailers' price (and effort) choices. When the interdependence of the retailers' pricing decisions in their local market is recognized, it is plausible that contract terms are set by the manufacturer/wholesaler in such a way that the retailer's choices are "optimal", given rival retailers' choices. Or in other words: the delegating manufacturer will want to elicit from his retailer the "optimal" supply of effort *and* choice of price, taking into account that his retailer's price/effort choices affect the rival retailer's price/effort decisions. Hence the features of the contract are crucial instruments of upstream ("interbrand") competition, and there is room for strategic behaviour on the part of the manufacturer: the terms of the contract might be set with a view to conferring upon the retailer a Stackelberg-leader advantage in playing the downstream game. Vertical contracts are then most valuable for their commitment value for the manufacturer.

Predictions on contract choices based on arguments (a) and (b), i.e. on simple agency or multitask agency arguments, are not the purpose of this paper and will be addressed in a companion paper. The specific question we consider here is that implied by (c): when the firm operates in an oligopolistic context, can the delegation decision be motivated by the possibility of increasing the firm's final payoff (relative to the non-cooperative integrated equilibrium)? And what are the implications of specific choices of contract type for brand competition? We propose a simple model of a manufacturing duopoly in which both manufacturers have the opportunity to delegate the retailing of their product to an agent, and we explicitly consider the agency costs of such delegation. The petrol

retailing case is taken as our empirical reference throughout, and should provide fertile ground for testing our general insights into the role of contracts (organizational choices) in brand competition. Such testing, and in particular the empirical discrimination between competing interpretations of contract choice such as multitask agency and strategic behaviour, are left for future work.

2 INCORPORATING AGENCY CONSIDERATIONS INTO A MODEL OF STRATEGIC BEHAVIOUR

The recent literature on strategic behaviour in oligopoly² established that delegation of the retail function to an agent can have strategic value for the delegating manufacturer: it may provide him with a credible commitment device to a particular choice of action, thus giving him an advantage over his rival(s) in the downstream market game. This can improve the manufacturer's payoff.

The intuition is that in oligopolistic rivalry, the manufacturer *de facto* alters his strategy space by employing an agent to play the game on his behalf. He can set the terms of the contract (crucially, the level of the wholesale price) in such a way that the agent will play the game differently from what he himself would have done (credibly), and the possible outcome is an improvement in his final payoff. In particular, in a duopoly the effect of the delegation decision on the manufacturers' profits has been shown to depend on whether the strategic variables are substitutes or complements (Bonanno and Vickers, and Fershtmann and Judd). Both in price-space and quantity-space, delegation implies an outward shift in the firms' reaction curves, hence a move of the equilibrium point away from the standard Nash results to the Stackelberg equilibrium. Thus, delegation can be profit-enhancing (relative to the Nash equilibrium) only if the reaction functions are positively sloped (strategic complements). In addition, with strategic complements the benefits from delegation also depend on the degree of demand substitutability in the market (Coughlan and Wernerfelt 1989, Gal-Or 1991).

Most of the standard literature on strategic behaviour in a duopoly tends to be based on two (restricting) assumptions: that the retailer only chooses retail prices or quantities, and not simultaneously the level of effort; and/or that the retailer is generally risk-neutral. With few exceptions (notably Katz 1991), the implications of risk aversion on the part of the agent are not considered, as are other agency considerations which might prevent the achievement of the first-best solution for the manufacturer. Indeed, the common assumption in this literature is that the intermediate price schedule set by the manufacturer has a two-part structure, with a fully extracting franchise fee. This means that the manufacturer is able to appropriate the entire downstream profit through a lump-sum fee, calculated (and paid) *ex-ante* on the basis of expected sales; he can therefore choose the wholesale price w , so as to maximize the entire vertical profit p, q . The feasibility of a fully-extracting fee also means that the agency problem is implicitly solved: such a fee is only conceivable under the specific assumption that the retailer is risk-neutral, and can be made the residual claimant to the retail activity. Residual claimancy internalizes the agency cost of effort, and therefore ensures that effort is optimally provided, from the point of view of the vertical structure.³

² Vickers (1985), Fershtmann and Judd (1987), Sklivas (1987), Bonanno and Vickers (1988), and others.

³ In fact, this is strictly true only if we assume that the personal cost/disutility of effort for the retailer is the same as the manufacturer's own, i.e. the manufacturer and the retailer not only have the same risk preferences, but also the same preferences over income/leisure. Unless we make this additional assumption on preferences it is not strictly true that the retailer will choose the optimal amount of effort from the manufacturer's point of view, and perfectly internalize the cost of agency through residual claimancy. This is obvious when considering that agency costs are of two kinds: the direct cost of effort, and its transaction cost, i.e. the premium required by the retailer for

Although the assumption of a risk-neutral retailer (residual claimant) is made most often in the literature, from an empirical perspective the only relevant cases are likely to be those where a fully-extracting franchise fee is not feasible, and agency considerations prevent the attainment of the first-best. Implicitly recognizing this, Katz (1991) first argued that with strategic complements, agency considerations could affect prices in the same direction as strategic motives: thus the agent's risk aversion can allow the manufacturer to commit himself to a higher wholesale price, thereby improving his payoff. And more generally, all agency considerations which prevent full extraction of the downstream profit – thereby increasing the wholesale price – provide the manufacturer with a credible commitment device to less aggressive pricing (relaxing price competition).

Focusing on the case of a duopoly with prices as the strategic variable, this paper explores in greater detail the potential for agency considerations (costs) to be used as commitment devices, under different assumptions on the responsiveness of demand to rivals' price changes. For this purpose, we identify the separate components of the agency costs incurred by the manufacturer as a consequence of his delegation decision, and their mutual relationships. Our main results are as follows:

1. For some such relationships (i.e. over some intervals of the relevant agency parameters), the net impact of delegation on the manufacturer's profit is positive (relative to the non-delegated case). This suggests that under given circumstances, the manufacturer might deliberately incur agency costs in order to be able to commit himself to a less aggressive pricing strategy, which enhances his payoff.
2. Furthermore, we find that the manufacturer's benefit from delegation can even be increasing in his agency costs, at least over a certain interval: that is, his profits under the delegation regime increase in the retailer's risk aversion r and marginal cost of effort C' (in that range). This suggests that we may identify a particular combination of r , C' which maximizes (*ceteris paribus*) the manufacturer's benefit from delegation, i.e. the difference between his delegated and integrated profits. This is of particular significance for empirical applications. In particular, it implies that for given intensity of local competition, and given asset characteristics (location, size, presumed responsiveness of volumes to effort), the manufacturer can achieve maximum benefit from delegation when employing a retailer with specific personal characteristics (risk preferences, personal cost of effort). Thus, if we postulate that the contracts are drawn up by the manufacturer with the purpose of attracting that type of retailer, we can predict the type of contract most likely to be found at any given filling station on the basis of two pieces of information: intensity of local competition, and station characteristics.

In other words, there is a strategic dimension to delegation, consisting of its potential as a credible

bearing the risk associated with his expected income. When the retailer is risk-neutral, the second type of cost is eliminated, while residual claimancy fully internalizes the first type of cost – i.e. ensures optimal provision of effort from the manufacturer's point of view – only if $C(e)$ is the same for both. If, say, the cost/disutility of effort were to be greater for the retailer than for the manufacturer, then even residual claimancy would not ensure the optimal choice of effort from the manufacturer's perspective (effort would be underprovided).

commitment device for the manufacturer to less aggressive pricing, even when (and partly because) there are agency costs for the same manufacturer to bear. In addition, the relative benefits from delegation can be maximized by the manufacturer by devising the terms of his contract offer to retailers to match the location/station characteristics. The contract offer is thus a screening device for the manufacturer to sort the most suitable retailer "types", in such a way as to optimize the benefit from delegation. Thus not only can delegation play a strategic role, but also the specific choice of contract, with its screening implications, can optimize this strategic role.

3 THE MODEL

General Intuition and Formal Description of the Game

Standard agency considerations predict that if the agent/retailer is risk-averse, he will demand the payment for his activity to incorporate a premium for the risk he bears, as well as a compensation for the personal cost/disutility he incurs in providing effort. This implies that, if the retailer is risk-averse (and yet a fully-insuring fixed wage is not desirable for its bad incentive properties), the manufacturer will not be able to appropriate the whole of the downstream profit $(p_i - w_i)q_i$ through the fixed fee. The retailer will have to be left with a portion of this profit, large enough to compensate him for the risk borne, and the cost of effort incurred. Only if the fixed fee specified in the manufacturer's contract offer leaves the retailer with enough profit, in expected value terms, to cover these costs, will the contract be accepted.

Hereafter we characterize a "contract" as a pair $\{w_i, F_i\}$, i.e. a document specifying the wholesale price set by the manufacturer, and the relative fixed fee he expects to receive (pay) *ex ante* from (to) the retailer. Agency theory predicts that a residual claimancy contract – which is optimal for incentive purposes – will not be accepted by a risk-averse retailer because it implies he bears all the risk, while the manufacturer is fully shielded (he extracts the entire expected downstream profits *ex-ante*). The size of the retailer's margin $(p_i - w_i)$, which measures the intensity of his effort incentives, also defines the retailer's risk (the absolute risk to which the retailer is exposed increases with the margin); a risk-averse retailer will only accept a contract which suitably compensates him for this risk. We can thus expect that (compared to residual claimancy) the contract which is acceptable to a risk-averse retailer specifies a lower F_i (and a higher w_i), leaving him with a risk-adjusted profit in expected-value terms at least as large as his (riskless) reservation profit. Following Milgrom and Roberts (1992), we can be more precise about this constraint. If we define the retailer's income as $\pi = (p_i - w_i)q_i - F_i$ (we assume retailing costs are zero), the "certain equivalent" of this uncertain income is its expected value minus a risk premium which is approximately equal to $1/2r\text{Var}(\pi)$,⁴ and minus the direct cost of the effort required.

In this framework, the retailer will only accept a contract if the certain equivalent of his profit from the contract is (at least) as much as his reservation profit π_0 ; i.e. if

$$(p_i - w_i)q_i - F_i - C(e) - 1/2r\text{Var}\{(p_i - w_i)q_i\} \geq \pi_0$$

Thus, when agency considerations are explicitly introduced, the fixed fee the manufacturer can extract is defined by a specific constraint: that in certain-equivalent terms, the retailer's net profit (i.e. net of the fee) cannot be lower than his reservation profit, or he will not accept the contract. The fixed fee is therefore, by definition, the difference between the total expected downstream profit $(p_i - w_i)q_i - C(e)$, and the portion of that total the retailer must retain if he is to earn at least as much, in certain-

⁴ As shown by Arrow (1970), and others. This result holds under the assumptions that the (retailer's) utility function $u(\cdot)$ be three times continuously differentiable, and that $u'(\cdot) > 0$. The implicit assumption is that the variance of the uncertain income is not too large, or the coefficient of risk-aversion is small.

equivalent terms, as his reservation profit π_0 , that is $(\pi_0 + C(e) + \frac{1}{2}r\text{Var}\{.J})$. And if (for simplicity) we normalize the retailer's reservation profit from the outside activity to zero, then the fixed fee is just

$$(p_i - w_i)q_i - C(e) - \frac{1}{2}r\text{Var}\{.J\}.$$

If the retailer is risk-neutral, the manufacturer can extract the entire downstream profit $(p_i - w_i)q_i$ through the fee, and set w_i to maximize the integrated profit $[w_i q_i + (p_i - w_i)q_i] = p_i q_i$. On the other hand, the more risk averse the retailer is (and/or the higher his cost of effort, the lower the productivity of such effort, the higher the variance of sales), the larger the compensation he will demand for his agency, and therefore the lower the fixed fee. Indeed, depending on the actual parameters of the agency problem it may be the case that the compensation required by the retailer fully offsets (or even exceeds) the downstream profit $(p_i - w_i)q_i$, in which case we have linear pricing (or a negative fixed fee, i.e. a net lump-sum transfer to the retailer).

Of course, the manufacturer will take all this into account when setting the wholesale price w_i , which will be increasing with the retailer's risk aversion at least over some interval for r . This way the manufacturer extracts some of the downstream profit through the wholesale price, while the fixed fee is reduced. Beyond a certain threshold for r , however, w_i will start to decline in r . The intuition is as follows (as we shall see below in greater detail): the larger is r , the more the retailer tries to reduce his absolute risk by setting the final price p_i comparatively lower; thus p_i also increases with r , but at a slower rate than w_i , which implies – as $(p_i - w_i)$ declines – that the intensity of incentives for the retailer's effort is lessened. Thus when r rises beyond a certain value, the delegating manufacturer's profit may be lower than its integrated equivalent, or even negative, and therefore this may not be an equilibrium strategy.

Formally, we consider a three-stage game:

1. In a manufacturing duopoly, each manufacturer offers his retailer a contract $\{w_i, F_i\}$, specifying a wholesale price w_i and a fixed fee F_i .
2. Each retailer accepts the contract $\{w_i, F_i\}$ only if it yields him a net profit which in expected value terms is worth at least as much as his (riskless/effortless) reservation profit π_0 ; that is, if his profit net of the fixed fee equals π_0 plus the "direct" and "transaction" costs of effort. When π_0 is normalized to zero, this implies that it must be

$$F_i \leq E[(p_i - w_i)q_i] - C(e) - \frac{1}{2}r\text{Var}\{(p_i - w_i)q_i\}.$$

In fact, for given retailer characteristics (risk-aversion, disutility of effort), and other parameters (variance of sales, productivity of effort), there will be a particular pair $\{w_i, F_i\}$ at which the retailer is just indifferent between accepting or rejecting the contract. And as he can always adjust the fee to extract any surplus downstream profit from the retailer, the manufacturer will not need to leave the retailer with more than this "threshold" level of profit. Thus for each set of parameter values $(r, C', \sigma^2, \gamma)$, there will be only one contract offer: a pair $\{w_i, F_i\}$ where w_i is set by the manufacturer to maximize his profit $(w_i q_i + F_i)$, subject to the constraint that F_i must leave the retailer with a strictly non-negative net profit in certain-equivalent terms. This contract will be accepted by the retailer.

Otherwise, the contract will be rejected. Hence the above inequality is strictly an equality, i.e. it will be $F_i = E[J] - C(e) - \frac{1}{2}r\text{Var}[.]$.

3. The retailers compete in the product market, each choosing the retail price p_i and the level of effort to be supplied, e_i (for the moment, we restrict our attention to the case where effort is only *demand-expanding*, and not *cost-reducing*). We consider a (differentiated) manufacturing duopoly with firms competing in prices. The demand function has a random component θ and it is linear in prices and effort, of the form $q_i = (\theta + \gamma e_i) - p_i + \beta p_j$, $\theta \sim N(V_\theta, \sigma^2)$

satisfying the standard conditions:

- demand for good i is decreasing and concave in price, i.e. $\partial q_i / \partial p_i < 0$ and $\partial^2 q_i / \partial p_i^2 \leq 0$, while it is increasing in retailer's effort, i.e. $\partial q_i / \partial e_i > 0$;
- goods are (demand) substitutes: $\partial q_i / \partial p_j > 0$ (which implies $\beta > 0$).

The coefficient β on rival's price is also constrained to be < 1 (as we have normalized the coefficient on own price to 1).

Solution of the Game

As usual, the game is solved backwards. In the last stage, the retailer maximizes the certain equivalent of his (net) income with respect to retail price p_i and effort e_i . The solution to this problem yields the optimal price p_i chosen by the retailer as a function of a given wholesale price w_i , of the agency parameters ($r, C(e), \sigma^2, \gamma$), and of the market parameter β . This price is optimal in the sense that it is set by the retailer to maximize his own payoff for given w_i ; and as it incorporates the retailer's incentive compatibility condition, it is also the price for which effort is optimally chosen from the retailer's point of view (again for given w_i). That is, for each given w_i there will be a unique Nash equilibrium in the downstream market (a unique set of equilibrium prices p_i, p_j , and effort levels e_i, e_j).⁵ By substituting this expression for p_i in the demand function, we obtain q_i as a function of w_i and the agency parameters; and then the (expected) downstream profit $\pi = (p_i - w_i) q_i$ also as a function of w_i and the agency parameters.

In the second stage, the retailer accepts the manufacturer's contract offer, because this is a pair $\{w_i, F_i\}$ which leaves him with a net profit (after the fee is extracted) which is equal – in certain equivalent terms – to his reservation profit π_0 (here normalized to zero). And given the above definition of "certain equivalent", this means that the fixed fee F_i (i.e. the portion of total downstream profit π that the manufacturer can claw back) must be equal to the difference $\pi - [\pi_0 + C(e) + \frac{1}{2}r(p_i - w_i)^2 \sigma^2]$. This is the retailer's participation constraint, which we can therefore also express as a function of w_i and the agency parameters r, C , etc.

In the first stage, the manufacturer chooses the wholesale price w_i to maximize his total profit $\Pi_i = w_i q_i + F_i$ (we assume production costs are zero), subject to the retailer's participation constraint (that

⁵ Such equilibrium is assumed stable, i.e. it must be $\partial^2 \pi_i / \partial p_i^2 + \partial^2 \pi_i / \partial p_i \partial p_j < 0$ which is satisfied for $\beta < 2$. As we assumed above that in any case $\beta < 1$, this stability constraint is not binding.

the retailer's profit in certain equivalent terms equals his reservation profit). This yields w_i and then p_i , q_i , F_i and Π_i as functions of β and the agency parameters r , $C(e)$, γ , σ^2 . These steps are developed as follows.

As mentioned, demand for good i is assumed linear, with the following arguments: a random component $\theta \sim N(V_0, \sigma^2)$, the retailer's own effort e_i (filtered through a productivity parameter γ), own and rival's price: $q_i = (\theta + \gamma e_i - p_i + \beta p_j)$. In order to understand the interaction between effort, its marginal cost, and the retail price, it helps if we think of the demand curve as a demand surface, in three dimensions: q_i , p_i , and e_i (or C'_i). Everything else being equal, demand for good i decreases in own price p_i , and increases in effort (or decreases in the marginal cost of effort).

