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Corporate Provision of Public Goods

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Abstract. Milton Friedman famously suggested that firms ought not divert profits toward public goods because shareholders can better make these contributions themselves. Despite this, activist shareholders are increasingly successful in persuading firms to be "socially responsible." We study firm behavior when shareholders care about public goods as well as profits and when managerial contracts reflect these concerns. Under these ideal conditions, managers redirect more profits toward public goods than shareholders would when acting separately—shareholders are poorer but happier. Further, so long as the public good is sufficiently desirable, the manager selects the *socially* optimal level of output, despite the mismatch between shareholder preferences and those of society at large.

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1. Introduction

Milton Friedman's 1970 op-ed piece in the *New York Times Magazine* offers the first, and perhaps the last, word on the economics of corporate social responsibility (CSR).[1] To wit,

> Insofar as [the manager's] actions in accord with his 'social responsibility' reduce returns to stockholders, he is spending their money. . . .The stockholders could separately spend their own money on the particular action if they wished to do so. The executive is exercising a distinct 'social responsibility,' rather than serving as an agent of the stockholders, only if he spends the money in a different way than they would have spent it. . . .There is one and only one social responsibility of business. . .to increase its profits. (p. 12)

Friedman argued that under perfect corporate governance, managers would (1) maximize profits, subject to legal constraints, and (2) subsequently distribute all profits to shareholders to do with as they please. Friedman acknowledges that shareholders may value both profits *and* 'social (public) goods,' yet, analogizing to the known superiority of cash over in-kind transfers in price theory, he concludes that shareholders prefer fully decentralized giving. In this paper, we show that Friedman's ideally governed manager does neither (1) nor (2).

The successor literature reconciles observed CSR to theory via two lines of reasoning: One suggests that agency problems are insoluble, so managers maximize objectives other than shareholder value (see Garriga and Mele 2004 for a survey). The other treats CSR as a consumer demand shifter; thus, firms engage in CSR to maximize profits. By contrast, we follow Friedman in assuming that shareholders care about consumption and public goods, but foreclose earlier arguments justifying CSR—agency problems are absent, and demand is independent of CSR. We also dispense with other economic and behavioral distortions like double taxation of dividends (Zivin and Small 2005) or warm glow utility (Baron 2007) that others have pointed out could motivate shareholders to use the firm as a vehicle to discharge their social responsibilities.

In such a setting, managerial incentives are fully aligned and corporate philanthropy produces no indirect benefits, yet socially responsible firms emerge. Shareholders optimally direct the manager to sacrifice profits, both directly through profit diversion and indirectly by reducing output (and the resulting harms like pollution from production). Shareholders end up happier but poorer. The key to the result is that, because shareholders care about public goods, there is scope for the manager to provide them if he can do so more efficiently than shareholders on their own.

The first such efficiency comes from centralized giving—the manager can play a key commitment role on shareholders' behalf. Shareholders recognize that they face a free-rider problem when public goods contributions are decentralized. Centralizing contributions

through the firm helps solve this problem. Our first result shows that, when managerial contracts account for shareholders' mixed motives, this leads to (1) diversion of profits to public goods, (2) higher overall levels of the public good, and (3) higher shareholder welfare. In this frictionless setting, shareholders give the manager complete decision rights over profit diversion because he internalizes the positive externalities of these contributions. Thus, as suggested by Coase (1960), when externalities are present, property rights need no longer be neutral—allocating the rights to the manager, who serves as a commitment device, perfectly solves the free-rider problem among shareholders. Although this Coasian bargain does not account for the value of the public good to nonshareholders, all citizens benefit from the higher levels of public good generated by shareholders' centralizing giving at the firm level.

The manager's control of production levels (and the resulting negative externality to shareholders) leads to the second efficiency. For instance, if shareholders care about global warming, a plant that produces greenhouse gases also affects their welfare. Shareholders might simply incentivize the manager to maximize profits and undo the environmental damage themselves, but this is never optimal. Shareholders always do better by incentivizing the manager to produce less than the profit maximizing output. To see why, consider the benefits of the last unit of production. The increase in profits is negligible, whereas the welfare reduction owing to the externality is not. Although shareholders can spend profits to reverse the externality, it would clearly be more efficient to direct the manager not to produce the output in the first place—throttling back production can be an efficient means to provide public goods that is unavailable to decentralized shareholders. Thus, we identify a weakness in Friedman's assertion that a perfect manager will deliver maximum profits to shareholders so that they may discharge their social responsibilities in a decentralized way—profits are not maximized nor are shareholder contributions completely decentralized.

Friedman suggested that increasing shareholders' oversight of firms should curb costly CSR. However, that hypothesis reconciles poorly with the recent increase in both the manager's accountability to shareholders and CSR initiatives.[2] Formal modeling reveals that no reliable relationship between reducing agency and CSR exists—it may well go up if shareholders' collective marginal utility of giving exceeds the manager's. Hence, our model rationalizes the observed simultaneous increases in CSR and shareholder control without requiring that CSR increase profits, something empiricists have struggled to consistently show (e.g., Margolis et al. 2009, Servaes and Tamayo 2013, and Flammer 2015). Although we acknowledge that agency can drive CSR, and some firms "do well by doing good," our model rationalizes CSR in many settings where these explanations do not apply.

The above intuitive results help explain why CSR exists, itself a significant question in the strategy and governance literatures. Our model also closely relates to the theoretical literature on the private provision of public goods, where it is central to ask how far short various provision mechanisms fall compared to the hypothetical choices of an ideal social planner. This literature treats CSR as the production of a mixed consumer good—that is, one with both private consumption and public goods aspects. The earliest of this work abstracts from firm behavior altogether. Cornes and Sandler (1984, 1994) examine consumer choice between a mixed good and a pure private consumption good. Vicary (1997, 2000) studies the opposite case: the choice between a mixed good and a pure public good. Kotchen (2006) unifies the analysis, examining demand for mixed goods when both pure private and pure public goods are available. He finds that, when the mixed good produces private and public goods as efficiently as their pure counterparts, the mixed good always enjoys positive demand, but the resulting public goods level is identical to the case where only the pure goods are available.

