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STRATEGIC INCENTIVES FOR MARKET SHARE

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Strategic incentives for market share

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Abstract

Market share objectives are prominent in many industries, especially where managers pay much attention to league table rankings. This paper explores the strategic rationale for giving managers incentives based on market share in an oligopoly competing in strategic substitutes. Moreover, the paper discusses evidence on executive compensation practice in the automotive and investment banking industries. As predicted by the theory, firms in both industries use explicit contractual incentives based on market share. The profitability squeeze in the US car industry due to aggressive buyer discount programs can thus be understood as a consequence of prevailing management incentives.

Keywords: strategic delegation, market share, executive compensation, league tables

JEL classifications: D21, D43, G24, J33, L62

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1 Introduction

Market share objectives are prominent in many industries. Countless press reports, mission statements and interviews with corporate executives reveal that managers place significant emphasis on their firm's market share. At the same time market share objectives are a sign of aggressive competition. This is particularly apparent in the automotive industry where buyer discount programs have for years been squeezing the profitability of major producers, perhaps most notably General Motors. Indeed, The Economist concludes a recent survey on the industry by noting that "car firms must reinvent themselves to seek profit, not just market share"[1].

This paper shows that strategic considerations provide a rationale for giving managers incentives based on market share. It also discusses empirical evidence on executive compensation practice in the automotive and the investment banking industries. In both of these, as predicted by the theory, firms use *explicit* contractual incentives related to market share. Therefore, the attention paid by managers in these industries to so-called league table rankings—which are based on market share, not profits—can be understood as a natural corollary of the incentive structure.

The strategic value of commitment, for instance to non-profit maximizing objectives, was first recognized by Schelling (1960). This idea was introduced into the industrial organization literature in seminal papers by Vickers (1985), Fershtman and Judd (1987) and Sklivas (1987). Fershtman and Judd also define the notion of "incentive equilibrium" in an oligopoly with compensation contracts based on profits as well as sales revenue. They find that, when competing in strategic substitutes, it is optimal to give managers aggressive sales incentives. Firms end up in a prisoners' dilemma as a result of this.

The present analysis aims to clarify the implications of strategic incentives for *market share*. These are shown to dominate the well-known sales revenue and output-based contracts analyzed in the early papers and many subsequent applications—as well as simple profit maximization. Moreover, and perhaps surprisingly, the incentive equilibrium with market share contracts turns out to be *less* competitive than under the other contracts—despite the inherent relative performance component. Players remain in a prisoners' dilemma, but in a less severe one.

More generally, the main insight from the model is that managerial incentive contracts have *two* roles in strategic settings. The first is very well-known: contracts constitute a commitment to making managerial behaviour *more aggressive*. The second is largely neglected in the literature: contracts can make managerial behaviour *less susceptible to*

[1] See *The Economist*, September 4, 2004.

strategic manipulation by rivals. Contracts observed in practice are rich enough to assume both of these roles.

The remainder of the paper is organized as follows. Section 2 presents empirical evidence for executive compensation based on market share. Section 3 analyzes a simple Cournot model to explore the strategic advantages associated with market share incentives. Section 4 summarizes the main result and provides further discussion. Section 5 concludes.

The appendix contains detailed derivations for proofs omitted from the main text for expositional continuity.

2 Evidence from executive compensation

This section discusses empirical evidence on executive compensation practice in the automotive and investment banking industries. Firms in both industries use *explicit* contractual incentives related to market share. Mainly for reasons of data availability, the focus throughout lies on analyzing US corporate proxy statements[2]. For present purposes, the relevant component of the proxy statement is the "Report of the Compensation Committee".

2.1 Automotive industry

The car industry is dominated to a large extent by the "Big Four" producers, namely General Motors, DaimlerChrysler, Ford and Toyota, who together accounted for over $600 billion in 2003 annual sales. The survey by The Economist mentioned in the introduction also notes that most manufacturers are operating at high output levels and there has correspondingly been considerable pressure on prices and margins. This is especially evident given the aggressive discounts, interest-free loans etc. given to consumers on their car purchases, most notably in the US. All major producers make use of these buyer discount programs to help boost market share, including the Japanese firms such as Toyota and Nissan[3].

[2]Proxy statements are mandatory disclosures by publicly listed US firms that contain management reports on the firm's strategy and financial results as well as committee reports on executive compensation, corporate governance, audit etc. These statements are sent to shareholders whenever corporate matters are subject to a shareholder vote. Typically, proxy statements are issued at least once a year and are freely available in the public domain.

[3]The magnitude of such buyer incentives is currently rather large. For example, in June 2005, General Motors offered the largest discounts averaging $7,032 per vehicle while Toyota offered an average of $4,022. (See *Financial Times*, August 2, 2005.) Operating profit margins in the first half of 2005 were "low or non-existent" for several firms in the industry. (See *New York Times*, August 30, 2005.)

The following quote from a compensation committee report shows that executive compensation at General Motors is indeed directly based on market share:

> "As in previous years, management recommended that the Committee establish very aggressive performance targets for 2003. We (the Compensation Committee) tied the payment of annual incentive awards to meeting specific levels of net income, ... market share..."
>
> (General Motors Corp., 2004 Proxy statement).

Furthermore, the quote reveals that management and the compensation committee both recognize the aggressive nature of a market share component. As basic economic analysis would suggest, managers' objectives and public statements are compatible with the contractual incentives provided. Indeed, General Motors' "2004 Priorities/Targets" include the management objective of "increasing automotive market share in all regions".

Similarly, at cross-town rival producer Ford the corresponding report states that:

> "... the (Compensation) Committee set a bonus formula based on ... worldwide market share... "
>
> (Ford Motor Co., 2004 Proxy statement).

Market share and other output-related information is quite readily available in the car industry. For instance, the Ward's Automotive Report in the US regularly provides statistics on sales forecasts, operating schedules and other industry developments. These are broken down to product-level by manufacturer. Interestingly, the General Motors website (at www.gm.com) also contains very detailed monthly releases on worldwide production levels (actual as well as scheduled) again broken down by region, product etc.

While data availability is generally much better for US firms, this need not imply that market share objectives do not feature elsewhere. For example, the Japanese manufacturer Toyota—probably the currently most successful of the major producers—has a stated ambition of capturing 15% of the global automotive market by the early 2010s.

2.2 Investment banking industry

Market share objectives are perhaps most visible in the investment banking industry for which the so-called league tables provide rankings of the major players based on their market shares, not profits. Most firms seem to actively take part in this "game", but doubts are often expressed particularly by weaker players and in downturns. Once again, this may be interpreted as a sign of aggressive competition. For example, the Financial

Times suggests in a recent commentary that "most investment banks find ways to be at or near the top (of the league tables), including taking work at a loss in order to gain market share". Furthermore, it appears that some banks also regularly accuse their rivals of "buying business"[4].