In certain-equivalent (C.E.) terms, the retailer's net income is

$$C.E. = (p_i - w_i) (\gamma e_i + V_0 - p_i + \beta p_j) - C(e_i) - \frac{1}{2} r (p_i - w_i) \sigma^2 - F_i$$

In the last stage, the retailer will maximize this expression with respect to both *effort* e_i and *retail price* p_i . The first-order conditions are

$$\text{wrt } e_i : \quad (p_i - w_i) \gamma - C'(e) = 0 \quad \text{Incentive Compatibility Constraint}$$

$$\text{wrt } p_i : \quad (V_0 + \gamma e_i - 2p_i + \beta p_j + w_i) - r(p_i - w_i) \sigma^2 = 0$$

The incentive compatibility constraint, which must be satisfied by any feasible contract, says that the retailer will select his level of effort in such a way that at the margin, his gain from one additional unit of effort (i.e. the productivity of this effort in terms of volume, times his margin on each extra unit sold: $\gamma(p_i - w_i)$) equals his marginal personal cost of effort $C'(e)$. Incorporating the constraint in the second first order condition yields $(V_0 + \gamma e_i) - 2p_i + \beta p_j + w_i - r \sigma^2 C'/\gamma = 0$.

Letting (for convenience) $(V_0 + \gamma e_i) = A$, $r \sigma^2 = \delta$, $C'/\gamma = \varepsilon$, we obtain $p_i = \frac{A + w_i - \delta \varepsilon + \beta p_j}{2}$.

The Nash equilibrium in the downstream market (assuming retailers are symmetric) yields

$$p_i = \frac{A - \delta \varepsilon}{2 - \beta} + \frac{2w_i + \beta w_j}{4 - \beta^2} \quad (1)$$

This is the optimal final price selected by each retailer for given wholesale price w_i (and agency parameters). It is optimal in the sense that it maximizes the retailer's income while at the same time satisfying the incentive compatibility condition, for given w_i . From this, we can derive q_i also as a function of w_i and all the agency parameters. By substituting (1) in $q_i = A - p_i + \beta p_j$, we obtain

$$q_i = \frac{A + \delta \varepsilon (1 - \beta)}{2 - \beta} - \frac{w_i (2 - \beta^2) - \beta w_j}{4 - \beta^2} \quad (2)$$

Let us now consider the manufacturer's maximization problem.

The manufacturer's profit is $\Pi_i = w_i q_i + F_i$, which in certain-equivalent terms is $w_i (A - p_i + \beta p_i) + F_i$. The wholesale price will be chosen by the manufacturer to maximize Π_i , subject to the retailer's participation constraint: that after the extraction of the fee, the retailer is left with just enough downstream profit to match, in certain-equivalent terms, his reservation profit (i.e. the riskless/effortless profit from his outside activity) π_0 , normalized at $\pi_0=0$. That is, it must be

$$(p_i - w_i)q_i - F_i \geq \pi_0 + C(e_i) + \frac{1}{2}r(p_i - w_i)^2\sigma^2 = C(e_i) + \frac{1}{2}r(p_i - w_i)^2\sigma^2$$

For the moment, we can assume the constraint is satisfied with equality: any contract where the fee did not leave the retailer with at least $\pi_0 + C + \frac{1}{2}r(p_i - w_i)^2\sigma^2$ would not be acceptable to him; on the other hand, if we assume the job market for retailers is fully competitive, the manufacturer should not need to leave the retailer with any pockets of rent (competition among retailers will ensure that this is the case – see however Section 6 below on this point). Any surplus downstream profit over the direct and transaction costs of effort will be appropriated by the manufacturer by increasing F_i . Hence

$$F_i = (p_i - w_i)q_i - C(e_i) - \frac{1}{2}r(p_i - w_i)^2\sigma^2 \quad \text{Participation Constraint}$$

and therefore the manufacturer's maximization problem is

$$\max_{w_i} w_i q_i + F_i \quad \text{s.t. } F_i = (p_i - w_i)q_i - C(e_i) - \frac{1}{2}r(p_i - w_i)^2\sigma^2 .$$

This can be solved by directly substituting the constraint into the maximand, and then maximizing the result with respect to w_i . The manufacturer's problem therefore becomes

$$\max_{w_i} p_i q_i - C(e_i) - \frac{1}{2}r(p_i - w_i)^2\sigma^2$$

Substituting (1) and (2) for p_i and q_i , and then differentiating with respect to w_i , yields

$$w_i = \frac{A\beta^2 + \delta [A(2-\beta^2) + \varepsilon(4-2\beta-\beta^2)] - \delta^2\varepsilon(2-\beta^2)}{4-2\beta-\beta^2 + \delta(2-\beta^2)(1-\beta)} \quad (3)$$

where, as above, $A = (V_0 + \gamma e_i)$, $\delta = r\sigma^2$, $\varepsilon = C'(e)/\gamma$.

Then substituting (3) back into (1) and (2) yields the optimal retail price chosen by the retailer,

$$p_i^* = \frac{2A + (A\delta - \varepsilon\delta^2)(2-\beta^2)}{4-2\beta-\beta^2 + \delta(2-\beta^2)(1-\beta)} \quad (4)$$

and the relative quantities sold

$$q_i^* = \frac{(2-\beta^2)[A + \delta\varepsilon(1-\beta)]}{4-2\beta-\beta^2 + \delta(2-\beta^2)(1-\beta)} \quad (5)$$

The comparative statics of the optimal wholesale price (i.e. how it varies with the agency parameters r , σ^2 , $C'(e)$, γ , or the demand parameter β) are discussed in detail in the next Section. We can however

anticipate the basic intuition. **Figure 1** shows the optimal w_i as a function of the agency parameters $r\sigma^2$ (for given $A, C'/\gamma$): w_i increases with the retailer's risk aversion and/or with σ^2 – at least up to a certain value for $r\sigma^2$. This reflects the manufacturer's response to the standard agency problem: the higher the (exogenous) demand uncertainty, or the retailer's aversion for risk, the lower the portion of the retailer's income which should be variable for the retailer to accept the contract. Thus, the manufacturer will have to offer a contract with a higher wholesale price, and (as will be shown below) a correspondingly lower fixed fee. Otherwise, the contract will not be accepted.

In addition, w_i is both higher, and increases faster with $r\sigma^2$, the higher is β (coefficient on the rival's price). The intuition for this is that the higher is the cross-price elasticity, i.e. the more sensitive is demand for good i to the price set by the rival, the more valuable for the manufacturer is the opportunity to commit to a higher wholesale price, for strategic reasons. That is, the more intense is downstream competition (high β), the more the manufacturer can benefit from behaving strategically – and he will therefore exploit the commitment possibilities of retailing through a risk-averse agent to the fullest. Vice versa, when the goods are not very close substitutes, and cross-price sensitivities are low, the benefit for the manufacturer of strategic behaviour is reduced, and he will be less interested in implicitly committing himself to a higher price by farming out the retail function to a risk-averse agent. The chosen wholesale price will therefore be lower. **Figure 2** shows the retail price as a function of $r\sigma^2$ (from (4)).

Necessary restriction: $p_i \geq w_i$

The w_i and p_i curves in Figures 1 and 2 are truncated beyond certain values of $r\sigma^2$ in order to satisfy the condition $p_i \geq w_i$, i.e. that the retail price is higher than (or at most equal to) the wholesale price. This condition must be imposed to ensure meaningful results from the model. Given that the amount of risk borne by the retailer is a function of the absolute difference between p_i and w_i , it follows that a very risk-averse retailer will at most set $p_i = w_i$, and receive a fixed payment from the manufacturer (at which point his volume-related risk is zero). It is not plausible for the retailer to set the final price *below* the intermediate price (and receive a "larger" net transfer in the form of a fixed wage): this would imply that he is still facing risk (absolute difference $p_i - w_i \neq 0$), but now the "downside" (what the retailer wants protection from) is higher-than-expected volumes. That is, the retailer would be better off (paradoxically) if volumes were low (because, given his fixed wage, he then pays a lower $w_i q_i$ to the manufacturer) than if they were high.

The condition for $p_i > w_i$ is $\delta < \frac{A}{\varepsilon} \frac{(2-\beta^2)}{(4-2\beta-\beta^2)}$ (i.e. it must be $0 < \delta < A/(2\varepsilon)$ for $\beta=0$, increasing

to $0 < \delta < A/2$ as $\beta \rightarrow 1$).

While we must impose $p_i \geq w_i$, there is no reason to require that the wholesale price charged by the manufacturer is greater than his (marginal) production cost (which is here normalized to zero). Suppose the retailer were risk-neutral (or even very slightly risk-averse), and effort very important for sales (high effort productivity), so that providing adequately large incentives was crucial. Then there would be no reason why the manufacturer could not sell to the retailer at an intermediate price which is

below marginal cost, recovering the difference through a large fixed fee. The only constraint on the manufacturer's willingness to adopt such a contract, once the participation constraint is satisfied and therefore the contract is acceptable to the retailer, is that he himself makes positive profits out of it. Better still, that the manufacturer's payoff under such arrangement is superior to the payoff he would obtain if he were to retail directly (Bertrand/Nash equilibrium profit), instead of delegating (if direct retailing were possible). In our particular case, however, it turns out that the interval in which $p_i \geq w_i$ is narrower than the one over which $w_i \geq 0$, hence the above condition $p_i \geq w_i$ also implicitly ensures that $w_i \geq 0$, i.e. the intermediate price never falls below marginal cost in our model.

Consider now the fixed fee. By substituting (3), (4) and (5) for w_i , p_i and q_i in the participation constraint $F_i = (p_i - w_i)q_i - C(e) - \frac{1}{2}r(C'/\gamma)^2\sigma^2$, we obtain

$$F_i^* = \frac{A(2-\beta^2)^2[A+\delta^2\epsilon(1-\beta)] - (2-\beta^2)(4-2\beta-\beta^2)[A\delta\epsilon + \delta^2\epsilon(1-\beta)]}{[4-2\beta-\beta^2 + \delta(2-\beta^2)(1-\beta)]^2} - C(e) - \frac{1}{2}\delta\epsilon^2$$

Figure 3 illustrates how the fixed fee F_i varies with the agency parameters $r\sigma^2$ (holding C'/γ constant), and must be seen in relation to Figure 1. In conformity with the predictions of agency theory, the fixed fee is largest when the retailer is risk neutral ($r=0$), and it decreases as the value of $r\sigma^2$ increases – while at the same time (as seen above) the wholesale price increases. That is, the higher is r , the greater the proportion of the downstream profit the manufacturer extracts through the wholesale price rather than through the fee – thus reducing the risk the retailer bears (and the efficiency loss from this). It is also apparent that beyond a certain value for $r\sigma^2$, the fee becomes negative, i.e. there is a net lump-sum transfer from the manufacturer to the retailer. This is consistent with our definition of the fixed fee as the "surplus" of the total downstream profit over the compensation the retailer must receive for the direct and transaction cost of effort (or he will not accept the contract). The fee becomes zero (that is, we have linear pricing) when the compensation demanded by the retailer exactly matches $(p_i - w_i)q_i$. This is confirmed in Figure 4, which shows the total agency cost $C(e) + \frac{1}{2}r\sigma^2(C'/\gamma)$ (direct + transaction cost of effort) as a function of $r\sigma^2$, together with the total downstream profit $(p_i - w_i)q_i$ for different values of β . The values of $r\sigma^2$ for which the fixed fee is nil (in Figure 3) correspond to those for which the agency cost equals the downstream profit (Figure 4).

Finally, the total manufacturer's profit (the sum of $w_i q_i$ and F_i) can be calculated as

$$\Pi_i = p_i q_i - C(e) - \frac{1}{2}r\sigma^2(C'/\gamma)^2$$

which yields

$$\Pi_i^d = \{A^2[2+\delta(2-\beta^2)] - A\delta^2\epsilon[(2\beta-\beta^2)-\delta(2-\beta^2)(1-\beta)] - (\delta^2\epsilon)^2(2-\beta^2)(1-\beta)\} \cdot \frac{(2-\beta^2)}{[4-2\beta-\beta^2 + \delta(2-\beta^2)(1-\beta)]^2} - C(e) - \frac{1}{2}\delta\epsilon^2$$

This profit (where the superscript "d" indicates it is the manufacturer's payoff under "strategic delegation") is graphed in Figure 5 as a function of $r\sigma^2$. It is decreasing in $r\sigma^2$ for all values of β ,

which is to be expected in the light of the agency costs involved: the more risk-averse the retailer, or the higher the variance of demand, the higher is the risk-premium he will ask for bearing the risk associated with any given income; that is, the larger the share of the total surplus that the retailer will retain, at the manufacturer's expense. Hence more of the manufacturer's profit will be "absorbed" by the retailer's compensation. The manufacturer's profit becomes nil where the total cost of agency wipes out the overall profit.

In order to assess the actual benefit to the manufacturer of employing an agent to retail the good on his behalf, the "strategic delegation" profit must be compared to the standard non-cooperative Bertrand/Nash profit on the one hand, and to the monopoly profit on the other. That is, to the profit each manufacturer would make if he played the game directly (i.e. if he retailed the product himself instead of employing an agent), without colluding with his rival in the (slightly differentiated) duopoly; and if he were able to collude fully and effectively with his competitor. Under the latter option, and assuming the manufacturers are symmetric, the market demand function becomes $Q = q_i + q_j = 2A - 2p(1-\beta)$, (from $q_i = A - p_i + \beta p_j$ and $q_j = A - p_j + \beta p_i$, where as usual $A = \theta + \gamma e_i$).

The joint profit-maximizing price is then $p^m = \frac{A}{2(1-\beta)}$, and the profit made by each

manufacturer (one half of the industry's collusive profit) is $\Pi_i^m = \frac{A^2}{4(1-\beta)}$. As shown in **Figure 6**

(for the particular case of $\beta=0.9$), this profit is higher than that achieved under strategic delegation. The outcome of the integrated non-cooperative game, ie the Bertrand/Nash equilibrium, is easily derived as follows: each manufacturer sets the retail price p_i for his good in such a way as to maximize his profit $\Pi_i^B = p_i q_i$, ie

$$\max_{p_i} p_i (V_0 + \gamma e_i - p_i + \beta p_j) .$$

This yields $p_i^B = \frac{A^2}{2-\beta}$ after solving the market game, and $\Pi_i^B = \frac{A^2}{(2-\beta)^2}$ is the equilibrium

Bertrand/Nash profit. **Figure 7** compares the manufacturer's profit under strategic delegation with the corresponding non-cooperative Bertrand/Nash profit, for different values of β , and clearly shows that delegation is not always profit-enhancing relative to the Bertrand base-case. The higher is β , the larger is the range of $r\sigma^2$ in which each manufacturer's total payoff Π_i exceeds its corresponding Bertrand/Nash value; and when the value of β is very low (*ceteris paribus*), it may not be at all worthwhile for the duopolist manufacturers to delegate (the payoff can be smaller than even the non-cooperative integrated case).

The intuition for this (discussed more fully in Section 4) is that when β is low, and therefore the sensitivity of retail demand to rivals' prices is very limited, the credible commitment opportunities afforded by delegation are inherently less attractive for the manufacturer. Since the demand for his product does not respond significantly to his rivals' price changes, his retailer is "almost" a monopolist

in his area, and there is less advantage to be gained in committing to less aggressive pricing. Indeed, the agency costs of employing a risk-averse retailer might completely offset what advantage there is in committing to a higher price, and the manufacturer may very well be better off foregoing delegation completely and retailing his product directly.

However, when the value of β is higher (i.e. the demand for good i is sensitive to the price of good j), there is a more substantial potential gain from delegation for the manufacturer. That is, when downstream competition is more intense, there is certainly more appeal in the possibility of credible commitment; and the manufacturer may find it in his interest to employ a risk-averse retailer and bear the agency cost involved, if he can reap a strategic advantage from higher retail prices. In other words: because the equilibrium retail price in the (delegated) market game increases with β , when β is high the manufacturer can employ a retailer with comparatively higher risk-aversion and still be relatively better off than the integrated case. Though the agency costs borne by the manufacturer increase with the retailer's risk aversion, it will take a higher value of r for these costs to dent the strategic benefits from delegation.

This important result can be re-stated as follows. When collusion at the manufacturers' level is not possible, the delegation of the retail activity to agents still allows the manufacturers to improve their payoffs, relative to the non-cooperative integrated case. Most importantly, delegation gives the manufacturer a strategic benefit not only when the retailer is risk-neutral and can be made the residual claimant, but even when there are agency costs to bear: such benefit will be realized until the manufacturer's strategic profit is greater than the agency costs.

Thus as originally suggested by Katz (1991), the very fact of employing a risk-averse agent provides the manufacturer with a credible commitment device to a higher wholesale price, and thereby with a way of sending an implicit "olive branch" to his rival. In this Section, we have developed this intuition further: we have identified the individual components of the agency costs sustained by the manufacturer for delegating, and argued that over a realistic range of values for the agency parameters, the manufacturer's net payoff is significantly higher than the non-cooperative profit level in spite of these costs. Indeed, it is precisely the manufacturer's willingness to bear them, which gives credibility to his commitment.

The cross-elasticity of demand plays a crucial role in this result, as the strategic benefits of retail delegation for the manufacturer increase with the intensity of downstream competition (β). Indeed, if β is small it is very possible that delegation (and bearing the related agency costs), may not be at all worthwhile for the manufacturer. However if β is large, the strategic benefit will be large enough to offset the agency costs.

4 COMPARATIVE STATICS OF MANUFACTURER'S AND RETAILER'S CHOICES

The purpose of the model is to make explicit the role of agency considerations in the game played by delegating duopolists. We now consider its comparative statics properties, verifying how the results change with changes in the parameters β , r , σ^2 , C' , γ . We provide an intuition for the influence of the agency parameters on the outcome of the game. We then consider an interpretation of these results in terms of oligopolistic interaction.

