Firms, Nonprofits, and Cooperatives

Herbst, P.; Prüfer, J.

Publication date:
2007

TILBURG UNIVERSITY

TILEC

TILEC Discussion Paper

DP 2007-003

Firms, Nonprofits, and Cooperatives: A Theory of Organizational Choice

By

Patrick Herbst and Jens Prüfer

January 2007

ISSN 1572-4042

Firms, Nonprofits, and Cooperatives: A Theory of Organizational Choice

Patrick Herbst* Goethe University Frankfurt

Jens Prüfer† Tilburg University

9th January 2007

Abstract

This paper formalizes the difference between firms, nonprofits, and cooperatives and identifies optimal organizational choice. In a model of quality provision, we find a clear ranking of quality produced: Firms provide lowest and nonprofits highest levels of quality. Efficiency, however, depends on the competitive environment, the decision making process and technology. Cooperatives are optimal when decision making costs are low. Else, cooperatives are increasingly dominated by either nonprofits or firms (depending on the incremental costs of quality production). Finally, changes in the competitive environment affect organizational choice: Increased competition induces a shift towards firm organization and away from nonprofits.

JEL classification: L21, L31, D23

Keywords: Theory of the Firm, Cooperatives, Nonprofits, Organizational Choice, Organizational Change

*Department of Economics – Industrial Organization, Schumannstr. 60, 60325 Frankfurt, Germany; e-mail: herbst@econ.uni-frankfurt.de

†Department of Economics – TILEC; Tilburg University; P.O. Box 90153; 5000 LE Tilburg, The Netherlands; e-mail: j.prufer@uvt.nl

1 Introduction

The form an organization operates under is an important determinant of its economic success. Although organizational choice may be perceived as fixed over the lifetime of many organizations, there exist several examples and incidences where the endogeneity of organizational form can be inferred from. This is probably most visible the case for recent events in the financial sector: In 2005, the New York Stock Exchange (NYSE) and Mastercard, two major financial institutions, announced their plans to demutualize – that is their conversion from a cooperative form of organization into an investor-owned firm.[1] Visa, another major credit card operator, followed suit in 2006 announcing its intention to demutualize (with the exception of its European business). These specific events accord well with a broader trend of organizational change in the financial sector, such as the banking and thrift or the insurance industry (see the survey by Chaddad and Cook, 2004). Demutualization is also seen or discussed in other sectors, such as retailing or the professional services.[2] On the other hand, there are also sectors where investor ownership is in decline (e.g. the nursing home industry – see Chou, 2002). More generally, privatization of formerly public services (such as hospitals, prisons, educational institutions) in many OECD countries also raises questions about the appropriate organizational form these organizations should be converted into. Here, the options discussed are usually investor-owned firm or nonprofit form.

The above observations raise the following question: What determines optimal organizational structures and changes therein? This paper aims at providing an answer to this question by proceeding in three steps. First, in the spirit of Hansmann (1996), it formalizes the difference between firms, nonprofits, and cooperatives. Second, it compares the efficiency of these organizational forms and thus endogenizes organizational choice. Third, the paper studies how changes in

[1] Both conversions were finalized in 2006: The NYSE converted its organization via the acquisition of Archipelago in March 2006, while Mastercard listed its stock in May 2006 in an IPO.

[2] In the UK, for example, the "Clementi Report" initiated a (still ongoing) discussion about the pros and cons of investor ownership of law firms. See *www.legal-services-review.org.uk/* and the reporting in *The Economist*, December 16th 2004, or in the business press (e.g. the *Financial Times*, December 16th and 20th 2004).

the environment affect this efficiency comparison and might thus induce organizational change. Specifically, it looks at the impact of outside competition – one of the most frequently cited reasons for shifts in organizational structures.

Our paper analyzes a situation where consumers want to consume a quality good and differ in their preferences for quality. Consumers may choose between the (higher) quality product provided by the organization in focus and a (lower quality) outside product. Starting from fundamental assumptions on objectives and rules of decision making but confronting each organization with the same environment, we derive equilibrium levels of quality, price, and total surplus. This allows us to compare efficiency and to determine optimal organizational choice for (i) purely profit maximizing firms (investor ownership); (ii) nonprofits, governed by a non-distribution constraint, and thus pursuing purely non-monetary objectives; (iii) cooperatives, whose members may enjoy both monetary payoffs and non-monetary benefits. In either case we assume that each organization employs a manager who can exert effort to produce a good with the quality level set by the organization's owners. Because of owner heterogeneity, the decision making process is costly whenever owners' goal alignment is not perfect. Additionally, we take into account the interaction between the set of owner-members (i.e. the decision to join a cooperative or a nonprofit) and organizational outcomes.

We derive the following main results. In equilibrium, there is a clear ranking of qualities provided: Firms provide lowest levels and nonprofits highest levels of quality. Efficiency, however, depends on the cost of production and the cost of collective decision making in an organization. For low cost of collective decision making, a cooperative usually is the most efficient form of organization as it honors both consumer surplus and profits. Yet, as soon as these costs rise, cooperatives are increasingly dominated by either nonprofits or firms (depending on the incremental costs of quality production). Increased competition improves the efficiency of firms vis-à-vis nonprofits and cooperatives. Hence, in accordance with the above-mentioned empirical observations, our model predicts organizational change towards investor ownership when competitive pressures rise.

In our approach, we follow the literature on organizational choice which emphasizes the differences in objectives induced by different organizational forms.[3]

[3]Note that this approach differs from the literature on organizational design that analyzes internal structures in order to determine their optimality – given the organizational objective.

Glaeser and Shleifer (2001) analyze nonprofit versus firm organization when quality matters but is non-observable. By choosing the nonprofit form, an entrepreneur commits to lowering his profit motive (as dividends are only consumed as perks), thus alleviating the underprovision of quality. Hart and Moore (1996) discuss the trade-off between firms and cooperatives when monopoly pricing or skewness in members' preferences distort prices away from the first-best. Additionally, their paper considers effects of competition and finds that firms are better suited to face competition than cooperative forms of organization. In an analysis of partnerships (defined via the profit-per-partner payout), Levin and Tadelis (2005) focus on the choice of partner quality. The authors show that partnerships are preferable in settings of high market power (informational asymmetries). Finally, Hart, Shleifer, and Vishny (1997) look at the trade-off between public versus private firms in the provision of quality and cost efficiency. Again, the different objectives implied by an organizational form affect the economic outcomes and highlight the trade-offs in organizational choice.

The structure of the paper is as follows. Section 2 characterizes the three organizational forms analyzed in this paper and relates our paper further to the literature. Section 3 outlines the model. In section 4 we derive and compare equilibria and efficiency for the three organizational forms. Section 5 analyzes how changes in the competitive environment affect organizational efficiency and thus choice. Section 6 discusses robustness and extensions while section 7 concludes. All proofs are relegated to the appendix.

2 Organizational Forms

Within the property rights based theory of the firm, an organization is characterized by ownership over assets. Following the literature, ownership is defined by residual rights of control in this paper.[4] Consequently, one of the crucial traits of any organization is the identity of its owners. The type of owners, combined with other restrictions and determinants of their action space, determines the nature of the organization's overall objective function. Hereafter, we characterize each organizational form in three dimensions: (i) Who holds the residual rights

See, for example, Athey and Roberts (2001) or Hart and Moore (2005).

[4]See Grossman and Hart (1986) or Hart and Moore (1990).

of control? (ii) Who owns the claims to any residual income? (iii) What is the objective function of the owners? Further questions to be asked for any organizational form are: Where does the organization obtain financing from? And how do (multiple) owners achieve a decision about the issues at hand (and at what cost)? We will discuss these issues in the following paragraphs. Table 1 in the appendix summarizes the major characteristics for all three organizational forms.

As the reference form, we define any organization owned by investors (shareholders) maximizing their financial return on investment as a *firm*.[5] These investors hold both residual rights of income and control. Absent any other imperfections, all shareholders of a firm pursue the same goal, that is maximizing firm profits. Our basic analysis will hence show that investors' interests are completely aligned, and thus any investor could decide on behalf of the other investors. All operational costs in a firm have to be covered by its (expected) retained earnings.

On the other side of the organizational spectrum, we find *nonprofits*. An organization is defined as a nonprofit if its owners – henceforth called members – have a purely non-financial interest in the activity of the organization. By definition, members of a nonprofit, in contrast both to firms and cooperatives, forego all rights of residual income. Generally, these rights could rest with the members as non-monetary perquisites (see e.g. Glaeser and Shleifer, 2001), be transferred to a manager or other employees (in cash or in perquisites), or be transferred to some other charitable use. Generally, this ex ante waiver of residual income is captured by the term *non-distribution constraint*.[6] Despite the absence of residual income rights, members may use their control rights to dismiss managers not complying with their duty. This managerial compliance could be assured either by delegation via a board of trustees or directly via the members' general meeting.[7] We

[5]Unlike Glaeser and Shleifer (2001), we exclude single-owner and owner-managed firms but focus on multiple ownership as this allows us to capture issues of collective decision making as a specific and important aspect of many ownership structures.

[6]Note that other authors allow nonprofits to distribute their profits to owners, be it directly (Lakdawalla and Philipson, 2006) or indirectly via price subsidies (Kuan, 2001). While relaxing the nondistribution constraint takes into account aspects of many real nonprofit organizations, we stick to the original constraint in order to highlight the generic characteristics of nonprofits.

[7]In any type of organization with dispersed multiple owners, a manager has some leeway. However, once the cost of (mis-)behavior are sufficiently high or issues at stake are sufficiently important, owners/members can be expected to interfere and to be actively involved in the decision making process. See O'Regan and Oster (2005) for empirical evidence on the behaviour

will show that the interests of the members of a nonprofit are perfectly aligned as all members only focus on quality. Hence, similar to the firm case, any individual owner could serve as a nonprofit's final authority writing the incentive contract. Finally, note that nonprofits may (and often do) receive financing from donations or membership fees, in addition to financing out of retained earnings.[8]

Cooperatives resemble firms regarding the ability to pay out dividends, but they also have elements of a nonprofit: We define an organization as a cooperative if its owners have a direct interest in the cooperative's activity (as consumers, in this paper) but also care about dividends. Hence, members of a cooperative hold both residual rights of income and control. Our results will show that this leads to disagreement among members. As a consequence, it is the median member who effectively determines the manager's employment contract.[9] In general, members of a cooperative have both their expected consumer surplus and the organization's revenues to finance operations.