Similar to the previous case of the automotive industry, data on market shares, transaction volumes etc. is quite readily available for banks. In particular, companies such as Thomson Financial and Dealogic provide this information to the business press, to the banks themselves and to other interested parties on a regular basis.

In the 2004 Proxy statement of Morgan Stanley (one of the leading firms in the industry), the compensation committee report states that:

> "We consider several factors in awarding compensation... Quantitative factors include, amongst others, absolute levels of and year-to-year changes in ... net revenues, ... net income, ... market share..."
>
> (Morgan Stanley Group Inc., 2004 Proxy statement).

This pattern of compensation is comparable to those found in the automotive industry and again includes incentives for market share. However, it is also considerably more complex in that dynamics (i.e., yearly changes) play a role too[5].

Consider also the proxy statement by Merrill Lynch:

> "This (Executive Compensation) program ensures that compensation is aligned with maximizing shareholder value... factors considered... in determining performance-based compensation levels for the CEO and all other executive officers include: financial results, ..., profit margins, ... market share, ..."
>
> (Merrill Lynch Inc., 2004 Proxy statement).

Importantly, this quote suggests that the board of directors (representing the firm's shareholders) wishes to maximize firm value. Nevertheless, it gives incentives to managers that quite plainly deviate from pure profit maximization by including a market share component. This is a key feature of the model developed, and the strategic delegation literature more generally: owners wish to maximize profits (or shareholder value) while managerial incentives deviate to include, say, firm size components. Again, the attention paid by managers to league table rankings can be understood as a natural corollary of the incentive structure.

[4] See *Financial Times*, September 2, 2004 and September 25, 2004 respectively.

[5] This latter feature is beyond the scope of the following formal analysis which is in a static context.

While the above evidence is suggestive, it is also selective. Nevertheless, reading of compensation committee reports for various other firms and previous years shows that the basic insights hold true. First, the compensation of leading executives in the two industries is explicitly based on market share as opposed to other measures of firm size[6,7]. Second, these contractual distortions from profit maximization arise despite the board of directors wishing to maximize shareholder value. Furthermore, managers in all of the firms examined also receive compensation based on the stock price. These appear to be quite reliable patterns of compensation practice more generally.

Another issue arises in the case of the investment banking industry (but may also have relevance for other industries). It is often argued that strategic deviations from profit maximization may be accomplished by behavioural commitment (recall also Schelling's (1960, p. 142) example of "conspicuous delegation of authority to a military commander of known motivation"). This is in contrast to the contractual incentives discussed so far and is exemplified by the following comment (taken from a banking industry publication):

> "League-table bragging rights have long been important on the (Wall) Street, but they became essential in the late 90's as the world quickly separated into one of few winners and many losers... No wonder the battle for league table status intensified. The fight was so great to be high in the league tables, ... that's how the management of these investment banks was graced."
>
> (Investment Dealers' Digest, 9th September 2002).

Of course, these behavioural motives, while also intuitively plausible, are much more difficult to trace empirically than strategic incentive contracts. There are two key points to recognize. First, contractual and behavioural deviations from profit maximization are *substitutes* in the strategic settings considered here. Second, some contracts and behavioural biases are "better than others". More discussion of this is provided later on.

[6] These industries were selected also in view of avoiding other potential "indirect" explanations for firm size objectives that may arise e.g., due to network effects.

[7] Note also that *none* of the firms considered makes use of relative performance evaluation in the form of a measure of relative *profits*.

3 Model

3.1 Preliminaries

This section outlines the benchmark Cournot duopoly model. Several extensions are discussed later in the analysis.

Consider an industry with two firms indexed by $i \in \{1, 2\}$ and let $j \neq i$ denote the rival duopolist. The firms sell homogeneous products and compete by setting quantity, $q_i > 0$. Let aggregate output be $Q = \sum_i q_i$ and define market share as $\sigma_i = q_i/Q$. It is assumed that the firms have access to identical technologies with constant marginal cost $c > 0$.

In terms of the empirical examples discussed above, a firm's output choice in the automotive industry can be thought of as committing to a capacity level (perhaps followed by price competition and thus invoking a familiar reasoning for Cournot-like models). For the banking industry, several interpretations exist that depend on the particular business activity in question. For instance, a bank's traders may be able to commit to a trading volume in financial markets as in Kyle and Wang (1997). Alternatively, this may reflect the choice of hours worked on an advisory mandate.

The industry faces an inverse demand curve $P = f(Q)$ where $f'(Q) < 0$. As usual, demand properties play a crucial role in the analysis. It is useful to characterize the curvature of (inverse) demand as

$$\begin{aligned} E(Q) &= \frac{f''(Q)Q}{-f'(Q)} \\ &= \frac{-d\log f'(Q)}{d\log Q}, \end{aligned} \tag{1}$$

where $E(Q) \geq 0$ (≤ 0) implies that inverse demand is convex (concave). Note that this is the elasticity of the *slope* of inverse demand.

Assume that $E(Q) = E$ for tractability (such that $E'(Q) = 0$). This parameterizes a rich class of demands of the general form

$$f(Q) = \alpha - \frac{\beta Q^{1-E}}{(1-E)}, \tag{2}$$

where $\alpha \geq 0$, $\beta > 0$ (and $\alpha > c$ where required). This class includes, amongst others, linear, constant-elasticity, log-linear and quadratic demands. All these inverse demand curves have an *iso-elastic slope*. Log-linear demand, for example, has a unit-elastic slope[8].

[8] This may be verified by applying L'Hôpital's rule to (1).

Loosely, one might think of $E'(Q) = 0$ as a smoothness condition. In economic terms, the ratio of the slope of industry marginal revenue to the slope of demand is held constant for all Q.

Furthermore, assume that demand is not too convex, such that $E < 2$. This assumption ensures that industry marginal revenue is downward-sloping (and hence a monopolist's problem would have an interior solution). It is *weaker* than, say, log-concavity (of direct demand). For the present analysis, it implies that quantities are strategic substitutes near symmetric equilibrium.

Each firm has a principal (owner, board of directors, shareholders...) and an agent (manager, CEO...). In line with the evidence from the proxy statements, suppose that the principals wish to maximize profits (or firm value more generally) but delegate decision-making to agents, who receive strategic incentive contracts and maximize their compensation.

A manager's objective function in the product market places weight on both profits and market share and is given by

$$\Omega_i = \pi_i + \gamma_i \sigma_i, \tag{3}$$

where $\pi_i = (P - c)q_i$ is firm profits and owners may set $\gamma_i \neq 0$. The assumption of additivity of performance measures is made for analytical convenience and corresponds to previous work. There is some empirical support for this (see the survey on executive compensation by Murphy (1999)) and it also seems to be in accordance with the proxy statements discussed above.