The Impact of Agency Considerations

Delegation of the retail function to a risk-averse agent has the effect of raising both the retail and the wholesale equilibrium prices, relative to the case where the retailer is risk neutral (i.e. $p_i^{(r \neq 0)} > p_i^{(r=0)}$ and $w_i^{(r \neq 0)} > w_i^{(r=0)}$, over the relevant range for the agency parameters). Similarly, equilibrium prices are higher when there is noise in the measurement of effort than if effort were perfectly observable; while lower retailer ability or lower productivity of effort reduces the equilibrium retail price (and also the wholesale price, over a certain range). The total impact of agency considerations on the manufacturer's and the retailer's choices can thus be broken down, *ceteris paribus*, into two separate effects: the effect of the retailer's risk aversion and/or demand variability ($r\sigma^2$); and the effect of C'/γ , the ratio of the retailer's marginal cost of effort to the productivity of such effort.

(a) The effect of $r(\sigma^2)$

Everything else being equal, the optimal *wholesale price* w_i^* set by the manufacturer increases with $r\sigma^2$, up to a certain value, then starts decreasing; while the *fixed fee* F_i^* the manufacturer can extract from the retailer is a decreasing function of $r\sigma^2$. The intuition is straightforward: the higher the retailer's risk aversion, the more concerned he will be to reduce the variable portion of his income; i.e. a more risk-averse retailer will only accept a contract which confers upon him a lower absolute risk (for given expected income); knowing this, the manufacturer offers him a contract specifying a comparatively larger intermediate unit price, and a smaller fixed fee.

The optimal *retail price* p_i^* also increases with $r\sigma^2$ up to a certain value for $r\sigma^2$, which is lower than the value at which w_i^* starts declining (i.e. w_i^* continues to increase for a while even as p_i^* is declining). This pattern reflects the implicit interplay of profit-maximization and risk-minimization in the retailer's decision-making process. Compare the Bertrand/Nash equilibrium in the downstream market for a risk-neutral and a risk-averse retailer: the risk-neutral retailer (facing a wholesale price w_i and a (linear) demand curve of the form $q_i = (\theta + \gamma e_i) - p_i + \beta p_j$), maximizes his profit by setting

$$p_i^* = \frac{A}{2-\beta} + \frac{2w_i + \beta w_j}{4-\beta^2};$$

while for a risk-averse retailer, setting the optimal retail price means

finding the optimal trade-off between standard profit maximization and minimization of his total absolute risk. The retailer's absolute risk is proportional to his marginal revenue ($p_i - w_i$) (the higher this markup, the larger the portion of his income which is variable); hence the higher the retailer's degree of risk aversion, the lower the marginal revenue he will consider optimal (for given w_i). He

will therefore set the retail price to yield a (comparatively) lower marginal revenue.

The final equilibrium price is defined as $p_i^* = \frac{A - \delta e}{2 - \beta} + \frac{2w_i + \beta w_j}{4 - \beta^2}$: this is the price which maximizes

the retailer's profit (for given w_i), compatibly with the risk he is prepared to tolerate.

Thus the more risk-averse the retailer is, the more he will try to reduce the variability of his income (his risk) by reducing the size of his marginal revenue. This is the reason why, at the margin, the retail price increases with $r\sigma^2$ more slowly than the wholesale price. And for high enough values of $r\sigma^2$, everything else being equal, the retail price can even decline as $r\sigma^2$ increases.

(b) *The effect of C'/γ*

The equilibrium price p_i^* set by the retailer increases in effort e ($\partial p_i / \partial e > 0$ always if $C(e)$ is linear⁶). The reason is simply that when more units are sold through effort, the retailer can set a higher profit-maximizing price. For analogous reasons, the equilibrium price p_i^* decreases with C'/γ :

$$\partial p_i / \partial (C'/\gamma) = -\delta^2(2 - \beta^2) < 0$$

That is, when the marginal cost of effort is higher (and/or the marginal product of such effort is lower), the retailer maximizes his profit by setting the final price comparatively lower (everything else being equal). The intuition is as follows. Given the incentive compatibility condition, the higher C' (lower γ) the higher should be the retailer's marginal revenue for him to provide the *same* amount of effort: hence the retailer should be setting a higher p_i^* for given w_i . However a higher price reduces sales, and therefore the volumes gained through effort must be set against the volumes lost through higher prices. In other words: given the shape of the demand surface in $\{p_i, q_i, C'\}$ -space, a higher C' means less effort is provided *ceteris paribus*, and therefore sales of good i are lower; in order to sell the same as before, the retailer must reduce his price. The lower the "efficacy of incentives", i.e. the higher C'/γ , the lower the price which optimizes the retailer's profit.⁷

The optimal wholesale price w_i^* increases with C'/γ for "low enough" values of $r\sigma^2$ (in particular, for

$r\sigma^2 < \frac{4 - 2\beta - \beta^2}{2 - \beta^2}$). That is when the retailer's risk aversion (or demand variability) is "low" the

optimal wholesale price *increases* with his dislike for effort. For "high enough" values of $r\sigma^2$, however, w_i^* *decreases* with C'/γ (and the range of "acceptable" values for C'/γ , i.e. the range over which $p_i > w_i$, is also narrower). The reason for this becomes clearer when the trade-offs of agency considerations and oligopolistic interaction are carefully considered.

⁶ When $C(e)$ is non-linear, $\partial p_i / \partial e$ can become negative for "high enough" values of $C'(e)$, i.e. when the marginal cost of effort increases very steeply with effort.

⁷ Also, the decrease in the retail price over C'/γ is steeper, the more risk-averse the retailer is (i.e. a more risk-averse retailer will reduce p_i^* more significantly as the marginal cost of his effort increases). This is because the smaller the prospective gain from effort (the higher C'), the less risk the retailer will be prepared to take on. Thus he will set the retail price in such a way that the marginal revenue decreases more steeply with C'/γ , the higher is r .

The duopolist manufacturer wishes to exploit the commitment value of delegation for increasing his wholesale price, provided the agency cost of doing so (which he must ultimately bear) is not too high (i.e. delegation is a credible way of raising w_i^* , and it is advantageous – relative to the Bertrand/Nash payoff – so long as the agency costs do not offset the gain from less aggressive oligopolistic rivalry). There is therefore a trade-off not only between risk aversion and incentives (as in a standard agency problem), but between incentives, risk aversion and strategic gains. There are two cases:

– "low" r : the incentive compatibility constraint ($p_i - w_i = C'/\gamma$) prescribes that the higher is C' (or, if we consider the dislike of effort an inverse function of the retailer's ability, the less able is the retailer) the higher should be the margin for the same effort to be provided: the manufacturer should set a lower w_i . However, a higher margin increases the retailer's risk, and therefore the risk premium he demands: hence the manufacturer would find himself reducing w_i to maintain incentives, while at the same time reducing F_i to satisfy the participation constraint. This is not desirable: volumes may benefit from increased effort, but at the same time the agency cost increases. The manufacturer may be better off raising his wholesale price instead: this reduces the incentives for effort (hence sales through effort are reduced), but at the same time the agency cost is lower (because the absolute risk faced by the retailer is lower).

– "high" r : if however the retailer's risk aversion is high, the wholesale price set by the manufacturer will decline with C'/γ . This is because high risk aversion already increases w_i significantly, and in these circumstances it may be worthwhile for the manufacturer to trade-off some of the strategic benefits of higher prices for the (agency) benefits of higher incentives (higher volumes). Thus if the retailer is "very able", and at the same time very risk-averse, the manufacturer's gains from extra effort are greater than his marginal benefit from increasing the wholesale price further. The volume-gain from effort is then preferable to the strategic gain from higher prices. In other words: a high value of $r\sigma^2$ "swings" the trade-off between agency and strategic considerations back in favour of agency.

Finally, the fixed fee F_i^* decreases with C'/γ (i.e. it increases as the "efficacy of incentives" increases); also, a lower efficacy of incentives (higher C'/γ) increases the steepness of the F_i curve over $r\sigma^2$: that is, F_i decreases more rapidly with $r\sigma^2$ the higher is C'/γ . This for two reasons: first, total volumes are lower the higher is C'/γ (either effort is more costly, and therefore less of it is provided, or its productivity is lower: in both cases, sales volumes are lower); secondly, as argued above, the retailer's marginal revenue is lower the higher is C'/γ , and therefore the fee is smaller.⁸

The Impact of Oligopolistic Interaction

The manufacturer's advantage from delegation (with strategic complements) depends not only on agency considerations, but specifically on the relationship between agency costs and the degree of demand substitutability between rival products in the market. Indeed, it is the intensity of the oligopolistic interaction which lends agency its strategic significance: greater interaction (more intense

⁸ This is true *ceteris paribus*, i.e. if the change in the slope of the $C(e)$ curve preserves the absolute level of $C(e)$. If an increase in the steepness of $C(e)$ is accompanied (say) by an increase in the absolute level of $C(e)$, then the two above effects are combined, and the F_i curve is simultaneously shifted down, and becomes steeper.

downstream competition) allows the manufacturer(s) to exploit more fully the potential of agency as a commitment device for relaxing price competition.

Developing the established result that the manufacturer's advantage from delegation ($\Pi_i^d - \Pi_i^B$) increases with β when the cost of agency is nil (fully-extracting franchise fee),⁹ our model shows that a higher β also allows the manufacturer to incur larger agency cost while at the same time still benefiting from delegation. That is, the benefit of agency can be realized by the manufacturer not only when the implicit agency cost is zero (in which case $\Pi_i^d - \Pi_i^B$ simply increases with β); but also when such cost is not internalized, provided that β is large enough.

Oligopolistic interaction is pivotal to this result: in a general principal-agent model, with risk-averse agent and a monopolist principal, the risk/insurance trade-off implies an efficiency cost for the principal, which *always* reduces his payoff relative to the first-best. What gives the standard agency relationship a strategic dimension is its introduction in an *oligopoly* context. In such a context, agency costs still prevent the manufacturer/principal from fully extracting the downstream profit (as in the monopoly case), but at the same time they provide him with a credible commitment device to a higher wholesale price, and therefore a higher retail price. Thus even when the extraction of the downstream profit through the fee is not perfect, the delegation decision may still be profitable. In particular, it depends on the degree of demand substitutability between the goods in the market (sensitivity of demand to rival prices), which in our model is measured by the value of β .

The effect of β on the outcome of the game, and therefore its bearing on the delegation decision, is immediately clear when considering **Figure 8 (a and b)**. The first diagram displays the effect of the delegation decision on the firms' reaction curves (in p_i, p_j space), providing a graphic justification for the claim that delegation with strategic complements relaxes price competition, and increases the manufacturer's profit. When the manufacturers are integrated and play non-cooperatively, the reaction

function is defined as $R_i^B(p_j) = \frac{A + \beta p_j}{2}$, and the equilibrium solution (Bertrand/Nash) is indicated

by N in the diagram. With delegation, the expression for firm i 's reaction function becomes

$$R_i^d(p_j) = \frac{A + \beta p_j + (w_i - \delta \epsilon)}{2}. \text{ This suggests that delegation shifts out the firms' reaction curves, at}$$

least until $w_i > \delta \epsilon$; and as a result, the equilibrium prices are higher (D) and the manufacturer's profits are higher. The presence of the extra term $(w_i - \delta \epsilon)$ concisely emphasizes the central idea of the model: that delegation can improve each manufacturer's payoff by committing him to a wholesale

⁹ If the retailer is risk-neutral, and a fully-extracting franchise fee can be charged by the manufacturer, the agency cost to the manufacturer is zero because residual claimancy for the retailer internalizes agency costs. Then

the manufacturer's profit is simply $\Pi_i = \frac{2A^2(2-\beta^2)}{(4-2\beta-\beta^2)}$ in our model. This payoff is larger than the Bertrand/Nash

payoff for any values of β , and also increases with β faster than Π_i^B – implying that the relative advantage of delegation for the manufacturer increases with β . For a formal general proof, see Bonanno and Vickers (1988).

price above his cost ($w_i > 0$), but at the same time there is an agency cost for him to bear if the retailer is risk-averse and/or dislikes effort. This agency cost fully offsets the benefit from delegation when $\delta\epsilon \geq w_i$: in that case the reaction curves are "shifted in", and at the new equilibrium prices and profits are lower. The second diagram (Fig.8.b) illustrates how the parameter β affects the shape of the reaction curves (everything else being equal), and thereby final prices and the manufacturers' equilibrium payoffs. As is apparent, higher values of β correspond to reaction functions which are "flatter" (each in relation to its axis). Altogether, an identical wholesale price w_i and identical retailer/station characteristics (δ, ϵ), which shift the curves by the same amount (relative to the integrated case), will produce a shift of the final equilibrium point which is greater, the larger is β (i.e. the "flatter" the curves). The delegating manufacturers find themselves on higher isoprofit curves, the higher is β (*ceteris paribus*).

5 COSTS AND BENEFITS OF AGENCY FOR THE MANUFACTURER'S PAYOFF

The significant result from the model is the possibility that delegation may improve the manufacturer's payoff even when there are agency costs to bear; indeed, incurring agency costs might be the most profitable strategy, for the commitment opportunities they provide to the manufacturer. The implications are remarkable: the manufacturer might attain a larger final payoff if he employs for example a more risk-averse, or a less able agent, than if he retailed his product directly. And this even after the direct and transaction costs of agency are accounted for. Furthermore, under some conditions the manufacturer's profit (and his benefit from delegation) may even be an increasing function of his agency costs. The implication is that he could deliberately incur such costs for their strategic benefits. The relationship between costs and strategic benefits of agency is therefore the key to any testable prediction we may derive from the model.

Clearly, the established literature on strategic vertical separation in oligopoly does not explore such a relationship. This is because agency costs are implicitly eliminated (internalized) in the adopted framework: the standard assumption is that a fully-extracting franchise fee can be charged by the manufacturer, which implies that the retailer is risk-neutral and can be made the residual claimant. With residual claimancy, the agency cost of delegation is fully internalized, and the duopolist manufacturers can always benefit from delegation (the more so the more intense is the competition among them). In other words, in such circumstances the manufacturer can benefit from the strategic effects of delegation, without directly incurring its agency costs.

However, when agency considerations prevent residual claimancy for the retailer, then the manufacturer must ultimately bear the agency cost of the retailer's effort. Such cost offsets, at least in part, the positive strategic effect of delegation. Hence, as a general principle, delegation will be chosen when its strategic benefits for competing duopolists outweigh the agency costs they bear. The strategic benefit for the manufacturer of employing a risk-averse retailer (the ability to commit himself indirectly to a higher retail price), must be weighed against the agency cost this implies (risk premium). The conditions for profitable delegation in our model are spelt out in Section 6 below.

A Parallel: Agency Costs and Strategic Benefits of Delegation in Signalling

The general idea of comparing (agency) costs and (strategic) benefits of delegation is also to be found in Caillaud and Hermalin (1993), in the context of a signalling model. Though the context is different, the premises are similar: these authors observe that "in most finance and industrial organization models in which an agent (the firm's manager) signals information about the firm, agency problems are typically ignored." They explicitly address the issue of whether in a signalling context, agency harms or benefits the principal, and show that the principal can sometimes do better by employing an agent than managing the firm himself. As in our case, the basic intuition is that "the costs inherent in employing an agent can serve indirectly (directly if the contract were observable) to commit the principal to actions which he could not otherwise commit if he played for himself."

This result is derived comparing a conventional signalling model where the signalling is done by the principal/owner, and an agent-managed firm where the signalling is done by the agent. In the first case (*the principal game*) the principal privately learns the characteristics of the firm (its "type"), and then takes an unobservable action directly affecting profits. This conveys information to a second party about the firm's characteristics; the second party, in turn, responds to this information, which also affects the firm's profits. (For example, an incumbent monopoly takes an action – e.g. investment or first-period pricing – that affects profits and influences the beliefs of a potential entrant about the profitability of entry; these beliefs, in turn, influence his entry decision). Under standard assumptions, the familiar result is obtained for signalling games: there exists a unique separating equilibrium, which can (typically) exhibit upward distortions in the actions: to distinguish themselves from worse types, better types take greater actions than they would under full information. In the case of the agent-managed firm (*the agent game*) it is the agent who privately learns the characteristics of the firm, and also bears the cost of signalling.

The agent-game and the principal-game are qualitatively similar,¹⁰ the only difference being that in the agent-game the principal must bear certain agency costs. These consist in particular of the information rent which the principal must pay the better-type agents to prevent them from mimicking worse-type agents. To reduce this information rent/agency cost, the principal distorts downwards the actions chosen by different types of agents, and this downward distortion partly offsets the upward distortion from signalling, benefiting the principal. This benefit, in turn, can exceed the agency cost, in which case the principal's expected profit is actually greater when employing an agent than when managing the firm himself.

Caillaud and Hermalin explore this general intuition with particular reference to limit-pricing, and show that (under certain assumptions) an incumbent monopolist (the principal) can do better to hire a retailer (the agent) than to retail his output himself. In particular, by comparing the principal's expected profits when he does his own retailing, and when he hires an agent to do his retailing in the first period, Caillaud and Hermalin show that the greater the gain by concealing from the potential entrant that the incumbent has high costs, the greater the distortion that is necessary for the low-cost type to prove his type. Then the principal benefits most from employing an agent when the signalling distortion is greatest. In other words, the cost of the signalling distortion is increasing in the gain enjoyed by a high-cost incumbent from successfully deterring entry. Furthermore, because this benefit can be increasing in the cost of agency, the principal can do better the greater are the costs of agency, i.e. his expected profit can even be increasing in the cost of agency.

Of course, there are substantial differences between this model and ours. The most obvious one is that in our model (as in Katz (1991)), the principal wishes to use the agency contract to force the agent to play a "tough" response to the other party's action; in their model, the agent moves before the third party; and also, there is asymmetric information between the firm's manager and the third party.

¹⁰ If a certain "screening condition" is satisfied: better-type agents find a given level of the signal less costly than worse-type agents.

The general point, however, remains the same: the principal must compare the costs and strategic/signalling benefits of agency. And the results are qualitatively similar: as in our model, the commitment benefits of agency are increasing in the cost of agency; and this gain in commitment can outweigh the greater cost of agency. Or vice versa, when the costs of agency are reduced, the commitment value of agency falls, and for certain parameter values, this loss in commitment value exceeds the savings from lower agency costs. A further development along these lines is that when the principal does better by employing an agent, he may prefer to hire a less able agent over a more able agent: the intuition, again, is that by lowering the cost of agency, the commitment value of employing an agent is reduced; and the loss of commitment value can exceed the savings from lower agency costs.