Another literature strand models competitive firms that engage in CSR to differentiate their products. In this setting, Bagnoli and Watts (2003) show that, so long as consumer warm glow utility is modest, mixed goods underprovide the public good relative to first-best levels. Besley and Ghatak (2007) remove warm glow as a consideration and show that public goods levels produced through CSR are identical to those under a voluntary contributions mechanism (VCM).

In summary, the extant literature bundles consumption and public goods to meet consumer demand; it finds little to no improvement in public goods levels over a VCM and no relationship between firms' optimal bundle composition and first-best actions of a planner.

Our model "bundles" shareholders' (rather than consumers') consumption in two ways: (1) The manager intentionally diverts some dividends to the public good, and (2) profits and pollution are inextricably linked by the production technology. We show that when consumption and public goods are bundled for shareholders, the firm diminishes the gap between shareholder and social planner decisions—in fact, their decisions perfectly align in one dimension. The social planner will produce widgets until the marginal profits equal the marginal damage of production, so long as the public good is sufficiently desirable (i.e., she would divert some profits to the public good). We show that, so long as the manager would also divert some profits to the public (albeit less than the social planner), he chooses the *same* output as the social planner, despite the fact that, from a social perspective, the manager's

incentives are misaligned. Intuitively, although manager and social planner disagree on the absolute level of public goods (and the amount of profit diversion), their respective constituencies both think the level should be higher than it is before firm activities begin, and furthermore that the firm should efficiently provision those goods.

Relatedly, Farrell (1985) models owner-consumers whose consumption utility depends both on firm profits and goods' prices. He shows that, if every owner-consumer's fraction of consumption equals his ownership share, then shareholders unanimously want marginal-cost pricing. Otherwise, production is inefficient—the firm withholds goods despite consumer surplus exceeding the cost of production. By contrast, we show that much weaker conditions suffice to ensure that firm output is socially optimal. So long as shareholders wish the manager to spend positive amounts on the public good, given optimal firm production, private and social production incentives align perfectly.

Second, this interiority condition on direct giving enables a sharp statement about the trade-offs between various production technologies. We propose a hypothetical improvement—production can be made either more cost-effective or comparably (in cost terms) cleaner. Although instinct suggests that a planner concerned about pollution would choose the latter over the former, we obtain a neutrality result—both innovations will produce the same overall level of pollution/public goods by the socially responsible firm.

These two additional theoretical results are too strong to be interpreted as empirically accurate—taken literally, they imply that governmental regulation of firm quantities (like a carbon tax) is superfluous and that environmentally motivated subsidy dollars for cleaner industrial processes might be better spent just making it cheaper. Nevertheless, we provide benchmark results on bundling public and private goods for shareholders in a frictionless environment that highlight how important these common theoretical assumptions are. These benchmarks have no analog in the existing CSR or public goods literature driven by consumer preferences for public goods.

To cleanly illustrate the paper's main idea, the baseline model is of a firm generating a fixed amount of profits, owned by exogenous, identical shareholders. To highlight the robustness of the intuitions, we then generalize the model along several dimensions: by introducing primary markets where CSR firms must compete with traditional investments for startup capital and secondary markets where firm ownership can change and outsiders with little concern for the public good attempt to wrest control of the firm to extract higher profits. Then, we endogenize the production process—considering both its influence on profits and externality on public goods. The case of shareholders with general heterogeneous preferences is reserved for Online Appendix B.1.[3] Although these variations alter some of the particulars of the results above and uncover new results along the way, they do not alter the overarching finding that shareholders will intervene to reduce production below profit-maximizing levels and redirect some of the firm's profits toward the provision of the public good nor that, in many circumstances, socially optimal abatement occurs. Formal proofs are removed to Online Appendix A.

2. Corporate Public Goods Contributions

2.1. Shareholders Delegate Contribution

To isolate the economic intuitions of interest, we begin with a simple model focused on the role of the firm in the classical "private provision of public goods" problem. We will gradually generalize it to capture more complex, novel, and realistic features, including financial and product markets as well as production externalities.

A firm is owned by $n \geq 1$ identical shareholders, each with strictly concave, continuously differentiable utility function $u(c,g)$, strictly increasing in both private consumption c and public goods quantity g. Although, in principle, this public good could be anything whose consumption is *nonrivalrous* and *nonexcludable*, environmental resources, like clean air and clean water, will be our canonical example. The public good should be understood to represent a composite—the overall state of land, water, and air resources that affect a shareholder's quality of life. As such, the construction/destruction of the public good represents additions and subtractions to this overall state, but not necessarily focused on any one specific resource or location. For instance, production might emit atmospheric pollutants or greenhouse gases, whereas CSR expenditures might be spent on cleaning up the oceans. Both activities will affect the level of the composite good, but differ in the precise location and manner of the additions and subtractions. We assume that the public good is a normal good. Throughout the paper we denote shareholders' marginal utilities of consumption and public goods u_c and u_g, respectively. Similarly, we use u_{xy} to denote the second partial derivatives of u with respect to x and y.

Initially, we abstract from production and simply assume that the firm generates π profits to be distributed by the firm manager. Later, we will model production that affects both profits and public goods levels through externalities (like pollution).

We consider a two-stage game. In an initial (passive) stage, the shareholders determine the manager's contract.[4] Second, the manager chooses an amount α to contribute to the public good, distributing remaining profits equally among shareholders. Simultaneously,

each shareholder contributes an amount, β_i, to the public good.[5] After contributing to the public good, payoffs are realized, with all remaining cash being consumed by the shareholder. Throughout our analysis, we subsume shareholders' initial wealth and the initial level of public goods into their utility function, because these do not change through our analysis. Thus, we can write each shareholder's utility as function of α and β_i. In the spirit of Friedman, we suppose that shareholders align the manager's incentives with their own preferences. The manager's contract induces him to select α to maximize the utility of a representative shareholder.[6] Thus, the manager's objective function is

$$\max_{0\le\alpha\le\pi} u\left(\frac{\pi-\alpha}{n}-\beta_i^*, \alpha+\sum_{j=1}^{n}\beta_j^*\right), \tag{1}$$

where β_i^* denotes equilibrium contribution of shareholders to the public good.