Compensation contracts are publicly observable[9] and linear in the objective function

$$w_i = \lambda_i + \Omega_i \geq \bar{U}, \tag{4}$$

where w_i and $\bar{U}$ are the manager's wage and reservation utility respectively . The market for managers is competitive so the participation constraint binds (and normalize such that $\bar{U} = 0$)[10].

The game thus features the usual two stages:

1. (Incentives) The principals choose incentives γ_i to maximize profits

[9]This assumption has been criticised most notably by Katz (1991). The present analysis does not attempt to resolve the issues surrounding this observability critique. However, most recent work in this area can be described as a "critique of the observability critique". The current state of the literature is discussed in more detail in Section 4.

[10]The lump-sum component of compensation adjusts to ensure that this is satisfied.

2. (Competition) The agents choose output q_i to maximize compensation

Both stages are non-cooperative and the equilibrium concept is subgame-perfect Nash equilibrium (SPE). This will also be referred to as the "incentive equilibrium".

At this point, it is useful to bear in mind two alternative interpretations of the game (as noted in Fershtman and Judd (1987)). The classic interpretation is that an owner hires a manager and gives him an appropriate incentive contract. The alternative interpretation is that it is the manager who proposes the incentive structure to the capital market and shareholders then select among competing proposals. Both of these are equivalent in the current setting, as owners have all the bargaining power (by assumption). It is particularly interesting to recall in this context the statement from General Motors that "*management* recommended that the Committee establish very aggressive performance targets" (my italics)[11].

3.2 Symmetric incentive equilibrium

The analysis of the game proceeds by solving the two stages backwards to find the SPE[12].

In stage 2, each agent chooses an output level, q_i, to maximize his compensation as given by (4). Assume for now that $\gamma_i > 0$ such that equilibrium contracts place a positive weight on market share. (This will be confirmed shortly.)

The first-order condition (where the manager takes γ_i as given) is

$$\frac{\partial w_i}{\partial q_i} = \frac{\partial \pi_i}{\partial q_i} + \gamma_i \frac{\partial \sigma_i}{\partial q_i} = 0. \tag{5}$$

This condition implicitly defines a manager's best response in the product market[13]. The Nash equilibrium of the stage occurs where both managers are simultaneously playing their respective best responses. In equilibrium, output levels are functions of the weight placed on market share by each manager as well as his rival such that $q_i^*(\gamma_i, \gamma_j)$ and $q_j^*(\gamma_i, \gamma_j)$ respectively.

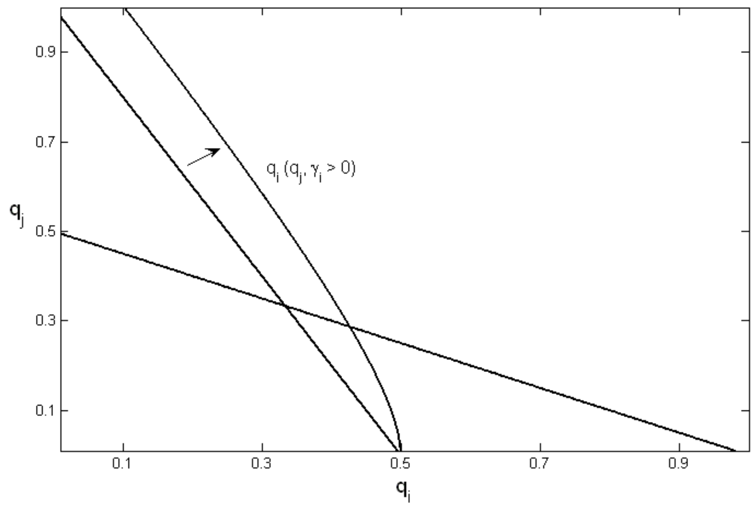
With positive weight placed on market share, a manager's perceived marginal return to a small increase in output exceeds the true marginal revenue to the individual firm.

[11] This also offers some indication that firms use market share incentives to commit to aggressive conduct in the product market, rather than, say, due to informational considerations. See, for example, Vickers (1985) for more discussion of this distinction.

[12] If one principal cannot give her agent strategic incentives (i.e., $\gamma_j = 0$), then the other manager (who receives optimal incentives with $\gamma_i > 0$) would effectively act as a Stackelberg leader in the product market. Since this result is fairly obvious it is not treated in any more detail here. It will be apparent that simple profit-maximizing objectives are dominated by strategic incentives throughout.

[13] It is easily verified that the second-order conditions are satisfied at the equilibrium values of the incentive parameters.

Figure 1: *Best response curve with market share contracts and linear demand*



Hence, delegation of decision-making to a manager tends to increase production levels and thus makes competition more aggressive.

The shape of the best response for the case of linear demand (with $f(Q) = 1 - Q$) is shown in Figure 1. Given the aggressive nature of the market share component, the best response "curves out" implying greater output levels (except where $q_j = 0$ and the firm, at least hypothetically, has 100% market share anyway). Notice also that the manager's best response is somewhat steeper than in the standard Cournot case (where the slope equals $-\frac{1}{2}$ everywhere), again most notably where the rival firm is small.

The inherent non-linearity in the first-order condition due to the market share component makes an explicit solution to a manager's best response intractable in general. Even with linear demand, for example, solving the first-order condition directly involves dealing with a polynomial equation of third order.

However, by making use of the underlying structure of the two-stage problem, as well as the curvature properties of demand, the solution can nevertheless be characterized completely.

For notational convenience, let $s_i = \frac{dq_i}{dq_j}$ and $s_j = \frac{dq_j}{dq_i}$ denote throughout the respective slopes of the managers' best responses.

Given the Nash equilibrium in stage 2 (with $q_i^*(\gamma_i, \gamma_j)$ and $q_j^*(\gamma_i, \gamma_j)$), each principal seeks to maximize firm profit by choosing her manager's incentives strategically. Thus, the first-order condition for stage 1 is given by

$$\frac{d\pi_i^*}{d\gamma_i} = [(f(Q) - c) + f'(Q)q_i^*(1 + s_j)] \frac{dq_i^*}{d\gamma_i} = 0, \tag{6}$$

where $\frac{dq_i^*}{d\gamma_i} > 0$ in any interior equilibrium where both firms produce positive output[14]. As expected, the term in this condition that induces distortion from profit maximization is the slope of the rival manager's best response, s_j.

The two first-order conditions, (5) and (6), derived above must hold in the SPE. Combining these shows that, in equilibrium

$$\gamma_i \frac{\partial \sigma_i}{\partial q_i} = f'(Q) q_i^* s_j,$$

or, equivalently,

$$\frac{\gamma_i}{f'(Q)Q^2} = \left(\frac{\sigma_i}{\sigma_j}\right) s_j. \tag{7}$$

From this it is immediate that $\text{sign}(\gamma_i) = \text{sign}(-s_j)$. Whenever the rival manager regards quantities as strategic substitutes (that is, has a downward-sloping best response curve) in the neighbourhood of equilibrium, the owner will wish to to commit to more aggressive product market behaviour by giving her manager strategic incentives for market share.