6 PREDICTIONS FROM THE MODEL: RETAILERS' SCREENING AS A STRATEGIC DEVICE

Caillaud and Hermalin's (1993) qualitative results, as presented in the previous Section, have important analogies with our own. **Figure 9 (a and b)** show the manufacturer's "delegated" profit simultaneously as a function of r and C' (for given A and two different values of β – "low" and "high"), and suggests that there are circumstances in which delegation is a worthwhile strategy, in spite of the agency costs it implies for the manufacturer. There are two interesting cases to consider:

- (i) For some particular combinations of values (or ranges of values) of the relevant parameters (β , A , $r\sigma^2$, C'/γ), delegation to a risk-averse/less able agent (higher r , C') improves the manufacturer's profit above the integrated, non-cooperative outcome (as defined by the Bertrand/Nash equilibrium): $\Pi^d > \Pi^B$. Outside these ranges, the manufacturer is better off retailing his product directly (if possible), and playing the market game non-cooperatively;
- (ii) Furthermore, for some ranges the manufacturer's profit under delegation is an increasing function of his agency costs, i.e. it increases with r and/or C' (everything else being equal).

The question is then under what specific conditions can we expect (i) and (ii) to occur. If delegation to an agent can improve the manufacturer's payoff relative to the integrated non-cooperative equilibrium, and indeed if such profit can be increasing in the agency costs incurred, what are the mutual relationships among the relevant parameters for which these are most likely to occur? Identifying such relationships is crucial for making (testable) predictions on the circumstances in which delegation is more profitable than integration, and in which therefore delegation is more likely to be found. If these predictions were confirmed empirically, it would suggest that contract assignment by manufacturers actually follows strategic considerations.

Let us now consider (i) and (ii) in turn.

Strategic Benefits of Agency (over the non-cooperative integrated profit)

The difference $\Pi_i^d - \Pi_i^B$ between the duopolists' profits under delegation and the integrated non-cooperative equilibrium is shown in **Figure 10 (a and b)** (again for two values of β , "low" and "high"). Ideally, we would like to be able to identify the specific conditions (i.e. the specific relationships among $r\sigma^2$, C'/γ , β , A) for which such difference is positive: under such conditions, adopting a delegated structure is beneficial for the manufacturer, and preferable to retailing directly. Unfortunately, the analytical expression for this difference is intractable. Further insight can be gained, however, from graphical analysis.

The graph of the manufacturer's payoff as a function of $r\sigma^2$ (Figure 7) suggested that delegation is worthwhile (relative to the Nash/Bertrand integrated profit) when (for given C'/γ) $r\sigma^2$ is "small enough" relative to the "combined value" of A and β . Similarly, delegation appears to improve

the manufacturer's payoff when (for given $r\sigma^2$) C'/γ is "small enough" relative to "some combination" of A and β . The intuition is straightforward: employing an agent/retailer can be a payoff-improving strategy for the manufacturer provided that the two goods are close substitutes (*high* β), so the potential strategic benefit from delegation is significant; and/or the transaction cost of effort is not too large (in equilibrium, such transaction cost is measured by the risk premium $\frac{1}{2}r\sigma^2(C'/\gamma)^2$ which the manufacturer ultimately bears, and which increases with the retailer's risk aversion/disutility of effort). In other words: when the combined value of the retailer's risk aversion and marginal disutility of effort is "sufficiently low", then the agency cost of effort is not large enough to offset the manufacturer's benefit from a higher w_i . Beyond certain values of r and C' , however, the increase in the agency cost of effort defeats the purpose of delegation: an increasingly large portion of the total vertical profit is absorbed by the need to compensate the retailer for his effort, and the increase in w_i is not sufficient to counter the negative effect on the manufacturer's profit. When this is so, the manufacturer is better off remaining integrated.

The curves in **Figure 11** show the combinations of r and C' for which $\Pi_i^d - \Pi_i^B = 0$ (for given β and A). The shaded area below the curve indicates the region in which $\Pi_i^d > \Pi_i^B$. The shape of the curve indicates that there is a trade-off between retailer's risk-aversion and disutility of effort in the manufacturer's profit; and an increase in β (or A) has the effect of pushing out the curve, indicating that the manufacturer's tolerance of agency cost increases as β and/or A increase.

In other words: the difference $\Pi_i^d - \Pi_i^B$ tends to be positive (i.e. delegation is worthwhile for the manufacturer) as long as the "combined" values of r and C' remain *below* some "critical threshold"; which implies that simultaneously high values of r and C' are unlikely to improve the delegating manufacturer's payoff (at least when β , A are "low"). The "critical threshold" increases with β and A . The reason is that a higher β allows the manufacturer to set a relatively higher w_i , *ceteris paribus*, hence to benefit more from strategic behaviour; while a higher value of A reduces, *ceteris paribus*, the coefficient of variation of income (STD/Mean), and is therefore equivalent to a reduction in risk. This implies the manufacturer can then tolerate higher retailer's risk aversion (or dislike for effort): i.e. he can delegate to a more risk averse or a less able retailer and still make a profit which is larger than the Bertrand base-case. The parameters σ^2 and $1/\gamma$ have a role which is analogous, in terms of the manufacturer's payoff, to that of r and C' . The preliminary conclusion from this graphic analysis is therefore that delegation improves the manufacturer's profit, relative to the integrated case, when the combined values of r and C' are lower than a threshold which is an increasing function of β , A and γ , and a decreasing function of σ^2 .

The Manufacturer's Profit as an Increasing Function of his Agency Costs

As suggested by **Figure 9**, not only can agency costs improve the manufacturer's payoff relative to the integrated equilibrium; under certain conditions, such payoff can also increase in the agency costs. The implication is that, when the relevant conditions are fulfilled, not only can the manufacturer "do better" by employing a risk-averse/not-so-able retailer; but – somewhat paradoxically – he can do even better by employing an even more risk-averse/less able retailer.

The fundamental reason remains the trade-off between the higher wholesale price, which agency makes possible insofar as it constitutes for the manufacturer a credible commitment device, and the cost of such agency. Up to a point, higher r and/or C' increase w_1 , and the manufacturer's revenues, "more" than they increase the agency cost, which implies the manufacturer's relative benefit from delegation increases. This opens the possibility that the manufacturer may deliberately incur higher agency costs (employ a more risk-averse/less able retailer), in order to reap even greater (strategic) benefits.

Consider first the conditions under which Π_i^d is increasing in the agency costs. Again, as the partial derivative of such profit with respect to r (or C') is not analytically tractable, we cannot determine with precision the mutual ranges of the parameters β , A , $r\sigma^2$, C'/γ which make (ii) possible; we therefore proceed with the graphical analysis.

Figure 12 (approximately) delineates two regions: the shaded area "below" curve (1), and the hatched area "above and to the left" of curve (2). These have the following interpretations.

The shaded area below curve (1) is the region of all possible pairs $\{r\sigma^2, C'/\gamma\}$ for which Π_i^d increases with $r\sigma^2$, given C' (and given β , A). Curve (1) is the "frontier" of this region, and defines the values of $r\sigma^2$ which maximize the partial derivative of the manufacturer's profit, for each value of C'/γ , i.e. it is the locus of pairs (r, C') which maximize the manufacturer's profit with respect to one dimension only: r . This frontier is shifted "out" by increases in β , which suggests the following general pattern: for low values of β , the manufacturer's profit can be increased (until reaching a maximum) by "reducing" r (i.e. by compensating the agency cost of low retailer ability with lower risk aversion); unless C' is low enough, in which case profits may be improved by increasing r instead. That is, when C' is sufficiently low there might be some gain for the manufacturer in increasing rather than decreasing r , i.e. compounding the agency cost of lower ability with that of higher risk-aversion (instead of trying to offset one component of agency cost with lower values of the other). When β is high, the latter effect becomes more and more dominant, i.e. for each given C' there is a larger range of values of r over which the manufacturer's payoff increases with r (in other words the manufacturer's profit is maximized for gradually higher, rather than lower, values of r).

Analogous considerations can be applied, *mutatis mutandis*, to the other dimension of the retailer's profile: C' . The hatched area "above and to the left" of curve (2) is the region of all possible combinations of r and C' for which $\partial\Pi_i^d/\partial C' > 0$ (for given r); and the "frontier" of such region traces the optimal combinations of C' in relation to r (locus of $\partial\Pi_i^d/\partial C' = 0$). The shape and position of this frontier suggest the following pattern: when β is low, the manufacturer's profit can be generally improved by reducing C' ; but if r is high enough, it is possible that the manufacturer's profits may be improved by increasing C' (up to a point where a local maximum is reached): again, the effects of the two types of agency costs are compounded.

These patterns come into focus bearing in mind that the *leitmotiv* of the model is the trade-off between strategic and agency considerations. There is a fundamental tension, running throughout the model, between the two arguments: while it is possible for one to reinforce the other (agency can indeed serve as a commitment device), it is also possible that the cost of doing so might be too high, and fully

offset the (relative) benefit. In this framework, the value of the parameter β is ultimately crucial in determining the "swing" towards one outcome or the other (i.e. in deciding whether in the end strategic or agency considerations prevail).

Figure 13a shows the manufacturer's profit, on which we marked the two distinct sets of profit-maximizing pairs (r, C') . The two ridges of the profit curve in the Figure correspond to the "frontiers" discussed above: one represents the set of optimal r for given C' (i.e. the set of values for r which maximize the payoff for each given C'), and the other the set of optimal C' for given r (everything else being equal). This makes it possible to explore the full effects of the trade-off between agency and strategic motives, i.e. the impact of simultaneous changes in both variables (r, C') on the manufacturer's profit from delegation.

The essence of strategic behaviour (with price competition) is to make use of any available device which makes it possible to *credibly* increase the wholesale price, or to reduce effort (at least up to a point). This is because in both cases, the intensity of downstream price competition is reduced. *Ceteris paribus*, the wholesale price can be increased by employing a more risk-averse retailer (higher r); while effort can be reduced by employing a less able retailer (higher C'). Thus, if purely strategic considerations were to prevail, the manufacturer would want to combine lower retailer ability with higher risk-aversion (high C' , high r).

However, the agency cost of such behaviour must always be reckoned with: both r and C' affect the risk-premium demanded by the retailer, and (as we have seen) their combined effect on the participation constraint and on the size of the fixed fee may offset the strategic benefit altogether. Hence if purely agency considerations were to prevail (disregarding any effect on prices, and any potential strategic benefit), then the manufacturer would try to reduce the efficiency loss of delegation by combining higher r with lower C' , and vice versa (i.e. offset the efficiency loss of high retailer's risk-aversion with high ability, and vice versa).

The general prediction has to be that in circumstances where the strategic benefit of delegation is more likely to be low (that is, where oligopolistic interaction is weak), then agency considerations might very well prevail in the manufacturer's decision process. He will therefore set his choice variables to maximize his profit from an agency point of view, i.e. to minimize the efficiency loss of his choices. At the same time, if oligopolistic interaction is intense the choice will be made – most likely – on strategic grounds.

This analysis clearly points to the pivotal role of β in the process: when β is high, and therefore there is more scope for oligopolistic interaction, the strategic motive prevails, and the trade-off will "swing" in favour of strategic considerations: it is worthwhile for the manufacturer to exploit the commitment opportunity offered by a more risk-averse/less able retailer. When β is low, however, there is not so much potential gain to be made from oligopolistic interaction (when demand is not very sensitive to rivals' prices, the manufacturer is by definition a quasi-monopolist on his territory); thus agency issues will prevail. Figure 13b demonstrates this clearly with an example. Starting from any particular combination of r, C' for which $\partial \Pi_i^d / \partial C' = 0$, such as a , suppose C' were to increase (for

exogenous reasons) while r remains constant (i.e. move to b). The question is then how can the manufacturer's payoff be maximized (new equilibrium) by appropriate changes in r . There are two possibilities:

- (a) On the basis of agency considerations alone, for given C' the manufacturer would wish to reduce r , in order to compensate at least in part for the higher agency cost (higher C'): this should push the equilibrium at point d ;
- (b) From the strategic point of view, however, the new equilibrium for given C' should be at point c , as strategic considerations induce the manufacturer to combine higher C' with higher r (at least up to a certain point). That is, strategic behaviour implies that following an exogenous change in either C' or r , the manufacturer can improve his profit by producing a change in r or C' in the same direction as the exogenous change in C' (r).

Which solution prevails in the end is a matter of the relative positions of c and d , and in particular on the slopes of the ridges. When point c is in absolute terms higher than point d , then we should expect the strategic argument to prevail, and vice versa. This depends on β : when β is low, d is likely to be higher than c , and therefore the equilibrium should veer towards d ; when β is high, c tends to be relatively higher. (In graphic terms, the effect of an increase in β can be visualized as "lifting" the profit surface from its "far end" – i.e. where r is high. In other words, the ridge $\partial\Pi_i^d/\partial C' = 0$ is "upward sloping"). Thus an increase in β produces an increase in the relative heights of c and d , lifting up c relative to d , and the strategic solution will be more likely to prevail.

To sum up: considering the two dimensions of the retailer's profile (r and C'), and their *joint* impact on the manufacturer's (delegated) profit, it is possible to make some statements on the most attractive retailer's profile (from the manufacturer's point of view) for given asset/location. And assuming the manufacturer will then try to attract that type of retailer through his contract offer, this translates into a prediction on the *type of contract* which should be associated with any given station.

Our key result is therefore that contracts may have a "screening" function, but for strategic reasons: the manufacturer knows that for a given asset/location he may improve his profit most when the retailer has given characteristics, and tries to attract that type of retailer through the contract offer.

Menus of Contracts: Is the Equilibrium Separating?

The underlying assumption of the previous Sections is that, given specific station/location characteristics (σ^2 , γ , β), it should be possible to identify the retailer "type" which can maximize the manufacturer's profit (above the integrated level). One problem with this approach is that the possible combinations of market/asset/retailer characteristics (and therefore the possible contracts) are potentially very large, which implies that the total transaction costs of individually negotiating a contract with each retailer are manifestly disproportionate. These costs explain why manufacturers often narrow down their contract offers to a limited number of contract "types", i.e. to a "menu" of standardized contracts.

This is particularly relevant in petrol retailing, where there is an established menu of contract types under which filling stations are operated, each incorporating a different structure for the retailer's compensation – i.e. a different incentive mechanism. The fact that contract terms differ across types, but tend to be fairly homogeneous within each type, suggests that each type forms a separate category in the menu of contracts – one which is not observationally equivalent to any other. The implication, which is the underpinning of this work, is that each contract type is "best suited", or "preferable" under particular circumstances, and will therefore be adopted when such circumstances arise. Thus for certain ranges of the underlying market/asset/retailer parameters, it is to be expected that one particular "type" of contract will be the wholesaler's "optimal" response to his agency problem; this is the contract we expect to be adopted.

In this framework, picking out a contract from a given (standard) menu, and offering it to the retailer(s) on a take-it-or-leave-it basis takes the place of setting the terms of each contract in each individual circumstance. Both stem from the manufacturer's search for a solution to the incentive problem, but using a menu drastically reduces the transaction costs of contract negotiation. Of course, since the parameters which ultimately determine the optimal incentive scheme are in a continuum,¹¹ while the contracts offered in the "menu" are just a limited number of types (with similar terms within types), it is to be expected that some degree of pooling will take place within each type. The fact that, for example, retailers with somewhat different individual profiles might be offered the same contract to operate a particular filling station is an inevitable expression of this pooling. The implication of course is that if no individual adjustment can be made on the lump-sum transfer, there is always a portion of the downstream rent that the contract is not able to extract from the retailers who are "better" than implied by the contract profile. This loss is however compensated, for the manufacturer, by saving on the transaction costs of negotiation.

The question raised by menus of contracts is whether contracts designed by the wholesaler to attract a particular type of retailer (leaving him, by construction, with zero excess profits in certain-equivalent terms) would not also attract other types. If this were to be the case, then the notion of "sorting" retailers through the terms of the contract offer (i.e. the contract type) would not be sustainable. We thus have to show that the equilibrium of the model is separating, i.e. that there are (at least two) plausible retailer types who would choose different contracts from a given menu.

In what follows, we adopt a simplified representation of contract types as "points" in $\{r, C'\}$ -space. If a particular contract – say "Y" in **Figure 14a** – is designed to fit a specific retailer profile *exactly* (i.e. it is "just right" for a retailer with risk-aversion r_Y and marginal cost of effort C'_Y , leaving him with a risk-adjusted profit exactly equal to his reservation wage), then that contract will certainly never attract retailers with characteristics "to the right and above" Y, i.e. retailers with risk-aversion greater than r_Y and marginal cost of effort greater than C'_Y . Such a retailer would not receive enough compensation for the risk he is supposed to carry, and his certain-equivalent income would be negative.

¹¹ For example the retailer's profile, as concisely expressed by his risk aversion and attitude to effort, can have potentially infinite values, as many as the possible combinations of these two parameters.

However a contract like Y will always be accepted by a retailer such as "A", with lower risk-aversion and greater ability (lower r , lower C'). Since he is more able/less risk-averse than the retailer for which that contract is (in principle) designed, retailer A is left with some rent the manufacturer cannot extract: the wholesale price he pays is higher than what he would be willing to accept (i.e. the unit margin is lower), but he is more able and can therefore sell more this way, and in any case he pays a lower fee. The question is then why a retailer like X, or below X, in **Figure 14a** would accept contract X but not Y; i.e. why should retailers "separate" on the different contracts, instead of all taking contract Y (the one designed for the more risk-averse, less able type). Indeed, it turns out that for the same reasons given for A, even a retailer with characteristics matching X *exactly* will still prefer Y to X. This is because by accepting X, a retailer with $r = r_X$ and $C' = C'_X$ is left with a C.E.-income exactly equal to his reservation wage, while if he takes Y he is left with a positive surplus: his greater ability means he can sell more unit than a "true-Y" at the same margin.

