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A Theory of Consumer Boycotts under Symmetric Information and Imperfect Competition

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Abstract

This paper models strategic interactions between non-identical duopolistic firms and a public interest / environmental organization (EO) that promotes "green" production practices by threatening consumer boycotts against "brown" producers. The paper describes when boycotts are deterred by prior firm commitments to be "green" and, alternately, when a boycott arises in equilibrium, despite symmetric information. When a boycott arises, it is either a small persistent boycott against the "small firm" in the industry, or a large transitory boycott against the "large firm" in the industry that prompts the target firm quickly to accede to the boycott demands.

Keywords: Consumer boycott, environmental practices, symmetric information, imperfect competition

JEL: Q20, L13, D70

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Private firms often voluntarily engage in costly actions that are deemed to be "socially responsible." For example, since 1999, over 400 large corporate retailers and users of timber products have agreed to phase out all products of old growth forests and to give preference to wood that is certified as "environmentally friendly" by the Forest Stewardship Council (FSC). Processed food producers and fast food retailers (including Heinz, Gerber, McCains, Frito Lay, McDonalds, and Burger King) have taken steps to ensure that their products are free of genetically modified content. Fast food producers (including McDonalds, Burger King and Wendy's) have responded to animal rights groups' demands by requiring their suppliers of chickens, eggs and other meats to make their production practices more humane.

Economists have offered a number of theories to explain such apparently altruistic behavior by profit-driven firms. On one hand, private firms' "voluntary overcompliance" with pollution standards may influence government policy to the firms' advantage. By reducing pollution somewhat, firms may deter environmental groups from lobbying the government for costly environmental regulations (Maxwell, Lyon and Hackett, 2000), or prompt regulators to exercise less enforcement effort (Maxwell and Decker, 2001; Heyes and Rickman, 1999; Decker, 2003), or spur tighter government standards that disadvantage rival producers (Innes and Bial, 2002). On the other hand, firms may voluntarily engage in altruistic conduct because this conduct is rewarded in the marketplace. If "green consumers" are willing to pay a premium for goods produced in an environmentally benign way, firms may seek to be certified as green in order to capture this premium (Arora and Cason, 1996; Arora and Gangopadhyay, 1995; Feddersen and Gilligan, 2001; Engle, 2000). For example, McDonalds might offer GM-free food because customers are willing to pay sufficiently more for it.

In all of the cases described above, however, firms were prodded to action by either the threat or use of consumer boycotts by a public interest / environmental organization (EO). Large

lumber retailers were subject to boycott by the Rainforest Action Network and others until concessions were made to end marketing of old growth timber and adopt FSC standards (Barker, 2002). Food retailers limited GM content due to fear of boycott by Greenpeace and others (Koenig, 2000). Animal rights reforms by McDonalds and other food retailers were preceded by short and virulent boycott efforts by the People for the Ethical Treatment of Animals (PETA) (Zwerdling, 2002). Indeed, boycotts are a pervasive phenomenon in contemporary society. Between 1988 and 1995, for example, over 200 firms and over a thousand products were actually subject to organized boycotts in the U.S..[1] Recent empirical work finds that the threat of boycott is a significant explanator for corporate environmentalism, over and above any "green marketing" and regulatory incentives that may be at play (Sam and Innes, 2004).

Despite a long history of consumer boycotts (Laidler, 1968; Smith, 1990) and increasing threats of (and responses to) boycotts for practices opposed by public interest groups (Feddersen and Gilligan, 2001), there has been surprisingly little formal economic analysis of this phenomenon. The notable exceptions are Baron (2001, 2002, 2003).[2]

Asymmetric information is at the heart of Baron's theories of boycotts. In a game of symmetric information, Baron (2001) concludes that boycotts are unlikely to arise in equilibrium, avoided by demands to which target firms rationally agree. However, he shows that a boycott can signal a firm's private information about the saliency with which the boycott issue resounds with the public. Alternatively, Baron (2002, 2003) argues that boycotts may arise due to asymmetric information about the intransigency of the EO and the firm, respectively; in this model, boycotts persist indefinitely if both parties are intransigent, but can be shorter lived when rational players update their assessments of the probability that their opponent is intransigent. One can envision other models wherein boycotts signal the EO's private information about the

[1]See National Boycott News (1992-1993) and Boycott Quarterly (1992-1995).

[2]Rea (1974) considers consumer boycotts as a mechanism for the exercise of monopsony power, but not for the achievement of other societal or economic objectives. Brennan (1992) studies firm boycotts of consumers as mechanisms for exercising market power. There is also a literature on the history, sociology, and marketing effects of consumer boycotts (e.g., Friedman, 1996), including identification of factors that influence the likelihood of boycott success (Smith, 1990), predictors of likely boycott participation (Sen, et al., 2001), and the financial impacts of boycotts (Koku, et al., 1997). However, to my knowledge, only Baron (2001, 2002, 2003) formally models the boycott mechanism and its economic effects.

strength of consumers' environmental preferences and/or the firm's private information about the costs of the EO's demands.[3]

In practice, however, boycotts arise in some cases wherein information would seem to be quite good and at least one player is "rational." For example, in his survey of boycott leaders, Friedman (1999) finds that boycotters carefully design their campaigns in view of the known susceptibilities of both a potential boycott target (its reputation, financial position, prominence in the public/consumer eye, and propensity for responsiveness) and the target consumer audience (due to the saliency of the message, and the visibility, substitutability, and brand identification of the product). Moreover, the propensities of EOs -- such as PETA -- are well-known to large companies such as McDonalds.

In view of these cases, and in view of the industry concentration that pervades many boycotted markets (more below), the puzzle that this paper seeks to address is why boycotts might arise under *symmetric* information and imperfect competition. More specifically, we consider a number of questions unanswered in the literature: In a concentrated industry with heterogeneous firms, some larger than others, how can an environmental organization play one firm off against its rivals in order to persuade all firms to agree to its demands? Which firms are boycotted first? And can a boycott actually occur (despite symmetric information), rather then being deterred by a Coasian bargain?

To address these questions, this paper builds upon Baron's (2001) seminal work by modeling strategic interactions between non-identical duopolistic firms and an environmental organization (EO) that advocates an "environmentally friendly" production practice. Using contributions from its members, the EO can invest in a boycott of a "brown" firm that does not adopt "green" environmental practices. A higher boycott investment provides a greater deterrent to consumer purchases of the targeted firm's products. Although there is symmetric information

[3]In principle, boycotts might also arise due to mistakes by participants in their assessment of the economic setting, although this explanation is seemingly belied by the pervasiveness of boycotts in practice. In addition, boycotts might serve to help corporate managers convince their shareholders of the need for "green" actions, although this effect cannot explain long-lived boycotts.

between relevant negotiating parties (the EO and producing firms), boycotts can convey information to consumers about the "brown" practices of boycott targets.[4] However, the potential "negative information label" role for boycotts does not, per se, explain the emergence of boycotts; knowing their tarnishing effects, firms can avoid boycotts by making prior concessions to the EO.

Consonant with empirical realities, this paper nonetheless finds that boycotts can actually arise in equilibrium. This conclusion contributes to a substantial economic literature that asks why actions that are costly to all parties, such as labor strikes and wars, are not avoided by Pareto-improving bargains (Kennan and Wilson, 1993). In this literature, some authors have shown that labor strikes can occur despite perfect information (Fernandez and Glazer, 1991; Haller and Holden, 1990). However, in these papers, strikes occur only when there are multiple equilibria, with any strike outcome Pareto dominated by another (no-strike) equilibrium.[5] Here, in contrast, not only is the economic context quite different, but boycotts arise in *unique* subgame-perfect pure-strategy equilibria.

Two types of boycott are shown to be possible here: (1) a small persistent boycott that is levied against the small firm in the industry, and (2) a large transitory boycott that is levied against the large firm and quickly prompts the target firm to accede to the boycott demands. Conversely, when boycotts do not arise in equilibrium, either both firms accede to the interest group's demands or, when costs of doing so are sufficiently high, neither do. The former outcome -- when boycott threats are effective -- is more pervasive when the interest group has larger contribution resources available for investment in a boycott effort.

Section 2 below fully describes the logic underpinning these results. Loosely speaking, a persistent boycott arises when, due to plausible economies of scale in the boycott process, the two firms anticipate different boycotts when they do not agree apriori to the EO's "green"

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[4]This paper models interest groups as intermediaries between consumers and firms, building most closely upon Feddersen and Gilligan's (2001) treatment of interest groups as credible certifiers of "green" products. The twist, as in Baron (2001), is that interest groups are advocates with private firms. See Dewatripont and Tirole (1999) for a study of interest groups' role as advocates in the political process.

[5]MacLeod and Malcomson (1995, p. 362) also cast doubt on the robustness of these strike outcomes to plausible equilibrium refinements.

production demands. The large firm anticipates a large boycott and thus concedes apriori in order to deter the boycott. The small firm, on the other hand, anticipates a much smaller boycott. This anticipation is rational because, due to its smaller market share, the EO has less to gain from action against the small firm. Because its costs of agreeing to the EO's green demands exceed its costs of sustaining the modest boycott that is otherwise launched, the small firm does not concede to the EO. Nevertheless, the EO conducts a boycott in order to shift custom away from the target "brown" (small) firm and toward the "green" (large) firm.

These results accord rather well with stylized facts in boycott practice. Table 1 illustrates these facts by comparing U.S. targets of non-labor boycotts between 1988 and 1995 to the overall population of U.S. firms listed in the COMPUSTAT database. Table 1 indicates that boycott targets tend to be much larger (in terms of sales and employment) and have much more market power (as measured by market share and industry rank) than the typical COMPUSTAT firm, suggesting that this paper's focus on the strategic interactions between powerful firms is appropriate when modeling the boycott process. In addition, and consonant with the predictions of our theory, Table 1 reveals that transitory boycotts (those less than six months) tend to be focused on the dominant firms in their respective industries, whereas longer-lived boycotts are more broadly focused on the top tier of industry leaders.[6] To my knowledge, this evidence is not explained by asymmetric-information-based theories of boycotts that do not predict, per se, a systematic link between the length of a boycott, as a signal of private information about the boycott's saliency or costs, and the market power of the target.

The balance of the paper is organized as follows. Section 1 lays out the model. Section 2 presents the intuitive underpinnings of our results. Sections 3-6 follow with an inductive analysis of the game between the interest group and producing firms. Firms first commit (or not) to the "green" conduct demanded by the interest group (Section 6). The interest group next makes its boycott decisions -- which firm to boycott, and how much to invest in the effort

[6]Although this paper's theory predicts that non-transitory boycotts will not be levied against dominant firms, this conclusion is sensitive to our assumption that consumer demands are perfectly inelastic. See Section 8 for discussion.