Of course, not everyone in society is a shareholder. There are $N-n$, potentially heterogeneous, nonshareholding citizens. To isolate the effects of the firm's actions on welfare, we assume that citizens neither have wealth nor do they receive dividends from the firm.[7] They do, however, benefit from the public good—nonshareholding citizen i has continuously differentiable utility $v^i(g)$, increasing and strictly concave in its argument. Citizen i's utility can be similarly stated

$$v^i\left(\alpha+\sum_{j=1}^{n}\beta_j\right).$$

Notice that the manager is not simply a social planner in disguise. He acts on behalf of shareholders, not society at large. Whereas the planner accounts for the preferences of the $N-n$ nonshareholders in making choices, the manager pays these individuals no mind. As a consequence, a planner desires a higher public goods level than the manager. Nevertheless we assume that the planner cares enough about shareholders that her contributions to the public good from firm profits would not leave them with zero consumption. We use the planner's choices as a benchmark throughout our analysis.

We characterize behavior in the voluntary contributions game by shareholders conditional on their beliefs that the manager contributes $\tilde{\alpha}$. We then characterize the manager's contribution conditional on his beliefs over shareholder contributions. The following lemma shows that, given $\tilde{\alpha}$, there is a unique equilibrium at the voluntary contributions stage, and, furthermore, all shareholders contribute the same amount (if any) in this equilibrium:

Lemma 1. *Given any belief $\tilde{\alpha}$, the voluntary contributions game among shareholders has a unique, symmetric equilibrium.*

Because there is a unique equilibrium following every belief $\tilde{\alpha}$, and because beliefs are correct in equilibrium, we can speak unambiguously about the manager's problem accounting for the strategic interaction of shareholders.

Do shareholders benefit by delegating public goods contributions to the manager? The following lemma shows that, if shareholders contribute strictly positive amounts to the public good, the answer is "no."

Lemma 2. *When all shareholder contributions are interior (i.e., $\beta_i > 0$), (beliefs about) manager contributions per shareholder $\tilde{\alpha}_i$ (where $\tilde{\alpha}_i = \tilde{\alpha}/n$) crowd out private contributions at a one-for-one rate. That is,*

$$\frac{d\beta_i}{d\tilde{\alpha}_i} = -1.$$

The proof of the lemma follows directly from Bergstrom et al. (1986).

On the surface, this well-known result would appear to settle the matter: Shareholders precisely undo the manager's additional philanthropy, so delegation seems pointless. However, the predicate of Lemma 2, "when shareholder contributions are interior," never holds when the manager can contribute to public goods. To see why, notice that whenever shareholder contributions are interior, their marginal utilities of consumption and public goods are equalized, an additional unit of either gratifies them equally: $u_c = u_g$. On the other hand, the manager can take a unit of consumption from each shareholder (in the form of a reduced dividend) and provide n units of public goods to each shareholder. From the perspective of the manager, who accounts for the positive impact of public goods on *all* shareholders, a unit of public goods is n times as valuable: $u_c < nu_g$. Thus, whenever shareholders contribute themselves, the manager always wants them to have more public goods, and, hence shareholders', contributions cannot be interior. The manager's optimal public goods contributions crowd out all private shareholder giving. The following formalizes this intuition:

Theorem 1 (Delegation). *When shareholders are identical, the following occurs*: (1) *No shareholder contributes privately—all contributions are delegated to the manager.* (2) *If shareholders would (not) contribute positively absent manager contributions, then this delegation strictly (weakly) raises overall public goods provisioning and shareholder welfare.*

Delegating contributions to the manager helps because he acts as a commitment device. By internalizing

the benefits to all shareholders from the public good and setting contributions accordingly, the manager *perfectly solves the free-rider problem from the perspective of shareholders.* Nonshareholding citizens also benefit from this increased level of the public good, but note that the level of public goods is still *suboptimal from a societal perspective*—a social planner would also internalize the benefits accruing to nonshareholders, which the manager does not. Although complete delegation relies on the fact that shareholders are identical, the manager's commitment power remains potent even when shareholders are heterogeneous (see Online Appendix B.1). In that case, at least one shareholder delegates giving to the manager, and the overall public goods level will exceed that when CSR is prohibited.

We can sharpen Theorem 1 by adopting an assumption common in the private provision of public goods literature, namely, that relevant individual citizens sufficiently desire public goods so that they contribute strictly positive amounts to their provision (see, e.g., Warr 1983, Andreoni 1990, and Bagnoli and Watts 2003).[8,9] This interiority condition enables marginal analysis of public goods levels. Without it, public goods provision corners at zero, comparative statics become troublesome, and the models are of reduced interest. Because shareholders drink the same water and breathe the same air as other citizens, it would be equivalent to assume, absent any firm activity, that shareholders would likewise contribute something to the public good:

Condition 1 (Individual Fundability). *Individuals enjoy public goods enough to sacrifice some private consumption for them. That is,*

$$u_c(0,0) < u_g(0,0). \tag{2}$$

Casual empiricism also suggests that this condition holds for shareholders in practice: "Most (91.0%) high-net-worth households gave to charity in 2015" (*The 2016 U.S. Trust Study of High Net Worth Philanthropy*).[10] Although our results hold under Condition 1, a weaker condition also suffices—the manager optimally contributes something to the public good from firm profits:

Condition 2 (Corporate Fundability). *Shareholders enjoy public goods enough to direct the manager to sacrifice some dividends for them. That is,*

$$u_c\left(\frac{\pi}{n}, 0\right) < n u_g\left(\frac{\pi}{n}, 0\right). \tag{3}$$

To see that Condition 2 weakens Condition 1, compare their respective mathematical statements (3) and (2). Because $u_g > 0$, $u_{cc} < u_{cg}$ (follows from concave utility and the fact that the public good is a normal good; see Lemma 5) and $n \geq 1$, individual fundability implies corporate fundability (but not necessarily the reverse). That is, if individuals would ever contribute in a decentralized manner, before the profits are generated, then they would definitely have a manager make a contribution on their behalf, but he might optimally contribute on their behalf even when they would not do it on their own. Technically, corporate fundability guarantees that the manager's first order condition (FOC) is satisfied in equilibrium (or is cornered above) rather than individuals'.