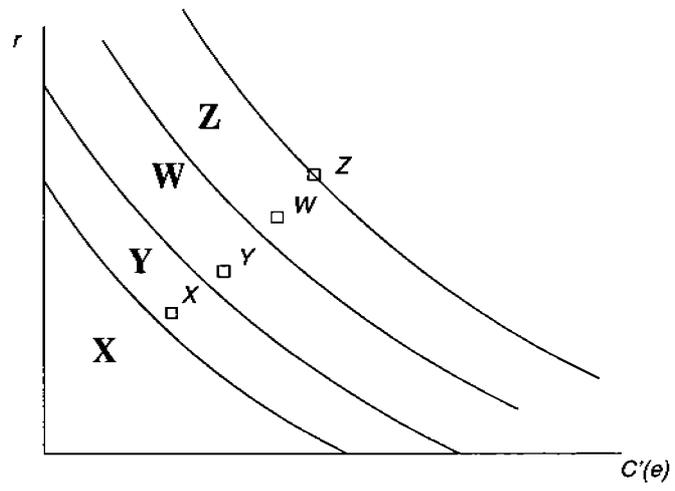
Proposition 6.1 For a retailer with characteristics exactly equal to X, contract Y is preferable because he is left with a positive C.E.-income. (Proof in Appendix)

For the same reasons, contract Y will also attract a retailer with lower risk-aversion and greater ability than X (e.g. point "D" in **Figure 14a**). There is however a point (such as "B" in the diagram) at which the retailer will indeed find contract X preferable over Y. Thus

Proposition 6.2 At some point "below" X (such as "D"), the retailer will find contract X preferable to Y. (Proof in Appendix)

The gist of the Proof is to compare the C.E.-income of a retailer such as D under contracts X and Y. Because of Proposition 6.1, they are both positive; their difference $C.E.(X|D) - C.E.(Y|D)$ is positive if D's increased revenue under X is so much greater than under Y, to outweigh the fact that the fixed fee he pays is lower under Y.

This can be seen also through a diagram. **Figure 14b** shows how the retailer's C.E. changes under different contracts, as his individual characteristics change. (The x-axis is thus the one-dimension equivalent of the $\{r, C'\}$ plane in the first diagram, i.e. each point on the x-axis corresponds to some vector of r, C' characteristics). After locating contracts X and Y on the line, the diagram suggests that for " rC' " greater than Y (i.e. $1/rC'$ lower), the retailer's C.E.-income under contract Y is negative, it becomes zero exactly for a retailer with characteristics equal to "Y", and then becomes positive. The same applies to the retailer's C.E.-income under contract X. However, when the retailer's characteristics are at "D" his C.E.-income becomes greater under X than under Y, and the retailer will prefer X to Y. The implication is that in $\{r, C'\}$ -space the presumed "regions" for the various contract types (eg contracts X, Y, Z, W) should look (approximately) as in the diagram below.



7 SOME GENERAL IMPLICATIONS FOR CONTRACT ASSIGNMENT: THE CASE OF PETROL RETAILING

The model's main qualitative result is the finding that not only is it possible for the manufacturer to improve his profit over the (non-cooperative) integrated level, by choosing the "right" contract – for given asset characteristics, or retailer characteristics, or competitive environment; but also, such profit can sometimes increase in the agency cost of delegation. By identifying the individual contribution of asset/retailer characteristics to such cost, the model implicitly suggests an interpretation not only for a simple binary choice of the type "delegate vs. integrate", but also for a multinomial choice such as the assignment of contract type.

The most immediate prediction from Section 6 centres on the role of β (which measures the sensitivity of own demand to rival's price). When β is low, which indicates that the intensity of local competition around the outlet is modest, the agency cost of delegation is more likely to prevail over its strategic benefit. This means that the manufacturer/wholesaler should be better off retailing its product through a retailer with low risk aversion, and low (marginal) disutility of effort. And in trying to attract such a retailer, he will offer a contract with a higher unit margin (only a retailer with low risk aversion would accept such a contract; and if he is also quite able it means he can provide more effort, *ceteris paribus*). When, on the other hand, β is high and therefore local competition is quite fierce, the strategic benefits of agency will tend to prevail over its costs, and the manufacturer/wholesaler can be better off employing a retailer who is comparatively more risk averse, or less able. Again, he will try to attract such a retailer through the terms of his contract offer: the unit margin will be relatively lower.

Thus, the first broad prediction from the model is that contracts with lower wholesale prices (higher unit margin) should be found more often where the intensity of local competition is low; and higher wholesale prices (lower margins) are more likely to be found where local competition is more intense, because gains from strategic behaviour in that case are more significant. This suggests a few comments on the interaction of agency and strategic considerations in the case of petrol retailing, with one possible prediction on the contract-assignment rule.

As we know, the problem facing a petrol refiner/wholesaler in deciding how best to operate an outlet for the sale of its branded petrol (choice of distribution mode), can be simplified as follows:¹² he can either be *integrated*, and staff the outlet with his own employees; or he can *delegate* the operation of the station to an agent/retailer, in which case he can choose among a number of options (contract types). The difference is that in the first case, the choice of retail price is made directly by the company, which also decides the amount of effort expected from the retailer and stipulates it in the contract (contracts of employment spell out in great detail standards of operation, and monitoring at company-managed outlets is more comprehensive and frequent). The retailer's compensation in this

¹² We assume there is no capital constraint, or any other constraint preventing the upstream company from buying a site and operating it directly if this is desirable for incentive purposes.

case does not contain explicit incentives (the – fixed – wage is set to take into account the desired amount of effort). In the second case, the retail price and the level of effort are chosen by the retailer, and the choice of contract type is essential because it defines the retailer's incentive scheme: in particular, the choice of the wholesale price (and of the fee) is the instrument through which the company can elicit "optimal" retailer's choices (from its own point of view).

Of course, delegation implies an agency cost (efficiency loss) when the agent's characteristics prevent the attainment of the first best solution (residual claimancy); and if it were possible to ignore any implication of delegation for price competition (that is, if we could think of the outlet as a monopolist in its local area), this cost alone would tend to discourage delegation (or at least induce the company to minimize it by choosing for example the least risk-averse, or most able retailer).

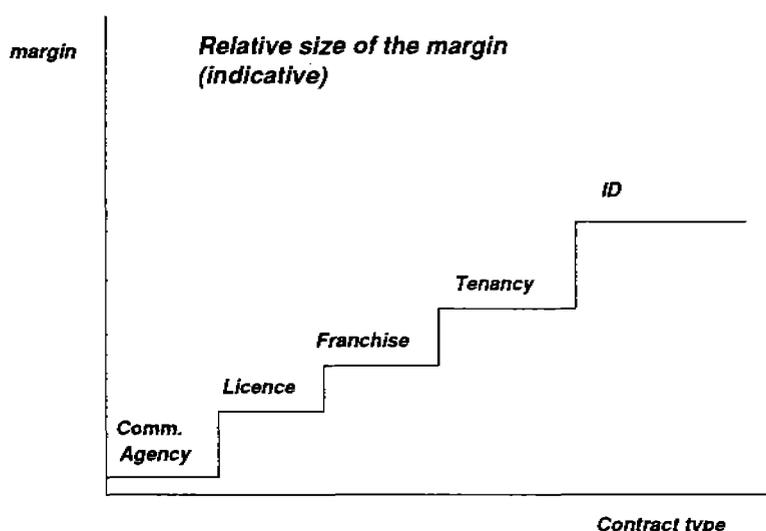
But as soon as we introduce a competitive dimension, it is in the company's interest to adopt any device which might reduce the intensity of *price* competition (while balancing this objective with ensuring that the retailer also provides the desired amount of effort). One effective way of doing so is to visibly raise the wholesale price, because this implies that one's retailer will set a relatively higher price; observing this, the rival will realize that he will be better off setting a higher wholesale price as well, and the final prices are higher in equilibrium. That is, setting a *visibly* higher wholesale price is a way of ensuring that one's final price will also be higher – or at least to reduce the incentives for gradual price reductions, leading otherwise to Bertrand-outcomes.

Visibility of the wholesale price is the obvious requirement for this commitment-effect to operate. Without such visibility (i.e. where rival companies in the market cannot see the actual wholesale price set by each of them), it is still possible to achieve this effect by otherwise conveying information on the relative level of the wholesale price. This is done in petrol retailing through the choice of contract type. Each contract is sufficiently stereotyped in its characteristics to define what the (relative) level of the wholesale price is. As the type of contract under which a station is operated can be plausibly considered common knowledge (at least for that station's rivals), the commitment-effect can still be obtained. For instance, a way of ensuring credible commitment to a higher price is to delegate retailing to a very risk-averse agent, who will only accept a contract where the variable portion of his income is very low (higher wholesale price, lower fixed fee). In practice, this is achieved by offering a contract where the margin per unit sold (commission) is very low. A low margin is equivalent in its screening properties, and in its commitment implications, to a high wholesale price: in both cases the retailer accepting the contract is relatively more risk averse, and in both cases the retailer's low marginal revenue ensures that his incentive to cut prices is very limited.

In terms of retailer's compensation, the crucial difference across the contract types in use in UK petrol retailing can indeed be identified in the *typical size of the margin* recognized to the retailer. The common practice in the UK petrol industry is to calculate the wholesale price backwards, as the difference between the official schedule price, which is changed periodically, and a discount/rebate specified in the contract. The final price is set by the retailer on the basis of this invoice price. Contracts also tend to specify that the retailer should not charge more than a "maximum recommended retail price": this is defined as the sum of invoice price and an official "recommended margin", which

is publicly announced by the wholesaler for all retailers in a particular class, and changed from time to time (usually every year). Though it may differ slightly from the actual margin the retailer pays (individual circumstances may change), this "official margin" provides at least an implicit ordering for the wholesale price paid by the retailer: in an industry where exogenous cost shocks are very frequent (changes in the dollar price of oil, or in the £/\$ exchange rate), and more generally retail conditions change rapidly, by setting the official margin the wholesaler commits himself to a relative distance between retail and wholesale price. Thus, setting the margin is equivalent to specifying a rule for calculating the wholesale price, and the ranking of typical margins for different contracts implicitly defines the ranking of the relative wholesale prices.

This notion that there is a "typical range" for the margin in each agreement, and therefore contracts can be ranked in terms of size of the margin (and wholesale price), is the underpinning to our entire investigation. This notion comes out strongly from all contract surveys (including the Monopolies and Mergers Commission Report, 1990). Our own discussions with a number of wholesalers also confirmed that, across companies offering the same type of agreement, the specified margins tend to fall within fairly narrow bands; and for different contract types, there is a significant enough difference in the average size of the margin to justify the ordering in the diagram below.



That is, different contract types are associated with different typical margins, the lowest applying to commission agencies and increasing step-wise through licences, tenancies and franchises to independent dealers. The full range pictured in the diagram goes from 0.7–0.8ppl (pence per litre) for commission agents, to 5–6 ppl for independent dealers.¹³

¹³ Of course in practice each individual contract (whatever its type) can be made equivalent to any other type, by introducing additional features which affect the apportionment between wholesale price and fixed fee. For example, an ID contract for a retailer who is also in receipt of a loan from the wholesaler might specify a margin which is lower than that typical for IDs, and possibly closer to a tenancy (or even a licence). This is because the retailer's risk preferences might imply he prefers to reimburse the loan in the way that most diffuses his risk. However this does not change the fact that *in general and on average*, IDs have the highest margin of all, and the description in the diagram tends to hold true.

In conclusion: if commitment to a higher price is desirable where local competition is more intense, we can therefore predict that stations which are located in urban areas, with a high density of competitors in the vicinities (and which can therefore benefit more from the possibility of reducing the intensity of price competition) should be operated under contracts where the retailer's margin is lower (e.g. commission agency, or licence). On the other hand, rural stations, or stations conveniently located in a residential catchment area, or stations with few nearby competitors, can be expected to be operated under tenancies or independent dealerships.

8 SUGGESTIONS FOR FUTURE WORK

More detailed predictions could be obtained from the model. Indeed its key feature is that, in describing how the manufacturer's payoff changes with each of the relevant parameters (β , γ , σ^2 , r , C'), it implicitly defines if and how such payoff could be improved, and optimized, with respect to any such parameter (everything else being equal). This suggests that it should be possible to make inferences on the contract-type which maximizes the manufacturer's benefit from delegation not only for given σ^2 , γ and β (as in Section 6); but also for different values of σ^2 and γ . That is, one possible way of refining the general prediction above could be to take into account the characteristics of the asset, as well as the intensity of local competition (β). Because of the analogies in the manufacturer's profit function between r and σ^2 , and between C' and $1/\gamma$, the idea is to apply the framework of Section 6 to the problem of evaluating the interaction of retailer and asset characteristics (for given intensity of competition). This should in turn provide suggestions on the type of retailer which optimizes the manufacturer's profit for given intensity of competition *and* characteristics of the asset; and ultimately therefore on the type of contract the manufacturer should offer to attract such retailer.

The physical characteristics of the asset are summarized in the model by parameters σ^2 and γ : it is plausible to assume that some such characteristics (e.g. convenience, facilities, additional services offered) may affect the variability of demand for the good at that outlet, as well as the productivity of effort. We could then reproduce the profit surface of Figure 13 as a function of σ^2 and $1/\gamma$, rather than of r and C' , and represent any given outlet (petrol station in our case) as a "point" in $\{1/\gamma, \sigma^2\}$ -space. Whether the manufacturer's profit is maximized will depend on whether such point is located on a ridge (*locus* of profit-maximizing pairs $\{r, C'\}$). Since the position of the asset in $\{1/\gamma, \sigma^2\}$ -space is fixed, what can be changed is the relative position of the ridges, by changing r and C' .

Thus for given asset characteristics (and local competition), the manufacturer should be able to optimize his profit (above the integrated level) by selecting the retailer with the "right" combination of r and C' : that which shifts the relative position of the ridge in such a way that the point representing the asset is located on the highest ridge (or as close as possible to it).

Pursuing this type of argument is most important for the petrol retailing case. If we identify the specific combination(s) of retailer's risk aversion r and dislike for effort C' , for which the manufacturer's strategic advantage is maximized for different stations' characteristics σ^2 , γ (for given intensity of local competition β), then we identify the type of retailer which is most desirable for operating that asset. This would yield in turn a prediction on the type of contract which the manufacturer should offer to attract that retailer. As in Section 6, we could then put forward predictions on the specific choice of contract for a given filling station's characteristics, and intensity of local competition, on the basis of the retailer "type" which is best suited for that station/location (and assuming that the oil company will try to attract precisely that type through the contract offer).

This line of argument, with the formulation of detailed predictions on contract-assignment rules, and their empirical testing on a sample of UK petrol filling stations, will be fully developed in a future paper.

APPENDIX

The main contract types in use in UK petrol retailing differ from one another essentially in the following aspects:

i. Legal Status, Duration

Independent Dealers own the petrol station they operate, and sell branded petrol on the basis of an exclusive supply agreement with a refiner/wholesaler. The duration of an exclusive supply contract is normally 5 years, though "a significant number of dealers prefer a shorter tie, and . . . some of the larger retailers prefer to negotiate single year contracts and to make their own arrangements for financing site developments" (MMC, 1990).

A lease or tenancy agreement is the granting of exclusive possession of the station premises, with an additional supply agreement. Tenure is 3 to 5 years, with an important distinction, both from the legal and the economic point of view: tenants who have the protection of Sections 24–28 of the Landlord and Tenant Act (LTA) 1954, and those who do not.

A licence is the granting of permission to carry out a business activity (sale of petrol) on premises owned by the wholesaler. In essence, the licence permits the licensee to occupy premises for the purpose of carrying on a petrol retailing business without conferring upon him the rights and obligations of the LTA. The standard duration of a licence is 3 years,

A commission agent sells petrol which belongs to the wholesaler on his behalf, receiving a commission per unit of petrol sold. The ownership of the petrol does not pass to the retailer at any point, but it remains with the wholesaler, who sets the pump price. Very low security of tenure: it can be typically terminated at very short notice (30 days).

Franchising has elements in common with the licence, but the screening function is reinforced by the requirement that the retailer pays an initial bond, in addition to the working capital requirements. This (rather substantial) initial capital investment on the part of the retailer conforms to the principle of bond posting in franchising. Other structural differences between licence and franchise are

- a longer duration (5 years initially, plus the option to re-sign for a further 5 years)
- assignability (for the retailer to benefit from the goodwill built over time).

ii. Structure of the Retailer's Compensation

In the case of tenancies and licences, the retailer's gross revenue is the gross fuel margin recognized to him by the wholesaler on the sale of motor fuels. From the gross fuel margin (and ignoring for the moment the contribution of ancillary activities to the site's overall profit) the operator must meet different categories of retail costs.

Licensees normally pay the wholesaler a licence fee, typically including an annual fixed fee and an additional volume-related fee. At the margin, this volume-related fee (additional, or variable fee) is either constant (royalty), or increasing in volumes (but at a decreasing rate). In addition, the licensee normally pays the wholesaler also a contribution to advertising and promotions, which can be a rather substantial proportion of his costs, and usually takes the form of a fixed charge per litre sold (in practice, this could amount to anything between .1 and .5ppg). Finally, there are wage costs and possibly some miscellaneous expenditures when not covered by the wholesaler (i.e. not reimbursed). These might include insurance, heat/power, water rates, security, finance/legal/accounting, shortages and drive offs, etc.

Like licensees, tenants are expected to pay an annual lease fee, and an additional throughput fee on fuel sales (this is normally a fixed contribution per litre sold). Retail costs also include staff wages, advertising and promotion charges, and some miscellaneous expenses. Unlike licensees, however, tenants are also responsible for maintenance costs, as leases make the occupier of the premises legally liable for all repairing and insurance costs. This important qualitative difference in the nature of the risk taken by the operator is reflected in the average unit margin recognized to tenants on fuel sales, which is slightly larger than for licensees.

The commission agent is remunerated by a (fixed) commission per litre sold, from which he only pays staff wages (agents are not responsible for any other costs). The commission on the sale of fuel is derived from an estimate of his costs and the expected volumes at the site: the wholesaler calculates how much the agent needs to pay staff wages and his own, then it divides this sum by the volume of fuel it expects to sell at the site, and the result is the commission paid to the agent (in ppl). Of course, such an arrangement would put all the risk on the operator without an appropriate "safety net". Most contracts therefore stipulate that if the agent fails to meet the volume target (on reasonable grounds), the wholesaler generally grants him income support up to the forecast level. In case volumes exceed expectations, however, the agent is usually allowed to retain at least part of the extra profit, thus providing the agent with some incentive to exceed the target.