(Section 5). Firms then choose their conduct, whether "green" or "brown" (Section 4); in response to this choice, the interest group may cancel its boycott effort. Finally, firms engage in price competition (Section 3). Section 7 discusses extensions and Section 8 concludes. An Appendix contains proofs of results.

1. The Model

Consider a differentiated product duopoly, serving N consumers with unit demands. For notational simplicity, let N=1. The consumers are indexed by $\theta \in [-\bar{\theta}, \bar{\theta}]$, where θ measures a consumer's net preference for supplier 2 over supplier 1 and is distributed uniformily on its support. Specifically, let $(\theta-k)$ represent a consumer's net cost of buying from firm 1 vs. firm 2 (ceteris paribus). Absent boycotts, a consumer thus compares his total cost of purchase from firm 1, $P_1 + \theta - k$, to his cost of purchase from firm 2, P_2, where P_i is the ith firm's price. Without loss, we assume that $k>0$, so that firm 1 serves the larger market (ceteris paribus).

The suppliers have a discrete choice of production technology. Either the technology is "environmentally friendly," G (for green), or it is "environmentally harmful," B (for brown). For example, B may represent production of genetically modified (GM) food, whereas G may represent GM-free production. It is assumed that a firm produces all of its output with one of the two possible technologies (not fractions in each),[7] and that the green technology is more costly. Specifically, the two suppliers have identical and constant marginal costs of production, equal to c for technology B and $c+\eta$, $\eta>0$, for technology G. c and η are fixed and known.

As we will soon see, costs of the green technology will prevent its adoption in the absence of organized consumer action. Consumer action is directed by an environmental organization (EO) that promotes green production practices by threatening and organizing boycotts against brown firms. Boycotts operate in the following way: If the EO invests $b of member contributions in a boycott, consumers assign an additional net cost to purchasing the

[7]This premise may be motivated by fixed technology set-up costs that can make it cost-prohibitive to use two technologies. It may also be prohibitively costly to verify the extent of mixed production, and quite easy to verify a "none or all" technology choice. If so, a technology choice that voids a boycott, as modeled in this paper, may require unmixed production.

boycotted (vs. non-boycotted) product. This cost is denoted d(b) and is increasing in b, as higher boycott expenditures increase the visibility and strength of the boycott.[8]

Because consumers have unit demands, the only effect of boycotts on consumer choice, and thus firm profit, is the *net* boycott penalty to consumption of *one* of the products. For example, if the EO invests in separate boycotts of both firms, say b_1 against firm 1 and $b_2<b_1$ against firm 2, then the boycotts yield the net consumer penalty to firm 1 consumption, $d(b_1)-d(b_2)$. The EO can achieve the same impact, at lower cost, by ending the small boycott and reducing the investment in the large boycott to b_1': $d(b_1')=d(b_1)-d(b_2)$. Therefore, without loss in what follows, we assume that the EO boycotts no more than one firm at a time.

To keep the model as simple as possible, consonant with making our argument, we assume that consumers are homogeneous with respect to their preferences for environmental conduct. In principle, there are two elements to these preferences: (1) Consumers value the *public* benefits from the production of green goods; and (2) there may be a *private* cost from consuming a brown product; for example, consumers may ascribe private health costs to consuming GM foods, or feel guilt from knowing that they are consuming old growth timber. With regard to the first (public value) benefit of greenness, a boycott fires up a social ethic that penalizes consumption of a targeted product -- a social ethic against crossing the picket line and/or patronizing "environmentally bad" firms, for example.[9] Implicitly, this social ethic enables consumers to view their individual purchase decisions as concerted actions, helping to avoid the free-rider problems that otherwise plague uncoordinated action.

Boycotts can also impart information to consumers that affects both the strength of the inspired social ethic and the imputed private value that they may assign to green products.

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[8]Formally, we assume $d(0)=0$, $d'(b)>0$ and $d''(b)\leq 0$.

[9]If consumers have full information about firms' technology choices, their ethical cost of product purchase may depend upon whether the boycotted firm is singled out, despite "harmful" B production by both firms, or is targeted for being the only "bad" actor -- with the other firm using green practices. In the former case, the ethical strength of the boycott may be diminished, lowering its effectiveness in deterring purchase of the boycotted product. For simplicity, we abstract from this distinction here, but discuss its implications in Section 7 below. Note that some extra "ethical" onus must be placed on a boycotted firm, vis-a-vis other bad actors, in order for the boycott to have any effect at all when both firms are brown producers. Such an added "ethical penalty" is motivated by the social ethic spawned by a boycott -- that of solidarity with the EO's cause.

Boycotts can then serve as "negative information labels," the effects of which are captured by our posited d(b) penalty.[10] Of course, consumers may have some noisy information about the environmental attributes of available products, and thus assign some private value to green products, even absent boycotts. For simplicity, we assume that there are no such private values, and that environmental preferences are manifested exclusively via boycotts. However, extensions that allow consumers to have heterogeneous environmental preferences and private environmental benefits are discussed in Section 7 and can be shown to have no qualitative impact on the arguments presented here.

The environmental organization (EO) cares exclusively about the extent of environmental harm, which we assume is proportional to the volume of brown production. Formally, the EO obtains the benefit ϖE, where E is the proportion of overall production that is green and $\varpi>0$ is a preference parameter.[11] If the EO makes expenditures on a boycott, it bears a cost (in lost opportunities for activity in other domains) equal to o(b) ("o" for opportunity cost), where o(0)=0, o'(b)>0, and o"(b)>0 (boycott investments are increasingly costly). Boycott investments are limited by the EO's available contributions Q.[12]

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[10]We are indebted to a referee for this observation. In principle, there may also be "positive information labels" paid for by green firms (see Engle (2000), Feddersen and Giligan (2001), and Amacher, et al. (2004)). For simplicity, such labeling is ruled out here. For example, if there are no boycotts in the present model and if the net private consumer value of a green (vs. brown) product is exceeded by a firm's unit cost of green production (η) and labeling, then both firms will select the brown technology and neither will label. One possible effect of boycotts is that they provide green firms with a free and credible negative label for brown rivals, versus a costly positive label for themselves. The present model implicitly captures such effects.

[11]By our premise of unit demands and N=1, E equals the total volume of green production and one minus the total volume of brown production. Here the EO is assumed to be organized by a few (measure zero) set of advocates with particularly strong preferences for environmental performance. Consumers delegate their representation to these advocates by joining the EO. However, in competition between potential EOs for the patronage of the consumers, would this EO objective emerge? An alternative is a consumer association that maximizes representative member utility. While the latter objective requires a much more complicated analysis, there is also reason to believe that the "advocacy EO" modeled here may prevail in practice. Beyond reputation effects that imbue advocates with "market power" in the competition for patronage, advocates may be more effective in achieving consumer-desired conduct precisely because of their strong preferences and the attendant vigor with which they pursue their environmental objectives; delegation to advocates may thus be a valuable commitment mechanism for consumers in negotiating with firms. (Amacher and Malik (1996) make a related point by demonstrating that an optimal objective function for environmental regulators is biased in favor of environmental performance.)

[12]The opportunity cost o(b) will generally depend upon the available contributions Q. For notational simplicity, we suppress this dependence here.

EO organization, consumer action, firm technology choices, production and trade occur in the following sequence. First (Stage 1), there is a preliminary negotiation between the EO and the firms, wherein each firm either commits to the green technology or does not. Second (Stage 2), the EO decides whether or not to launch a boycott against at most one firm. If it launches a boycott, the EO chooses its boycott investment b. If a firm makes a Stage 1 commitment to the desired technology, it is immune to a Stage 2 boycott. However, if neither firm makes a Stage 1 commitment, the EO chooses which firm to target for boycott (if any). Third (Stage 3), each firm chooses its technology, honoring any Stage 1 commitments. If a boycotted firm chooses the EO's desired technology, the boycott is called off. In this event, the EO bears a fraction of its boycott investment cost, βb where $\beta \in [0,1]$. In addition, the boycotted firm can only counter the effect of the initial boycott -- negating the consumer penalty d(b) -- by spending $r>0$ per unit output sold. Finally (Stage 4), firms compete in posted prices, followed by production and trade.

Table 2 summarizes model notation. In what follows, we consider a subgame perfect equilibrium in pure strategies; we thus proceed by backward induction, starting with Stage 4. First, however, we discuss the essential logic underpinning our results.

2. The Basic Argument

In this model, larger boycotts impose higher costs on the target firm. As a result, a target firm will accede to the boycott demands -- and adopt the green G technology -- when the boycott investment is above a critical level, $b \geq \overline{b}$. In this case, the boycott is *effective* and is quickly cancelled. Conversely, if the boycott investment is lower, $b < \overline{b}$, then the boycott is *ineffective* in the sense that it does not prompt adoption of the G technology.

For the EO, the benefits of an effective boycott are clear: it achieves the adoption of the green technology when brown production would otherwise prevail. However, if neither firm pre-commits to be green, then an *in*effective boycott does nothing to increase the extent of green production and, hence, yields no benefits to the EO; in this case, therefore, the EO will either launch an effective boycott against the larger firm ($b=\overline{b}$) or launch no boycott at all ($b=0$). The EO's incentive to invest in a boycott is always greater against the larger firm 1, ceteris paribus,

because the boycott can thereby affect more customers and have a greater impact on the extent of green production.

Now consider the firms' choices in Stage 1 when each can either "sign" (S) with the EO by pre-committing to G production, or "not sign" (N). There are three possibilities:

(1) Either firm, whether the large firm 1 or the smaller firm 2, can anticipate facing an effective boycott if it does not pre-commit (N) and the other firm does (S).

(2) Conversely, if a firm does not pre-commit (N), then it can anticipate facing at most an ineffective boycott.

(3) The large firm 1, if it does not pre-commit (N) and its rival does (S), faces an effective boycott. However, the smaller firm 2, if uncommitted (N) and faced with commitment (S) by its rival, is subject to an *in*effective boycott.

In the first case, each firm, knowing the other will sign if it doesn't, faces the prospect of green production regardless. Both firms thus want to sign in order to save the per-unit cost r of countering the effective boycott to which they will otherwise be subject. Because both firms accede to the EO's demands apriori, no boycott is conducted. Firms thus exhibit pure voluntary environmentalism in response only to the *threat* of boycott.

In the second case, anticipated boycotts are too small to motivate adoption of the green technology. In essence, the boycott threat against a brown (non-signing N) firm is too small to counter the competitive disadvantage to which a green (signing S) firm is subject as a result of its higher (green technology) production costs. Hence, firms prefer to be brown; neither firm signs; and again, no boycott is launched.