In the terminology of Hansmann (1996), our model analyzes the ability of the three organizational forms to overcome the costs of market contracting which arise from market power in setting price and quality.[10] By assuming certain key features distinguishing the organizations, we model the trade-off between several costs of ownership. On the one hand, all organizations face the same cost structure for the production of quality (mainly in the form of managerial effort costs). On the other hand, there are costs of ownership which differ between the organizational forms: In investor-owned firms and to a lesser extent in cooperatives, consumer surplus has less weight (relative to profits) in the decision making process of the owners than is socially desirable. In combination with market power, this leads to underprovision of quality. The reverse is true for nonprofits: Due to the nondistribution constraint, consumer surplus is key in owners' decision

of nonprofits' board members and executive directors.

[8]In the paper, we assume donors and members to be identical. We use the term members in order to highlight their possession of residual rights of control. Our specification of nonprofits and its owners is equivalent to the *nonprofit cooperative* of Hart and Moore (1998) and is related to the *commercial nonprofit* of Hansmann (1996).

[9]This is a standard assumption in voting procedures. Refer to Roberts (1977) or Hart and Moore (1996), for example.

[10]For cooperatives, Hart and Moore (1998) highlight another source for costs of market contracting: Price differentiation between members and non-members (or the payment of dividends as price subsidies).

making while profitability aspects are neglected. Hence, costly overprovision of quality results. Finally, if individual members' preferences for quality differ and goal alignment of the membership base is not achieved, an organization incurs extra costs of collective decision making. In our model, these costs may translate the cooperative's advantage of featuring both consumer surplus and profits in owners' optimization problem into a disadvantage.

Costs of collective decision making are common in the organizational economics literature, as discussed broadly in Hansmann (1996). In this paper, we mainly interpret them as costs of the decision making process (see Dow and Putterman, 2000; Dow, 2001, for examples of the costs incurred in worker cooperatives). Costly decision processes usually stem from the need of members to collect information prior to the decision making, and from the costs of attending meetings. Additionally, there is a set of costs arising in the decision process when multiple issues are to be decided and voting cycles might occur (see Zusman, 1992). Costs of collective decision making usually increase in the heterogeneity of a cooperative's members. Finally, apart from the direct costs of the decision making process, further costs can arise from influence activities in organizations (see Milgrom, 1988, for example).

3 The Model

3.1 General Structure

Consider a market for a quality product supplied by a single organization and demanded by a set of consumers (see below). Irrespective of its form, an organization is run by a single manager controlled by the organization's owners. These owners are either financial investors or a sub-set of the consumers in the market. Finally, there is a benevolent social planner whose only aim is to maximize the sum of consumer and producer surplus in the market.[11] All agents are risk-neutral.

[11]The focus in our paper is on organizational efficiency. For this reason, we introduce the social planner as a player maximizing total surplus to ensure that the efficient organizational choice is made ex ante. The central trade-off of the model prevails as long as the agent in charge of choosing organizational form positively values both consumer and producer surplus – even with excessive weight put on either side of the market.

Demand for the good stems from a mass of consumers normalized to unity. While consumers appreciate quality, they differ in the degree they value it. Let

$$v(p, q, \theta^i, y) = \max\{\psi(p, q, \theta^i); 0\} + y \tag{1}$$

be consumer i's indirect utility, where y denotes any monetary income and $\psi(p, q, \theta^i) \equiv \theta^i q - p$ is i's consumption utility, which depends on the quality $q \in [0; 1]$ and the price p of the good as well as her personal valuation of quality, θ^i. The term $\theta^i q$ thus represents consumer i's willingness to pay for a good of quality q, which is assumed to be unaffected by potential dividend payments.[12] Individual valuation of quality is private knowledge and distributed uniformly over $[0; 1]$.

Due to minimum efficient scale requirements (fixed set-up costs), no entry occurs and the quality q offered is identical for all consumers. At the same time, there exists an imperfectly substitutable product offered in an alternative market. This competitive fringe is characterized by the tuple (p_0, q_0) where p_0 is the price of this good and q_0 denotes the quality equivalent of the substitute. We impose the following restrictions: $q > q_0 + p_0$ and $q_0 > p_0 \geq 0$.[13] The former implies that the organization analyzed here provides a superior good (low degree of substitutability of the alternative good) while the latter ensures that the substitute good is a relevant alternative.

All organizational forms face the same technology and production and sales processes. Operations require spending fixed costs of M, normalized to zero for the main part of the analysis.[14] Production then requires a manager to exert

[12]Consumers are thus assumed to have quasi-linear preferences with respect to the quality product and some composite good. Hence, dividends do not affect the purchasing decision of consumers. Alternatively, one could assume that consumers purchase a large set of goods and have further sources of income. Any dividend payments in our model would hence be split on the whole set of goods and can be considered negligible relative to the other income.

[13]The parameters for the competitive fringe are exogenous and may not be affected directly by any player, including the social planner. We think of (p_0, q_0) being influenced by the general environment and trends such as globalization or technological development. Also note that although the model shares some features with those of vertical differentiation (see for example Shaked and Sutton, 1982; Choi and Shin, 1992), there are different comparative static effects (see section 5). These are due to the non-strategic interaction between the organization considered and the competitive fringe.

[14]The effect of positive levels of M will be discussed in section 6.

personal effort to produce quality q. Let

$$e(q) \geq 0 \tag{2}$$

be the twice continuously differentiable effort cost function of the manager with standard convexity assumptions:[15]

$$e'(q) \geq 0\ , \quad e''(q) > 0 \quad \text{and} \quad e(q=0) = 0 \tag{3}$$

Finally, the manager sets the price p monopolistically and produces as many units of the good as demanded with marginal cost normalized to zero. Given this structure of production, owners of an organization have to induce the manager to provide the desired quality (and thus personal effort). This is done by a simple incentive contract specifying quality and a corresponding wage structure w. Assuming the manager has an outside option of zero and limited liability, this reduces to compensating the manager for his personal effort when quality is as required (and paying a zero wage otherwise). If owners' preferences concerning the specifics of the contract (the quality to be produced) are not perfectly aligned, they have to induce a decision by majority voting. In this case, the decision making process involves costs of collective decision making D.[16]

While we assume quality to be observable and contractible, it is also possible to use our framework when quality is imperfectly observable, such as in the case of experience goods. Then, the fixed cost of M might be interpreted as the cost of installing some monitoring technology (e.g. independent audits) that allows owners of an organization to contract on quality again. Or, M might capture the cost of commitment or build-up of reputation for an organization (or its manager). Investment in credibility then alleviates the potential moral hazard problem between the organization and its customers.

3.2 Timing

Organizational set-up:

[15]Where necessary, we impose additional restrictions in the subsequent analysis that restrict attention to interior solutions.

[16]Under perfect goal alignment, decision making authority can be assigned to any owner. Without goal alignment, costly joint decision making is necessary.

- At $t = 0$ the social planner chooses the organizational form and decides about setting up a membership fee structure. Consumers decide about joining the organization as owners.
- At $t = 1$ owners specify the management contract (quality to be produced). This is costless if all owners agree on the quality level to be specified. Otherwise, costs of D are incurred to identify the median owner.

Production and consumption period:

- At $t = 2$ the manager produces quality q, expands effort $e(q)$, and sets price p.
- At $t = 3$ consumers decide about purchasing the good (or its substitute). All payoffs (consumption utility, wage payments and dividend payments) are realized thereafter.

We solve this game by backward-induction to identify a subgame-perfect equilibrium.

3.3 Organizational Set-up

Owners' decisions during the set-up period (in $t = 1$) are influenced by expectations on the profits $\pi_j(p, q, w)$ of the organizations, where $j \in \{F, N, C\}$.[17] Let q_j^* be the solution to the optimization problem of the organization's owners without any budgetary restrictions. $\pi_j(q_j^*, \cdot)$ is then the organization's profit. We will assume

$$\pi_j(q_j^*, \cdot) \geq 0 \tag{4}$$

such that the organization does not need to collect fees to finance operations. In section 6 we will discuss robustness of our results if profits are negative.

While fees are not needed to support operations (in the basic model), we allow the social planner to levy a fee in order to influence the set of consumers owning the organization. However, the ability of the social planner to collect membership fees from organization j's owners is restricted by private knowledge

[17] We use subscripts to denote organizational forms and superscripts to identify specific consumers.

of individual preferences for quality, θ^i. Nevertheless, the literature on mechanism design has shown that one can induce agents to reveal their privately observable preferences.[18] Following this literature, we assume that a mechanism exists such that the social planner can collect a uniform fee from any consumer with preferences for quality above some threshold level. This is achieved by specifying a membership fee f plus a minimum amount of membership fee income (or mass of consumers to join), such that every consumer with (expected) consumer surplus higher than f is vital for the organization to be set up.[19]

It is crucial that the social planner is able to credibly commit to not establishing an organization whenever the minimum mass of fee income is not collected. The capability of the social planner to commit to this mechanism could be interpreted as the power of the government to enact a law that binds judiciary and executive authorities. Then, the legislative body will not alter any regulations or laws as long as the cost of ex post adjustment of the law is sufficiently high. Finally, note that the social planner will only use the right to levy a fee in $t = 0$ if this measure increases efficiency.

4 Organizational Performance

Before analyzing the effects of the three different organizational forms, let us derive some preliminary insights. Consider first the pricing decision of the manager in organization j once the quality level q_j is set. Consumer i will purchase the good as long as $\psi(p_j, q_j, \theta^i) \geq \max\{\psi(p_0, q_0, \theta^i), 0\}$. With $q_0 > p_0$, total demand for the good is $1 - \hat{\theta}_j$, where $\hat{\theta}_j$ denotes the marginal consumer who is indifferent between purchasing from organization j and the competitive fringe:

$$\hat{\theta}_j = \frac{p_j - p_0}{q_j - q_0} \tag{5}$$

Faced with this demand structure, the manager sets the price in $t = 2$ in order to maximize revenues (given zero marginal cost) $(1 - \hat{\theta}_j(p))p$. The market outcome

[18] See Fudenberg and Tirole (1991), chapter 7. In contrast to the literature on the private provision of public goods (Bergstrom, Blume, and Varian, 1986; Bilodeau and Slivinski, 1997), consumers have zero marginal effect on the good's provision in our framework.