This accords well with the observed compensation patterns in the automotive and investment banking industries. It may also be interpreted in terms of the commentary by the Financial Times on banks "taking work at a loss in order to gain market share". In the incentive equilibrium, managers end up serving a low valuation segment of the market for which marginal cost exceeds the true marginal revenue to the firm.

At this point, it is useful to characterize the competitiveness of an industry. As opposed to actually working out equilibrium prices and so forth for the class of demands under consideration, it is far more convenient—and essentially equally insightful—to proceed by employing the elasticity-adjusted Lerner index. This index is defined in the conventional way as $L_\eta = \eta \frac{(P-c)}{P}$, where $\eta > 0$ is the industry price elasticity of demand. Note that $\frac{\partial}{\partial Q} L_\eta < 0$ under the present assumptions. Thus, as usual, a lower L_η represents a higher degree of competitiveness.

Recalling the symmetry of the two principal-agent pairs and hence letting $\sigma_i^* = \sigma_j^* = \frac{1}{2}$, $s_i = s_j = s^*$ etc. the following proposition is obtained by combining equations (5), (6) and (7) and some further manipulation.

[14] To see this last point, observe that

$$\frac{dq_i^*}{d\gamma_i} = \frac{\partial q_i^*}{\partial \gamma_i}(1 - s_i s_j)^{-1},$$

where $(1 - s_i s_j)^{-1}$ is positive by stability of equilibrium. Thus the sign of this expression is determined by $\frac{\partial q_i^*}{\partial \gamma_i}$. It is easy to confirm that $\frac{\partial q_i^*}{\partial \gamma_i}$ is indeed strictly positive by applying the implicit function theorem to (5) and noting that $\frac{\partial \sigma_i}{\partial q_i} > 0$ at any interior equilibrium.

Proposition 1 *(Symmetric incentive equilibrium with market share contracts). In symmetric equilibrium,*
i) The slope of a manager's best response, $s^*(E) \in (-1, 0)$, satisfies

$$s^* = \frac{-(1 - E/2)}{(2 - E/2 - s^*)}.$$

ii) Industry competitiveness is characterized by the elasticity-adjusted Lerner index,

$$L_\eta^* = \frac{1}{2}[1 + s^*(E)].$$

Proof. See appendix. ■

This fully describes the solution as claimed. Note that Proposition 1 in fact *does not* require the assumption of iso-elasticity of the slope of inverse demand, i.e. $E(Q) = E$. Furthermore, an analogous expression for the elasticity-adjusted Lerner index holds generally for all (symmetric) incentive equilibria considered in the paper.

It is helpful to consider the implications for the case of linear demand (where $E = 0$). Substituting this into Proposition 1, one finds that $s^*(0) = 1 - \sqrt{2} < 0$ and thus $L_\eta^* = \frac{1}{2}(2 - \sqrt{2})$. It is then straightforward to verify that per firm output is $q^* = \frac{(\alpha - c)}{(4-\sqrt{2})\beta}$ which is somewhat greater than in standard Cournot duopoly. This is achieved by a positive contractual weight on market share (using (5)) of $\gamma^* = \frac{4(\sqrt{2}-1)(\alpha-c)^2}{(4-\sqrt{2})^2\beta} > 0$.

More generally, the assumption $E < 2$ implies that $s^*(E) < 0$ such that competition is in strategic substitutes (in the neighbourhood of symmetric equilibrium). Thus $\gamma^* > 0$ and L_η^* is strictly less than $\frac{1}{2}$—the standard Cournot duopoly result. Note that L_η^* increases in $s^*(E)$ which in turn increases in E.

From the owners' point of view, this is a prisoners' dilemma in that they would *jointly* prefer to give managers less aggressive contracts. Hence, strategic incentives for market share confirm the conclusion in this literature that the separation of ownership from control increases consumer surplus and welfare more generally[15].

3.3 Comparison with other firm size contracts

Apart from deriving the symmetric incentive equilibrium with market share contracts, one of the contributions of the present analysis is to compare incentive contracts based on

[15] In independent work, Jansen, van Lier and van Witteloostuijn (2004) derive special cases of Propositions 1 and 2 by restricting their analysis to linear demand. I would like to thank Simon Cowan for drawing my attention to this reference.

various measures of firm size, such as sales revenue.

Is the incentive equilibrium with market share contracts more or less competitive? This section shows that, perhaps surprisingly, the answer to this is that competition is *less* fierce with market share objectives. This result also turns out to be quite robust to changes in model specification.

Consider the two leading measures of firm size used in the strategic delegation literature to date.

The first of these is sales revenue, as employed by Fershtman and Judd (1987) and Sklivas (1987) as well as the application to takeovers by Fauli-Oller and Motta (1996), for example. With incentives for sales revenue, a manager j's objective function (the equivalent of (3) above) is given by

$$\begin{aligned} \Omega_j &= \theta_j \pi_j + (1-\theta_j) R_j \\ &= (P - \theta_j c) q_j, \end{aligned} \tag{8}$$

where $R_j = Pq_j$ is sales revenue. Hence, whenever $\theta_j < 1$, the manager is induced to act as if the firm has lower costs than it actually does. Naturally, this results in more aggressive competition.

The second is output (or units sold), as considered for example by Vickers (1985). Here, a manager's objective function is given by

$$\begin{aligned} \Omega_j &= \pi_j + \tau_j q_j \\ &= (P - (c - \tau_j)) q_j. \end{aligned} \tag{9}$$

It easily seen that this is equivalent to sales revenue incentives whenever $\tau_j = (1-\theta_j)c > 0$.

However, the crucial issue is the *slope* of the manager's best response. As seen in Proposition 1, this is what drives the competitive implications of the various contracts.

Placing positive weight on either of the above measures of firm size induces an outward, *parallel* shift in the manager's best response that leaves the slope unchanged. Therefore, the slope is still given by the standard result for Cournot duopoly[16]. In symmetric equilibrium (recalling the definition of the elasticity of the slope of inverse demand, $E = \frac{f''(Q)Q}{-f'(Q)}$) this is

$$s_{FJSV}(E) = \frac{-(1 - E/2)}{(2 - E/2)}, \tag{10}$$

where $FJSV$ is used to abbreviate the class of other firm size contracts. Comparing with the market share case from above, the following proposition is immediate.

[16] See for instance Vives (1999, p. 97).

Proposition 2 *(Comparison of symmetric incentive equilibria). The following inequalities hold for any $E < 2$,*

i) $0 > s^*(E) > s_{FJSV}(E) > -1$,

ii) $\frac{1}{2} > L^*_\eta > L^{FJSV}_\eta > 0$.