The third case is arguably the most interesting, because boycotts arise in equilibrium. As required for this case, it is possible to have an effective boycott against the large firm (when it does not commit to the green technology) and an ineffective boycott against the small firm (when it alone produces with the brown technology). The reasons are two-fold. First, due to its larger market, an effective boycott against firm 1 yields more green production. Hence, the EO may want to effectively boycott firm 1 and not firm 2. Second, even though the EO does not

effectively boycott firm 2, it may launch a small ineffective boycott in order to shift custom from firm 2 (the brown producer) to firm 1 (the pre-committed green producer).

In this third case, let us further suppose that, when neither firm pre-commits to G production, there is an effective boycott against the large firm 1 ($b=\bar{b}$). Then a dominant strategy for firm 1 is to sign. Failing this, firm 1 necessarily faces an effective boycott, regardless of whether firm 2 signs or not; hence, firm 1 adopts G regardless and pre-commits in order to save the costs of countering the boycott (r per unit). For firm 2, however, the anticipated boycott against it is ineffective and, hence, too small to motivate its adoption of the green technology, whether apriori (in Stage 1) or after the boycott's launch (in Stage 3). Hence, in equilibrium, there is a small persistent boycott against the smaller firm 2.

There is a second possibility: When neither firm pre-commits to G production, no boycott is conducted ($b=0$). Boycotts also arise in this case, although their logic is more subtle. In the initial (Stage 1) negotiations, the EO can place its green production demands either by approaching firm 1 first or by approaching firm 2 first. By approaching firm 2 first, the EO obtains the worst possible outcome -- no pre-commitments, no boycotts, and no green production. In essence, the firms avoid boycotts altogether, and avoid costs of adopting the green technology, by sequentially refusing to pre-commit.

The EO can do better by approaching firm 1 first. Then, if firm 1 does not pre-commit (N), firm 2 *does* (S). Why? Because firm 2 knows that, if it does not sign, no boycott is conducted, whereas if it signs, the rival firm 1 is subject to an *effective* boycott; hence, by signing, firm 2 can disadvantage its rival with the costs of countering the boycott to which it is temporarily subject (r per unit). Conversely, if firm 1 signs (S), then firm 2 responds by not signing (N). Why? Because the anticipated boycott against firm 2 is ineffective and, thus, too small to offset the cost-savings from the brown technology; hence, vis-a-vis its green rival, firm 2 enjoys a cost advantage by remaining brown. In sum, when approached first, firm 1 has two alternatives: (1) "not sign" (N), which spurs a pre-commitment by firm 2 (S), an effective boycott against firm 1, and the per-unit costs of boycott cancellation (r); and (2) sign (S), which spurs an

ineffective boycott against the uncommitted firm 2 (N) and an attendant cost disadvantage for firm 1. When the boycott cancellation cost (r) is small, firm 1 prefers the first (N) strategy; when r is large, it prefers the second (S) strategy. Either way, the EO does better than when it approaches firm 2 first, because it elicits green production by at least firm 1. Moreover, in either case, a boycott is launched, whether a transitory and effective one against the large firm 1 (in the first case) or a small, persistent, and ineffective one against the small firm 2 (in the second case).

In what follows, the challenge is to formalize these arguments, characterizing conditions under which boycotts arise in equilibrium (our "third case"), and documenting that these conditions can hold.

3. Stage 4 Outcomes: Pricing, Sales, and Profit

Outcomes from Stages 1 to 3 imply the firms' respective costs of production, c_1 (for firm 1) and c_2 (for firm 2), including any costs of countering a cancelled boycott (r). In addition, they imply a net boycott penalty to firm 1 (vs. firm 2) purchases, W. Table 3 delineates the possible cases. For example, suppose firm 1 commits to G production in Stage 1, the EO boycotts firm 2 in Stage 2, and firm 2 chooses the B technology in Stage 3 (the third case in Table 3). Firm 1 then bears the green technology cost, $c_1=c+\eta$, while firm 2 does not, $c_2=c$; moreover, consumers bear the d(b) boycott cost on firm 2 products, for the additional net penalty to firm 1 consumption, W = - d(b).

For any set of values, (W,c_1,c_2), we can calculate each firm's equilibrium profits in this Bertrand duopoly:

Lemma 1. In a Stage 4 equilibrium, firms earn the respective profits,

$$\Pi_1(\Delta) = \frac{1}{2\bar{\theta}} \{\bar{\theta} + (1/3)(k-\Delta)\}^2 \quad , \quad \Pi_2(\Delta) = \frac{1}{2\bar{\theta}} \{\bar{\theta} - (1/3)(k-\Delta)\}^2 \qquad (1)$$

where

$\Delta \equiv W + (c_1-c_2)$ = index of net profit cost to firm 1 (and net profit advantage to firm 2). (2)

Notice that the relationship between a firm's profits under alternative decisions can be determined by comparing corresponding values of the Δ index: Firm 1 (F1) benefits from a lower Δ value, while firm 2 (F2) benefits from a higher Δ.

4. Stage 3: Firm Technology Decisions

For a boycotted firm, adoption of the G technology voids the consumer boycott penalty (d(b)) at the cost of countering the boycott (r) and bearing the incremental G production cost (η). Hence, the net benefit of adopting the G technology is positive when $d(b) \geq \eta + r$ --that is, when the boycott investment (b) reaches or exceeds the following $\bar{b}$ threshold:

$$\bar{b} \equiv b: \; d(b) = \eta + r. \tag{3}$$

Lemma 2. A minimum boycott investment of $b \geq \bar{b}$ (>0) is necessary and sufficient for a boycott to prompt a target firm to adopt the G technology. The minimum "effective boycott investment," $\bar{b}$, *rises* with the cost of green production (η) and the cost of countering boycotts (r), and *falls* with the effectiveness of boycotts in deterring consumption (d(b)).

Note that, without any boycotts (b=0), both firms will choose the brown B technology; costs of the green G technology (η), absent an offsetting benefit, deter its adoption.

5. Stage 2: EO Boycott Decisions

There are four possible outcomes from Stage 1: neither firm agrees apriori to G production, NN; firm 1 "signs" and firm 2 does not, SN; firm 2 signs and firm 1 does not, NS; and both sign, SS. Clearly, the EO most prefers the SS outcome, because then there is a maximum possible extent of green production (E=1) at minimum possible cost in requisite boycott investment (b=0). In this case, there are no boycotts. In all other cases, we note that the EO will never set $b > \bar{b}$; by setting b above $\bar{b}$, rather than equal to $\bar{b}$, the EO obtains no additional green production, but bears additional cost.

Turning to the NN outcome, we have:

Proposition 1. If neither firm commits to green production in Stage 1 (case NN), then in Stage 2, the EO launches either an effective boycott against the large firm 1 (with $b=\bar{b}$) or none

at all (with b=0). An effective boycott ($b=\bar{b}$) is launched if and only if η is less than or equal to a critical η^*.

In case NN, an "ineffective" boycott ($b<\bar{b}$) yields no additional green production, but costs the EO money that could be spent elsewhere. Moreover, when there is a higher firm cost of adopting the green technology (η), a firm must be confronted with a higher minimal boycott investment ($\bar{b}$) in order for the boycott to be effective; hence, the EO's incentive to launch an effective boycott is lower. Perhaps most importantly, an effective boycott yields more green production when launched against firm 1 than against the smaller firm 2, while costs of the boycott are the same in either case; hence, firm 1 is the EO's desired boycott target.

For cases in which one firm, and not the other, agrees to the green technology in Stage 1, the EO can benefit from an ineffective boycott because the boycott can increase the market for the non-targeted "green" firm -- thus raising E -- even though it does not succeed in making the target firm become green. If an ineffective boycott is launched, the EO's optimal investment (when positive) uniquely solves the following (see Appendix for derivation):

$$b^*: \quad \frac{d'(b)\varpi}{6\bar{\theta}} - o'(b) = 0. \qquad (4)$$

The first term in (4) gives the EO's marginal benefit of b in shifting market share to the green producer from the targeted brown producer. The second term gives the EO's marginal cost of the boycott investment.

Facing one uncommitted firm, the EO chooses between an ineffective boycott, b*, and an effective one, $\bar{b}$. Although b* is the same in cases NS and SN (due to the symmetry of marginal boycott effects), the EO's incentive to choose b* over $\bar{b}$ is not the same:

Lemma 3. The EO's optimal Stage 2 boycott investment is never lower in case NS than it is in either case SN ($b_{NS} \geq b_{SN}$) or case NN ($b_{NS} \geq b_{NN}$).

Comparing cases NS and SN, the EO enjoys greater gains from increased green production when an effective boycott converts firm 1, rather than firm 2, to the green technology;

the reason is that firm 1 serves the bigger market (ceteris paribus). Comparing cases NS and NN is somewhat more complicated. Under NN, an effective boycott of firm 1 leaves the firm faced with a lower cost competitor, which is not true in the NS case. The competitor's lower cost under NN leads in turn to a lower firm 1 market share and, thus, a lower gain to the EO from the effective firm 1 boycott. An effective boycott also enjoys an added advantage in the NS case: ending the cost disadvantage of the green firm 2. Both forces lead to higher EO benefits of effective boycotts under an NS outcome.

Effective (vs. ineffective) boycotts yield the EO the benefit of more green production at the cost of launching and canceling the boycott, $\beta\bar{b}$ (vs. the cost b* for an ineffective boycott) . Clearly, if $\beta\bar{b} < b^*$, the EO will prefer the effective boycott. More generally, the higher are the EO benefits from green production (ω) and the lower are its costs of boycott cancellation (β), the greater is its net incentive to launch an effective boycott. In addition, a more potent boycott technology (higher d'(b)) implies a lower effective boycott investment ($\bar{b}$) and a higher ineffective boycott investment (b*), thereby reducing any cost disadvantage of the effective boycott.

Lemma 4. In cases SN and NS, the EO prefers effective boycotts whenever they are feasible ($\bar{b} \leq Q$), provided the EO places a sufficiently large value ϖ on the green technology and/or costs of an effective boycott β are sufficiently small. The EO is also more likely to prefer effective boycotts when boycott investments are more potent (with d'(b) larger), and marginal opportunity costs of boycott investments (o'(b)) are smaller.

Conversely, there are circumstances under which the EO prefers an ineffective boycott to an effective one, as we will demonstrate momentarily.