Contracts with independent dealers also specify a unit margin (which is largely fixed by the practice of setting the pump price as the invoice price plus such margin, and – where needed – by the use of selected price support). The size of such margin is however significantly larger than at any wholesaler-owned sites. This is clearly shown by the MMC's finding that in 1988 the net price (after rebates and discounts) to independent dealers was on average about 1.2ppl below that to wholesaler-owned sites.

In addition, contracts differ from one another in terms of

- iii. Operating Costs the Retailer is Responsible for;**
- iv. Size of the Initial Investment Demanded from the Retailer.**

These key differences across contract types are summarized in the Table on the next page.

Key Differences in Economic Terms Among the Various Contract Types

	Direct Management	Commission Agency	Licence	Tenancy	Franchise	Independent Dealer
Duration/ Security of Tenure	-	1-3 years 30 days' notice	3 years— no right to renewal	3 years— renewal only with LTA protection	5 years— renewable for 5-10 more yrs	5 years—
Retailer's Compensation:						
- Fixed base-wage	Yes	(income support)	sometimes	No	No	No
- Margin per unit sold	No	Small (eg 0.75ppl)	Larger (eg 2ppl)	Slightly larger	-	Larger
- Annual fee paid	No	No	Yes	Yes	Yes	No
- Royalty paid	No	No	Yes (often increasing in volumes)	Yes (generally fixed)	Yes	No
Operating costs borne by the retailer	-	Staff wages	Wages, promotions general retail costs	As licence plus maintenance costs	As tenant	All
Initial investment by from the retailer	-	None for fuel	Working capital	Working capital	Working capital plus initial bond	Full

Proposition 6.1. Proof

Consider Fig.14.b. Let (as in the diagram) $r_X < r_Y$, $C'_X < C'_Y$. This means generally that $(p_X - w_X) = m_X > (p_Y - p_Y) = m_Y$, i.e. the unit margin is lower under Y. Since the fixed fee is defined (approximately) as $F = (p-w)q - \frac{1}{2}r\sigma^2 C'/\gamma$ (we neglect for the moment the direct cost of effort $C(e)$), the above inequalities imply that $F_X > F_Y$. In what follows the notation $X|X$, or $Y|X$ indicate respectively "under contract X for retailer (with characteristics equal to) X", or "under contract Y for a retailer (with characteristics equal to) X", etc.

Now, the C.E.-income for a retailer with characteristics exactly (r_X, C'_X) under contract X is (by assumption)

$$CE(X|X) = m_X q_{X|X} - F_X - \frac{1}{2} r_X C'_X = 0$$

The same retailer (with characteristics X), under contract Y earns a CE-income

$$CE(Y|X) = m_Y q_{Y|X} - F_Y - \frac{1}{2} r_X C'_X > 0$$

This is because $F_Y = m_Y q_{Y|Y} - \frac{1}{2} r_Y C'_Y$, therefore

$$CE(Y|X) = m_Y (q_{Y|X} - q_{Y|Y}) + \frac{1}{2} (r_Y C'_Y - r_X C'_X)$$

This is >0 because $q_{Y|X} > q_{Y|Y}$ (the retailer is more able, and will sell more at the same margin), and $r_Y C'_Y > r_X C'_X$ (the risk premium he gets is larger). Q.E.D.

Proposition 6.2 Sketch of proof

Compare the C.E.-income of a retailer such as D under contract X and contract Y:

$$CE(X|D) = m_X q_{X|D} - F_X - \frac{1}{2} r_D C'_D = m_X (q_{X|D} - q_{X|X}) + \frac{1}{2} (r_X C'_X - r_D C'_D) (>0)$$

$$CE(Y|D) = m_Y q_{Y|D} - F_Y - \frac{1}{2} r_D C'_D = m_Y (q_{Y|D} - q_{Y|Y}) + \frac{1}{2} (r_Y C'_Y - r_D C'_D) (>0)$$

Because of Proposition 1, they are both positive. Now consider their difference, ie

$$CE(X|D) - CE(Y|D) = m_X (q_{X|D} - q_{X|X}) - m_Y (q_{Y|D} - q_{Y|Y}) - \frac{1}{2} (r_Y C'_Y - r_X C'_X)$$

This is >0 if $m_X (q_{X|D} - q_{X|X}) - m_Y (q_{Y|D} - q_{Y|Y}) > \frac{1}{2} (r_Y C'_Y - r_X C'_X)$

i.e. **if D's revenue increase under X is so much greater than under Y that it outweighs the fact that the fixed fee he pays is lower under Y.**