Therefore the incentive equilibrium with market share contracts is less competitive than with sales revenue or output-based contracts.

Proof. The inequalities follow from the above discussion and Proposition 1. The comparison of the two equilibria makes use of the assumption that $E(Q) = E$. ■

Despite the relative performance component inherent in market share the intensity of competition turns out to be lower than with the other firm size-related contracts. This may seem surprising as relative performance objectives are perhaps naturally associated with fiercer competition and lower profits. However, Proposition 2 demonstrates that this reasoning is not correct.

The intuition for the result is that market share contracts ensure that managerial behaviour becomes *less susceptible to strategic manipulation by rivals* (as $s^* \to 0$) . Less scope for strategic manipulation gives the rival principal less reason to provide aggressive incentives and so competition remains softer.

More formally, the market share contract induces the manager to act as if an additional unit-elastic demand segment with zero costs had been added to the market (with weight $\gamma^* > 0$). Importantly, this segment has the property of being "strategically neutral" (neither strategic substitutes nor complements) in the case of symmetric duopoly. Thus, giving the manager incentives based on market share pushes the slope of his best response toward zero (recall also Figure 1).

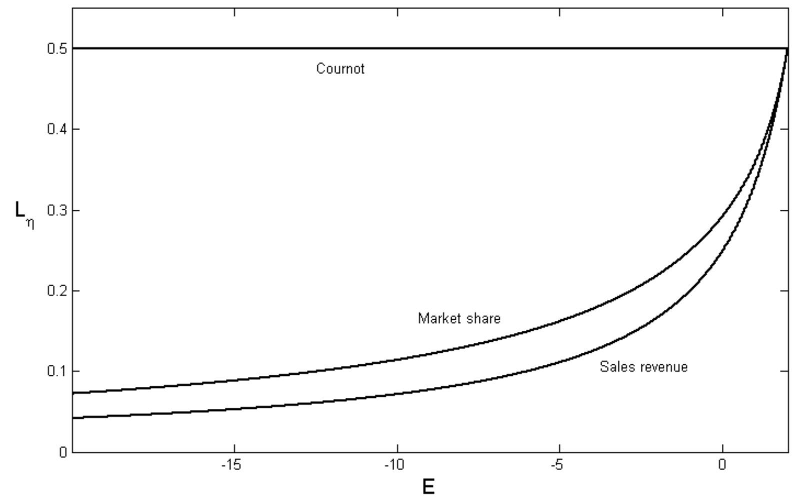
Figure 2 illustrates the quantitative implications of the proposition in terms of L_η by contrasting the market share, sales revenue and standard Cournot duopoly ($L_\eta = \frac{1}{2}$) results.

To again consider an example with linear demand, how do the magnitudes of increase in consumer surplus compare? Relative to the standard Cournot outcome, the increase in consumer surplus with sales revenue contracts equals 44.0%. This reflects one of the main results in this literature, namely that strategic delegation implies substantial welfare gains. However, with market share contacts this increase in consumer surplus is considerably lower at 34.6%.

How robust is Proposition 2?

First, the other firm size contracts could be replaced by *any* ("top-dog") contract or behaviour that does not change the slope of the manager's best response. For example, one

Figure 2: *Competitiveness of different firm size contracts*



might argue that in the banking industry some managers are prone to "overoptimism" and treat a true state of demand of α as one of $(\alpha + \nu)$, with $\nu > 0$. The distortion from profit maximization then is due to an agent's type ("behaviour") rather a strategic contract. The optimal value of ν is reached, say, by an evolutionary process. As observed earlier, contractual and behavioural deviations from profit maximization are *substitutes* in the strategic settings under consideration. But Proposition 2 also helps shed some light on which contracts and behavioural biases are "better than others"[17].

Second, the market share incentive equilibrium will continue to be less competitive for any finite number of firms (with identical technologies and contracts). The difference in competitiveness will of course decrease as the number of firms becomes large and both equilibria converge to the perfectly competitive outcome in the limit.

Third, the result is also robust to the introduction of non-constant returns to scale. It is well-known that the sign of the slope of the manager's best response is not affected by this. For instance, if marginal costs are affine (of the form $c + kq_i$, where $k \neq 0$) it is easy to see that the ranking of the slopes still holds in the same way. (This is of course subject to second-order conditions being satisfied—returns to scale cannot increase too strongly.)

Fourth, the assumption that $E(Q) = E$ can be relaxed to some extent. While analytically convenient, it is immediate that this is only a sufficient condition. More generally, $E'(Q) \leq 0$ is sufficient and $E'(Q)$ not too positive is necessary for the results to go through. Recall that best response slopes are generally increasing in E and that slopes closer to

[17]The main dominance result which implies that Proposition 2 is relevant for comparisons is derived later on and summarized in Proposition 4.

zero imply softer competition. If $E'(Q) < 0$, then the less competitive (lower Q) incentive equilibrium (market share) will also have higher E and thus be relatively less competitive than with $E(Q) = E$. By contrast, if $E'(Q)$ is strongly positive, then this additional effect is reversed and the results may flip. It is somewhat difficult to judge the importance of this, as standard demands satisfy $E'(Q) = 0$ (iso-elastic slope) and potential counterexamples appear rather intractable.

Fifth, the result also goes through for a linear differentiated products Cournot duopoly. This is an intermediate situation between the homogeneous products duopoly analyzed above and two independent monopolists (for the special case of linear demand). Thus, the degree of strategic interaction can also be thought of as being intermediate. Again, the market share component will be strategically neutral in symmetric equilibrium and placing positive weight on this, in effect, reduces the scope for aggressive incentives.

Sixth, it is possible to introduce uncertainty into the model. For instance, it is clear that *additive* demand uncertainty of the form $P = f(Q)+\eta$ (where $E[\eta] = 0$ and $E[\eta^2] > 0$) will not affect the key conclusions. The same holds true for additive marginal cost uncertainty. However, it would be interesting to know how the results might be affected by more general forms of uncertainty. This is an issue for further research.

Overall, then, the result that market share contracts lead to less intensive competition turns out to be quite robust to changes in model specification. A well-known limitation of the strategic delegation literature in general is that most intuitive results hinge crucially on competition being in strategic substitutes near equilibrium (that is, $E < 2$ in the present context).

3.4 Incentive equilibrium with asymmetric contracts

Much the same reasoning as above applies when comparing different types of strategic incentives directly. For example, when paired with $FJSV$ contracts, market share contracts always do better. This is again because they make a manager's behaviour *less susceptible to strategic manipulation by rivals*. Thus the rival firm has less reason to be aggressive in the first place and optimally chooses to produce relatively less. The other firm size contracts cannot address this role, as they merely induce a parallel shift in best responses.