[19] We use this mechanism to rule out free-riding among individuals with high θ^i-realizations in our continuous modelling of agents.

in $t = 2$ and $t = 3$, respectively, is characterized by:

$$p_j^* = \frac{q_j - q_0 + p_0}{2} \quad \text{and} \quad \hat{\theta}_j^* = \frac{1}{2} - \frac{p_0}{2(q_j - q_0)}. \tag{6}$$

Next, the manager has to be compensated for his personal effort cost in producing quality q_j; hence his wage is $w_j = e(q_j)$. Thus, the profits of the organization will be

$$\pi_j(q_j) = \frac{(q_j - q_0 + p_0)^2}{4(q_j - q_0)} - e(q_j) - I_j D \tag{7}$$

where $I_j = 1$ if costs of collective decision making have to be incurred, and $I_j = 0$ otherwise. These results hold for any organizational form and create the level playing field for the subsequent derivation of organizational outcomes.

Finally, consider the choice of quality if the social planner were owner of the organization. Generally, given the price setting behavior of the manager, the total surplus created in the market as a function of q_j is defined as the sum of consumer surplus and profits generated by organization j as well as by the competitive fringe:

$$TS_j \equiv \int_{\hat{\theta}_j^*}^{1} (\theta q_j^* - p_j^*) d\theta + \pi_j(q_j^*, \cdot) + \int_{\underline{\theta}}^{\hat{\theta}_j^*} (\theta q_0 - p_0) d\theta + \int_{\underline{\theta}}^{\hat{\theta}_j^*} p_0 d\theta \tag{8}$$

where $\underline{\theta} = \frac{p_0}{q_0}$ defines the marginal consumer who is indifferent between buying from the outside option and not buying at all. Re-arranging (8) yields

$$TS_j = \frac{3}{8} q_j^* - e(q_j^*) - p_0^2 \left(\frac{1}{8(q_j^* - q_0)} + \frac{1}{2q_0} \right) + \frac{q_0}{8} + \frac{p_0}{4} - I_j D. \tag{9}$$

Maximization of this surplus with respect to q_j by the social planner defines the second-best quality level, q_{SB}:[20]

$$e'(q_{SB}) \;=\; \frac{3}{8} + \frac{p_0^2}{8(q_{SB} - q_0)^2} \tag{10}$$

[20]We use the term *second-best* to highlight that the quality choice of the social planner is made under the assumption of monopolistic pricing behavior by the manager. The *first-best* quality level q_{FB} would solve $\max_q \int_0^1 (\theta q) d\theta - e(q)$; hence, $e'(q_{FB}) = 1/2$. Derivation of this first-best result embodies price equal marginal cost (here: zero). Finally, note that convexity of effort cost ensures that second-order conditions for both first-best and second-best are always satisfied.

To ensure an inner solution, $q_{SB} < 1$, we henceforth assume

$$e'(q=1) \quad > \quad \frac{3}{8} + \frac{p_0^2}{8(1-q_0)^2}. \tag{11}$$

The second-best quality level serves as a reference level for the subsequent analysis.

4.1 Firms

By definition, shareholders of a firm do not consume the good themselves. Profit maximization is the single objective equally aspired by all shareholders. Given the expected market outcome as specified in equation (7), an investor thus aims to maximize his share δ_F of profits:

$$\max_{q_F} \qquad \delta_F \left(\frac{(q_F - q_0 + p_0)^2}{4(q_F - q_0)} - e(q_F) - I_F D \right). \tag{12}$$

Lemma 1 (Quality Provision of the Firm)
(i) The firm offers product quality $q_F^* \equiv \left\{ q \in (q_0 + p_0; 1] | e'(q) = \frac{1}{4} - \frac{p_0^2}{4(q-q_0)^2} \right\}$.
(ii) Goal alignment among shareholders is perfect ($I_F = 0$).

The trade-off investors face is the increase in revenues from higher pricing versus higher costs of compensating the manager for his effort to produce higher quality. Firms hence provide goods of superior quality relative to the quality of the fringe as long as profits are non-negative. At the same time, it is obvious that a firm never has to bear costs of collective decision making: The pure focus on financial returns and the resulting goal alignment among shareholders is one of the key strengths of investor-owned firms, as it has been stressed in the literature for already some time (see Fama, 1978).

4.2 Nonprofits

Members of a nonprofit organization explicitly waive their rights to any residual income, which we assume to be transferred to some charitable organization not modelled explicitly.[21] The manager's constraints are not affected by the organizational form of his employer. Let θ^i denote member i's preference for quality.

[21] This is a common legal rule, internationally.

Then, i would prefer a product quality maximizing her indirect utility from the quality-price combination:

$$\max_{q_N} \quad \theta^i q_N - \frac{q_N}{2} + \frac{q_0 - p_0}{2}. \tag{13}$$

Lemma 2 (Quality Provision of the Nonprofit)
(i) The nonprofit offers product quality of $q_N^* \equiv 1$.
(ii) The social planner imposes a membership fee $f_N = \frac{q_0 - p_0}{2}$ *and a minimum membership requirement of 50% of the population. Consumers with* $\theta^i \geq 1/2$ *pay the fee and become members, others do not.*
(iii) Goal alignment among members is perfect ($I_N = 0$).

The result for the nonprofit in this lemma depends on the non-distribution constraint in two respects. First, without any potential dividend payments, owners simply care about their indirect utility from consuming the good. Hence, for the set of owners (or at least the median owner) higher quality is always better. As a consequence, maximum quality $q_N^* = 1$ is chosen. Second, the non-distribution constraint allows the social planner to exclude consumers with relatively low preferences for quality from the set of owners: Levying a fee is a credible device as excess funds will never be returned to owners.[22] Excluding certain consumers establishes goal alignment among the remaining owners (with high preferences for quality) without affecting the final quality decision.

4.3 Cooperatives

In a cooperative, owners potentially get the best of two worlds: They are able to decide about the quality of the good to be provided (which they value themselves as consumers) and they participate in residual profits. Due to individual preferences for quality being private knowledge we assume the simplest dividend structure feasible: Each member gets an equal share of total operating profits. However, members have to buy the good for being eligible to receive dividend payments.[23]

[22] This contrasts with the subsequent discussion of the cooperative results.

[23] This is common in many cooperatives. The requirement generally ensures that individuals do not join the cooperative as members for pure financial reasons (as investors).

Let $\tilde{\theta}_C$ be the marginal member of the cooperative and $\delta_C \equiv \frac{1}{1-\tilde{\theta}_C}$ a member's profit share. Then member i solves:

$$\max_{q_C} \quad \theta^i q_C - \frac{q_C}{2} + \frac{q_0 - p_0}{2} + \delta_C \left(\frac{(q_C - q_0 + p_0)^2}{(q_C - q_0)4} - e(q) - I_C D \right) \tag{14}$$

Member i thus maximizes the sum of his indirect utility from purchase of the good and his share in the residual income (profits).

Lemma 3 (Quality Provision of the Cooperative)
(i) The cooperative offers product quality $q_C^* \equiv \left\{ q \in (q_0 + p_0; 1] | e'(q) = \frac{3}{8} - \frac{3p_0^2}{8(q-q_0)^2} \right\}$.
(ii) There is no goal alignment among members ($I_C = 1$).

Members of the cooperative face the trade-off between choosing higher quality levels, which increases consumption utility at higher costs of inducing managerial effort, or inducing lower quality and thus increasing their dividend payout. Consequently, neither the maximum quality level of the nonprofit nor the profit-maximizing level of the firm are optimal for members. Additionally, the trade-off between consumption utility and dividends depends on individual preferences. Hence, members of the cooperative incur costs of collective decision making. Finally, although the social planner is unable to avoid costly decision making by excluding some consumers from ownership, it would be possible to improve upon the organizational outcome by restricting membership to the cooperative: The resulting shift of the position of the median member would also affect the quality decision of the cooperative's owners. However, since fees collected at the beginning will be repaid at the end (as part of the dividends), levying a fee is no credible device to exclude consumers from the set of owners. Hence, there is no restriction on ownership of the cooperative by the social planner.

Overall, there is a clear ranking in terms of quality provided in the market by the three forms of organization.

Proposition 1 (Ranking of Qualities Provided)
Given the definitions in lemmas 1 to 3 and equation (10), we have $q_F^* < q_C^* \leq q_{SB} < q_N^*$.

Nonprofit members, by waiving their rights to appropriate the residual income, only care about consumer surplus. Consequently, they demand the maximum level of quality and neglect any inefficiencies arising from *overspending* on

quality. This explains why nonprofits are often perceived to operate inefficiently and expensively. Nevertheless, overspending is completely in the interest of their members, as they exchange income rights for quality. The social planner, in contrast, trades off the benefits and costs (specifically the manager's effort cost) of quality. By (11), q_{SB} is an interior solution.

On the other side, firms exclusively maximize monetary profits, thus producing too low a quality.[24] Cooperatives, while being an organizational mix of firms and nonprofits, provide a level of quality that lies between the level of firms and the second-best level. The objective function of cooperative members contains both consumer surplus and producer surplus. Consequently, cooperatives even achieve the second-best quality level under certain circumstances.[25] However, the presence of the competitive fringe (with $q_0 > p_0 > 0$) leads the cooperative to include inefficiently many members with low quality preferences ($\tilde{\theta}_C = \hat{\theta}_C < 1/2$). Therefore, under these circumstances cooperatives provide inefficiently *low* quality.

4.4 Comparing Organizational Forms

The preceding analysis has shown that the three organizational forms provide different levels of price-quality combinations. However, the quality level alone does not automatically determine which organization is efficient. To draw conclusions about the efficiency of an organization, total surpluses have to be compared. We will thus use the total surplus as in (9) to compare two organizations at a time and to characterize the conditions under which each of them generates a higher total surplus.