6. Stage 1: Firms' Technology Commitment Decisions.

In Stage 1, the EO asks each firm to commit upfront to the green technology. In doing so, the EO is assumed to approach the firms sequentially. That is, the EO chooses whether to approach firm 1 first or firm 2 first, with public information about the first firm's decision.[13]

We note at this juncture that the ability of firms to make credible commitments in Stage 1 is essential to boycott deterrence. Absent this capability, boycotts are necessary (in Stage 2) to elicit any adoption of the green technology (in Stage 3); in this case, Proposition 1 describes equilibrium outcomes, with case NN prevailing by construction. However, it is much less obvious that boycotts can arise when Stage 1 commitments enable their deterrence apriori. Such commitments can be motivated in a number of ways. Firms may be able to make their technology adoption decisions before the EO has launched a boycott (in Stage 1), as well as after (in Stage 3). Alternately, commitments could be backed up by refundable bonds, posted by committing firms, that would be forfeit in the event of a commitment breach. Or reputation effects could implicitly penalize violations of commitments and thereby ensure their credibility. Whatever the mechanism, we simply assume that these commitments can be made.

Now let $\underline{b}$ represent the anticipated boycott investment that is "effective" absent any boycott cancellation costs (r):

$$\underline{b} \equiv b: d(b) = \eta. \tag{5}$$

As of Stage 1, the firm need not cancel a boycott in order to enjoy benefits of the green technology; hence, the relevant "effective boycott" becomes $\underline{b}$, rather than $\bar{b} > \underline{b}$. Given this construct, Table 4 presents the complete set of possible equilibria in view of Proposition 1 and Lemma 3 ($b_{NS} \geq b_{SN}$, $b_{NS} \geq b_{NN}$, $b_{NN} \in \{0, \bar{b}\}$, and $b_{NS} = b_{SN} = \min(b^*, Q)$ if $b_{NS} < \bar{b}$).

If anticipated boycott investments are always ineffective (as in case 1 of Table 4), then firms have incentives neither to sign in Stage 1 nor to adopt the green technology in Stage 3.[14]

[13]Allowing the EO to approach firms simultaneously does not alter our qualitative results. See our expanded paper and note 17 below. We also implicitly assume that a firm's commitment decision is "once and for all." The premise that a commitment to the G technology is irreversible is important to the analysis, as discussed above. However, the analysis is robust to allowing the EO to approach "non-signing" firms repeatedly during a protracted Stage 1; see note 18 below.

Conversely, if a non-signing firm anticipates an effective boycott whenever the other firm signs (so that $b_{NS} \geq \underline{b}$ and $b_{SN} \geq \underline{b}$, as in cases 2, 5 and 6 of Table 4), then both firms have an incentive to sign;[15] facing the prospect of green production regardless, each firm wants to sign in order to avoid costs of countering the effective boycott that will otherwise confront them.

The remaining possibility (by Lemma 3) is that a lone non-signing firm 1 anticipates an effective boycott ($b_{NS}=\bar{b}$), while a lone non-signing firm 2 does not ($b_{SN}=b^* < \underline{b}$), as in Table 4's cases 3 (when $b_{NN}=0$) and 4 (when $b_{NN}=\bar{b}$). Recalling Lemma 4, these cases cannot arise if the EO always prefers effective to ineffective boycotts or if the two firms are sufficiently close in size; then optimal boycott investments on lone non-signers are the same ($b_{NS}=b_{SN}$). However, if firms are different in size (k is not small) and the EO does not always prefer effective to ineffective boycotts (with effective boycott costs β sufficiently large and EO gains from effective boycotts ω sufficiently modest), then cases 3 and 4 can occur. Formalizing these requirements and documenting that they hold in a specific example, we have:

Lemma 5. Cases 3 and 4 (of Table 4) can arise in equilibrium.

A. Case 3 Equilibrium. For case 3, figure 1 describes the Δ values that result from the firms' possible Stage 2 strategies. (Recall that firm 1 profits fall with Δ and firm 2 profits rise with Δ.) To describe equilibria for this case, we adopt the following tie-breaking convention:

> Convention 1: If a firm is indifferent between committing to the G technology (S) and not committing (N), it does not commit (N).[16]

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[14]Formally, in case 1, the NS-BG, SN-GB, SS-GG, and NN-BB outcomes yield (from Table 3) $\Delta_{NS}=-\eta+d(b)<0$, $\Delta_{SN}=-\Delta_{NS}>0$, and $\Delta_{SS}=\Delta_{NN}=0$; hence, with firm 1 (2) preferring a lower (higher) Δ, each firm has a dominant strategy of not committing to the green technology (N).

[15]For example, in case 5 when $b_{NS}=b_{SN}=\bar{b}$ and $b_{NN}=0$, we have: $\Delta_{NS}=r$, $\Delta_{SN}=-r$, and $\Delta_{SS}=\Delta_{NN}=0$. With firm 1 (2) preferring a lower (higher) Δ, sign (S) is a dominant strategy for both firms.

[16]If firms instead resolve indifference in favor of signing (S), then both firms will sign in the case 3 equilibrium. However, Convention 1 is arguably more plausible two reasons. First, loosely speaking, it is natural to think that firms view the EO as an adversary and, hence, resolve indifference to the disadvantage of the EO. Second, if the firms could choose apriori a decision rule that resolves any indifference in Stage 1, firm 2 would choose Convention 1 if it anticipates case 3. The reason, as will become clear in the ensuing discussion, is that firm 2 obtains a higher profit in case 3 under Convention 1 (where Δ equals $\Delta_{NS}>0$ or $\Delta_{SN}>0$) than under the SS alternative (where $\Delta_{SS}=0$). Hence, as it is firm 2's indifference that is crucially resolved by Convention 1 in the case 3 equilibrium, Convention 1 is an equilibrium outcome in the expanded game.

		Firm 2 Strategy: S	Firm 2 Strategy: N
Firm 1 Strategy	S	$\Delta_{SS}=0$	$\Delta_{SN}=\eta-d(b_{SN})>0$
	N	$\Delta_{NS}=r>0$	$\Delta_{NN}=0$

Figure 1: Δ Values for Firms' Alternative Stage 1 Strategies in Case 3

Now suppose that the EO first approaches firm 2 with its green production demands. If firm 2 chooses S, then firm 1 follows suit because $\Delta_{SS}=0<\Delta_{NS}$. If firm 2 chooses N, then firm 1 also chooses N because (with $b_{SN}<\underline{b}$) $\Delta_{NN}=0<\Delta_{SN}$. Firm 2 thus chooses between an SS outcome (when it signs) and an NN outcome (when it does not sign), both of which yield the same profit, $\Delta_{NN}=\Delta_{SS}=0$. Under Convention 1, firm 2 chooses the "no sign" (N) strategy, yielding the worst possible outcome from the EO's point of view -- namely, NN-BB wherein both firms are "brown."

The EO can do better by approaching firm 1 first.[17] Then there are two possible equilibria, NS-GG and SN-GB, either of which yields green production by at least firm 1. To understand these equilibria, consider firm 1's choice problem. If it pre-commits to be green (S), then firm 2 will respond by not signing because (with $b_{SN}=b^*<\underline{b}$) $\Delta_{SN}>0=\Delta_{SS}$. Intuitively, the cost advantage from brown production exceeds firm 2's prospective cost of boycott; hence, by not signing and remaining brown, firm 2 burdens firm 1 with a relative cost disadvantage. Similarly, if firm 1 does not sign, then firm 2 prefers to sign (with $\Delta_{NS}>0=\Delta_{NN}$). By signing, firm 2 confronts firm 1 with an effective boycott that it otherwise would not face; hence, both firms will adopt the green technology, but firm 1 will be relatively disadvantaged by the costs of boycott cancellation (r). Given the choice between NS-GG and SN-GB outcomes, firm 1 will

[17] Although ruled out here, the EO can also do better by approaching the firms simultaneously, provided the unique mixed strategy equilibrium is supported in this case. (There is no pure strategy Nash equilibrium in the simultaneous move Stage 2 game.) The mixed strategy equilibrium yields (SS)/(GG) outcomes with probability $\gamma_1\gamma_2$; (SN)/((GB) outcomes with probability $\gamma_1(1-\gamma_2)$; (NS)/(GG) outcomes with probability $(1-\gamma_1)\gamma_2$; and (NN)/(BB) outcomes with probability $(1-\gamma_1)(1-\gamma_2)$. $\gamma_1 \in (0,1)$ and $\gamma_2 \in (0,1)$ represent the following equilibrium firm 1 and 2 probabilities of "signing" (S) in Stage 2 (where Δ_{NS} and Δ_{SN} are as described in Figure 1 and $\Pi_i()$ is as defined in equation (1)):
$\gamma_1 = [\Pi_2(0)-\Pi_2(\Delta_{NS})]/[2\Pi_2(0)-\Pi_2(\Delta_{NS})-\Pi_2(\Delta_{SN})]$, $\gamma_2 = [\Pi_1(0)-\Pi_1(\Delta_{SN})]/[2\Pi_1(0)-\Pi_1(\Delta_{NS})-\Pi_1(\Delta_{SN})]$.

prefer the former provided the cost disadvantage from boycott cancellation (r) is sufficiently small (so that $\Delta_{SN}>\Delta_{NS}$). Conversely, firm 1 will prefer the latter SN-GB outcome if r is sufficiently large (Proposition 3 below).[18]

Proposition 2. There are circumstances under which, in equilibrium, the larger firm 1 is effectively boycotted -- with a boycott that is quickly cancelled as firm 1 accedes to the EO's demands -- while the smaller firm 2 pre-commits to the green technology. Sufficient conditions for this NS-GG outcome to arise are case 3 ($b_{NS}=\bar{b}$ and $\underline{b}>b_{SN}=b^*>0=b_{NN}$), Convention 1, and a sufficiently small r.

B. Case 4 Equilibrium. Here, firm 1 anticipates an effective boycott whenever it does not commit to be green in Stage 1, $b_{NS}=b_{NN}=\bar{b}$. Hence, in contrast to case 3 above, firm 1 has a dominant strategy of signing (S), regardless of firm 2's signup decision. For firm 2, the boycott level b_{SN} is too small to counter the cost advantage that it enjoys by keeping the brown technology; hence, not to sign (N) is now its dominant strategy. SN thus becomes the unique equilibrium, as is easily verified from the case 4 Δ-matrix given in Figure 2.