The following corollary sharpens Theorem 1:

Corollary 1. *When shareholders are identical*: *If corporate fundability holds, then* (1) *no shareholder contributes privately—all contributions, totalling* $\alpha^* > 0$ *satisfying*

$$u_c\left(\frac{\pi - \alpha^*}{n}, \alpha^*\right) = n u_g\left(\frac{\pi - \alpha^*}{n}, \alpha^*\right),$$

are delegated to the manager. (2) *This delegation strictly raises overall public goods provisioning and shareholder welfare. If corporate fundability does not hold, then neither shareholders nor manager contribute to the public good.*

The "commitment device" intuition above would seem to apply equally well to charities, but differences in the source of funds break down this equivalence. A firm generates profits, which management can redirect to the public good, whereas a charity relies on voluntary contributions, which are subject to the free-rider problem. Thus, the charity cannot replicate the commitment function of the firm and hence is less effective. More generally, an institution that relies on individual contributions to provide public goods also needs some sort of punishment mechanism to work. There is a vast literature devoted to formulating such mechanisms.[11] Because the manager controls a firm's predistribution profits, member contributions, and hence, such mechanisms, are unnecessary.

But this raises the question, "Did the free-riding problem simply move outside the CSR firm?" More pointedly, "Could such a firm raise startup funds?" "Would shareholders flee the firm in search of higher dividends?" "Could a takeover artist, who cares little for public goods, profitably wrest control and change the firm's behavior?" We take these questions up in the next two subsections.

2.2. Primary Equity Markets

In this subsection, we investigate whether a CSR firm could raise enough funds to begin operations in the presence of other investment opportunities yielding better financial return.

Now assume there are N identical citizens with utility $u(c, g)$ as previously defined, each endowed with \$1, which they must completely invest in period 0. A bond, which pays π in each subsequent period, costs

\$1, and its net present value exceeds \$1. There is also an entrepreneur, with no money of his own, who has an idea for a firm. It will generate $n\pi$ profits (net of all payments to the entrepreneur) in each subsequent period if it successfully raises \$$n$ in an initial public offering (IPO) in period 0. Thus, a would-be investor is indifferent between investing in the firm or the bond so long as there is zero profit diversion in the former. However, any corporate provision of public goods reduces firm dividends strictly below bond returns. Thus, we rule out the possibility of hidden profit motives driving corporate giving. If n or more individuals subscribe to the IPO, n are chosen at random to be shareholders at an IPO price of \$1—the remainder of the population invests in the bond. If the IPO succeeds, all players are informed of the outcome. Then, the entrepreneur can divert some profits to the public good before paying out the rest as dividends to the n shareholders—he always makes this decision in the best interest of shareholders. Simultaneously (with the entrepreneur and each other), shareholders and bondholders may contribute to public goods from their dividends themselves if they wish. There is no saving, and public goods expire each period. From Theorem 1, we know that shareholders will prefer to delegate contribution to the manager rather than contribute privately, but we denote the contribution of each bondholder by β.[12] Here, we assume corporate fundability holds, and hence shareholders direct the manager to divert some profits to the public good. Were this not the case (as when corporate fundability fails), the IPO could succeed or not without any material difference to either shareholders or bondholders and the analysis would be of little interest.

If the IPO succeeds, then the entrepreneur will divert $\alpha > 0$ profits to the public good so that his FOC holds:

$$-u_c\left(\pi - \frac{\alpha}{n}, (N-n)\beta + \alpha\right) + nu_g\left(\pi - \frac{\alpha}{n}, (N-n)\beta + \alpha\right) = 0, \tag{4}$$

and nonshareholders will chose to divert $\beta \geq 0$ from their bond coupons such that their complementary slackness condition holds:

$$\beta\left[-u_c(\pi - \beta, (N-n)\beta + \alpha) + u_g(\pi - \beta, (N-n)\beta + \alpha)\right] = 0. \tag{5}$$

We will denote the utility of shareholders and nonshareholders in this case U_S and U_B. Observe that if the square bracketed factor in Equation (5) equals zero (i.e., bondholders' FOC holds), then $\pi - \frac{\alpha}{n} < \pi - \beta$, because public goods are shared. Otherwise, $\beta = 0$ (i.e., bondholders' are cornered below and contribute nothing). In both cases, all citizens enjoy the same level of public goods, but the shareholders direct the manager to contribute strictly more to the public good than they would on their own—they are strictly poorer than bondholders: $U_B > U_S$.

If the IPO fails, all citizens will divert $\bar{\beta} \geq 0$ from their bond coupons to the public good so that their complementary slackness condition holds:

$$\bar{\beta}\left[-u_c(\pi - \bar{\beta}, N\bar{\beta}) + u_g(\pi - \beta, N\bar{\beta})\right] = 0.$$

We denote the utility of all citizens in this setting as $U_\emptyset$. To see that $U_S > U_\emptyset$, notice that the manager could contribute nothing if he wished, and shareholders and bondholders alike would contribute as if the IPO failed, each enjoying $U_\emptyset$. Because shareholders optimally direct the manager to divert some profits to the public good, it must be that $U_S > U_\emptyset$. The following lemma summarizes these observations:

Lemma 3. *If the IPO is successful, bondholders are happier than shareholders, but both are better off than if the IPO fails. Formally,*

$$U_B > U_S > U_\emptyset.$$

The IPO amounts to a public goods provision point mechanism—a game where individuals commit to a specific action if and only if a sufficient aggregate commitment threshold is reached. Unlike the standard provision point game, IPO subscribers do not directly "buy" the public good; rather, when the threshold n subscribers is surpassed, the commitment power of the manager partially overcomes the free-rider problem and hence leads to increased public goods production. Of course, because subscribers anticipate this, they act as if buying the public good directly.