Proposition 2 (Organizational Efficiency)
(i): Total surplus under nonprofit organization is higher than under firm organization (or equal to) if

$$\frac{e(q_N^*) - e(q_F^*)}{q_N^* - q_F^*} \leq \frac{3}{8} + \frac{p_0^2}{8(q_N^* - q_0)(q_F^* - q_0)} \tag{15}$$

[24]Note that consumers with $\theta < \hat{\theta}$ have the same objectives as these investors: Given the monopolistic behavior of the firm, they will never purchase the good and would only care about dividends. A firm in our model might thus be owned by consumers with low valuation of quality.

[25]Cooperatives would produce second-best quality for $p_0 = 0$, that is under highest competitive pressure from the competitive fringe.

is satisfied. Otherwise, firms generate higher total surplus.
(ii): Total surplus under cooperative organization is higher than under firm organization (or equal to) if

$$0 \leq D \leq \bar{D}_{CF} \equiv \frac{3}{8} + \frac{p_0^2}{8(q_C^* - q_0)(q_F^* - q_0)} - \frac{e(q_C^*) - e(q_F^*)}{q_C^* - q_F^*} \tag{16}$$

is satisfied. Otherwise, firms generate higher total surplus. $\bar{D}_{CF} \geq 0$.
(iii): Total surplus under cooperative organization is higher than under nonprofit organization (or equal to) if

$$0 \leq D \leq \bar{D}_{CN} \equiv \frac{e(q_N^*) - e(q_C^*)}{q_N^* - q_C^*} - \frac{3}{8} - \frac{p_0^2}{8(q_C^* - q_0)(q_N^* - q_0)} \tag{17}$$

is satisfied. Otherwise, nonprofits generate higher total surplus.

Comparing nonprofit with firm organization, firms provide lower quality but generate higher profits as the compensation of managerial effort is less costly. Nonprofits, on the other hand, provide higher quality and hence consumer surplus, but this comes at the expense of higher effort cost. The LHS of condition (15) measures the additional costs incurred from increasing the quality level of the firm to nonprofit level relative to the quality change. Intuitively, if the excess quality provision by the nonprofit is less costly, high quality production by the manager is affordable and nonprofit organization dominates firm organization. If high effort is instead overly costly, it is more efficient to let a firm produce the good.

Since decision making in cooperatives implies extra costs of collective decision making, parts *(ii)* and *(iii)* of proposition 2 depend on D. We find that cooperatives dominate firms as long as the costs of collective decision making are sufficiently low. This result is intuitive since we have $q_F^* < q_C^* \leq q_{SB}$: Only large realizations of D can make cooperatives less efficient than firms. Therefore, if collective decision making is not very costly – for example because of low heterogeneity of owners – cooperatives combine the best of two worlds by maximizing both consumer surplus and owners' profits.

As $q_C^* \leq q_{SB} < q_N^*$, it is not so clear whether cooperatives or nonprofits are more efficient, even if decision making costs in cooperatives are low. In addition to low D, superiority of cooperative relative to nonprofit organization requires

that the cost increases from raising quality from cooperative level (potentially too low) to nonprofit level (excessively high) is sufficiently high.

All three pairwise efficiency comparisons depend on the relation of cost and quality differences, which is equivalent to the slope coefficient of a line through the effort cost function at the two distinct quality levels. These three slope coefficients can be varied most easily by altering the convexity of the effort cost function: An increase (decrease) in convexity for the whole curve increases (decreases) the relevant slope coefficients, and hence affects the relative efficiency of the three organizations. This effect is used in figure 1 which illustrates the efficiency comparisons of proposition 2. Using a numerical example, we plot the critical

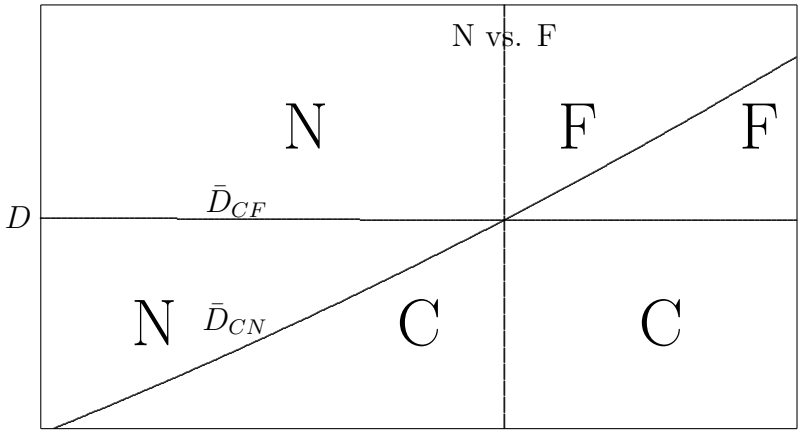

Figure 1: Optimal Organizational Forms (Numerical Example)

levels of the costs of collective decision making against a measure for the convexity of effort cost.[26] For decision making cost levels above the line $\bar{D}_{CF}$, firms produce higher total surplus than cooperatives. Similarly, for levels above the line $\bar{D}_{CN}$, nonprofits dominate cooperative organizations. With rising costs D the set of parameters where cooperatives are preferable shrinks and becomes empty at the intersection of the two lines. For even higher cost levels, only firms or nonprofits can be efficient, depending on the convexity of effort (with the vertical line giving the threshold level). The figure also highlights which organization is most efficient in the six parameter sets defined by the three plotted lines.

[26]For details on the numerical example see appendix A.10.

Proposition 2 and figure 1 specify the main results of the analysis so far. The social planner will choose the most efficient organizational form in $t = 0$, which depends on specific parameters of the exogenous variables. This strategy, together with lemmas 1 to 3 as well as equation (6), characterizes a unique subgame-perfect equilibrium.

5 Organizational Change

What happens to relative organizational efficiency if the pressure exerted by the competitive fringe is increased? Or, alternatively: Do we expect organizational persistence in a changing competitive environment (due to, for example, globalization or technological progress)? To approach this issue, we now consider how our previous results are affected by changes in the competitive fringe.

Note first that in $t = 2$, the decisions of the organization's manager determine the market outcome, described by p_j^*, $\hat{\theta}_j^*$ and π_j^* in (6) and (7). The comparative statics of these variables with respect to the price p_0 of the substitute good is intuitive: A decrease in p_0 makes the substitute good more attractive, thus taking away market share from the organization. Although this is countered by the manager decreasing the price, the overall effect on market share and profits remains negative. Formally, $\frac{dp_j^*}{dp_0} > 0$, $\frac{d\hat{\theta}_j^*}{dp_0} < 0$ and $\frac{d\pi_j}{dp_0} > 0$.

A change in the quality equivalent q_0 of the substitute good, however, has slightly different effects: A more attractive substitute good (higher q_0) is countered by a lower price which leads to a higher market share than before for the organization, formally: $\frac{dp_j^*}{dq_0} < 0$ and $\frac{d\hat{\theta}_j^*}{dq_0} \leq 0$. This latter result appears counterintuitive and is due to the increased elasticity of demand. As the substitute good's quality rises, not only its attractiveness rises but also the vertical differentiation between the two markets decreases. Hence, consumers react more sensitively to price differences. For this reason, the lowering of p_j^* actually leads to a higher level of sales than before. Overall however, profits still decrease: $\frac{d\pi_j}{dq_0} < 0$. As the effect of changes in q_0 are rather specific to our modelling structure, we will focus on changes in the price level p_0 of the competitive fringe in our following analysis.[27]

[27] In the standard models of vertical differentiation, prices *and* quality levels are strategic choices of *all* players. As we disregard strategic interaction between the organization and the

5.1 Changes in Quality and Ownership

Optimal quality levels q_j^* chosen in $t = 1$ are also affected by changes in the competitive fringe. We now analyze how the price p_0 affects quality, and use a decrease in this price (tougher competitive environment) for interpretation. This might be due to some process innovation in the market segment producing the closest substitute which decreases marginal costs and thus affects the price level in a similar fashion.

Lemma 4 (Changes in Quality)
A more competitive substitute good (a decrease in p_0) has the following effects:
(i) the quality of the nonprofit remains unaffected, $\frac{dq_N^*}{dp_0} = 0$;
(ii) the quality of the firm increases, $\frac{dq_F^*}{dp_0} \leq 0$;
(iii) the quality of the cooperative increases, $\frac{dq_C^*}{dp_0} \leq 0$.

The intuition for this lemma is rather simple. Owners in firms and cooperatives positively value dividends and therefore counter the negative effect of a more attractive competitive fringe by further differentiating their product quality from the substitute quality. Hence, competition induces them to increase the quality on offer (*competition effect*). For the cooperative, there is an additional *membership effect*: A tougher competitive environment implies that the cooperative loses some members/customers. As this shifts the preferences of the median member upwards, there is an additional positive effect on the quality (as long as $\tilde{\theta} \leq 1/2$). Since nonprofits already produce the maximum quality achievable, they cannot increase quality furthermore. The only measure of nonprofits to react to increased competitive pressure is by cutting the price. Accordingly, since q_N in (6) remains constant, nonprofits will lose a comparatively higher market share than cooperatives or firms.

Lemma 5 (Relative Changes in Quality)
A more competitive substitute good (a decrease in p_0) has the following effects:
(i) firms increase the level of quality by more than nonprofits do, $\frac{dq_N^*}{dp_0} - \frac{dq_F^*}{dp_0} \geq 0$;
(ii) cooperatives increase the level of quality by more than nonprofits do, $\frac{dq_N^*}{dp_0} -$

competitive fringe, focussing on changes in the exogenous price p_0 (as a proxy for changes in competitiveness) is appropriate here. For completeness, we report the results for changes in q_0 in the appendix as well.

$\frac{dq_C^*}{dp_0} \geq 0$;
(iii) firms increase the level of quality by more than cooperatives do, $\frac{dq_C^*}{dp_0} - \frac{dq_F^*}{dp_0} \geq 0$, *if* $2e''(q_C^*)(q_C^* - q_0)^2 - 3e''(q_F^*)(q_F^* - q_0)^2 \geq p_0^2 \frac{q_F^* - q_C^* - 0.5(q_C^* - q_0)}{(q_C^* - q_0)(q_F^* - q_0)}$ *and vice versa otherwise.*

The comparisons of quality changes of the nonprofit with the firm or the cooperative are trivial: Nonprofits do not alter the quality level in the light of increased competition from the fringe, but firms and cooperatives do so. Therefore, firms and cooperatives reduce the quality lead of the nonprofit by increasing their own quality levels.