The remainder of this section makes this argument more formally. To help distinguish from the above, market share incentives are denoted MS and sales revenue incentives as SR in the asymmetric equilibria. (Recall that this latter type of incentive could equivalently be replaced by output-based contracts or "overoptimistic" behaviour etc.)

Using the same result as in the previous section (see again Vives (1999, p. 97)),

$$s_{SR} = \frac{-(1 - \sigma_{SR} E)}{(2 - \sigma_{SR} E)} \tag{11}$$

is the slope of the best response associated with the sales revenue contract. Conveniently, this expression does not depend directly on the specifics of the contracts both firms select. This in turn greatly simplifies solving for the asymmetric equilibrium.

Determining the slope of the best response for the market share contract (s_{MS}) is more involved and detailed derivations are provided in the appendix. However, the intuition provided suggests that $s_{MS} > s_{SR}$ which implies that the market share player indeed does better, that is, $\sigma_{MS} > \sigma_{SR} = (1 - \sigma_{MS})$.

This is made precise as follows (where *asym* denotes the asymmetric equilibrium).

Proposition 3 *(Incentive equilibrium with asymmetric contracts). In the asymmetric equilibrium, for any $E < 2$,*
i) Market shares satisfy

$$\left(\frac{1}{\sigma_{SR}} - \frac{1}{\sigma_{MS}}\right) = -s_{SR},$$

where $s_{SR} \in (-1, 0)$, and thus are bounded by

$$2\sigma_{MS} \in (1, (\sqrt{5} - 1)).$$

ii) Industry competitiveness lies between that in the two symmetric equilibria

$$L^*_\eta > L^{asym}_\eta > L^{FJSV}_\eta.$$

Proof. See appendix. ∎

The result is again illustrated by considering the case of linear demand ($E = 0$) for which $s_{SR} = -\frac{1}{2}$ is independent of equilibrium market shares (see (11)). It now follows easily from Proposition 3 that $\sigma_{MS} = \frac{1}{2}(\sqrt{17} - 3)$ which equals approximately 56%. Interestingly, the market share player does better even when the optimal sales contract places *negative* weight on profits (which may occur, for example, with linear demand when α/c is large).

Specifically, the bound on market shares shows that σ_{MS} can be as high as $\frac{1}{2}(\sqrt{5} - 1)$, approximately 62%—with technologically identical firms. This occurs when $s_{SR} \to -1$ as $E \to -\infty$. Here, the scope for strategic manipulation is greatest and so is the market share contracts advantage. Again, note that this result does not depend on the assumption that $E(Q) = E$.

Proposition 3 further states that the degree of competitiveness in the asymmetric incentive equilibrium is sandwiched between the two symmetric equilibria (see Propositions 1 and 2). The intuition for this is that competition becomes fiercer the more sales revenue players are active, as these make their respective rival relatively more aggressive.

Again, making similar arguments to those following Proposition 2, the key insights from Proposition 3 are seen to be quite robust to changes in demand, cost structure, the degree of product differentiation or introduction of uncertainty.

4 Summary of main result and discussion

This section summarizes the main result of the analysis as Proposition 4 and provides further discussion. In particular, it is shown that giving managers market share contracts is a dominant strategy in an extended game where owners can commit to particular types of contracts *ex ante*. Recall that owners are assumed to maximize firm profits.

More specifically, consider an additional stage added up-front (stage 0) in which firms can commit to a particular type of contract (such as market share etc.). The SPE now extends over all three stages. Solving backwards, the owners' payoffs in stage 0 are as shown in Table 1. For convenience, the other firm size contracts in the asymmetric equilibria are again summarized as sales revenue (SR).

Table 1: *Firm profits in stage 0*

	Market share	Sales revenue
Market share	π^*, π^*	π^{MS}, π^{SR}
Sales revenue	π^{SR}, π^{MS}	π^{FJSV}, π^{FJSV}

To show that committing to market share contracts is dominant for owners in this stage, one needs to show that $\pi^* > \pi^{SR}$ as well as $\pi^{MS} > \pi^{FJSV}$. It turns out that the results derived above are sufficient to prove this.

Perhaps the most intuitive way to think about a principal's payoff is to consider it as her firm's share of the equilibrium industry profit by rewriting profits as $\pi_i = \sigma_i \cdot (P -$

$c)Q$. Of course, higher market share and higher industry profits are preferred by owners, ceteris paribus. Equilibrium industry profit may be rewritten as $(P-c)Q = -f'(Q)Q^2 L_\eta$. Crucially, this is a decreasing function of industry output, Q and, conversely, an increasing function of L_η.

Now consider the two inequalities in turn.

First, $\pi^* > \pi^{SR}$—profits in symmetric equilibrium with market share contracts exceed profits for the sales revenue player in asymmetric equilibrium. By Proposition 3, $\sigma_{SR} < \frac{1}{2}$ in the asymmetric equilibrium, while in the symmetric equilibrium the market is, of course, split evenly. Again, by Proposition 3, $L_\eta^* > L_\eta^{asym}$ such that the "pie" is larger in the symmetric market share equilibrium. Combining these implies that $\pi^* > \pi^{SR}$ as claimed. Faced with a market share player, a sales revenue player will prefer to deviate (and also commit to market share) as this promises a larger share of a larger pie[18].

Second, $\pi^{MS} > \pi^{FJSV}$—profits for the market share player in asymmetric equilibrium exceed profits in symmetric equilibrium with sales revenue contracts. Similar reasoning applies here too and further detail is hence omitted for brevity.

This can be summarized in the following proposition.

Proposition 4 *(Equilibrium in the extended game). i) In stage 0, it is a dominant strategy for owners to commit to market share contracts. ii) The symmetric incentive equilibrium is thus characterized by Proposition 1. iii) By Proposition 2, this equilibrium is less competitive than with sales revenue or output-based contracts.*

Proof. This follows from the above discussion. ■

The proposition thus establishes a strategic rationale for committing to market share objectives. From the owners' point of view, market share contracts actually *soften* competition despite (indeed, because of) their inherent relative performance aspect. Delegation still leads to a prisoners' dilemma, but to a less severe one.

As pointed out by Klemperer and Meyer (1989), delegation games with strategic incentives can be viewed as a "reduced form" of competition in supply functions (see also Vives (1999, p. 188)). In the present analysis, market share objectives effectively constitute a commitment to steeper supply schedules (without restricting attention to linear schedules). This softens competition (increases L_η) and confers strategic advantage as discussed above[19].

[18] In practice, this "adoption dynamic" may be facilitated by the widespread use of compensation consultants, see e.g., Murphy (1999) for further details.