		Firm 2 Strategy: S	Firm 2 Strategy: N
Firm 1 Strategy	S	$\Delta_{SS}=0$	$\Delta_{SN}=\eta-d(b_{SN}) > 0$
	N	$\Delta_{NS}=r>0$	$\Delta_{NN}=(\eta+r) > \Delta_{SN}(\Delta_{NS})$

Figure 2: Δ Values for Firms' Alternative Stage 1 Strategies in Case 4

Proposition 3. There are circumstances under which, in equilibrium, the smaller firm 2 is subject to a boycott; the larger firm 1 pre-commits to the green technology; and the boycott is ineffective because the EO's boycott investment is too small to prompt firm 2 to adopt the green

[18]This logic is robust to allowing the EO to approach "non-signing" firms repeatedly. For example, suppose that there is a known, exogenous, and finite number of firm approaches that is possible in Stage 1. Then, in case 3, firms will play a game of chicken by not signing until only two approaches remain, giving us the equilibrium described above. Alternately, suppose that the EO can choose either to commit to a given (finite) number of firm approaches in Stage 1, or to make no such commitment. Without an EO commitment, what happens in case 3? If firm 2 signs before firm 1, then firm 1 will be re-approached and will sign as well. Knowing this, firm 2 never signs (by Convention 1 and firm 2's preference for SN over SS). Firm 1, knowing that firm 2 will not sign, also prefers not to sign (N). In sum, without an EO commitment to a finite number of firm approaches, the NN-BB outcome is obtained in case 3. Clearly, the EO does better by committing to the one-approach-per-firm strategy assumed here.

technology. Sufficient conditions for this "persistent boycott" / SN-GB equilibrium to arise are either (1) case 4 ($b_{NN}=b_{NS}=\bar{b}$ and $0<b_{SN}=b^*<\underline{b}$), or (2) case 3 ($b_{NS}=\bar{b}$ and $\underline{b}>b_{SN}=b^*>0=b_{NN}$), Convention 1, and a sufficiently large r.

C. Necessary Conditions for Boycotts. Inspecting Table 4, we have:

Corollary 1. Necessary for a boycott to occur is that case 3 or 4 (of Table 4) prevails.

When a boycott arises, it takes one of two possible forms: (1) an effective boycott against firm 1, yielding NS-GG outcomes (per Proposition 2), or (2) an ineffective boycott against firm 2, yielding SN-GB outcomes (per Proposition 3).

Hence, boycotts do not arise if cases 3 and 4 are ruled out -- for example, when k and β are sufficiently small, ϖ is sufficiently large, and boycotts are quite effective (d' is large).

7. Extensions[19]

Consumer Environmental Preferences. For simplicity, we have modeled consumers' environmental preferences as homogeneous. In reality, however, only a subset of consumers may care about the environmental practices of firms. For example, some consumers are concerned about GM foods, while others are not. Moreover, even absent boycotts, "green" consumers may have some noisy information about the environmental conduct of firms and (ceteris paribus) have a higher willingness to pay for green goods; we have so far ignored such private values of green consumption. Formally, we could suppose that only the proportion $\alpha\in[0,1]$ of consumers are sensitive to boycotts (bearing the cost d(b)). Similarly, the proportion $\gamma\in[0,1]$ of consumers may enjoy the private benefit $v>0$ when consuming a green (vs. brown) good, while other consumers enjoy no such benefit. As some consumers may be averse to "crossing the picket line," even when unconcerned per se about their own consumption of a brown product, α can differ from γ. An expanded version of this paper (available upon request) extends all of this paper's results to a model with these features. Qualitatively, a greater extent of environmentalism -- whether due to a higher α, γ or v -- implies that a lower boycott investment is needed for the boycott to be effective ($\bar{b}$). A higher α implies that target firms suffer from the boycott penalty (d(b)) for

[19]We are indebted to the referees for identifying a number of these extensions and their potential effects.

more of their customers and thus bear a higher cost from any given boycott. When γ or v is higher, firms experience a higher market reward to green production, implying a lower net unit cost of the G technology, η-γv. Hence, a greater extent of environmentalism raises a firm's cost of fighting a boycott and lowers its cost of adopting the G technology; a firm will therefore agree to the EO's demands when boycott investments (b) are lower. Because the EO must invest less, it has a greater incentive to launch effective boycotts, which in turn improves its ability to successfully demand green practices from firms apriori, without actual boycotts ever launched.

Preempting Boycott Threats. We have so far assumed that firms are confronted with demands from an EO to which they must respond or risk a boycott. However, there may be steps that a firm can take to avoid this confrontation. For example, suppose that the EO must bear a fixed cost whenever it engages a firm in a boycott threat game. Then, by adopting an environmental technology that is somewhat less green and less costly than would otherwise be demanded by the EO, the firm may be able to deter the EO from investing in a confrontation, thus preempting boycott threats altogether. Similarly, by establishing a reputation as a "green citizen," a firm may be able to avoid direct altercations with an EO, altercations that ultimately result in more costly environmental practices. The EO, dealing with a "green reputation" firm, knows that its investment in a confrontation with that firm is unlikely to bear significant environmental fruit.[20]

Implicit in this discussion is the presumed scope for "lesser" environmental performance, that is, a continuous choice of "greenness." In the foregoing analysis, we have instead assumed that there is a single (given) environmental technology at issue (such as GM-free foods or old-growth-free products). Even with a continuous technology choice, however, the EO may have to choose a single (common) environmental standard to demand from all firms in an industry, in order to effectively communicate its message to its constituencies. The EO's choice of demand

[20]The potential flip-side of a "green reputation" is the inference that the firm is a sucker for environmental demands. Baron (2003) argues, for example, that Starbucks' reputation as a green citizen may have invited more demands for socially responsible corporate practices on BGH milk products, gentrification of Seattle communities, and coffee production in developing countries. However, it is not clear that these demands were spurred by Starbucks' reputation as opposed to the sensitivity of its customers to environmental concerns.

then adds another dimension to the boycott game described earlier, but does not alter the logic of the analysis. In selecting an optimal demand, the EO trades off benefits of better environmental technologies against increased costs of deterring adoption and spurring boycotts.[21] Moreover, even if the EO can place distinct demands on different firms in an industry, the foregoing logic of boycotts persists. For example, consider the case of the small firm that is subject to a persistent boycott in the above analysis. As an alternative, the EO could launch an effective boycott that demands a less-green technology. However, the EO may still prefer the persistent boycott that shifts demand to the superior-technology firm.

Multiple Firms. Suppose that there are more than two firms in the industry. Then there is no longer a reason to boycott only one firm.[22] If the EO boycotts more than one firm, there are a variety of ways in which economies of scale might be realized. For example, perhaps the d(b) penalty costs could be imposed on all boycotted firms, regardless of how many there are. In this case, boycotts can arise in equilibrium for the same reasons as described above. For instance, suppose that the top firm is sufficiently large that it can always anticipate an effective boycott against its brown products, while the remaining firms are sufficiently small that, even when collectively boycotted, only an ineffective boycott is launched. Then, in equilibrium, the large firm pre-commits to the green technology and an ineffective boycott is launched against all others.

Alternatively, perhaps separate boycotts must be launched against each individual firm. Then it is to be expected that the smallest firms will be completely exempted from any boycott threat because they are simply too small to make a boycott "pay" for the EO. Likely boycott targets will be among the largest firms in the industry. For example, the second largest firm may be subject to an ineffective boycott, while the largest firm is successfully prompted to accede to the EO's demands. Moreover, if even the largest firms are quite small -- because the market is

[21]In making this choice, the EO has two alternatives: (1) the best environmental technology that achieves an SS equilibrium , and (2) a greener (and more costly) technology that will, in equilibrium, be adopted by the large firm, but possibly not the small firm, and spurs a boycott.

[22]With inelastic demands, however, the EO would not launch a boycott against *all* firms because, as in the foregoing analysis, the boycotts would then serve to cancel each other out.

quite competitive -- then no firm may anticipate an effective boycott, even a relatively "big" and brown one. In this case, there is "safety in numbers," and the boycott instrument is not only completely ineffective, but will not be observed at all. Hence, other things the same, less concentrated industries are likely to be less subject to boycotts and boycott threats, implying an associated deterrent to concentration.

Multiple Products and Brands. In this paper, we have focused on a market for a given (single) product. If there are multi-product firms, then there is scope for secondary boycotts against all products of a firm, even though the target environmental practice relates to only one of the firm's products. Many of the examples cited at the start of this paper have this property: home improvement retailers were boycotted for carrying old growth products in a small section of their overall business; McDonalds was boycotted, as a company, for practices related to its handling of chickens. Boycotts against multi-product firms are more likely to be effective (in the sense of this paper) because they have greater scope for harming the firm. For this reason, however, one expects to see fewer actual boycotts against large multi-product firms, with consumer action avoided by apriori agreements.

Firms may also carry multiple brands or styles of a good within a given product class. On one hand, if boycotts can only be targeted brand by brand, then establishing multiple brands may serve to insulate a firm from harmful boycotts (essentially by making each "brand" smaller). On the other hand, however, brand visibility can increase a boycott's effectiveness in influencing target consumers (Friedman, 1999; Baron, 2003). Moreover, if the EO can target *firms* for boycott (as opposed to brands), then there can be cross-brand boycott economies. For example, suppose that a firm carries a "high quality" brand, consumers of which have strong environmental preferences, and a "low quality" brand, consumers of which have weak environmental preferences. By threatening the overall firm with boycott, the EO may leverage the preferences of the "high quality" consumers to achieve desired environmental practices in the production of the "low quality" brand.

Ethical Limits of Boycotts. We have so far assumed that boycotts have the same impact when launched against a lone "brown firm" as when a target firm is singled out despite brown production by both firms. Suppose instead that boycotts have a lesser impact in the latter case. Then the hurdle for a boycott to be effective ($\bar{b}$) is higher under NN strategies, and incentives for NN boycotts will be weakened. In the extreme, a one-firm boycott may have no ethical strength when rivals are brown; then there are no NN boycotts and cases 4 and 6 of Table 4 are ruled out. Our qualitative results nonetheless persist for cases 1, 2, 3, and 5.

Endogenous EO Contributions. In this paper, we have assumed that the contribution resources available to the EO for boycott threats and investments (Q) are exogenous. Where do the EO contributions come from? How do prospective boycotts affect these contributions and, conversely, how do the contributions affect the effectiveness of EO boycotts? And how does the contributions equilibrium affect the extent of green production? In particular, accounting for the contributions mechanism, does the threat of boycotts lead to "too little," "too much," or just the right amount of G technology adoption, relative to an efficient benchmark?

An expanded version of this paper makes a preliminary attempt to address these questions. In the model, contributions from "environmentalist" consumers are motivated by three benefits: (1) the marginal impact of an individual's membership contribution in elevating EO resources available to successfully threaten effective boycotts and thereby raise the probability of green production; (2) direct benefits of membership, including member services (e.g., newsletters) and the "warm glow" of affiliation with the EO (Andreoni, 1989); and (3) marginal benefits of contributions in increasing the scope of the EO's pursuits in other domains, including investigative, public outreach, consumer action, and governmental lobbying activities. The first (boycott) benefit derives from costs of the green G technology (η) that are assumed to be uncertain at the time contributions are made (although they are known at the time of this paper's boycott game). As higher η costs require higher EO investments in order for a boycott to be effective ($\bar{b}$), increased contributions raise the probability that effective boycotts are possible (i.e., that $\bar{b}$ =Q).