The comparison of changes in qualities for cooperative and firm is less obvious. Lemma 5.*(iii)* illustrates that the form of the effort cost function plays an important role. If its curvature and the quality differences between firm and cooperative are large enough, then the firm will react more strongly to changes in the competitive environment than the cooperative.[28] However, if the condition in lemma 5.*(iii)* is not satisfied, then the cooperative's quality lead over the firm increases under a more competitive environment.

5.2 Changes in Efficiency

We have characterized all preliminary results needed to analyze changes in the optimality of organizational forms. We now present our central result on organizational change.

Proposition 3 (Changes in Organizational Efficiency)
A more competitive substitute good (a decrease in p_0*) has the following effects:*
(i) total surplus under firm organization relative to nonprofit organization increases, $\frac{d(TS_N - TS_F)}{dp_0} \geq 0$;
(ii) total surplus under cooperative organization relative to nonprofit organization increases, $\frac{d(TS_N - TS_C)}{dp_0} \geq 0$;
(iii) total surplus under firm organization relative to cooperative organization increases, $\frac{d(TS_C - TS_F)}{dp_0} \geq 0$, *if the condition in lemma 5.*(iii) *for* $\frac{dq_C^*}{dp_0} - \frac{dq_F^*}{dp_0} \geq 0$ *is satisfied.*

[28] Note that the condition $e'''(q) \geq 0$ is not sufficient for the condition in lemma 5.*(iii)* to be met. The reason for this is the aforementioned membership effect which adds upon the more standard competition effect.

The total surplus generated by an organizational form directly depends on the position of its quality level relative to the second-best quality level. As specified in proposition 1, $q_F^* < q_C^* \leq q_{SB}$, while $q_N^* > q_{SB}$. Both firms and cooperatives react to increased outside competition by increasing their quality levels, thus getting closer to the second-best solution and diminishing inefficient underprovision of quality. Nonprofit quality, on the other side, is not affected by outside competition as nonprofit members only care about their utility from consumption. This explains why nonprofits lose relative to firms and cooperatives when competition gets tougher, as emphasized in parts *(i)* and *(ii)* of proposition 3.

Whether firms or cooperatives become more efficient when outside competition is increased depends on the pace with which their quality levels move towards q_{SB}. The discussion of lemma 5.*(iii)* above illustrates the relevant factors and explains that this issue is generally unclear. However, if firms adapt to competition more strongly than cooperatives, they also gain in terms of total surplus under higher competition.[29]

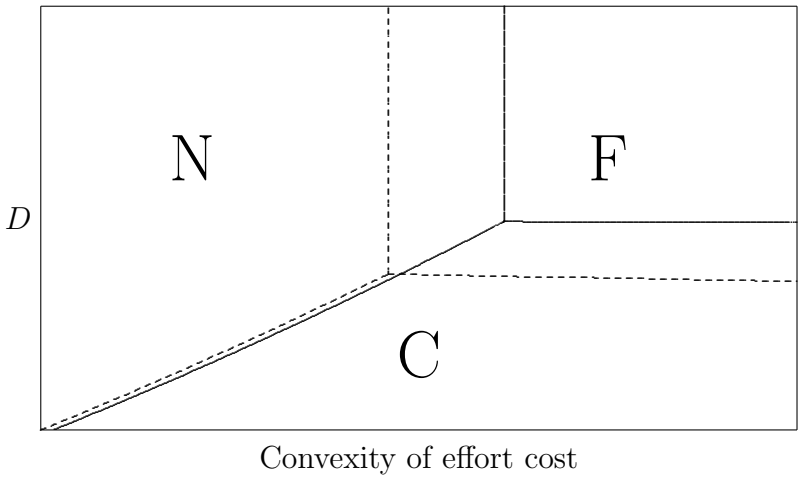

Figure 2: Organizational Change (Numerical Example)

Figure 2 illustrates the efficiency comparisons of proposition 3. Using the same numerical example as in figure 1, we plot the critical levels of the costs of collective decision making against the measure for convexity of effort cost.[30] The figure

[29]It is worth pointing out that in numerical simulations of the model, the growth of total surplus under firm organization always exceeded the growth of total surplus under cooperative organization for various effort cost functions.

[30]See appendix A.10 for more details on the numerical example.

illustrates how the set of parameters where either of the organizational forms is optimal changes under competition. The solid lines replicate the static efficiency comparison of figure 1. The dashed lines show the new optimal organizational choice if outside competition has increased. The effort function used here results in firms becoming more efficient relative to both nonprofits and cooperatives. Similarly, nonprofits lose against both firms and cooperatives, while cooperatives lose against firms but gain relative to nonprofits.

6 Discussion and Extensions

Operational losses, organizational existence, and membership fees: We assumed throughout the previous analysis that profits of all organizations are non-negative (see (4)). We will now argue that the results of our model are robust even if the revenues of an organization are too low to finance its operations. Since the fixed costs M are the only cost type that affects all three organizational forms equally, we consider an increase in these costs and ask how this affects our results in terms of relative efficiency of the organizations.

For both firms and nonprofits, an increase in costs such that profits turn negative has straightforward effects: Firms with negative profits will be closed down by its owners as investors solely care about financial returns. As long as a firm can exist, it will provide the quality level q_F^* described in lemma 1. Nonprofits are the organizational form whose owners, by definition, care least about profits. If a nonprofit's existence is threatened, the social planner may increase the fee f_N. This would affect the set of owners by driving the marginal owner $\tilde{\theta}_N$ upwards, but it would neither affect the equilibrium quality level of $q_N^* = 1$ nor the goal alignment among its members.[31]

The case of cooperatives is less obvious. When profits become negative, the social planner may levy a fee f_C that, in contrast to the case with $\pi_C(q_C^*) \geq 0$, would affect the set of owners as nobody could expect to get back his entire upfront payment later in the form of dividends. The marginal owner $\tilde{\theta}_C$ would move upwards, as would the median owner. Initially, the equilibrium quality level q_C^* would hence increase, and so would the price p_C^* and the marginal buyer $\hat{\theta}_C$.

[31]Note that in our previous analysis f_N was levied because of efficiency reasons – to avoid costs of D – while here it is used as a means to enable existence when profits turn negative.

Thus, apart from a *fee income effect*, levying f_C would entail a *membership effect* and a *revenue effect*, the aggregate effect of which on a cooperative's income does not have a clear-cut sign.[32] Despite increased quality, the relative position of q_C^*, however, would not change as the upper bound on q_C^* is still q_{SB} (proposition 1 remains valid). Note, nevertheless, that a tighter budget can, under certain circumstances, increase the efficiency of a cooperative.

Generally, if losses in any organizational form are sufficiently high it will not be able to exist. As a consequence, choosing this organizational is not in the social planner's strategy space any more. The de facto efficient form can thus differ from the theoretically efficient form characterized in proposition 2. Alternatively, if an organizational form is found to be efficient for specific parameter realizations but incurs negative profits, the social planner (as a government) may decide to finance it via lump-sum transfers. This can be interpreted as creating a kind of public organization, a topic that is of high importance in itself (not least because of the interaction between the public financier and the formal, private owners) but not the focus of our analysis.[33]

In the next subsection we will discuss another implication of negative profits for the social planner's objective to maximize efficiency: strategic underfunding.

Strategic underfunding and membership fees: Up to now, we constrained the analysis to cases where organizational profits are non-negative. If this assumption is relaxed, the social planner might be able to raise organizational efficiency: For certain parameter combinations, setting up an underfunded nonprofit increases total surplus. As the quality level chosen by its members is inefficiently high, choosing insufficiently low levels of fees to finance operations renders the high quality unfeasible. As a consequence, members would (unanimously) choose the highest quality achievable under the restricted budget. Hence, inefficiently high quality levels may be reduced towards the efficient quality level without jeopardizing goal alignment among members. Restricting the financial situation

[32]Note that the relation between the marginal owner and quality is actually non-monotonic. Once the marginal owner surpasses $\theta = 1/2$, quality and price actually decrease in $\tilde{\theta}_C$. Hence, from an efficiency perspective, the membership effect (increasing $\tilde{\theta}_C$) can both reduce inefficient inclusion (if $\tilde{\theta}_C < 1/2$) or create inefficient exclusion (if $\tilde{\theta}_C \geq 1/2$).

[33]Refer to Besley and Ghatak (2001) or DeWenter and Malatesta (2001) for related literature.

of nonprofits can therefore be a welfare increasing strategy.[34] On the other hand, the social planner needs to make sure that the fee asked for is not too low: If low fees make nonprofit membership so attractive that the marginal owner $\tilde{\theta}_N < 1/2$, efficiency is increased via lower quality produced but is decreased because costs of collective decision making will accrue.

Allowing strategic underfunding of nonprofits by tightening their budget constraint would thus add new aspects to the choice and structure of organizations. However, tightening the constraint also calls for changes to the owners' strategy space: Individual owners with high preferences for quality may (individually or collusively) choose to support an organization's budget with private donations. This would relax the financial constraints imposed by the social planner again and thwart the benefits of underfunding. As introducing strategic funding and donations is beyond the focus of our paper, we leave this issue for future research.

Exclusion, inclusion, and private benefits of control: If expected profits of an organization are positive, each consumer (weakly) has incentives to become its owner. As indicated above, ownership of consumers with low preferences for quality (with $\theta < 1/2$) can have two direct effects on their fellow owners, both of them potentially reducing efficiency: It can cause costs of collective decision making and, via majority voting, it can decrease the median owner's position and hence the quality chosen. These considerations support the view that, from the perspective of consumption-oriented consumers (whose $\theta > 1/2$), it could be necessary to have some tool to exclude certain groups of consumers in order to shelter other owners' interests (and to ensure overall efficiency of the organization).