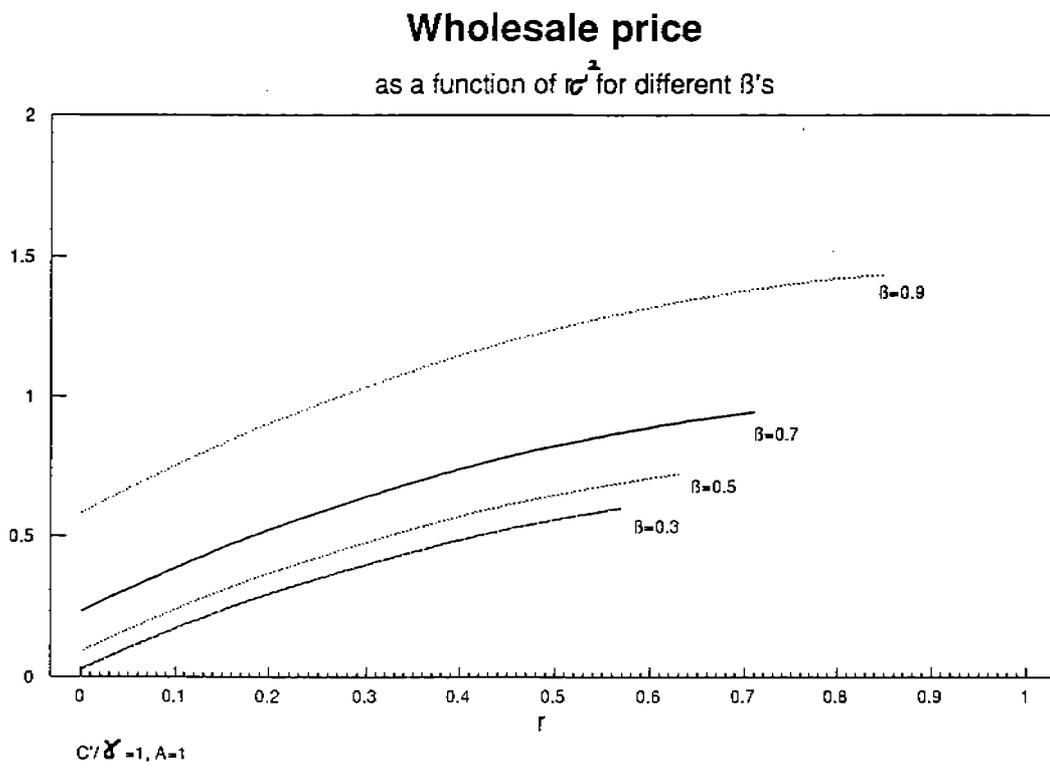


Figure 1

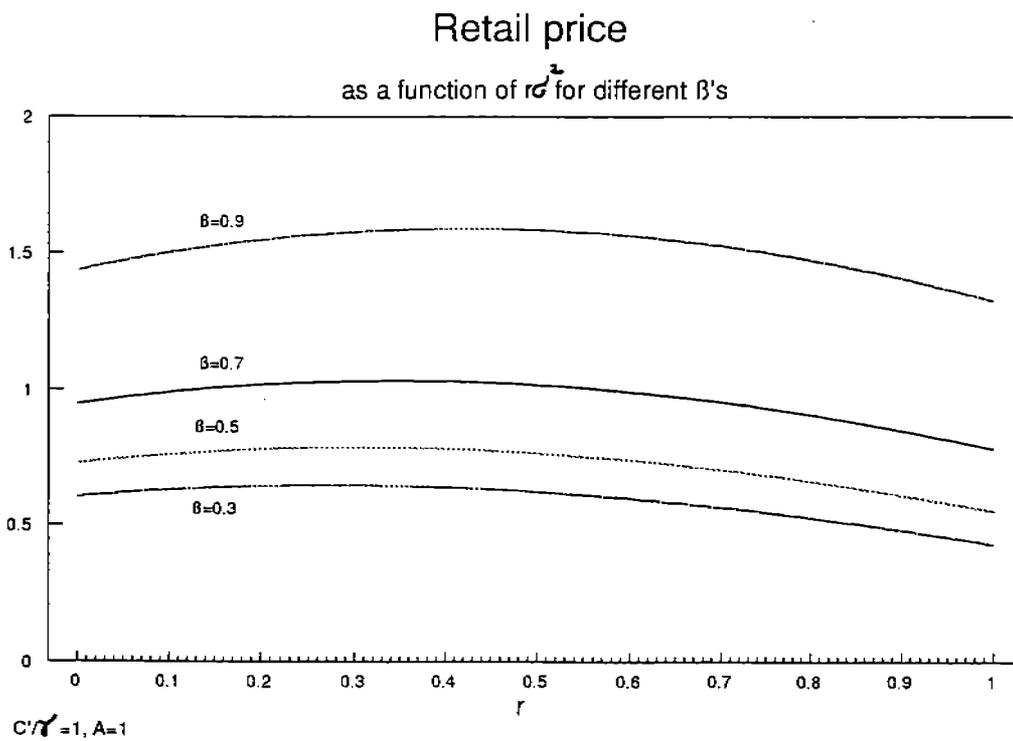


Figure 2

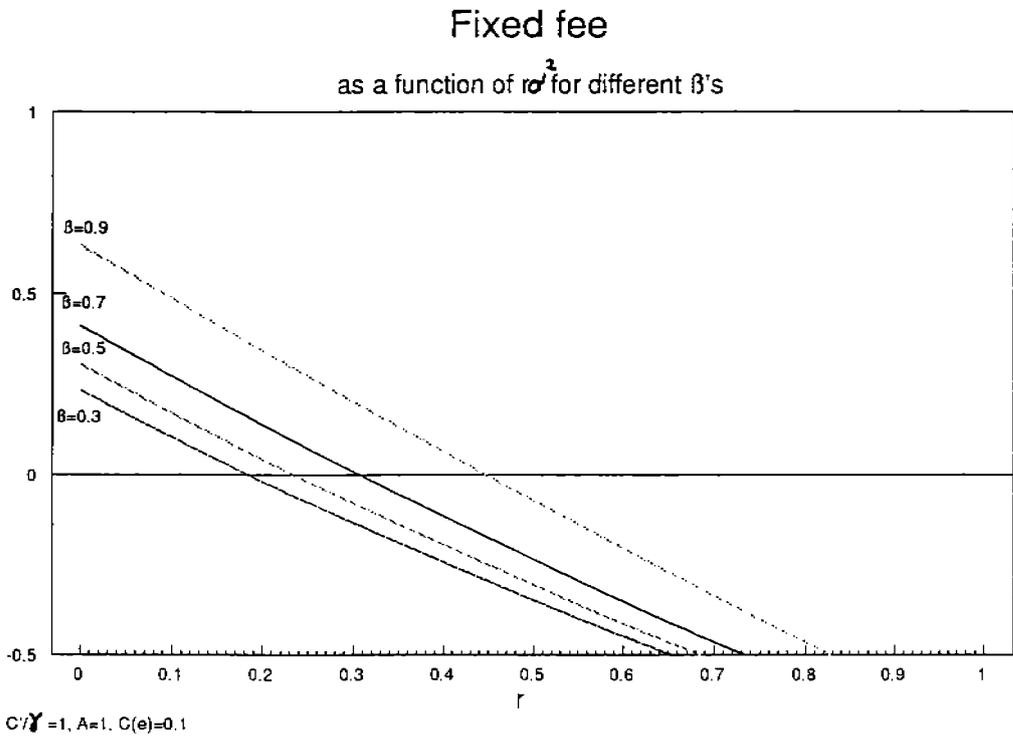


Figure 3

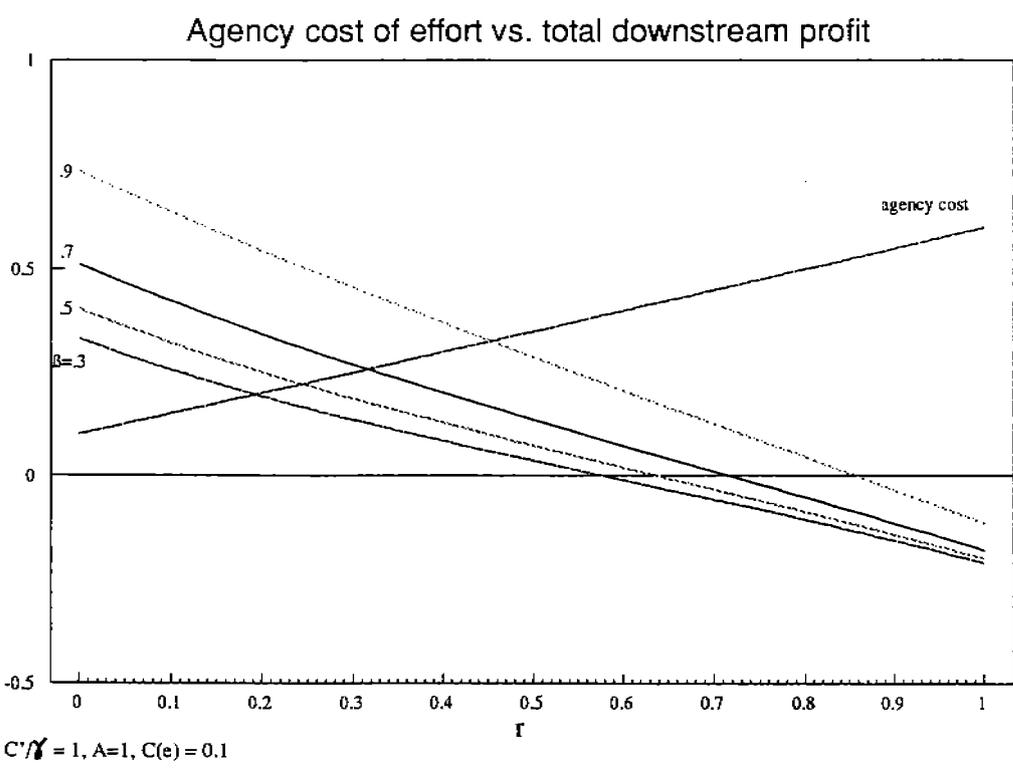


Figure 4

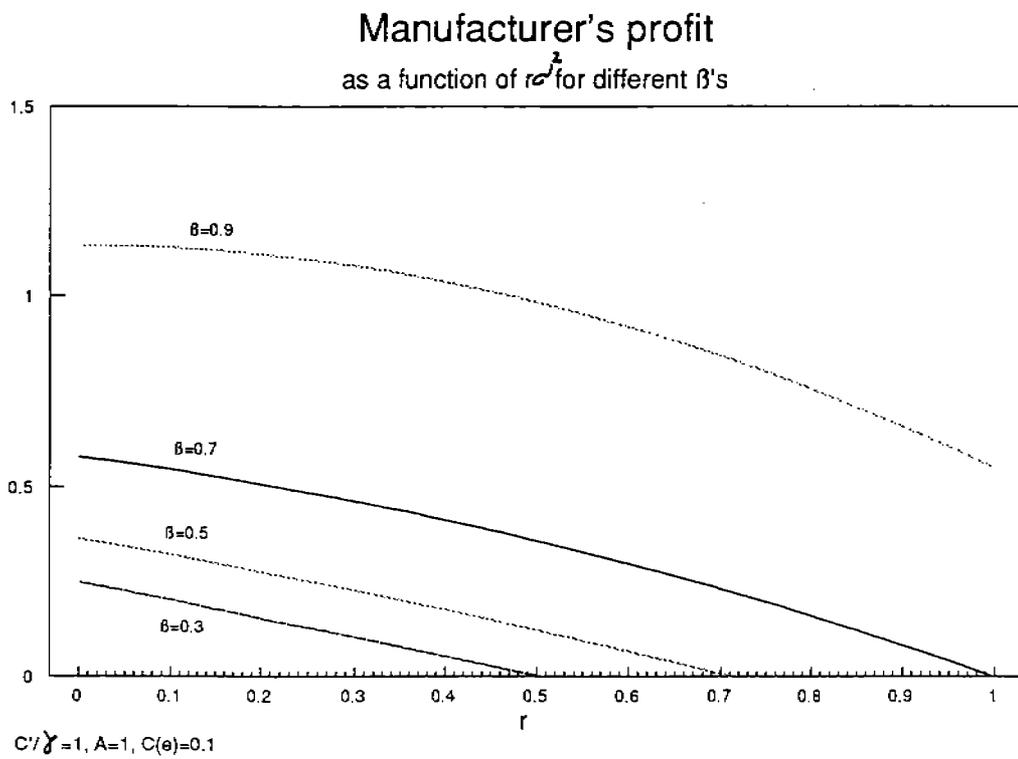


Figure 5

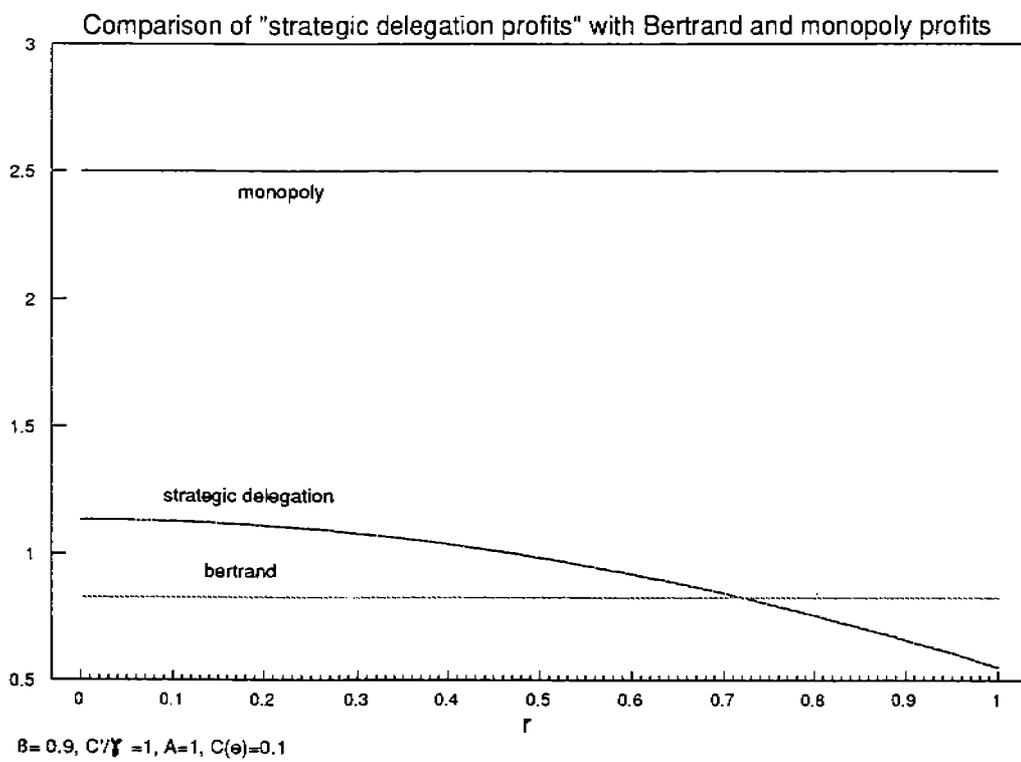


Figure 6

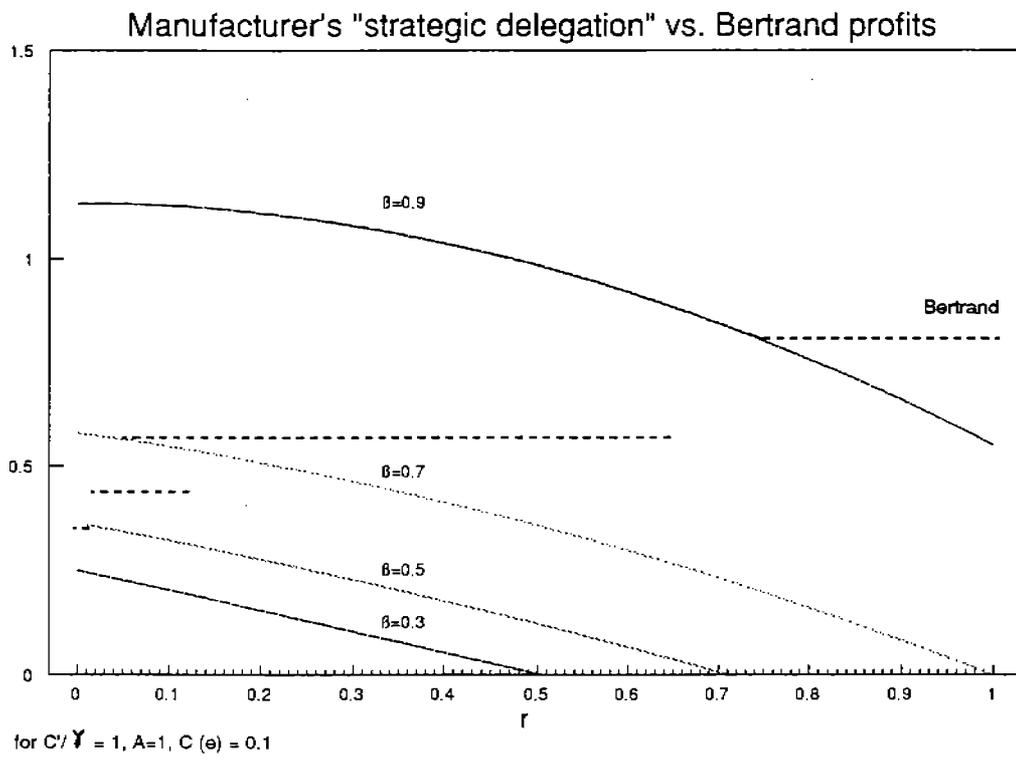


Figure 7

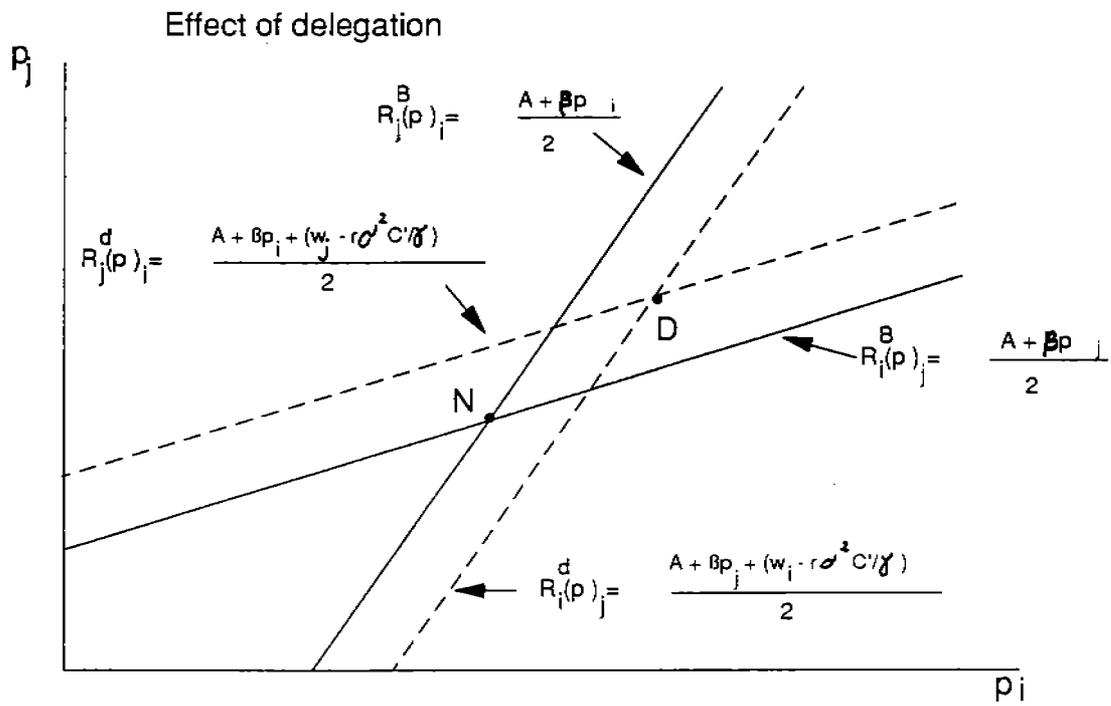


Figure 8a

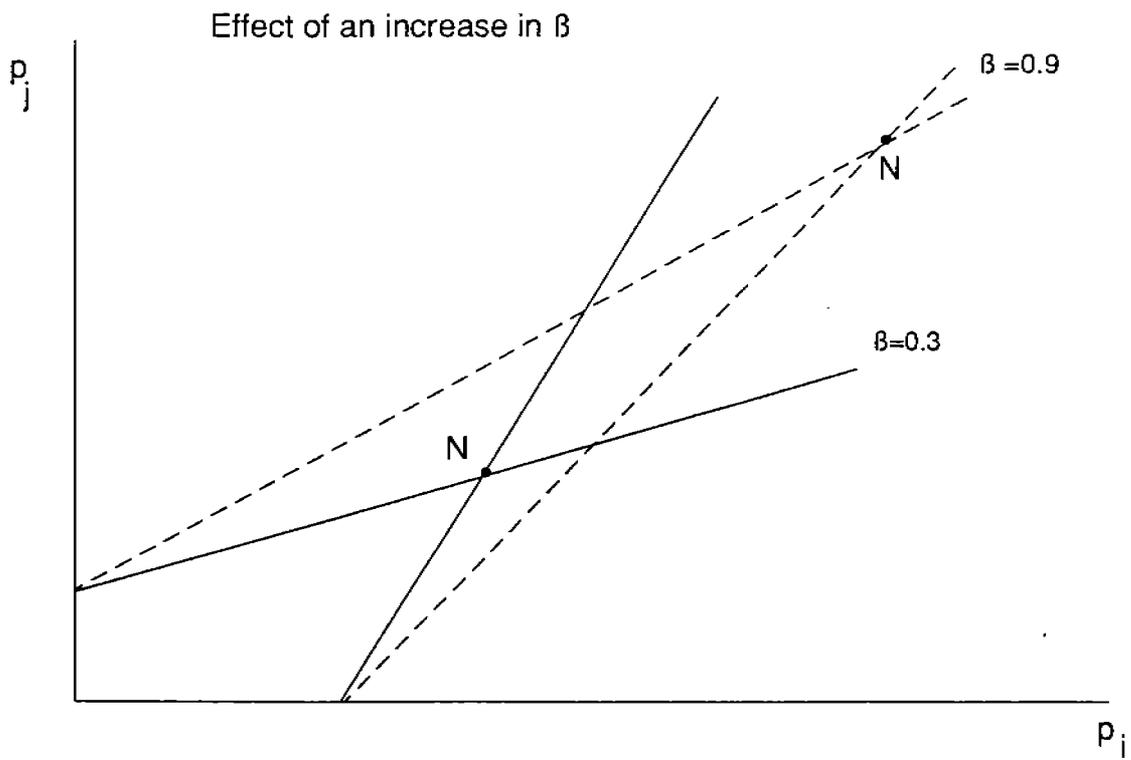


Figure 8b

Manufacturer's "delegated" profit
as a function of $r\sigma^2$ and C/γ

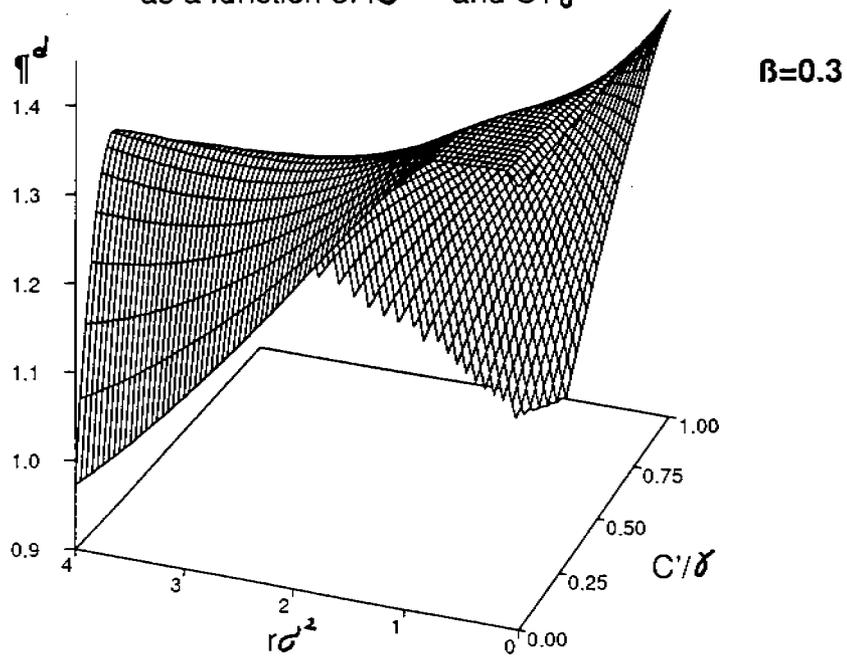


Figure 9a

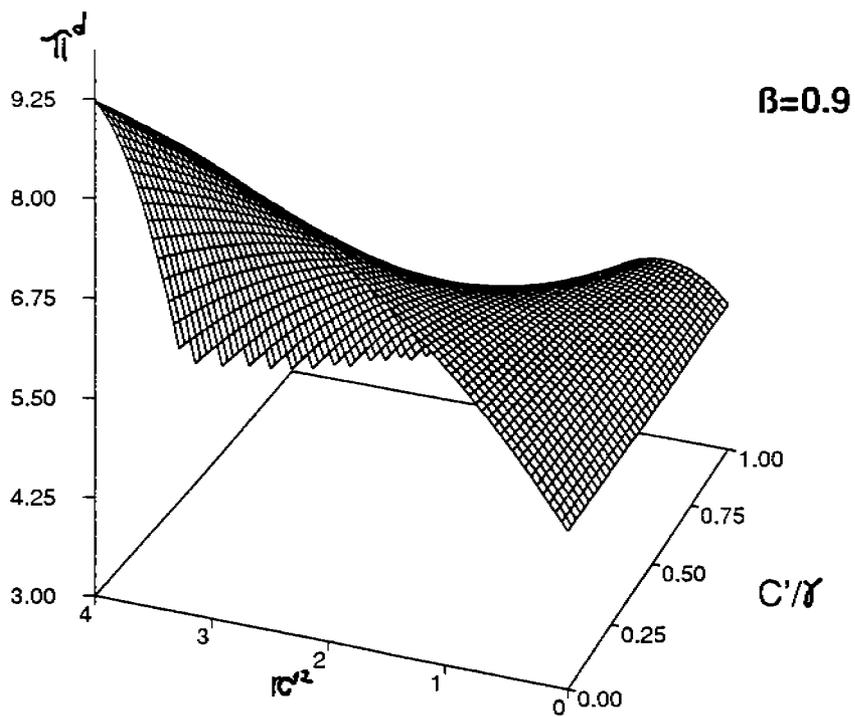


Figure 9b

**Difference between "delegated" and Bertrand profits
as a function of $r\sigma^2$ and C/γ**

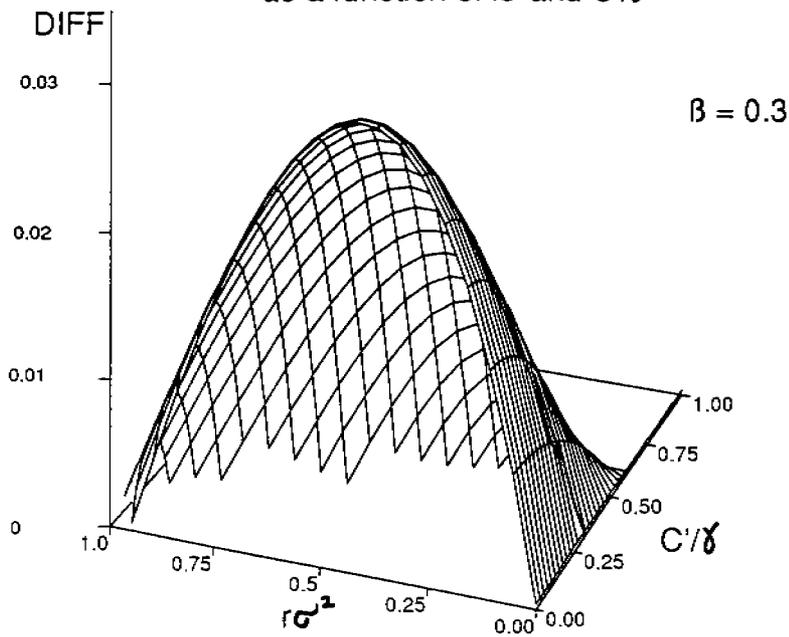


Figure 10a

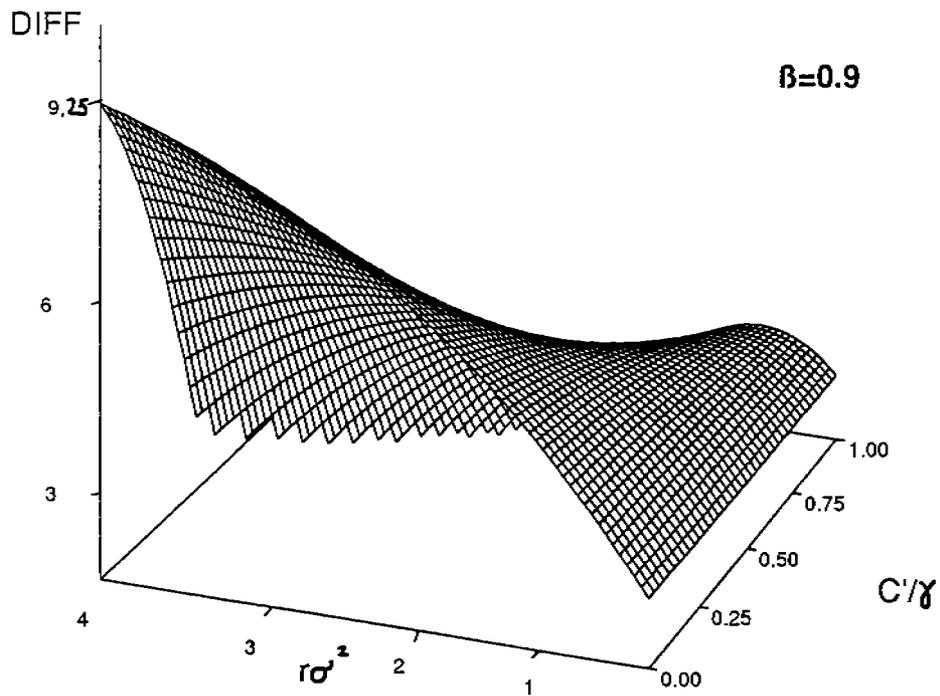


Figure 10b

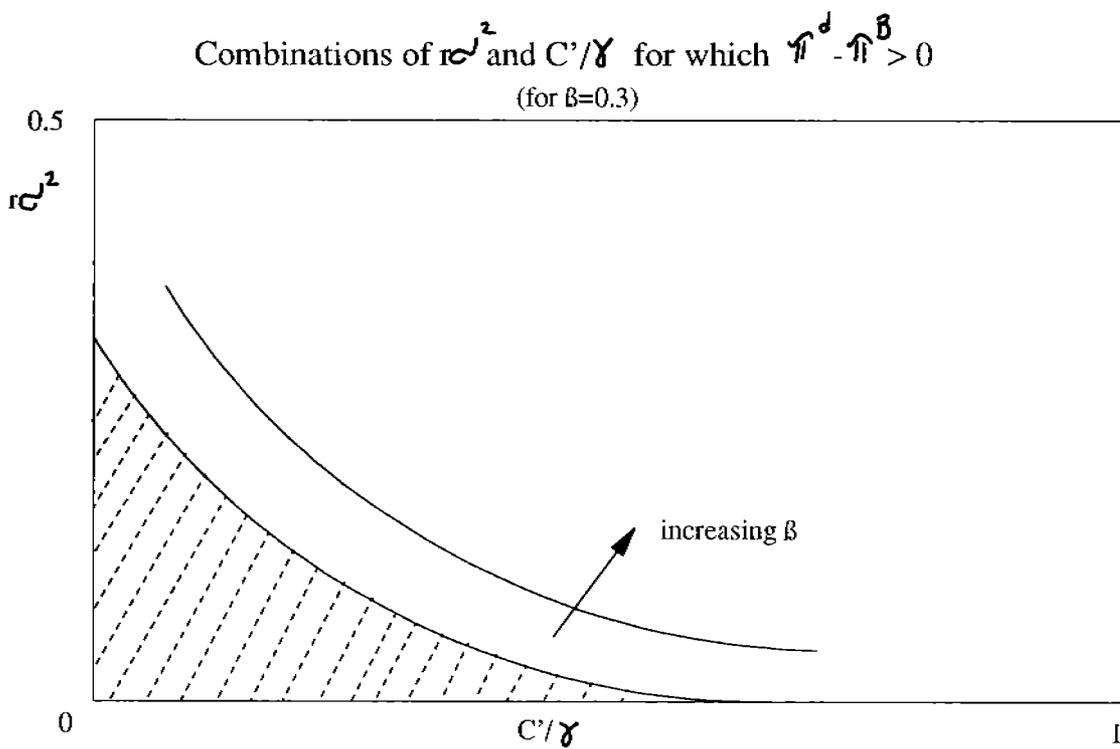


Figure 11

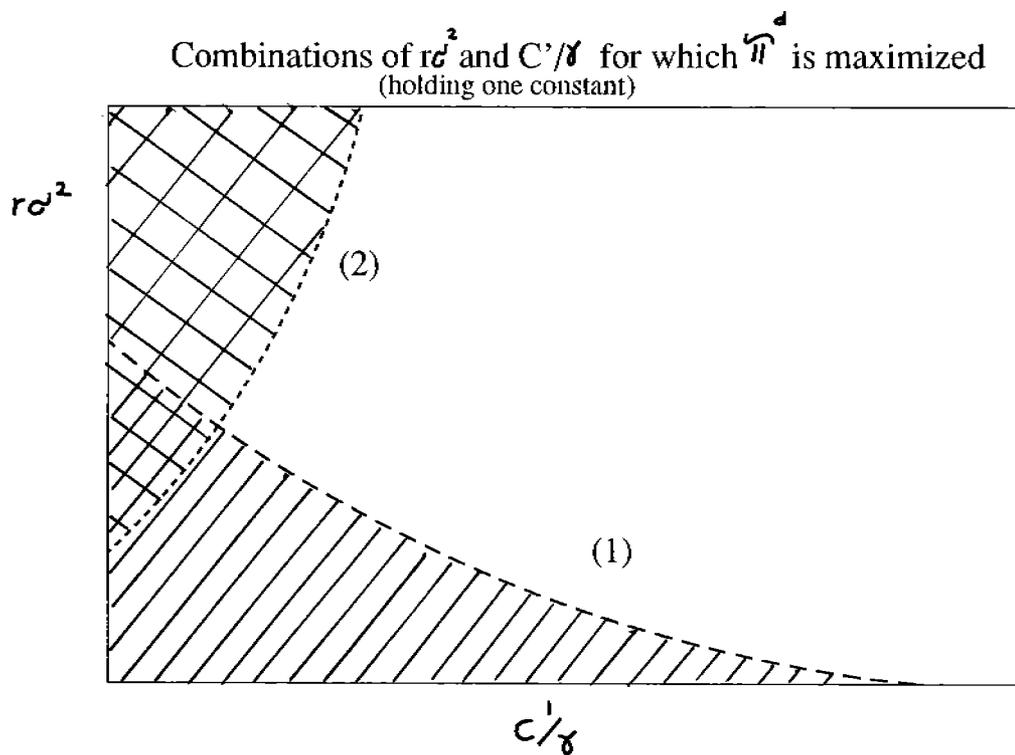


Figure 12

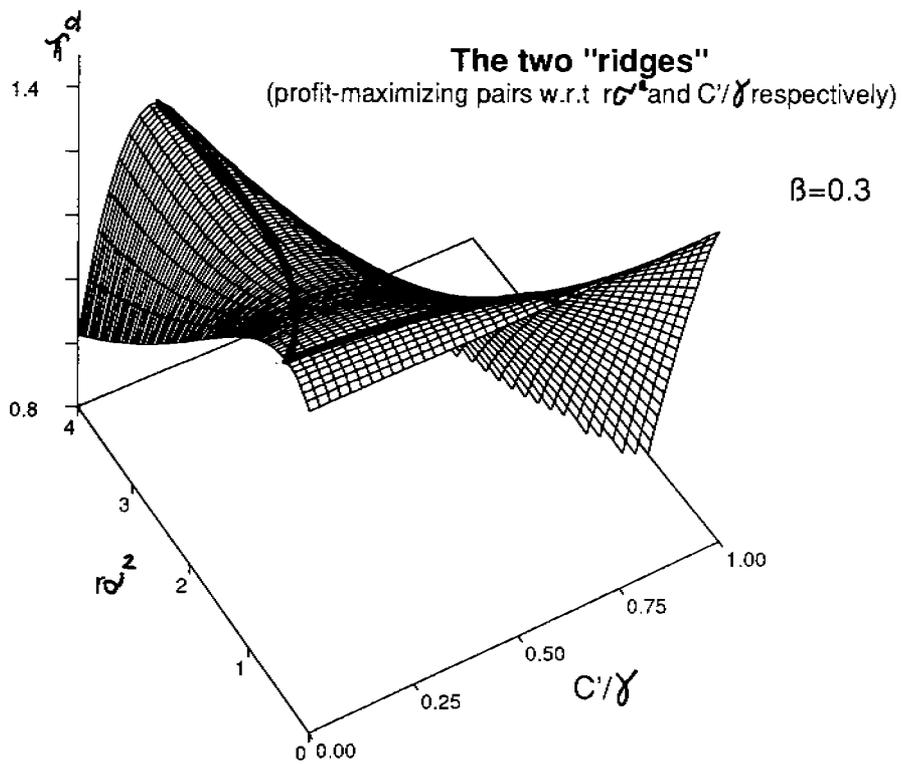


Figure 13a

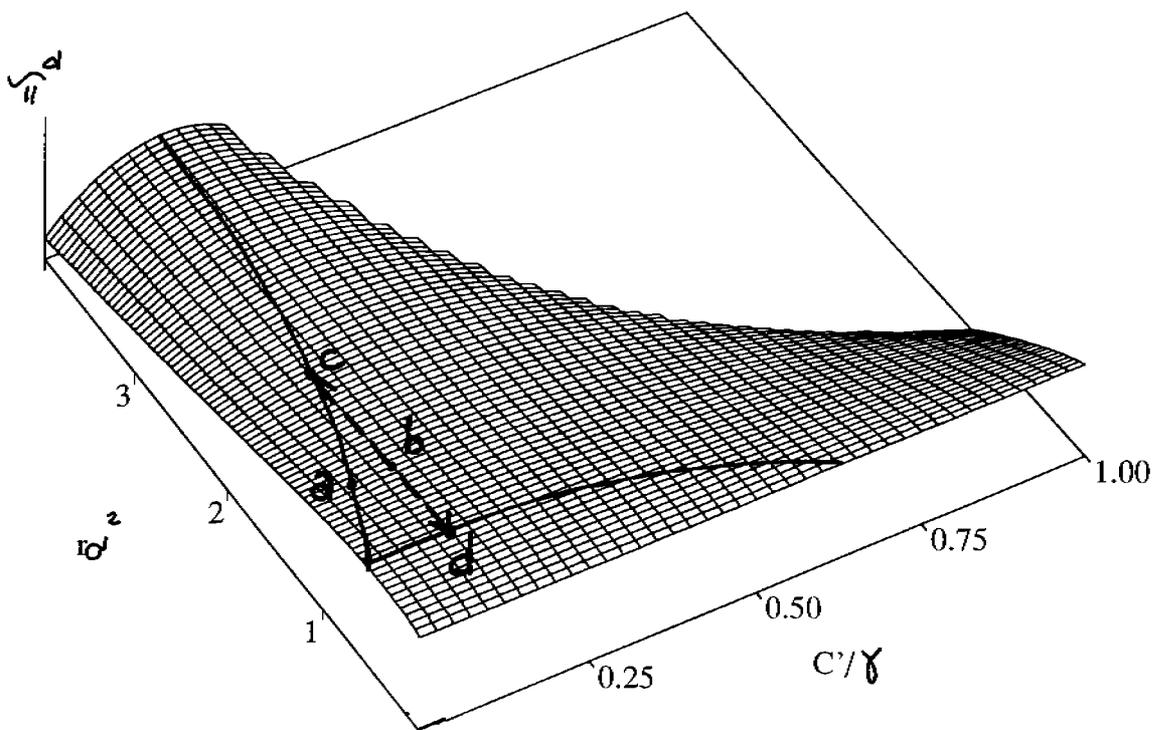


Figure 13b

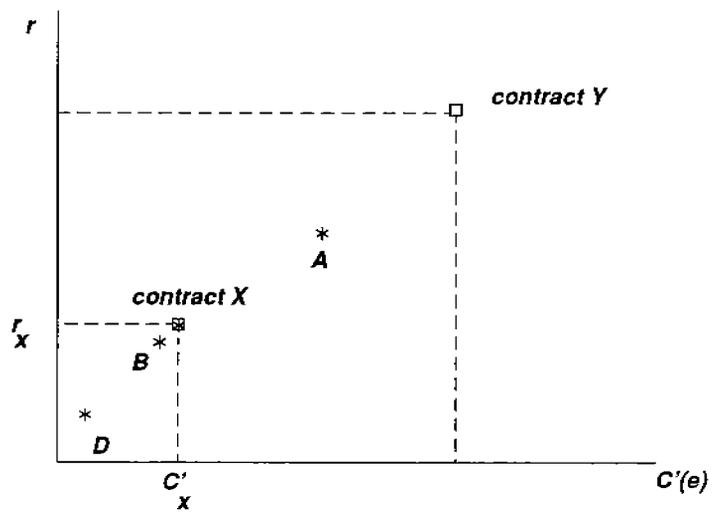


Figure 14a

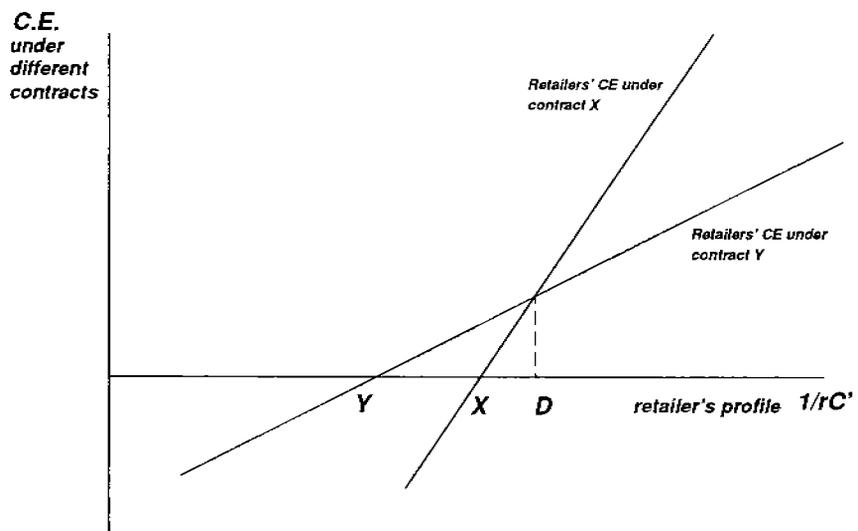


Figure 14b

BIBLIOGRAPHY

- Acemoglu, D. (1993), 'Credit Market Imperfections and Separation of Ownership from Control as a Strategic Decision', MIT Working Paper.
- Allen, F. (1982), 'On Share Contracts and Screening', *Bell Journal of Economics*, vol.13 no.3, pp.541-7.
- Arrow, K.J. (1979), *Essays in the Theory of Risk Bearing*, Chicago: Markham.
- Baker, G.P., Jensen, M.C., and Murphy, K.J. (1988), 'Compensation and Incentives: Practice vs. Theory', *Journal of Finance*, vol. 43, pp. 593-616.
- Bolton, P. (1990), 'Renegotiation and the Dynamics of Contract Design', *European Economic Review*, vol. 34, pp. 303-10.
- Bonanno, G. and Vickers, J.S. (1988), 'Vertical Separation', *Journal of Industrial Economics*, vol. 36, pp. 257-65.
- Brickley, J.A. and Dark, F.H. (1987), 'The Choice of Organizational Form. The Case of Franchising', *Journal of Financial Economics*, vol. 18, pp. 401-20.
- , -----, and Weisbach, M.S. (1991), 'An Agency Perspective on Franchising', *Financial Management*, vol.20, no.11, pp. 27-35.
- Caillaud, B., and Hermalin, B. (1993), 'The Use of an Agent in a Signalling Model', *Journal of Economic Theory*, vol. 60, pp. 83-113.
- , Jullien, B., and Picard, P. (1993), 'Competing Vertical Structures: Precommitment and Renegotiation', mimeo, January.
- Coughlan, A.T., and Wernerfelt, B. (1989), 'On Credible Delegation by Oligopolists: A Discussion of Distribution Channel Management', *Management Science*, vol. 35, no. 2, pp. 226-39.
- Dewatripont, M. (1988), 'Commitment Through Renegotiation-Proof Contracts with Third Parties', *Review of Economic Studies*, vol 55, pp.377-90.
- Fershtman, C., and Judd, K.L. (1986), 'Strategic Incentive Manipulation in Rivalrous Agency', Technical Report No. 496, IMSSS, Stanford.
- , and ----- (1987), 'Equilibrium Incentives in Oligopoly', *American Economic Review*, vol. 77, no. 5, pp. 927-40.
- Gal-Or, E. (1991), 'Duopolistic Vertical Restraints', *European Economic Review*, vol. 35, pp. 1237-53.