Given these benefits of EO membership, one can characterize a contributions equilibrium wherein the EO extracts the maximum possible amount of contributions from its client consumers. Two key cases emerge: when the last two (non-boycott) membership benefits are alternately "large" and "small." When these benefits are large -- arguably the more interesting case -- the EO is "big" and broadly focused, attracting large contributions due to its activities in a broad range of domains, even when EO membership imparts no marginal boycott benefit to its "environmentalist" consumer clientele. In this case, boycott threats lead to the *excessive adoption* of the green technology, relative to an efficient benchmark, for two reasons: First, given its ample contributions, the EO elicits green production whenever its members benefit from this production (net of the η cost that is passed on to consumers). However, as "environmentalists" -- the EO members -- are a subset of the overall consumer population, they benefit from green production more often than does the *average* consumer. And second, the EO may even achieve green production more often than is strictly desired by its members.

8. Summary and Conclusion

This paper models strategic interactions between duopolistic firms and a public interest / environmental organization (EO) that threatens boycotts in order to promote a "green" (vs. "brown") production practice. We find that a boycott can arise in equilibrium, despite symmetric information, provided firms are sufficiently different in size and the EO bears costs when it launches and subsequently cancels a boycott. Conversely, if it is not very costly to cancel a boycott, and/or the EO attaches a sufficiently high value to green practices, then (i) whenever it has the resources to do so, the EO will launch a boycott against a brown firm that is "effective" in prompting the target firm to revise its practices; (ii) actual boycotts never arise in equilibrium; and (iii) either both firms adopt green practices (when the cost of doing so is sufficiently small) or neither do (when the cost is high).

These results are developed under the premise that consumers have perfectly inelastic demands for the target products. Allowing for elastic demands, although it would greatly complicate this analysis, is unlikely to upset our qualitative conclusions. However, when an EO

faces undesirable practices from an entire industry, and is too small to launch an effective boycott, it may have an incentive to launch a small persistent boycott, contrary to conclusions from our inelastic demand specification. The reason is that, even though the boycott cannot prompt the target firm to adopt the desired technology, it can reduce demand for the industry product and thereby reduce the extent of brown production. Moreover, if one firm is targeted for boycott, it will be the large firm whose boycotted market will suffer the most. Elastic demands may thus give rise to small persistent boycotts against large firms.

Overall, this paper offers some thoughts on when and why boycotts might arise in practice and how the threat of boycott may motivate "corporate social responsibility." In doing so, however, our simple modeling raises a number of issues. For example, there may be competing public interest organizations that represent "non-environmentalist" consumers and counter the EO's efforts. There may be different EOs -- with different objective functions -- competing to represent consumers. If firms can "contest" boycotts (Baron, 2001), then investments required for boycotts to be effective will be higher and boycott threats will successfully elicit adoption of green environmental practices less often.

Perhaps most importantly, this analysis does not model a public interest organization's choice between boycott strategies (Baron's "private politics") and lobbying the government for regulations ("public politics"). An expanded version of this paper considers such an alternative, revealing an inherent advantage of boycott-backed negotiations, from the EO's point of view: eliciting "corporate social responsibility" with costless threats, rather than costly lobbying. This advantage suggests that "private politics" will supplant lobbying whenever boycott threats are effective, and implies that boycott opportunities will increase the likelihood that green practices are adopted. Such logic may help explain the increasing prevalence of boycotts and boycott deterrence that motivate this paper.

Appendix

Proof of Lemma 1. Note first that the space of consumers is partitioned into those who buy from firm 1 ($\theta \leq \theta_0$) and those who buy from firm 2 ($\theta > \theta_0$), where

$$\theta_0 \equiv \theta: P_1 + (\theta - k) + W = P_2 \quad \Rightarrow \quad \theta_0 = (P_2 - P_1) + (k - W).$$

Throughout, we assume that parameter values support an interior partition of consumption. (Sufficient for an interior partition, $\theta_0 \in (-\bar{\theta}, \bar{\theta})$, is that $\bar{\theta}$ be sufficiently large.) Associated product demands are:

$$\Phi = \Phi(P_1, P_2, W) \equiv \frac{1}{2\bar{\theta}} \{ \bar{\theta} + \theta_0 \} = \text{demand for firm 1 products, and}$$

$(1-\Phi)$ = demand for firm 2 products.

In view of their demands, the firms choose prices to maximize profits:

$$\text{F1: } \max_{P_1} \Phi(P_1, P_2, W)(P_1 - c_1) \quad , \quad \text{F2: } \max_{P_2} (1 - \Phi(P_1, P_2, W))(P_2 - c_2) \ .$$

Solving these maximizations jointly yields equilibrium prices:

$$P_1 = c_1 + \bar{\theta} + (1/3)(k - \Delta) \quad , \quad P_2 = c_2 + \bar{\theta} + (1/3)(\Delta - k), \tag{A1}$$

Substituting equilibrium prices into firm demand and profit functions gives equation (2) and:

$$\Phi = \frac{1}{2\bar{\theta}} \{\bar{\theta} + (1/3)(k - \Delta)\} \quad , \quad 1 - \Phi = \frac{1}{2\bar{\theta}} \{\bar{\theta} - (1/3)(k - \Delta)\}. \tag{A2}$$

QED.

Proof of Lemma 2. There are four cases to consider: SN (wherein firm 2 is the boycott target), NS (wherein firm 1 is the boycott target), NN with firm 2 targeted for boycott, and NN with firm 1 targeted for boycott. Consider the last case, NN. Culling from Table 3, the following values of Δ result from the firms' alternative Stage 3 strategies:

		Firm 2 Strategy: G	Firm 2 Strategy: B
Firm 1 Strategy	G	$\Delta = r$	$\Delta = \eta + r$
	B	$\Delta = -\eta + d(b)$	$\Delta = d(b)$

Figure A1: Δ Values with No Technology Commitments and a Boycott of Firm 1

By inspection, Δ is higher when firm 2 chooses B, regardless of firm 1's technology choice; hence, B is a dominant strategy for firm 2. Given a B strategy by firm 2, Δ is lower when firm 1 chooses G provided $d(b) > \eta+r$, that is, $b > \bar{b}$. Conversely, if $b<\bar{b}$, Δ is lower when firm 1 chooses B. Hence, firm 1 chooses G if and only if $b\geq\bar{b}$, assuming (without loss) that firm 1 resolves indifference (at $b=\bar{b}$) in favor of G. Following similar logic for the other cases yields Lemma 2. QED.

Proof of Proposition 1. In case NN, the net benefits to the EO from an effective boycott of firm 1 and firm 2, respectively, are

$$u_{NN} = \Phi_1 \varpi - o(\beta\bar{b}) \quad , \quad \Phi_1 = \frac{1}{2\bar{\theta}} \{ [\bar{\theta} + (1/3)k] - (1/3)[\eta+r]\} \qquad \text{(A3)}$$

$$u'_{NN} = (1- \Phi_2) \varpi - o(\beta\bar{b}) \quad , \quad 1- \Phi_2 = \frac{1}{2\bar{\theta}} \{ [\bar{\theta} - (1/3)k] - (1/3)[\eta+r]\} \qquad \text{(A4)}$$

where, using (A2), Φ_1 and Φ_2 are derived from the NN-GB and NN-BG cases in Table 3, respectively. Subtracting,

$$u_{NN} - u'_{NN} = \frac{\varpi}{3\bar{\theta}} \quad k > 0,$$

where the inequality follows from $k>0$.

To establish the last statement in Proposition 1, define $\bar{\eta}$ as the maximum cost level such that the effective boycott investment $\bar{b}$ can be made from available contributions Q,

$$\bar{\eta} \equiv \eta : d(Q) = \eta+r. \qquad \text{(A5)}$$

Eq. (A3) gives the EO's net benefit from an effective ($b=\bar{b}$) vs. ineffective ($b=0$) boycott in case NN. Differentiating gives:

$$\partial u_{NN}/\partial\eta = -[(\varpi/6\bar{\theta})+\beta o'(\beta\bar{b})(\partial\bar{b}/\partial\eta)] = -(d'(\bar{b}))^{-1}[(\varpi/6\bar{\theta})d'(\bar{b})+\beta o'(\beta\bar{b})] < 0. \qquad \text{(A6)}$$

Eq. (A6) and Proposition 1(a) directly imply the following (assuming, without loss, that the EO resolves indifference in favor of an effective boycott):

Observation 1. If NN occurs in Stage 1, then either (I) the EO never launches an effective boycott ($b_{NN}=0$ for all η) or (II) there is a unique $\eta_{NN}>0$ such that (a) $u_{NN}=0$ at $\eta=\eta_{NN}$, (b) the EO launches an effective boycott when $\eta \leq \eta^*=\min(\eta_{NN},\bar{\eta})$ (with $u_{NN}>0$ and $b_{NN}=\bar{b}$), and (c) the EO does not boycott when $\eta > \eta^*$ (with $b_{NN}=0$). QED.

Derivation of Equation (4). Consider the EO's net benefits in NS and SN cases when it launches an ineffective boycott, $b<\bar{b}$. In the NS case, firm 2 produces with the green technology, gaining the market share $E=(1-\Phi)$; the EO's net benefit is thus

$$U_{NS} = \varpi(1-\Phi_{NS}) - o(b) = \frac{\varpi}{2\bar{\theta}} \{\bar{\theta} - (1/3)[k+\eta-d(b)]\} - o(b),$$

where (from Table 3 and (A2)) $\Phi_{NS} = \frac{1}{2\bar{\theta}} \{\bar{\theta} + (1/3)(k-\Delta_{NS})\}$ and $\Delta_{NS}= - [\eta-d(b)]$. Similarly, in the SN case, the EO's net benefit (with $b<\bar{b}$) is

$$U_{SN} = \varpi\Phi_{SN} - o(b) = \frac{\varpi}{2\bar{\theta}} \{\bar{\theta} + (1/3)[k-\eta+d(b)]\} - o(b).$$

Maximizing U_{NS} (or U_{SN}) yields the optimality condition, eq. (4). QED.

Proof of Lemma 3. It suffices to show that the EO's net gain from an effective boycott ($b=\bar{b}$) vs. an ineffective boycott ($b<\bar{b}$) is greater in case NS (when firm 1 is the boycott target) than in case SN (when firm 2 is the target) or NN (when firm 1 is the target).