[19] However, no claim is made that this incentive structure would be optimal within a general class of

An important assumption thus far is that the contractual distortion of preferences is taken to be observable to other players. (Recall once more Schelling's example of the military commander of *known* motivation.) Indeed, Katz (1991) notes that the strategic value of pre-commitment is zero if contracts are unobservable (or renegotiable). In a related paper, Bagwell (1995) shows that the "standard" equilibrium (e.g., Cournot-Nash) is the only equilibrium even with only an ε-probability of error in observing a rival's action.

However, much of the recent work in this area can be regarded as a "critique of the observability critique". For instance, Bagwell's ε-result is itself highly sensitive to assumptions on the type of noise and may break down with plausible alternative specifications, see van Damme and Huskens (1997). Fershtman and Kalai (1997) show that modifying Katz's "rational agent" equilibrium concept may also restore commitment value, as does repeated interaction. More recently, Koçkesen (2004) and Koçkesen and Ok (2004) point out that even completely unobservable contracts can have commitment value in some settings.

These results also receive support from experimental studies. For instance, Huck and Müller (2000) find that Bagwell's ε-result holds true for inexperienced players and large noise but fails for experienced players (even with fairly large noise). There is also experimental evidence for commitment value of unobservable delegation in an ultimatum game, see Fershtman and Gneezy (2001).

Overall, then, recent work suggests that the observability assumption might not be as problematic as the original Katz critique suggests. However, the (implicit) assumption that contracts are not renegotiable remains crucial (see especially Koçkesen (2004)).

5 Conclusions

Committing to market share contracts dominates the well-known sales revenue and output-based contracts—as well as simple profit maximization—in an oligopoly competing in strategic substitutes. This provides a strategic rationale for the prominence of market share objectives in current executive compensation practice in the automotive and investment banking industries.

The analysis thus sheds some light on the interplay between contracts and competition in industries where managers pay much attention to league table rankings. In contrast to a well-known principle from incentive theory, see Kerr (1975), "the folly of rewarding A—market share—while hoping for B—profits" may in fact be a "necessary evil". This

unrestricted contracts that includes non-linear incentives and arbitrary objective functions. The present analysis concentrates on a natural class of contracts that seems to accord well with actual compensation practice.

might also help explain why The Economist's call for car firms to "reinvent themselves to seek only profit" is proving to be somewhat difficult to realize.

Giving managers incentives for market share is an aggressive but moreover also a "robust" strategy, as it makes managerial behaviour less susceptible to strategic manipulation by rivals. This latter property sets market share apart from the other measures of firm size considered in the literature. Relatedly, and perhaps surprisingly, the incentive equilibrium with market share contracts is in fact *less* competitive. The gains to consumers from firms' market share objectives are substantial, but nevertheless lower than might have been expected.

Indeed, it is clear that this basic intuition holds far more generally. When competing in strategic substitutes, players will wish to commit to aggressive conduct, but also make their behaviour less manipulable by rivals. This reduces the degree of interdependence and, hence, the temptation to be aggressive in the first place. Players remain in a prisoners' dilemma, but in a less severe one. These theoretical predictions would also lend themselves naturally to testing in experimental markets.

6 Appendix

Proof of Proposition 1

i) By differentiating the first-order condition (5) and recalling that $s_i = \frac{dq_i}{dq_j}$, the slope of a manager's best response is given as

$$s_i = \frac{\left(\frac{\partial^2 \pi_i}{\partial q_i \partial q_j} + \gamma_i \frac{\partial^2 \sigma_i}{\partial q_i \partial q_j}\right)}{-\left(\frac{\partial^2 \pi_i}{\partial q_i^2} + \gamma_i \frac{\partial^2 \sigma_i}{\partial q_i^2}\right)}.$$

Expanding this yields

$$\begin{aligned} s_i &= \frac{\left(f'(Q) + f''(Q)q_i + \gamma_i \frac{(q_i - q_j)}{Q^3}\right)}{-\left(2f'(Q) + f''(Q)q_i - \gamma_i \frac{2q_j}{Q^3}\right)} \\ &= \frac{-\left(1 - \sigma_i E + \gamma_i \frac{(\sigma_i - \sigma_j)}{f'(Q)Q^2}\right)}{\left(2 - \sigma_i E - \gamma_i \frac{2\sigma_j}{f'(Q)Q^2}\right)}, \end{aligned}$$

where the last expression makes use of the definitions $E = \frac{f''(Q)Q}{-f'(Q)}$ and $\sigma_i = q_i/Q$. Now, using the equilibrium result from (7),

$$\frac{\gamma_i}{f'(Q)Q^2} = \left(\frac{\sigma_i}{\sigma_j}\right) s_j,$$

this in turn becomes

$$s_i = \frac{-\left(1 - \sigma_i E + \frac{\sigma_i}{\sigma_j}(\sigma_i - \sigma_j)s_j\right)}{(2 - \sigma_i E - 2\sigma_i s_j)}. \tag{12}$$

In symmetric equilibrium (letting $\sigma_i^* = \sigma_j^* = \frac{1}{2}$ and $s_i = s_j = s^*$) this simplifies to

$$s^* = \frac{-(1 - E/2)}{(2 - E/2 - s^*)} \tag{13}$$

as required. (It is easy to check that the relevant root of the quadratic is indeed $s^*(E) \in (-1, 0)$.)

ii) The expression for the elasticity-adjusted Lerner index, $L_\eta = \eta\frac{(P-c)}{P}$, is easily obtained by rearranging the first-order condition from (6),

$$\frac{d\pi_i^*}{d\gamma_i} = [(f(Q) - c) + f'(Q)q_i^*(1 + s_j)]\frac{dq_i^*}{d\gamma_i} = 0,$$

as follows

$$\begin{aligned} \frac{(f(Q) - c)}{-f'(Q)Q} &= \frac{q_i^*}{Q}(1 + s_j) \\ &= \eta\frac{(P - c)}{P}, \end{aligned}$$

and recalling the definitions $\eta = \frac{f(Q)}{-f'(Q)Q} > 0$ and $P = f(Q)$. Again imposing symmetry (and letting $s_i = s_j = s^*(E)$),

$$L_\eta^* = \frac{1}{2}[1 + s^*(E)] \tag{14}$$

as claimed.