Palfrey and Rosenthal (1984) first studied this class of problems and characterize the set of equilibria. Bagnoli and Lipman (1989) note that many of these equilibria are implausible. They show that if one refines the set of equilibria by eliminating dominated strategies and imposing trembling hand perfection, then all implementable outcomes lie in the core. In terms of our model, their result implies that, if the manager's commitment power is valuable, then CSR firms will form. The need for refinements to obtain such a result stems from the existence of unstable equilibria. For example, if $n \geq 2$, then no subscribers is also an equilibrium, as no individual can alter the outcome by herself. To see that such an equilibrium is implausible, imagine that individuals harbor a seed of doubt about others' behavior. In particular, if an individual believes that there is any chance whatsoever that her decision to fund the firm will prove the difference between the firm existing or not, then funding is a best response. The reason is that, if fewer than $n-1$ other individuals decided to fund, the individual funding decision is irrelevant. Moreover, as the probability that an individual funds the firm goes to zero, the chance n or more

others choose to fund (via trembles), is infinitely less likely than the chance that $n-1$ others choose to fund, so individual funding is again optimal.[13]

If such extreme beliefs are ruled out, CSR firms arise with positive probability in all remaining equilibria (even without eliminating dominated strategies a la Bagnoli and Lipman):[14]

Proposition 1. *In all trembling hand perfect equilibria, the venture is funded with positive probability.*

It should be noted that there are $\binom{N}{n}$ economically equivalent trembling hand perfect pure equilibria in which exactly n individuals subscribe and the firm is funded with probability one. (See Lemma 8 in Online Appendix A for details.) There are also potentially many mixed strategy equilibria (including a symmetric one; see Lemma 6 in Online Appendix A) in which the firm is funded with strictly positive probability less than 1.

Having established that CSR firms can raise funds in primary equity markets, but that shareholders after such offerings will experience "buyer's remorse"—they experience lower utility than their bondholding peers—it is reasonable to ask whether the firm will retain shareholders in the secondary market. We take up this question in the next subsection.

2.3. Secondary Markets and Takeovers

So far we have assumed shareholders are "stuck" holding shares of a CSR firm. In reality, shareholders can trade their shares for cash and free ride rather than paying for the public good through profit diversion. A naive intuition suggests that were such markets in place, the value of managerial commitment would evaporate as shareholders exited, preferring to stand on the sidelines. Here, we examine that intuition in detail.

To do that, we generalize the previous subsection's setting to include individuals who do not care about public goods and examine the feasible trades on the secondary market. Formally, suppose that there are two types of citizens: (1) N civics (women) who care about both consumption and public goods with utility $u(c,g)$ as described above, and (2) M materialists (men) who only like money. Although all citizens were civics in the previous subsection, had we included pure materialists, they would never subscribe to the IPO, because doing so is always inferior to the bond for them. Thus, immediately after the IPO there are three types of citizens in equilibrium: (1) shareholding civics (IPO civics), (2) bondholding civics (non-IPO civics), and (3) bondholding materialists.

Finally, we assume that the manager is a utilitarian on behalf of his shareholders and treats each share as if it were held by a separate individual, be they IPO civic, non-IPO civic, or materialist. That is, the manager's objective in choosing a contribution to the public good is to maximize a convex combination of the types of citizens' individual utilities, weighted by each group's proportional shareholdings. Because before the secondary market opens all shareholders are IPO-civics, they do not privately contribute (recall Theorem 1). However, for later use, we denote IPO civics giving before trading $\hat{\beta}^* = 0$, and firm contributions before trading $\alpha^* > 0$. Materialists never contribute. Non-IPO civics may contribute positive amounts $\beta^* \geq 0$. Public goods, then, can be written $g^* = \alpha^* + (N-n)\beta^*$ before the secondary market opens. We will consider the consequences of displacing an IPO civic by either a materialist or non-IPO civic and whether a trade between two such individuals is possible.

Can a materialist profitably buy out a civic shareholder? First, note that such trade will strictly reduce corporate contributions to the public good, because the manager will dutifully adjust to the aggregate preferences of his new constituency: $\alpha_M^* < \alpha^*$, where the M subscript denotes the situation that a materialist has displaced a non-IPO civic as shareholder. Thus, it is possible that previously cornered IPO civics could contribute positively after the trade: $\hat{\beta}_M^* \geq 0$. Suppose that to acquire the share, the materialist buyer irrationally offered the seller a price (i.e., fractional bond equivalent) equal to the full *future* dividend of a share $p = \pi - \frac{\alpha_M^*}{n}$ (which is strictly higher than the *current* dividend $\pi - \frac{\alpha^*}{n}$). Observe that in this case, the IPO-civic seller will have exactly the same pre-private-contribution wealth as the remaining IPO-civic shareholders. In particular, although she is no longer a shareholder, the price the seller receives for the share exactly equals the dividend that the remaining shareholders will receive after the manager's contract is rewritten; hence, after the trade the seller is in the same financial position as remaining shareholders. It then follows that the seller's private contribution, if any, is exactly the same as the private contribution of remaining civic shareholders. Further, because all civics equally enjoy public goods, the seller's utility will be exactly the same as the remaining IPO civic shareholders':

$$\underbrace{u\left(p-\hat{\beta}_M^*, g_M^*\right)}_{\text{IPO civic seller}} = \underbrace{u\left(\pi-\frac{\alpha_M^*}{n}-\hat{\beta}_M^*, g_M^*\right)}_{\text{Remaining IPO civic shareholders}}.$$

Thus, the seller would only accept the buyer's offer if the remaining IPO civil shareholders are better off when the materialist acquires the share. This contradicts the principle of optimally: The manager's presale objective function was more skewed to the IPO civics' ideal preferences than the postsale one. So, civics must be worse off after the sale. Hence, the sale cannot occur. Neither buyer nor seller are satisfied with the price—no mutually agreeable price exists.[15] We have shown the following:

Proposition 2. *A materialist cannot profitably tender an offer to a civic shareholder that she will accept. The firm is immune to takeovers by profit maximizers.*

Now, could a bondholding non-IPO civic buy out a shareholding IPO civic? This question is pertinent, because recall from Lemma 3 that immediately following the IPO, shareholding IPO civics are poorer than bondholding non-IPO ones. Because public goods are normal goods, these richer non-IPO civics would actually prefer a higher-level public goods than poorer IPO ones. Suppose a non-IPO civic offered an IPO civic shareholder a price equal to the full current dividend of a share $p' = \pi - \frac{\alpha^*}{n}$. This trade would leave the wealth of all parties unchanged prior to rewriting the contract of the manager. The manager's contract would change because a poorer IPO civic would be displaced in his constituency by a richer non-IPO civic, who wants more public goods. Accordingly, the manager will contribute strictly more to the public good: $\alpha_N^* > \alpha^*$.