- Gibbons, R., and Murphy, K.J. (1992), 'Optimal Incentive Contracts in the Presence of Career Concerns: Theory and Evidence', *Journal of Political Economy*, vol. 100, no.3.
- Grossman, S.J., and Hart, O.D., (1986), 'The Costs and Benefits of Ownership: a Theory of Vertical and Lateral Integration', *Journal of Political Economy*, vol. 94, pp. 691-719.

- Hart, O.D., and Holmstrom, B. (1987), 'The Theory of Contracts', in T. Bewley (ed.), *Advances in Economic Theory*, Cambridge: CUP.
- , and Moore, J. (1990), 'Property Rights and the Nature of the Firm', *Journal of Political Economy*, vol. 98, pp. 1119–58.
- Holmstrom, B., and Milgrom, P. (1987), 'Aggregation and Linearity in the Provision of Intertemporal Incentives', *Econometrica*, vol. 55, no.2, pp. 303–28.
- Katz, M.L. (1989), 'Vertical Contractual Relations', in Schmalensee, R. and R. Willig (eds), *Handbook of Industrial Organization*, Amsterdam: North Holland.
- , (1991), 'Game-Playing Agents: Unobservable Contracts as Precommitments', *RAND Journal of Economics*, vol. 22, pp. 307–28.
- Kuhn, K-U. (1991), 'Vertical Restraints in a Manufacturer Duopoly: the Case of Nonlinear Pricing', DP No. 65, Nuffield College, Oxford.
- Krueger, A.B. (1991), 'Ownership, Agency, and Wages: an Examination of Franchising in the Fast Food Industry', *Quarterly Journal of Economics*, pp. 75–101.
- Lafontaine, Francine (1992), 'Agency Theory and Franchising: Some Empirical Results', *RAND Journal of Economics*, vol. 23, pp. 263–83.
- Mathewson, G.F. and Winter, R.A. (1984), 'An Economic Theory of Vertical Restraint', *RAND Journal of Economics*.
- , and ----- (1986), 'The Economics of Vertical Restraints in Distribution' in *New Developments in the Analysis of Market Structure*, Stiglitz and Mathewson, (eds), New York: Macmillan.
- Milgrom, P., and Roberts, J. (1992), *Economics, Organization and Management*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.
- Monopolies and Mergers Commission (1989), *The Supply of Beer*, HMSO, London.
- Monopolies and Mergers Commission (1990), *The Supply of Petrol*, HMSO, London.
- Moore, J. (1992), 'The Firm as a Collection of Assets', *European Economic Review*, vol. 36, pp.493–507.
- Norton, S. (1988), 'An Empirical Look at Franchising as an Organizational Form', *Journal of Business*, vol.61, no. 2, pp. 197–217.
- Rey, P., and Stiglitz, J. (1988), 'Vertical Restraints and Producers' Competition', *European Economic Review*, vol. 32, pp. 561–8.
- , and Tirole, J. (1986), 'The Logic of Vertical Restraints', *American Economic Review*, vol. 76, no.5.
- Shepard, A. (1993), 'Contractual Form, Retail Price, and Asset Characteristics in Gasoline Retailing', *Rand Journal of Economics*, vol 24, no.1, pp. 58–77.

- Sklivas, S.D. (1987), 'The Strategic Choice of Managerial Incentives', *RAND Journal of Economics*, vol. 18, pp. 452-8.
- Slade, M.E. (1992), 'Strategic Motives for Vertical Separation: An Empirical Exploration', mimeo.
- Vickers, J.S. (1985), 'Delegation and the Theory of the Firm', *EJ Supplement (Conference Papers)* pp. 138-47.
- Waterson, M. (1986), 'The Economics of Vertical Restraints on Retailers', in *Spatial Pricing and Differentiated Markets*, in G. Norman, (ed), London Papers in Regional Science no. 16, London: PION.

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