In firms, due to their one-dimensional objective function, such a shelter is not necessary. In nonprofits, the non-distribution constraint enables the social planner to easily implement a fee that avoids inefficient inclusion of owners (with respect to D).[35] In cooperatives though, tying dividend payments to owners'

[34]Propper, Burgess, and Green (2004) find in a study of the UK hospital industry that the relation between competition and quality of care in hospitals is negative. Within our model, increased competition (and thus lower revenues) lowers nonprofit quality if the organizational budget constraint binds. In this case, hospitals would have to decrease quality as the originally preferred, maximum quality is not feasible anymore. However, 'buyers' of hospital services in the UK market are public agents who care mostly about prices and less about quality.

[35]Refer to lemma 2 for more details.

actions (such as the purchase decision in our model) is the only tool to restrict inefficient inclusion, as long as operating profits are positive. When profits are negative, the set of (inefficient) owners can be additionally reduced, driving $\tilde{\theta}_C$ and $\hat{\theta}_C$ apart. The same mechanism (called *membership effect* above), however, can also create inefficient exclusion of consumers whose θ is slightly above 1/2:[36] if M is very large and high fees have to be collected to sustain operations of the cooperative, it is likely that the marginal owner's position is above 1/2. Then, existence of the cooperative is paid for by reduced efficiency.

Taking the issue of exclusion of specific types of owners even further adds another interpretation to our model: The consumer surplus we modelled could be interpreted in the broader sense of *private benefits of control*. Even in organizations that are firms in a legal sense it could be profitable not to accept all types of investors as owners, given incumbent owners' private benefits of control are large enough.This could be the case for structures like joint ventures, closely held firms or family-controlled and owner-managed firms.[37]

Monopolistic pricing: In our previous analysis, price and quality choice of all organizations were delegated to a self-interested manager. However, owners were able to exert control by contracting on product quality. Given contractible quality, one might wonder whether prices could also be determined by an organization's owners. In our set-up, we have assumed a very simple cost structure (zero cost of production). Usually, however, cost components in an organization are numerous, fluctuating, and consequently hard to evaluate for an outsider. This is one reason why tasks are delegated to a professional manager. In a nonprofit or cooperative, members then might only observe and evaluate the organization's budget after production and sales. With some discretion on costs, a manager could then always justify monopolistic price levels via budget break-even.[38]

[36]Appendix A.4 shows that the quality level of the cooperative is most efficient at $\tilde{\theta}_C = \frac{1}{2}$.

[37]It is well-known that there are many firms, in particular small and medium sized ones, where the owners' interests are not restricted to pure maximization of profits. Potentially, our model of cooperatives is more applicable to explain their behavior than our model of the firm.

[38]It is straightforward to see that the managerial pricing behavior is optimal for firm owners. However, analyzing the simultaneous decision of nonprofit or cooperative owners on price and quality is tedious as one would have to take ownership decisions into account and to distinguish between effects on insiders versus outsiders. We leave these issues to future research.

Managerial altruism: In the analysis, the manager only incurred costs from producing higher quality. However, one can argue that often employees and management derive some benefits from higher quality production as well (see Glaeser and Shleifer, 2001, for example). Assume that a manager derives a personal benefit $b(q) \geq 0$ from producing quality q, where $0 \leq b'(q) \leq e'(q)$. Given a zero outside option wage and a quality level q, the wage of a manager can thus be reduced by the size of the personal benefit. Hence, cooperatives and firms would provide higher qualities, and nonprofits would be able to provide maximum quality at lower costs. Qualitatively, however, altruism does not change our results.[39]

7 Conclusion

This paper highlights some key differences between firms, nonprofits and cooperatives where each of these organizations is governed by economic principles and rational decision making. The different organizational structures and members' objective functions lead to different costs of ownership and thus affect organizational efficiency. The final efficiency trade-off then depends on the competitive environment, the decision making process and technology.

In the static efficiency comparison, cooperatives are the optimal organizational form when costs of collective decision making are sufficiently low. Members of a cooperative are concerned with both operational profits as well as (their own) consumer surplus. In an environment with imperfectly competitive markets, the overall objective function in a cooperative most closely resembles the objective function of a social planner. The drawback of this more complex objective function lies in the cost of collective decision making for the heterogenous set of owners. As a consequence, cooperatives will be preferable whenever there is a sufficiently low number of members which can coordinate easily or whenever the membership base is sufficiently homogeneous.

[39]This result relates to the literature on objectives of owners and managers in nonprofits. Note that our focus is on the level playing field among organizational forms, so we explicitly exclude potential self-selection effects of managers of different types to different organizational forms (see e.g. Besley and Ghatak, 2005). Francois (2003) provides another approach by recruiting managers from the set of consumers.

Firms are optimal if costs of collective decision making drive out cooperatives and if the costs of incentivising a manager to increase quality are high. In other words, firms are a low-cost means to produce quality as they offer the benefits of a straightforward organizational form where goal alignment is easily ensured. This should be an advantage, in particular, if there is high uncertainty about aspects such as the costs of producing high quality or about the heterogeneity or stability of members' preferences. This might provide an intuitive reason why we observe so many organizations being set up as profit maximizing firms.

Finally, nonprofits serve as a means to commit to the production of high quality due to the lack of alternative usage of an organization's profits. If a group of consumers has high but heterogeneous valuations of quality that cannot be fully revealed (or are too costly to uncover), then founding a nonprofit may be an optimal organizational solution. As the quality level produced under nonprofit organization is inefficiently high, it only dominates other organizational forms as long as the costs of raising quality (by inducing additional managerial effort) is low.

The results of our static analysis can be transformed into the following hypotheses:

- If the owners of an organization have an interest in consuming its output
  - cooperatives will prevail, if costs of collective decision making are low (e.g. due to a homogenous membership-base);
  - if costs of collective decision making increase, nonprofits should prevail when additional quality is inexpensively produced, and firms otherwise.
- The quality produced by an organization is higher
  - the higher the share of buyers in the organization's owners;
  - the lower the share of profits in total payoffs of owners.

Another implication from our analysis is that nonprofits and cooperatives may look very similar from an outsider's point of view: Both may break even given their budget, and members of both organizational forms may finance additional quality by paying membership fees.[40] In terms of the budget, the real difference

[40]In contrast, firms that just break even are on the verge of bankruptcy (in a one-shot game).

between nonprofits and cooperatives is that the former face an ex ante non-distribution constraint, while the latter might simply be financially restricted ex post and therefore do not pay any dividends either.

Apart from the static efficiency trade-off, this paper also considers changes in organizational forms due to changes in the market environment. Increases in competition have a disciplining effect on both firms and cooperatives: In order to compensate for lower demand, both organizational forms adjust the quality offered upwards. This implies that both organizations will be preferable to the nonprofit form more often. While the net effect on organizational efficiency may be ambiguous when cooperatives and firms are compared, our results suggest that for standard technologies, firms will react more strongly to competitive pressure. In sum, an increase in competition will affect organizational choice as follows:

- firms and cooperatives will dominate nonprofit organizations more often;
- firms will dominate cooperatives more often.

Although these hypotheses still await empirical testing, (anecdotal) evidence from studies of demutualization and from the statements made in the wake of the NYSE, Mastercard and Visa announcements suggests that competition plays an important role in organizational changes. Obviously, our theoretical analysis has suppressed other important aspects of organizational choice (such as taxes or financing restrictions). Nevertheless, it appears to us that competitive pressures induced the owners of these organizations to reassess organizational form.

References

Athey, S. and J. Roberts (2001). Organizational design: Decision rights and incentive contracts. *American Economic Review 91*(2), 200–205.

Bergstrom, T., L. Blume, and H. Varian (1986). On the private provision of public goods. *Journal of Public Economics 29*, 25–49.

Besley, T. and M. Ghatak (2001). Government versus private ownership of public goods. *Quarterly Journal of Economics 116*(4), 1343–72.

Besley, T. and M. Ghatak (2005). Competition and incentives with motivated agents. *American Economic Review 95*(3), 616–36.

Bilodeau, M. and A. Slivinski (1997). Rival charities. *Journal of Public Economics 66*, 449–467.

Chaddad, F. R. and M. L. Cook (2004). The economics of organization structure changes: A US perspective on demutualization. *Annals of Public and Cooperative Economics 75*(4), 575–94.

Choi, C. J. and H. S. Shin (1992). A comment on a model of vertical product differentiation. *Journal of Industrial Economics 40*(2), 229–31.

Chou, S.-Y. (2002, March). Asymmetric information, ownership and quality of care: An empirical analysis of nursing homes. *Journal of Health Economics 21*(2), 293–311.

DeWenter, K. L. and P. H. Malatesta (2001). State-owned and privately owned firms: An empirical analysis of profitability, leverage, and labor intensity. *American Economic Review 91*(1), 320–34.

Dow, G. K. (2001). Allocating control over firms: Stock markets versus membership markets. *Review of Industrial Organization 18*, 201–218.

Dow, G. K. and L. Putterman (2000). Why capital suppliers (usually) hire workers: What we know and what we need to know. *Journal of Economic Behavior and Organization 43*, 319–336.

Fama, E. F. (1978). The effects of a firm's investment and financing decisions on the welfare of its security holders. *American Economic Review 68*(3), 272–84.

Francois, P. (2003). Not-for-profit provision of public services. *Economic Journal 113*(486), C53–61.

Fudenberg, D. and J. Tirole (1991). *Game Theory*. Cambridge, MA.

Glaeser, E. L. and A. Shleifer (2001). Not-for-profits entrepreneurs. *Journal of Public Economics 81*, 99–115.

Grossman, S. J. and O. D. Hart (1986). The costs and benefits of ownership: A theory of vertical and lateral integration. *Journal of Political Economy 94*, 235–259.

Hansmann, H. (1996). *The Ownership of Enterprise*. Cambridge, MA.

Hart, O. and J. Moore (1990). Property rights and the nature of the firm. *Journal of Political Economy 98*, 1119–1158.

Hart, O. and J. Moore (1996). The governance of exchanges: Members' cooperatives versus outside ownership. *Oxford Review of Economic Policy 12*, 53–69.

Hart, O. and J. Moore (1998). Cooperatives vs. outside ownership. *National Bureau of Economic Research Working Paper 6421*.

Hart, O. and J. Moore (2005). On the design of hierarchies: Coordination versus specialization. *Journal of Political Economy 113*(4), 675–702.

Hart, O., A. Shleifer, and R. W. Vishny (1997). The proper scope of government: Theory and an application to prisons. *Quarterly Journal of Economics 112*(4), 1127–61.