This will increase the total level of public goods. To see this, consider each type of individual in turn. The increased corporate giving will crowd out any private giving by the buyer at a 1:1 rate (recall Lemma 2); however, if this crowd-out is complete, her share of the corporate contribution would strictly exceed her previous private giving. The increased corporate giving will also crowd out any private contributions by non-IPO civics not directly involved in the transaction, but only partially, because they bear none of the cost of increased corporate giving. Materialists never give. Finally, IPO civics who do not sell continue give nothing privately; thus, their implied contribution to public goods through dividend diversion strictly increases. Thus, every individual contributes, including both direct contributions and dividend diversion, weakly more. Further, IPO civics who do not sell their shares contribute strictly more.

How does this increase in public goods affect various parties' welfare? Materialists experience no utility change because they neither paid for the public goods increase nor do they appreciate it. IPO civics who do not sell subsidize the public goods increase that the buyer desires, to a level above their optimum—they are worse off. Nevertheless, this subsidy makes the buyer strictly better off, though poorer. The seller enjoys also an increase in public goods that she did not pay for. Because price p' makes both buyer and seller strictly better off, there is a ball of prices around p' under which the trade will occur. We have shown:

Proposition 3. *A wealthier civic will successfully buy out a poorer civic. Corporate provision of public goods and their overall level will increase.*

Although we do not formally analyze any secondary market transactions beyond the first, the intuition extends. First, a shareholder cannot merely shed her burden of paying for the public good by selling her shares—the burden (in the form of reduced dividends) will be priced in by the market. Individuals who value public goods less than current shareholders cannot profitably buy share from someone who values it more, because there exists no mutually beneficial trade. The reason for this is that although a potential buyer could influence the manager to reduce giving to the public good and receive some of the cash equivalent from the reduced level, he will only receive $1/n^{th}$ of it, because the remainder will be distributed to the remaining $n-1$ shareholders. This is not enough to compensate the seller for the *full* loss of the public goods from *all* shareholders' indirect contribution reductions. Potential buyers in our full information setting know this and would demand compensation that the buyer cannot rationally offer. On the other hand, individuals who value the public good more can tender mutually beneficial offers to individuals who value it less, whether because of preferences or income effects. If a buyer offered a price that equalizes the seller's utility at the current public goods level, this strictly benefits both parties, because the buyer will use the commitment power of the manager to get more public goods, and the seller gets an income effect boost to utility because she does not have to pay for the public goods windfall. Furthermore, those who value the public good least will be bought out first because their break-even prices are lowest. Thus, although we have modelled a simplified setting with a limited number of types, it is easy to see how the intuition carries forward and how those that value the public good most will displace those in a CSR firm who value it least, thus driving the firm to be held by shareholders desiring similar, high levels of public goods.

There are at least four caveats, however, to the above analysis that should be noted. First, the primary market analysis in the previous subsection does not comprehend the secondary market described in this one. Observe though that its inclusion would only increase the probability of a successful IPO, because any civic who subscribed to the IPO and was selected would recognize that, although she will be less well off than civics who are not selected for the IPO, she will recover some of this gap in the secondary market. This reduces the anticipated "buyer's remorse" and distributes the cost of providing the ultimate level of the public goods among civics who are not selected for the original IPO.

The second caveat is more practical: All of the analysis in this subsection is premised on the fact that an individual shareholder can costlessly exit from firm ownership via the market. In practice, such exit is far from costless and, in many cases, is difficult or impossible. In reality, individuals hold few shares; rather, institutional investors—pension, mutual, sovereign wealth, and

endowment funds—account for the lion's share of firm ownership (Rydqvist et al. 2014). By 2014, the institutional ownership of S&P 500 shares had grown to 82%.[16] Although institutions do ultimately have individual benefactors, those individuals cannot costlessly choose an individual portfolio so as to leave the burden of public goods provision on others represented by the institution. In many cases, represented individuals (e.g., Norwegian citizens or Calpers pensioners) are, for practical purposes, exogenously assigned shareholders with a collective fiduciary agent communicating their wishes to management. When there are significant costs associated with divestiture or it is impossible, then simply treating shareholders as exogenously assigned is reasonable.

Thirdly, our model does not allow managers to influence the type of investors they attract. Managers seeking to influence the values of their investor pool use positioning, advertising, and voluntary disclosure. Comments by Unilever Chief Executive Officer (CEO) Paul Polman are indicative of this last strategy. Speaking at the first shareholder meeting after ascending to CEO, Polman announced a holistic measure of, and motivation for, firm success. He indicated that investors uncomfortable with this approach should "not put [their] money in our company."[17] Polman was trying to select his shareholding "employers" by announcing how he intended to behave. The upshot of managerial strategies of this sort is to homogenize the values and beliefs of the firms' investors.

Finally, in all of the analyses so far, we have assumed that shareholders when acting individually have the same technology for providing public goods as the manager. Although that assumption may be reasonable for direct provision of the public good through charitable contributions, there are many ways in which firms influence public goods that decentralized shareholders could not. We take up these in the next section.