(NS) vs. (SN). In case NS or SN, the EO's benefit from an effective boycott ($b=\bar{b}$) is

$$\underline{U} = \varpi - o(\beta\bar{b}).$$

The EO's net gain from launching an effective boycott, vs. an ineffective one, is thus

$$u_{NS} = \underline{U}-U_{NS} = \Phi_{NS}\varpi + o(b)-o(\beta\bar{b}) = \frac{\varpi}{2\bar{\theta}} \{\bar{\theta} + (1/3)[k+\eta-d(b)]\} + o(b)-o(\beta\bar{b})$$

$$u_{SN} = \underline{U}-U_{SN} = (1-\Phi_{SN})\varpi+o(b)-o(\beta\bar{b}) = \frac{\varpi}{2\bar{\theta}} \{\bar{\theta} - (1/3)[k-\eta+d(b)]\} + o(b)-o(\beta\bar{b})$$

With $k>0$, $(1-\Phi_{SN})<\Phi_{NS}$; hence, $u_{NS}>u_{SN}$.

(NS) vs. (NN). With an optimal "ineffective boycott investment," b*,

$$u_{NS}-u_{NN} = o(b^*) + \frac{\varpi}{6\bar{\theta}} \{2\eta+r-d(b^*)\} \qquad (A7)$$

Now, if $b_{NN}=\bar{b}$, then $\bar{b} \leq Q$; hence, $b_{NS}=\bar{b}$ is feasible and it suffices to show that $u_{NS}>0$ when $b^*<\bar{b}$ and $u_{NN}\geq 0$ (with $b_{NN}=\bar{b}$). With $b^*<\bar{b}$, $\eta+r-d(b^*) > 0$ (from the definition of $\bar{b}$); thus, with $o(b^*)\geq 0$ (with $b^*\geq 0$), $u_{NS}-u_{NN}>0$ (eq. (A7)) and, therefore, $u_{NS}>0$ when $u_{NN}=0$. QED.

Proof of Lemma 4. The following result suffices (proof available from the author):

Lemma 4'. In cases $j\in\{SN,NS\}$ the EO launches an effective boycott whenever it can (when $\bar{b} \leq Q$=available EO contributions) if: (a) $b^*\geq \beta Q$; (b) with $\chi_{SN}=3\bar{\theta}-k$ and $\chi_{NS}=3\bar{\theta}+k$,

$$\frac{\varpi}{6\bar{\theta}} \{\chi_j-r\} + Q\{\frac{\varpi}{6\bar{\theta}} d'(Q) - \beta o'(\beta Q)\} \geq 0 ;$$

or (c) $\frac{\varpi}{6\bar{\theta}} \{\chi_j-r\}+o(b^*)-o(\beta Q) \geq 0$. (By our premise that there is an interior partition of consumption (see proof of Lemma 1), we have $\{\chi_j-r\}>0$.) QED.

Proof of Lemma 5. First note:

Lemma 5'. If the following (sufficient) conditions hold, then there exists an $\eta<\bar{\eta}$ such that case 4 arises (with $b_{SN}<\underline{b}$ and $b_{NN}=\bar{b}$) and an $\eta<\bar{\eta}$ such that case 3 arises (with $b_{SN}<\underline{b}$, $b_{NN}=0$, and $b_{NS}=\bar{b}$): (a) $\eta_{NN}\leq\bar{\eta}$; (b) $u_{SN}-u_{NN}<0$ at $\eta=\eta_{NN}$; and (c) $b^*<\underline{b}(\eta_{NN})$. (Recall the definitions of $\bar{\eta}$ (from (A5)) and η_{NN} (from Observation 1 in the proof of Proposition 1) as the threshold technology cost level such that the EO prefers effective case NN boycotts only for lower η levels, $\eta_{NN}= \eta: u_{NN}=0$.)

Proof of Lemma 5'. Case 4: It suffices to show that $b_{SN}<\underline{b}$ and $b_{NN}=\bar{b}$ at η_{NN}. By the definition of η_{NN}, $u_{NN}=0$ and, hence, $b_{NN}=\bar{b}$, at η_{NN}. With $u_{SN}-u_{NN}<0$ at η_{NN}, we have $b_{SN}=b^*<\underline{b}(\eta_{NN})$. Case 3: For $\eta=\eta_{NN}+\varepsilon$, ε arbitrarily small, we have $b_{NN}=0$ by the definition of η_{NN} and equation (A6); $b_{SN}<\underline{b}$ by conditions (b)-(c) and continuity; and $b_{NS}=\bar{b}$ by Lemma 3, the definition of η_{NN}, and continuity. QED Lemma 5'.

It now suffices to find an example that satisfies conditions (a)-(c) of Lemma 5'. To this end, consider: $\bar{\theta}$ =2, k=1, ϖ=1, β=1, o(b;.)=4b, d(b)=$b^{.5}$, and r≈0. Here we have b*=$(1/96)^2$ and $\underline{b}=\bar{b}$ =η^2. With

$$u_{NN} = \frac{\varpi}{2\bar{\theta}} \{[\bar{\theta} + (1/3)k] - (1/3)[\eta + r]\} - o(\beta \bar{b}) = (7/12) - (1/12)\eta - 4\eta^2,$$

we can solve for η_{NN} = (1/96)($(1345)^{.5}$ - 1) = .3716. Hence, b*=$(1/96)^2$<$(.3716)^2$=$\underline{b}(\eta_{NN})$. Moreover, with

$$u_{SN} - u_{NN} = \frac{-\varpi}{3\bar{\theta}} k - \frac{\varpi}{6\bar{\theta}} d(b^*) + \frac{\varpi}{3\bar{\theta}} \eta + \frac{\varpi}{6\bar{\theta}} r + o(b^*) = -.16710 + (1/6)\eta,$$

we have u_{SN}-u_{NN} = -.10516<0 at $\eta=\eta_{NN}$. Hence, with $\eta_{NN} \leq \bar{\eta}$ so long as Q≥$(.3716)^2$, the conditions required in Lemma 5' are indeed satisfied. (For this example, it is easily verified that, for relevant η ($\leq\eta_{NN}$), the partition of consumers between firms 1 and 2 is interior to the preference domain: $\theta_0 \in (-\bar{\theta}, \bar{\theta})$.) QED.

Proof of Proposition 2. It suffices to prove the second sentence. Consider the two alternative EO approach strategies under case 3, Convention 1 and a small r: (1) Approaching firm 2 (F2) first yields the NN-BB equilibrium (by Figure 1 and Convention 1). (2) Approaching firm 1 (F1) first yields an F1 choice between SN-GB (because, with $\Delta_{SN}>\Delta_{SS}$, F2 chooses N when F1 chooses S) and NS-GG (because, with $\Delta_{NS}>\Delta_{NN}$, F2 chooses S when F1 chooses N). When r is sufficiently small, $\Delta_{SN}>\Delta_{NS}$ and, hence, F1 chooses the NS-GG equilibrium. By revealed preference and ω>0, the EO prefers the second (F1 approach) strategy to the F2 approach strategy (and corresponding NN-BB outcome). QED.

Proof of Proposition 3. It suffices to prove the second statement. For case 4, the statement follows from Figure 2. For case 3, the statement follows from the proof of Proposition 2. Specifically, with $\Delta_{NS}>\Delta_{SN}$ when r is sufficiently large, F1 chooses the SN-GB equilibrium when approached first. By revealed preference, the EO prefers this outcome to the NN-BB outcome obtained when F2 is approached first. QED.

References

Amacher, G., and A. Malik, "Bargaining in Environmental Regulation and the Ideal Regulator," *J. Environmental Econ. & Management* 30 (1996): 233-53.

Amacher, G., E. Koskela, and M Ollikainen, "Environmental Quality Competition and Eco-Labeling," *J. Environmental Econ. & Management* 47 (2004): 284-306.

Anderson, B., "Secondary Boycotts and the First Amendment," *The University of Chicago Law Rev.* 51 (1984): 811-37.

Andreoni, J., "Giving with Impure Altruism: Applications to Charity and Ricardian Equivalence," *J. Political Econ.* 97 (1989): 1447-1458.

Arora, S. and T. Cason, "Why Do Firms Volunteer to Exceed Environmental Regulations? Understanding Participation in EPA's 33/50 Program," *Land Econ.* 72 (1996): 413-32.

Arora, S., and S. Gangopadhyay, "Toward a Theoretical Model of Voluntary Overcompliance," *J. Econ. Behavior & Organization* 28 (1995): 289-309.

Barker, R., "Trusting Forests to the Market," *Denver Post*, July 10, 2002.

Baron, D., "Private Politics, Corporate Social Responsibility, and Integrated Management Strategy," *J. Econ. & Management Strategy* 10 (2001): 7-45.

Baron, D., "Private Politics and Private Policy: A Theory of Boycotts," Research Paper No. 1766, Stanford University, December 2002.

Baron, D., "Private Politics," *J. Econ. & Management Strategy* 12 (2003): 31-66.

Beard, B., "Secondary Boycotts After DeBartolo," *Iowa Law Rev.* 75 (1989): 217-234.

Biglaiser, G., and A. Ma, "Price and Quality Competition under Adverse Selection: Market Organization and Efficiency," *RAND J. Econ.* 34 (2003): 266-86.

Brennan, T., "Refusing to Cooperate with Competitors: A Theory of Boycotts," *J. Law & Econ.* 35 (1992): 247-264.

Decker, C., "Corporate Environmentalism and Environmental Statutory Permitting," *J. Law & Econ.* 46 (2003): 103-29.

Dewatripont, M. and J. Tirole, "Advocates," *J. Political Econ.* 107 (1999): 1-39.

Engle (Kirchhoff), S., "Green Business and Blue Angels," *Environmental and Resource Econ.* 15 (2000): 403-420.

Feddersen, T. and T. Gilligan, "Saints and Markets: Activists and the Supply of Credence Goods," *J. Econ. & Management Strategy* 10 (2001): 149-171.

Fernandez, R. and Glazer, J., "Striking for a Bargain Between Two Completely Informed Agents," *American Econ. Rev.* 81 (1991): 240-52.

Friedman, M., "Grassroots Groups Confront the Corporation: Contemporary Strategies in Historical Perspective," *J. Social Issues* 52 (1996): 153-167.

Friedman, M., *Consumer Boycotts*, New York: Routledge (1999).

Haddon, J., "Three Exceptions to the Per Se Rule Against Boycotts," *Boston University Law Rev.* 65 (1985): 165-204.

Haller, H. and Holden, S., "A Letter to the Editor on Wage Bargaining," *J. Econ. Theory* 52 (1990): 232-36.

Heyes, A. and N. Rickman, "Regulatory Dealing -- Revisiting the Harrington Paradox," *J. Public Econ.* 72 (1999): 361-378.