Kuan, J. (2001). The phantom profits of the opera: Nonprofit ownership in the arts as a make-buy decision. *Journal of Law, Economics, and Organization 17*, 507–520.

Lakdawalla, D. and T. Philipson (2006). The nonprofit sector and industry performance. *Journal of Public Economics 90*(8-9), 1681–1698.

Levin, J. and S. Tadelis (2005). Profit sharing and the role of professional partnerships. *Quarterly Journal of Economics 120*(1), 131–71.

Milgrom, P. R. (1988). Employment contracts, influence activities, and efficient organization design. *Journal of Political Economy 96*, 42–60.

O'Regan, K. and S. M. Oster (2005). Does the structure and composition of the board matter? The case of nonprofit organizations. *Journal of Law, Economics, and Organization 21*(1), 205–27.

Propper, C., S. Burgess, and K. Green (2004). Does competition between hospitals improve the quality of care? Hospital death rates and the NHS internal market. *Journal of Public Economics 88*(7-8), 1247–72.

Roberts, K. W. S. (1977). Voting over income tax schedules. *Journal of Public Economics 8*, 329–340.

Shaked, A. and J. Sutton (1982). Relaxing price competition through product differentiation. *Review of Economic Studies 49*(1), 3–13.

Zusman, P. (1992). Constitutional selection of collective-choice rules in a cooperative enterprise. *Journal of Economic Behavior and Organization 17*, 353–362.

A Appendix

A.1 Organizational Forms

	Firm	Cooperative	Nonprofit
Residual Rights of Control	Shareholders	Members	Members (Donors)
Claim on Residual Income	Shareholders	(Consuming) Members	Donated to Charity
Financing	Revenues	Revenues + Membership Fees	Revenues + Membership Fees
Membership Calculus	Dividend	Dividend + Consumer Surplus	Consumer Surplus

Table 1: Major organizational differences

A.2 Proof of Lemma 1

(i): The assumptions on the effort cost function in (3) and (11) ensure existence of an interior solution strictly between zero and one. The first-order condition to (12) is then

$$\frac{1}{4} - \frac{p_0^2}{4(q_F - q_0)^2} - e'(q_F) = 0 \tag{18}$$

which defines q_F^*. The requirement $q_F^* > q_0 + p_0$ is fulfilled whenever

$$e'(q_0 + p_0) < \frac{1}{4} - \frac{p_0^2}{4(q_F^* - q_0)^2} \geq 0 \tag{19}$$

is satisfied. Second-order conditions additionally require

$$SOC_F \equiv \frac{p_0^2}{2(q_F^* - q_0)^3} - e''(q_F^*) < 0. \tag{20}$$

(ii) follows from the absence of θ^i in the first-order condition. Q.E.D.

A.3 Proof of Lemma 2

(i): The first-order derivative of consumer/owner i's objective function is $\theta^i - \frac{1}{2}$. This is strictly positive for $\theta^i > \frac{1}{2}$ and strictly negative for $\theta^i < \frac{1}{2}$. Hence, there are potential conflicting interests, such that a decision by majority voting is required. However, even under maximum ownership (marginal member equals marginal consumer, $\tilde{\theta}_N = \hat{\theta}_N > 0$), the median owner's preference parameter θ is always above $\frac{1}{2}$. Hence, maximum quality $q_N^* = 1$ is always chosen.
(ii): While the quality q_N^* offered is unaffected by the position of the marginal member, $\tilde{\theta}_N < \frac{1}{2}$ implies that costs of collective decision making D have to be incurred. Restricting the set of owners to $\theta^i \in [1/2, 1]$ would thus be efficiency enhancing by establishing goal alignment among owners. Hence, the social planner levies a fee that is acceptable for all $\theta^i \in [1/2, 1]$ but deters all $\theta^i < \frac{1}{2}$ from ownership.[41] This is achieved by a fee f_N satisfying $\psi(\theta^i = \frac{1}{2}, p^*, q_N = 1) - f_N = 0$ which results in $f_N = \frac{q_0 - p_0}{2}$. To avoid free-riding among consumers with $\theta^i \geq 1/2$, i.e. refusing to pay the fee but enjoying benefits from $q_N = 1$, the social planner conditions the organizational set-up on all consumers with $\psi(\theta^i, p^*, q_N = 1) - f_N \geq 0$ to join the organization.[42] Since $\psi(\theta^i, p^*, q_N^*) - f_N$ is increasing in θ^i consumers with $\theta^i \geq \frac{1}{2}$ will become members.
(iii) follows directly from *(ii)*. Q.E.D.

A.4 Proof of Lemma 3

(i): From (14) the first-order condition for member i translates into

$$e'(q_C) = \frac{1}{4} - \frac{p_0^2}{4(q_C - q_0)^2} + (\theta^i - \frac{1}{2})(1 - \tilde{\theta}_C). \tag{21}$$

Hence, the individually optimal quality levels differ for different θ^i; it is impossible to find two members with distinct preferences θ who would prefer the same level of quality. Consequently, collective decision making by a majority vote leads to the outcome preferred by the median member. Substituting the median member's

[41] Because of the non-distribution constraint, the sum collected from the members, together with any profits from operations, will be given to some charitable organization after production and sales have occurred; there is no deadweight loss from collecting the fee.

[42] Note that restricting the marginal member to strictly above 1/2 would lead to the same result as long as the fee levied and the minimum membership condition match.

preference parameter $\frac{1+\tilde{\theta}_C}{2}$ for θ^i in (21) gives

$$e'(q_C) = \frac{1}{4} - \frac{p_0^2}{4(q_C - q_0)^2} + \frac{\tilde{\theta}_C(1-\tilde{\theta}_C)}{2}. \tag{22}$$

Now, use the fact that every consumer who is eligible to join the cooperative will do so as, due to our assumption in (4), he expects a positive dividend. Therefore, since membership depends on consumption of the good, we have $\tilde{\theta}_C = \hat{\theta}_C^* = \frac{1}{2} - \frac{p_0}{2(q_C - q_0)}$ (marginal member equals marginal consumer). This results in q_C^* as defined in the proposition. Finally, second-order conditions require

$$SOC_C \equiv \frac{1}{1-\tilde{\theta}_C}\left(\frac{p_0^2}{2(q_C^* - q_0)^3} - e''(q_C^*)\right) < 0 \tag{23}$$

to hold, again with $\tilde{\theta}_C = \hat{\theta}_C^*$.

(ii) follows from the individually optimal quality as specified in (21).

Note that the social planner is unable to affect the outcome by levying a fee. While excluding some consumers from the set of owners would not affect the need for costly collective decision making,[43] exclusion of some consumers from the set of owners would affect the position of the median and thus the resulting quality level: Comparison of the definitions of q_C^* and q_{SB} shows that $q_C^* \leq q_{SB}$ and that q_C^* is maximized (closest to q_{SB}) at $\tilde{\theta}_C = \frac{1}{2}$. However, any fee income $(1-\tilde{\theta}_C)f$ would finally enter the operational profits and be distributed among the owners. With consumers anticipating the repayment in $t = 4$ of any fee levied in $t = 0$, fees do not affect the membership decision of individual consumers. Q.E.D.

A.5 Proof of Proposition 1

The results are based on the convexity assumption in (3): $q_C^* > q_F^*$ follows from $q_0 + p_0 < q_j$ and hence $\frac{p_0}{q_j - q_0} < 1$ for $j \in \{F, C, N\}$; $q_N^* > q_{SB}$ by assumption (11); $q_{SB} > q_C^*$ for $p_0 > 0$ and $q_{SB} = q_C^*$ for $p_0 = 0$. Q.E.D.

A.6 Proof of Proposition 2

(i): The difference between total surplus under nonprofit and under firm organization is $TS_N - TS_F = \frac{3}{8}(q_N^* - q_F^*) - (e(q_N^*) - e(q_F^*)) + \frac{p_0^2}{8}\left(\frac{1}{q_F^* - q_0} - \frac{1}{q_N^* - q_0}\right)$ which

[43] The only possibility for the social planner to avoid conflicting interests would be to reduce the set of members to a single individual. This, however, is in contrast to our focus on collective ownership and our definition of a cooperative.

results in the given condition for superiority of the nonprofit organization.
(ii): The same is true analogously for $TS_C - TS_F$, which provides condition (16) for cooperatives to provide total surplus at least as high as firms. To see that $\bar{D}_{CF} \geq 0$, note that, by the general definition of convexity, the maximum value of $\frac{e(q_C^*)-e(q_F^*)}{q_C^*-q_F^*}$ is $e'(q_C^*) = \frac{3}{8} - \frac{3p_0^2}{8(q_C^*-q_0)^2}$ (see lemma 3). Inserting this into the definition of $\bar{D}_{CF}$ provides

$$\bar{D}_{CF} \leq \frac{p_0^2}{8(q_C^*-q_0)(q_F^*-q_0)} + \frac{3p_0^2}{8(q_C^*-q_0)^2} \geq 0 \tag{24}$$

Hence, for $p_0 > 0$ and D sufficiently low, cooperatives are always more efficient than firms.
(iii): $TS_C - TS_N \geq 0$ provides condition (17) for cooperatives to generate higher total surplus than nonprofits. Q.E.D.
Remark: Note that $\bar{D}_{CN} \gtreqless 0$: *(a)* For $q_C^* \ll q_N^* = 1$, convexity of $e(q)$ implies $\frac{e(q_N^*)-e(q_C^*)}{q_N^*-q_C^*} > e'(q_C^*) = \frac{3}{8} - \frac{3p_0^2}{8(q_C^*-q_0)^2}$. For $p_0 = 0$ this implies $\bar{D}_{CN} > 0$. *(b)* For $p_0 > 0$ and $e'(q = 1-\varepsilon) = \frac{3}{8} + \frac{p_0^2}{8(1-q_0)^2}$ with $\varepsilon > 0$ arbitrarily small (but condition (11) still satisfied), $q_C^* \ll q_{SB} = q_N^* - \varepsilon$. Then, $\frac{e(q_N^*)-e(q_C^*)}{q_N^*-q_C^*} \leq e'(q_{SB}) = \frac{3}{8} + \frac{p_0^2}{8(q_{SB}-q_0)^2}$ is possible by convexity of $e(q)$. Consequently, $\bar{D}_{CN} \leq \frac{p_0^2}{8}\left((q_{SB}-q_0)^{-2} - (q_C^*-q_0)^{-1}(q_N^*-q_0)^{-1}\right) \leq 0$ is possible as well since $q_{SB} - q_C^* > q_N^* - q_{SB} > 0$.