3. Abating Production Externalities

In this section, we further generalize the model to comprehend production externalities, like pollution, which damage the public good in the pursuit of profits. The shareholders described above possessed the same technology to contribute to the public good as the firm, but they chose to delegate action to the manager to curb free-riding among themselves. Here, we add a production process to the firm, which shareholders cannot individually influence, except through the manager's contract.[18]

Now, rather than generating a fixed amount of profit, the firm produces and sells an amount q of a product. Production generates $\pi(q)$ profits, where $\pi(\cdot)$ is continuously differentiable, concave, and strictly single-peaked. Thus, there exists a unique profit maximizing quantity $\hat{q}$ (i.e., $\pi'(\hat{q}) = 0$). Output also reduces the stock of the public good. The replacement cost of this public good is given by continuously differentiable, strictly increasing function $\psi(q)$ ($\psi'(q) > 0$). We assume that the negative impact of a unit of production on the public good and the effectiveness of a dollar spent on the public good depends only on the current level of the public good. For this reason, we refer to this setting as the *instantaneous cost model of public goods*.[19] Most standard models of the private provision of public goods fall into this class—all that is required is that public goods production depends only on the sum of individual contributions. We describe the microfoundations of this public goods production technology in detail in Online Appendix B.3. We assume that the firm does not pollute when idle ($\psi(0) = 0$) and that the first unit of production generates more profits than it costs to clean up the resulting pollution ($\pi'(0) > \psi'(0)$)—these conditions guarantee that some q satisfying the manager's first order condition for output exists. In Online Appendix B.3, we also derive necessary conditions for the second order conditions (SOCs) to hold; however, convexity ($\psi''(\cdot) \geq 0$) suffices.

Although we use pollution as our canonical externality, the tension we analyze is more general—the model applies to settings where growing profits is increasingly difficult relative to the social costs of doing so. So, the firm might be a medical innovator with a pipeline of products ordered ascendingly by their expected health-benefit-to-risk ratio—it may be obvious to pursue the first product, whereas each successive positive decision is less easy. It could be a textile manufacturer in a country that loosely regulates the minimum age of workers—perhaps 18-year-old workers are viable, but younger workers are slightly more productive on a unit-cost basis but less safe and will miss out on more schooling each year below that age. Thus, although we formally model the manager's production quantity decision, quantity here need not be taken too literally; he might also be choosing which product releases to pursue, which ore bodies to mine, or which production processes to adopt.

In this revised model, the manager simultaneously chooses the production quantity q and an amount α to contribute to the public good. The remaining profits are distributed equally among the shareholders, who then can contribute to the public good, if they wish; however, because Theorem 1 established that shareholders will delegate all public goods contributions to the manager for an arbitrary level of firm profits, they will make no private contributions in equilibrium. Shareholders consume their dividends. The manager again maximizes the representative shareholder's utility

$$\max_{0\leq q,\, 0\leq \alpha \leq \pi(q)} u\left(\frac{\pi(q)-\alpha}{n}, \alpha - \psi(q)\right). \tag{6}$$

Equation (6) clearly exposes the manager's trade-off in choosing output—more widgets means more profits $\pi(q)$ but also more pollution (i.e., less public goods $-\psi(q)$). Recognizing that the marginal profits of output eventually diminish to zero, for that defines the profit-maximizing output, while its pollution continues to increase, the manager abates production:

Proposition 4 (No Profit Maximization). *The manager will always produce strictly less than the profit-maximizing quantity.*

Friedman argued that a manager acting in the interests of shareholders would maximize profits and distribute the proceeds for shareholders to do with as they please. Theorem 1 and Proposition 4 show that the shareholders incentivize the manager to do neither—optimal production is below profit-maximizing levels, and some profits are redirected to the public good. Moreover, neither result requires that the corporate fundability condition hold. When it does hold, sharper results are obtained. For instance, Theorem 1 to be sharpened into Corollary 1. We derive an analogous sharpening of Proposition 4 when this condition holds in the next section.

3.1. Socially Optimal Abatement

Theorem 1 and Proposition 4 do not imply that, from a societal perspective, the free-rider problem is solved. The manager accounts for the positive externality among shareholders, but not for the positive externality accruing to nonshareholders. Indeed, it follows immediately from Theorem 1 that public goods would be underprovided were society to rely only on the firm. A similar argument would seem to apply to production decisions as well, so one would expect the firm to overproduce from a societal perspective.

Before exploring this intuition, consider the following benchmark: Suppose that a social planner were given *full control of the firm and its profits.* How much would she optimally produce for the benefit of *all citizens*? As in Theorem 1, shareholders make no private contributions to the public good in this situation. A utilitarian planner would maximize the aggregate of shareholder and nonshareholder welfare,

$$\max_{0\le q,\, 0\le \alpha \le \pi(q)} nu\left(\frac{\pi(q)-\alpha}{n}, \alpha - \psi(q)\right) + \sum_{i=1}^{N-n} v^i(\alpha - \psi(q)).$$

We assume that the public good is *ex ante socially desirable*—that is, it is a "good" rather than a "bad" in aggregate—so that the social planner will want to divert some consumption from shareholders to public goods before production occurs ($q = 0$). Furthermore, if it is desirable before production, then it is certainly desirable at any positive output level ($q > 0$), because production enriches shareholders (with diminishing marginal utility of consumption) and depletes public goods (likewise, the marginal utility of public goods increases as their level falls).

The planner's problem may then be divided into two parts: choosing the optimal production level and then determining how much of the profit to redirect to the public good. The following lemma deals with the production decision:

Lemma 4. *The socially optimal production level, q^*, is the unique value of q solving $\pi'(q) = \psi'(q)$.*

Lemma 4 shows that the planner produces up to the point where marginal profit equals the marginal cost of repairing the damage to the public good.[20] When choosing the production quantity, the planner simply asks, "Will producing another unit generate more profits than it costs to clean up the resultant damage to the public good?" If the answer is "yes," then producing the unit and paying to completely negate the damage always makes society better off, regardless of how the planner decides to use the leftover profits from the additional unit. If the answer is "no," and the planner would spend any money at all, from any source, on the public good, then regardless of what other decisions the planner may make, she can save money and maintain public goods levels by not producing the additional unit. This intuition readily extends to a richer model where the planner also controls factors beyond those directly related to the firm, such as the ability to tax and redistribute income from citizens.