Innes, R., and J. Bial, "Inducing Innovation in the Environmental Technology of Oligopolistic Firms," *J. Industrial Econ.* 50 (2002): 265-288.

Kennan, J. and R. Wilson, "Bargaining with Private Information," *J. Econ. Literature* 31 (1993):45-104.

Koenig, D., "No Biotech Corn for Frito-Lay," *The Associated Press*, Feb. 1, 2000.

Koku, P., A. Akhigbe, T. Springer, "The Financial Impact of Boycotts and Threats of Boycott," *J. Business Research* 40 (1997): 15-20.

Laidler, H., *Boycotts and the Labor Struggle: Economic and Legal Aspects*, New York: Russell and Russell (1968).

MacLeod, W.B., and J. Malcomson, " Contract Bargaining with Symmetric Information," *Canadian J. Econ.* 28 (1995): 336-67.

Maxwell, J. and C. Decker, "Voluntary Environmental Investment and Regulatory Responsiveness," Working Paper, University of Nebraska at Omaha (2001).

Maxwell, J., T. Lyon and S. Hackett, "Self-Regulation and Social Welfare: The Political Economy of Corporate Environmentalism," *J. Law & Econ.* 43 (2000): 583-617.

Minda, G., "The Law and Metaphor of Boycott," *Buffalo Law Rev.* 41 (1993): 807-931.

Rea, S., "The Economics of a Consumer Boycott," *J. Econ. and Business* 27 (1974): 89-92.

Sam, A., and R. Innes, "Voluntary Pollution Reductions and the Enforcement of Environmental Law: An Empirical Study of the 33/50 Program," Working Paper, University of Arizona, 2004.

Sen, S., Z. Gurhan-Canli, V. Morwitz, "Withholding Consumption: A Social Dilemma Perspective on Consumer Boycotts," *J. Consumer Research* 28 (2001): 399-417.

Smith, N.C., *Morality and the Market: Consumer Pressure for Corporate Responsibility*, London: Routledge (1990).

Zwerdling, D., "McDonald's New Farm: the Fast Food Industry and Animal Rights," *American RadioWorks*, March 2002.

Table 1

Attributes of U.S. Boycott Targets, 1988-1995

	Average Values				
	COMPUSTAT Firms[A]	Boycott Targets[B]	Transitory Boycott Targets[C]	Non-Transitory Boycott Targets[D]	Difference of Means z-statistic[E]
No. of Obs.	15796	109	6	78	
Sales	799	16400			6.624
Employment	4646	78649			6.416
R&D Expenditure	38	681			3.325
Advertising	24	742			8.260
Market Share (%)[F]	.43	5.62			7.984
			15.27	5.08	2.679
Proportion of Firms with Industry Rank:[F]					
First	.028	.449			8.850
			.833	.436	2.451
First - Third	.083	.605			11.150
		1.000	.577	7.563	

[A]There are 15796 COMPUSTAT firms with sales data during 1988-1995, 13481 with employment data, 5424 with advertising data, and 6249 with R&D data. Sales, advertising and R&D are in millions of dollars.

[B]The boycott sample represents all non-labor boycotts from 1988-1995 against publicly traded U.S. companies, as reported in National Boycott News (1992-93) and Boycott Quarterly (1994-95). Targets are included in the sample if listed in COMPUSTAT, whether directly or via a parent firm. Of the 112 listed targets, 109 had data on sales, 108 on employment, 79 on advertising, and 55 on R&D.

[C]Transitory boycotts are boycotts known to have lasted less than six months in the 1988-95 period. Data on transitory boycotts is expected to be sparse because quickly cancelled or deterred boycotts are likely to go unreported.

[D]Non-transitory boycotts are boycotts known to have been conducted for more than six months. All of these boycotts lasted at least one year. Note that 25 boycotts launched in 1995 were of indeterminate duration and are therefore excluded from both "transitory" and "non-transitory" categories.

[E]The z-statistic is approximately distributed as a standard normal and tests for equality of means. Note that all reported values of z are statistically significant at the 5 percent (two-tail) level or better. The z-statistics are calculated as follows:

$z=(\bar{x}_1-\bar{x}_2)/\{(s_1/n_1)+(s_2/n_2)\}^{.5}$, where 1 and 2 index respective samples; $\bar{x}_i$ and s_i are estimated means and standard deviations, and for the proportions data, s_i is estimated by $\bar{x}_i(1-\bar{x}_i)$. The normal approximation appeals to large sample properties of the z-statistic. For transitory boycotts, the small sample ($n_1=6$) may potentially make this approximation relatively poor. An alternative statistic, based on the null hypothesis that the transitory and non-transitory boycott samples are drawn from the same population, is: $z_A=(\bar{x}_1-\bar{x}_2)/s_p\{(1/n_1)+(1/n_2)\}^{.5}$, where s_p is the estimated standard deviation for the overall boycott sample. Testing differences between means of transitory and non-transitory boycott samples, values of z_A are 3.547, 1.886 and 2.007 for market share and proportions of industry rank one and one-three, respectively; these values are statistically significant at the 1%, 10% and 5% levels, respectively.

[F]Market shares are calculated for 2-digit Standard Industrial Code (SIC) classes. Ranks are calculated for 4-digit SICs.

Table 2

Notation

θ-k = consumer preference parameter (for firm 2 vs. firm 1), $\theta \in [-\bar{\theta}, \bar{\theta}]$, $k>0$

P_i = price of firm i good

B,G = "brown," "green" technology label

c = cost of B production

η = additional cost of G production, $\eta>0$

b= EO's boycott investment

d(b) = consumer cost of buying boycotted product

β = proportion of boycott investment b that is borne by EO when boycott is cancelled

r = per-unit firm cost of countering a cancelled boycott

S,N = firms' Stage 1 strategies to "sign" / commit (S) or "not commit" (N) to the G technology

W = consumer net penalty to purchase from firm 1 (vs. firm 2) due to boycotts

Δ = index of net profit advantage to firm 2 (cost to firm 1), per equation (2)

$\Pi_i(\Delta)$ = equilibrium (Stage 4) firm i profit, $i \in \{1,2\}$, per equation (1)

E = proportion of total production that is by the G technology

ωE = EO benefit of G production

o(b) = EO's opportunity cost of boycott investment b

Q = EO's available contributions / funds for boycott investment

$\bar{b}$ = minimum effective boycott investment (equation (3))

$\underline{b}$ = minimum effective boycott investment when r=0 (equation (5))

b* = EO's (Stage 2) optimal ineffective boycott investment for cases (NS)/(SN) (equation (4))

b_{ij} = equilibrium Stage 2 boycott investment, given Stage 1 outcomes, $i,j \in \{S,N\}$

Table 3

Economic Outcomes in Stage 4 [A]

Stage 1 "Sign" Decisions	Stage 2 Boycott Target	Stage 3 Firm Tech. Decisions	W	c_1	c_2	$\Delta=W+c_1-c_2$
(1) [B]	(2)	(3) [C]	(4) [D]	(5)	(6)	(7)
SS	None	GG	0	$c+\eta$	$c+\eta$	0
SN	Firm 2	GG	0	$c+\eta$	$c+\eta+r$	-r
SN	Firm 2	GB	-d(b)	$c+\eta$	c	η-d(b)
NS	Firm 1	GG	0	$c+\eta+r$	$c+\eta$	r
NS	Firm 1	BG	d(b)	c	$c+\eta$	$-\eta+d(b)$
NN	Firm 1	GB	0	$c+\eta+r$	c	$\eta+r$
NN	Firm 1	BB	d(b)	c	c	d(b)
NN	Firm 2	BG	0	c	$c+\eta+r$	$-(\eta+r)$
NN	Firm 2	BB	-d(b)	c	c	-d(b)

[A] No boycott outcomes are special cases of the boycott outcomes described in the Table, with b=0, d(b)=d(0)=0, and r=0. For brevity, and because they cannot arise in equilibrium (Lemma 2), we omit NN cases wherein a non-boycotted firm adopts the G technology.

[B] In Stage 1, the EO asks firms to commit to adopt the "good" technology in Stage 3. Column (1) gives the firm 1 and firm 2 decision pairs, with the first component of the pair representing firm 1's decision, "S" denoting agreement with the EO's demand ("sign") and "N" denoting no agreement / commitment ("not sign").

[C] In Stage 3, firms choose whether to adopt the "green" (G) technology or retain the "brown" (B) technology, consistent with any Stage 1 commitments. Column (3) describes the firm 1 and firm 2 decision pairs, with the first component representing firm 1's choice between G and B.

[D] W represents the additional net penalty faced by consumers, due to boycotts, when they consume firm 1 (vs. firm 2) products.

Table 4

Stage 1 Equilibria Under Different Possible Stage 2 Boycott Responses

Case	b_{NS}	b_{SN}	b_{NN}	EO's Best Outcome
(1)	(2)[A]	(3)[A]	(4)[A]	(5)[B]
1	$\min(b^*,Q) < \underline{b}$	$\min(b^*,Q) < \underline{b}$	0	NN-BB
2	$\min(b^*,Q) \in (\underline{b},\bar{b})$	$\min(b^*,Q) \in (\underline{b},\bar{b})$	0	SS-GG
3	$\bar{b}$	$b^* < \underline{b}$	0	NS-GG when $\Delta_{NS} < \Delta_{SN}$ SN-GB when $\Delta_{NS} > \Delta_{SN}$
4	$\bar{b}$	$b^* < \underline{b}$	$\bar{b}$	SN-GB
5	$\bar{b}$	$b^* \in (\underline{b},\bar{b})$ or $\bar{b}$	0	SS-GG
6	$\bar{b}$	$b^* \in (\underline{b},\bar{b})$ or $\bar{b}$	$\bar{b}$	SS-GG

[A]Columns (2)-(4) indicate the anticipated Stage 2 EO boycott responses to the possible Stage 1 outcomes (NS), (SN), and (NN). For expositional purposes, we define cases 1, 3, and 4 with strict inequalities for b_{NS}/b_{SN} values ($\min(b^*,Q)<\underline{b}$ and $b^*<\underline{b}$, respectively); however, if Convention 1 holds, these cases apply with weak inequalities.

[B]Column (5) indicates equilibrium Stage 1 "sign" (S) vs. not sign (N) pairs for firms 1 and 2; and Stage 3 adoption of the "green" (G) vs. "brown" (B) technology by firms 1 and 2. In all cases (other than case 3), the indicated outcomes are achieved whether the EO approaches firm 1 first or firm 2 first in Stage 1. In case 3, the indicated outcome is achieved when the EO approaches firm 1 first, with Δ values as described in Figure 1.