A.7 Proof of Lemma 4

(i): q_N^* is independent of any parameter changes as long as its level, $q_N^* = 1$, can be financed by operational profits. This is satisfied by assumption (4).
(ii): Total differentiation of the first-order condition (FOC) of the firm (18) and use of the second-order condition, $SOC_F < 0$, yields

$$\frac{dq_F^*}{dp_0} = \frac{p_0}{2(q_F^*-q_0)^2(SOC_F)} \leq 0. \tag{25}$$

(iii): Total differentiation of the FOC of the cooperative (22) yields

$$\frac{dq_C^*}{dp_0} = \frac{1}{(1-\tilde{\theta}_C)SOC_C}\left[\frac{p_0}{2(q_C^*-q_0)^2} - \frac{1-2\tilde{\theta}_C}{2}\frac{d\tilde{\theta}_C}{dp_0}\right] \leq 0 \tag{26}$$

To see the sign of $\frac{dq_C^*}{dp_0}$, note that: $SOC_C < 0$ due to the second-order condition in lemma 3; $\tilde{\theta}_C = \hat{\theta}_C$, which implies $\tilde{\theta}_C \leq 1/2$ as well as $\frac{d\tilde{\theta}_C}{dp_0} = \frac{d\hat{\theta}_C}{dp_0} = -\frac{1}{2(q_C^*-q_0)} < 0$

by (6). Q.E.D.

Remark: Total differentiation of the FOC of the firm (18) with respect to the quality equivalent q_0 of the substitute good yields

$$\frac{dq_F^*}{dq_0} = \frac{p_0^2}{2(q_F - q_0)^3(SOC_F)} \leq 0 \,. \tag{27}$$

For the cooperative, the comparative static is

$$\frac{dq_C^*}{dq_0} = \frac{1}{(1-\tilde{\theta}_C)SOC_C}\left[\frac{p_0^2}{2(q_C - q_0)^3} - \frac{1-2\tilde{\theta}_C}{2}\frac{d\tilde{\theta}_C}{dq_0}\right] \leq 0 \tag{28}$$

where the sign follows from $SOC_C < 0$ and $\frac{d\tilde{\theta}_C}{dq_0} = \frac{d\hat{\theta}_C}{dq_0} = -\frac{p_0}{2(q_C^* - q_0)^2} \leq 0$. The quality level of the nonprofit remains unaffected by q_0.

A.8 Proof of Lemma 5

(i) and *(ii)* follow directly from lemma 4.
(iii): Using SOC_F, SOC_C, $\tilde{\theta}_C = \hat{\theta}_C$ and $\frac{d\tilde{\theta}_C}{dp_0} = -\frac{1}{2(q_C^* - q_0)}$ yields

$$\frac{dq_C^*}{dp_0} - \frac{dq_F^*}{dp_0} = \frac{1.5p_0(q_C^* - q_0)}{p_0^2 - 2e''(q_C^*)(q_C^* - q_0)^3} - \frac{p_0(q_F^* - q_0)}{p_0^2 - 2e''(q_F^*)(q_F^* - q_0)^3} \tag{29}$$

The sign of this difference depends on the specific model parameters (both numerators are positive, with the first being larger, both denominators are negative, with the second being closer to zero). Generally, (29) is (weakly) positive iff

$$2e''(q_C^*)(q_C^* - q_0)^2 - 3e''(q_F^*)(q_F^* - q_0)^2 \geq -p_0^2\frac{q_C^* - q_F^* + 0.5(q_C^* - q_0)}{(q_C^* - q_0)(q_F^* - q_0)} \tag{30}$$

The RHS of (30) is always negative because of Proposition 1. The sign of the LHS however depends on the shape of the effort cost function.

A.9 Proof of Proposition 3

Generally, the difference in total surplus between two organizations $j, k \in \{F, N, C\}$, $k \neq j$ is

$$\begin{aligned} TS_j - TS_k &= \frac{3}{8}(q_j^* - q_k^*) - (e(q_j^*) - e(q_k^*)) \\ &\quad + \frac{p_0^2(q_j^* - q_k^*)}{8(q_j^* - q_0)(q_k^* - q_0)} - D(I_j - I_k) \end{aligned} \tag{31}$$

The derivative of this excess surplus with respect to p_0 is then

$$\begin{aligned}\frac{d(TS_j - TS_k)}{dp_0} &= \left(\frac{3}{8} - e'(q_j^*)\right)\frac{dq_j^*}{dp_0} - \left(\frac{3}{8} - e'(q_k^*)\right)\frac{dq_k^*}{dp_0} \\ &+ \frac{p_0(q_j^* - q_k^*)}{4(q_j^* - q_0)(q_k^* - q_0)} \\ &+ \frac{p_0^2}{8(q_j^* - q_0)(q_k^* - q_0)}\left(\frac{q_k^* - q_0}{q_j^* - q_0}\frac{dq_j^*}{dp_0} - \frac{q_j^* - q_0}{q_k^* - q_0}\frac{dq_k^*}{dp_0}\right)\end{aligned} \tag{32}$$

(i): For the difference $TS_N - TS_F$, note that $q_N^* > q_F^* > q_0$, $\frac{dq_N^*}{dp_0} = 0$, $\frac{dq_F^*}{dp_0} \leq 0$ and $e'(q_F^*) \leq \frac{1}{4}$ (see firm's FOC (18)). Hence, by (32),

$$\frac{d(TS_N - TS_F)}{dp_0} \geq 0. \tag{33}$$

(ii): For the difference $TS_N - TS_C$, note that $q_N^* > q_C^* > q_0$, $\frac{dq_N^*}{dp_0} = 0$, $\frac{dq_C^*}{dp_0} \leq 0$ and $e'(q_C^*) \leq \frac{3}{8}$ (see coop's FOC (22) where $\tilde{\theta}_C \leq 1/2$). Hence, by (32),

$$\frac{d(TS_N - TS_C)}{dp_0} \geq 0. \tag{34}$$

(iii): For the difference $TS_C - TS_F$, inserting $e'(q_F^*)$ and $e'(q_C^*)$ from the firm's and coop's FOC into (32) yields, after rearranging,

$$\begin{aligned}\frac{d(TS_C - TS_F)}{dp_0} &= \left(\frac{1}{8} + \frac{3p_0^2}{8(q_F^* - q_0)^2}\right)\left(\frac{dq_C^*}{dp_0} - \frac{dq_F^*}{dp_0}\right) + \frac{p_0(q_C^* - q_F^*)}{4(q_F^* - q_0)(q_C^* - q_0)} \\ &- \left(\frac{\tilde{\theta}_C(1 - \tilde{\theta}_C)}{2} + \frac{(q_C^* - q_0)^2 - (q_F^* - q_0)^2}{(q_F^* - q_0)^2(q_C^* - q_0)^2}\right)\frac{dq_C^*}{dp_0}\end{aligned} \tag{35}$$

Apart from the first term, all expressions in (35) are weakly positive. Hence, for the whole expression to be (weakly) positive, $\frac{dq_C^*}{dp_0} - \frac{dq_F^*}{dp_0} \geq 0$ is a sufficient condition. Lemma 5.*(iii)* provides the conditions for the latter inequality to hold. Q.E.D.

Remark: Generally, the derivative of excess surplus with respect to q_0 yields

$$\begin{aligned}\frac{d(TS_j - TS_k)}{dq_0} &= \left(\frac{3}{8} - e'(q_j^*)\right)\frac{dq_j^*}{dq_0} - \left(\frac{3}{8} - e'(q_k^*)\right)\frac{dq_k^*}{dq_0} \\ &+ \frac{p_0^2}{8(q_j^* - q_0)(q_k^* - q_0)}\left(\frac{q_j^* - q_k^*}{q_k^* - q_0} + \frac{q_j^* - q_k^*}{q_j^* - q_0}\right. \\ &\left. + \frac{q_k^* - q_0}{q_j^* - q_0}\frac{dq_j^*}{dq_0} - \frac{q_j^* - q_0}{q_k^* - q_0}\frac{dq_k^*}{dq_0}\right)\end{aligned} \tag{36}$$

For the difference $TS_N - TS_F$, this implies

$$\frac{d(TS_N - TS_F)}{dq_0} \geq 0 \tag{37}$$

as $\frac{dq_N^*}{dq_0} = 0$, $\frac{dq_F^*}{dq_0} \leq 0$ and $e'(q_F^*) \leq \frac{1}{4}$.
For the difference $TS_N - TS_C$, this implies

$$\frac{d(TS_N - TS_C)}{dq_0} \geq 0 \tag{38}$$

as $\frac{dq_N^*}{dq_0} = 0$, $\frac{dq_C^*}{dq_0} \leq 0$ and $e'(q_C^*) \leq \frac{3}{8}$.
For the difference $TS_C - TS_F$, the sign of the derivative with respect to q_0 is generally indeterminate.

A.10 Numerical Example

To illustrate the efficiency comparisons and the effects of costs of collective decision making and the curvature of the effort cost function graphically, we computed the following example:

$$e(q) = \frac{e^{qx} - 1}{25}$$

where $x \in [1.9; 2.0]$ to meet the restrictions imposed by our model. We additionally assumed $q_0 = 0.1$ and $p_0 = 0.09$ (figure 1) or a decrease in p_0 from 0.09 to 0.06 (figure 2). Quality levels chosen and total surplus are then calculated explicitly for each organization. Figures 1 and 2 then plot levels of $D \in [0.010; 0.024]$ along the ordinate against the convexity measure.
Remark: The results from the numerical calculations do not depend on the specific form assumed above: Similar numerical computations were undertaken for $e(q) = xq^2$ and $e(q) = \frac{1}{4}q^{1+x}$ as specific functional forms. For valid parameter ranges and different degrees of convexity x, the same patterns emerge as those depicted in figures 1 and 2.