Proof of Proposition 3

i) The slope of the best response associated with the market share contract has already been derived in the proof of Proposition 1 (see (12)) as

$$s_{MS} = \frac{-\left(1 - \sigma_{MS}E + \frac{\sigma_{MS}}{\sigma_{SR}}(\sigma_{MS} - \sigma_{SR})s_{SR}\right)}{(2 - \sigma_{MS}E - 2\sigma_{MS}s_{SR})}.$$

The corresponding expression for the sales revenue contract,

$$s_{SR} = \frac{-(1-\sigma_{SR}E)}{(2-\sigma_{SR}E)},$$

is from the discussion in the main text. It is convenient to rewrite these as

$$(1+s_{MS}) = \frac{(1-s_{SR}\left[\frac{\sigma_{MS}}{\sigma_{SR}}\right])}{(2-\sigma_{MS}E-2\sigma_{MS}s_{SR})}$$

and

$$(1+s_{SR}) = \frac{1}{(2-\sigma_{SR}E)} \tag{15}$$

respectively. The ratio of the two equals

$$\frac{(1+s_{MS})}{(1+s_{SR})} = \frac{(1-s_{SR}\left[\frac{\sigma_{MS}}{\sigma_{SR}}\right])(2-\sigma_{SR}E)}{(2-\sigma_{MS}E-2\sigma_{MS}s_{SR})}. \tag{16}$$

Now, from the first-order condition for the incentive parameter in (6), see also the proof of Proposition 1,

$$L_{\eta}^{asym} = \sigma_{MS}(1+s_{SR}).$$

An analogous expression also holds for sales revenue contracts, such that

$$L_{\eta}^{asym} = \sigma_{SR}(1+s_{MS}).$$

Combining these yields that, in equilibrium,

$$\frac{\sigma_{MS}}{\sigma_{SR}} = \frac{(1+s_{MS})}{(1+s_{SR})}.$$

This implies that $\sigma_{MS} > \sigma_{SR}$ whenever $s_{MS} > s_{SR}$. Now, using (16), it follows that

$$\frac{\sigma_{MS}}{\sigma_{SR}} = \frac{(1-s_{SR}\left[\frac{\sigma_{MS}}{\sigma_{SR}}\right])(2-\sigma_{SR}E)}{(2-\sigma_{MS}E-2\sigma_{MS}s_{SR})}.$$

Some manipulation shows that the E's cancel and one is left with

$$\left(\frac{1}{\sigma_{SR}} - \frac{1}{\sigma_{MS}}\right) = -s_{SR} \tag{17}$$

as required.

Notice that this defines σ_{MS} as a quadratic in $-s_{SR}$. It is straightforward to verify that

σ_{MS} increases in $-s_{SR}$. Clearly, $\sigma_{MS} \to \frac{1}{2}$ as $-s_{SR} \to 0$ ($E \to 2$). To take the opposite extreme, observe that, as $-s_{SR} \to 1$ ($E \to -\infty$), σ_{MS} solves

$$\sigma_{MS}^2 + \sigma_{MS} - 1 = 0.$$

The relevant root of this is $\sigma_{MS} = \frac{1}{2}(\sqrt{5}-1)$. Thus, $2\sigma_{MS} \in (1, (\sqrt{5}-1))$ as claimed.

ii) The second part of the proposition states that

$$L_\eta^* > L_\eta^{asym} > L_\eta^{FJSV}$$

holds for any $E < 2$. Consider first the claim that $L_\eta^{asym} > L_\eta^{FJSV}$. Using the above results, this is equivalent to

$$\sigma_{MS}(1 + s_{SR}) > \frac{1}{2}(1 + s_{FJSV}(E)),$$

which in turn can be rewritten as (using (15) and symmetry)

$$\frac{\sigma_{MS}}{(2 - \sigma_{SR}E)} > \frac{1}{2(2 - E/2)}.$$

Some manipulation shows that that the E's cancel again and that this inequality holds whenever $\sigma_{MS} > \sigma_{SR} \Leftrightarrow 2\sigma_{MS} > 1$, which was already shown to hold earlier.

Proving the other inequality, $L_\eta^* > L_\eta^{asym}$, is somewhat more involved. Note first that this may be rewritten as

$$\frac{1}{2}(1 + s^*(E)) > \sigma_{MS}(1 + s_{SR}),$$

which is equivalent to (again using (15))

$$(1 + s^*(E)) > \frac{2\sigma_{MS}}{(2 - \sigma_{SR}E)}.$$

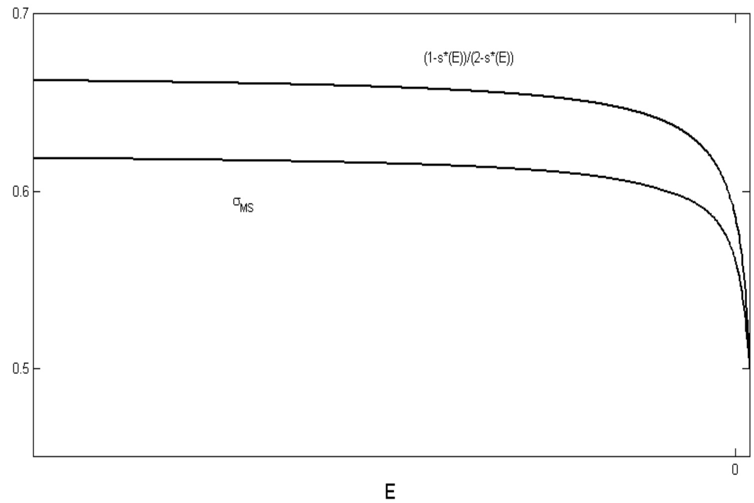
It follows from the proof of Proposition 1 that

$$(1 + s^*(E)) = \frac{(1 - s^*(E))}{(2 - E/2 - s^*(E))},$$

so the inequality now becomes

$$\frac{(1 - s^*(E))}{(2 - E/2 - s^*(E))} > \frac{2\sigma_{MS}}{(2 - \sigma_{SR}E)}.$$

Figure 3: $\frac{(1-s^*(E))}{(2-s^*(E))} > \sigma_{MS} \Longrightarrow L^*_\eta > L^{asym}_\eta$ *for all* $E < 2$



Some further manipulation shows that the E's cancel once again and this simplifies to

$$-s^*(E) > \frac{(\sigma_{MS} - \sigma_{SR})}{\sigma_{SR}},$$

or, equivalently,

$$\frac{(1 - s^*(E))}{(2 - s^*(E))} > \sigma_{MS}. \tag{18}$$

The left-hand-side of this inequality follows from (13) in the proof of Proposition 1. However, the right-hand-side involves dealing with a polynomial equation of third order.

To see this, observe that (17) can be expanded to yield

$$\frac{(\sigma_{MS} - \sigma_{SR})}{\sigma_{MS}\sigma_{SR}} = \frac{(1 - \sigma_{SR}E)}{(2 - \sigma_{SR}E)}.$$

Some rearranging shows that, in the asymmetric equilibrium, σ_{MS} satisfies

$$\sigma^3_{MS}E - \sigma_{MS}(1 - \sigma_{MS}) + (2\sigma_{MS} - 1)(2 - E) = 0. \tag{19}$$

Solving this numerically verifies that the last inequality in (18) indeed holds for all $E < 2$. This implies that $L^*_\eta > L^{asym}_\eta$ as claimed.

This result is illustrated in Figure 3 and the intuition is provided in the main text.

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