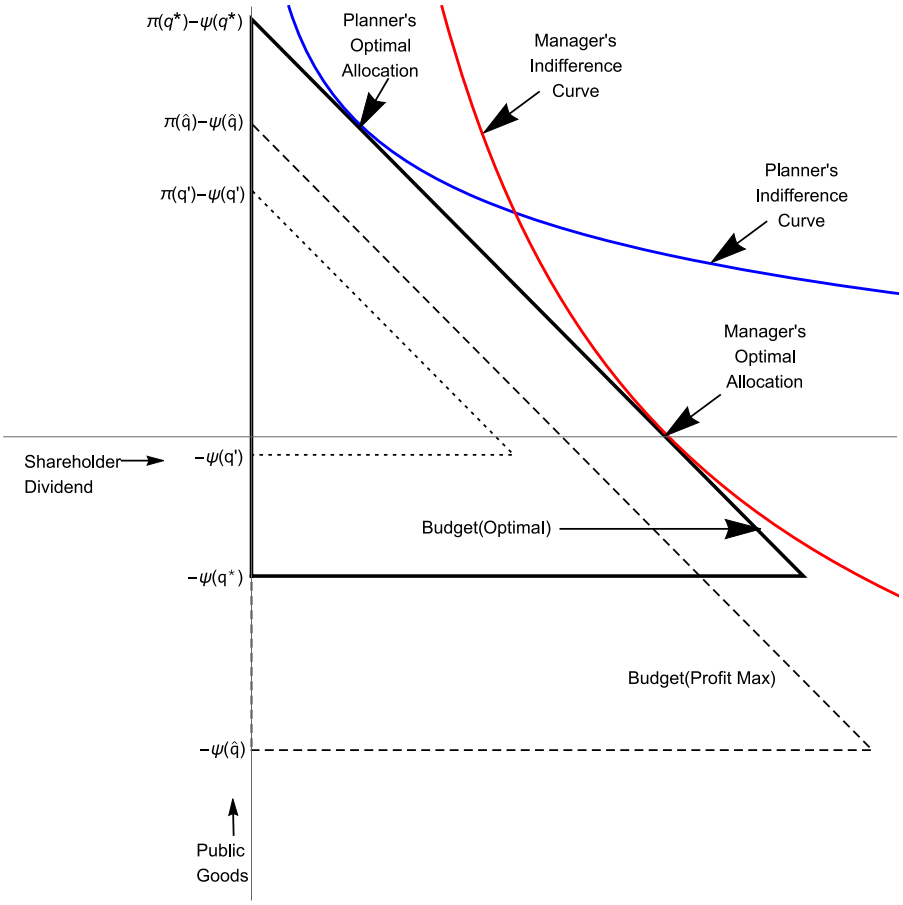
With this benchmark in mind, we now turn to production when the manager controls the firm. First, we must amend our corporate fundability condition to take account of production:

Condition 3 (Corporate Fundability with Production). *Shareholders enjoy public goods enough at the socially optimal level of production to direct the manager to sacrifice some dividends for them. Formally,*

$$u_c\left(\frac{\pi(q^*)}{n}, -\psi(q^*)\right) \le nu_g\left(\frac{\pi(q^*)}{n}, -\psi(q^*)\right). \tag{7}$$

Although the private provision of public goods literature does not generally incorporate the effects of firm production on either individuals' wealth or the public goods level, it is clear that this version of corporate fundability remains weaker than the standard individual fundability condition for the reasons stated in Section 2.1. That is, if shareholders would individually contribute something to the public good before firm profits and pollution, then they would surely have their manager (who solves shareholders' free-riding problem) contribute on their behalf after production

Figure 1. (Color online) Comparison of Optimal Allocation Decisions by the Manager and a Social Planner



Notes. Horizontal and vertical axes, respectively, denote the dividends per shareholder and public goods levels. The hypotenuse of each triangle denotes the feasible set of allocations under a given production choice ($q' < q^* < \hat{q}$)—the upper left corner is an allocation where all profits are diverted to the public good, and the lower left corner is an allocation where none are. So long as a tangency with the manager's indifference curve exists on the allocation set induced by the socially optimal production level (q^*, in bold), then manager and planner agree on output, though not public goods level. Max, maximum.

makes them personally richer and the environment dirtier.

Figure 1 graphically captures how the features of the model interact when the manager can use both abatement and profit diversion to supply public goods. First, notice that the allocation set under socially optimal production q^* (hypotenuse of the bold triangle) strictly dominates the allocation sets induced by all lower production levels (including q') because profits grow faster than the cost of cleaning up the resultant pollution. Thus, neither the manager nor the planner will choose output in this range. Between q^* and profit-maximizing quantity $\hat{q}$ (denoted by the dashed triangle), the absolute size of the triangles continues to increase because there are more profits to allocate, but the allocation set shifts downward as the cost to clean up pollution now grows faster than profits. Because one unit of dividend from each shareholder buys n units of public good, the slope of the manager's (or planner's) allocation set is $-n$. The manager's marginal rate of substitution in trading off one unit of dividend for a unit of the public good is $MRS = -u_c/u_g$. Thus, corporate fundability, which can also be written

$$-\frac{u_c\left(\frac{\pi(q^*)}{n}, -\psi(q^*)\right)}{u_g\left(\frac{\pi(q^*)}{n}, -\psi(q^*)\right)} \geq -n, \tag{8}$$

holds if and only if (iff) the slope of the allocation set (right-hand side (RHS) of Equation (8)) is steeper than the manager's MRS at the optimal level of production and zero contributions to the public goods (left-hand side of Equation (8)). Because the manager's indifference curves exhibit diminishing marginal rates of substitution (DMRS), if Equation (8) holds, then a tangency on the allocation set induced by socially optimal production exists.[21] Note also that the planner's MRS is everywhere shallower than the manager's because she also accounts for the benefits of public goods to nonshareholders. Thus, we can sharpen

Proposition 4: If the corporate fundability condition holds, then the manager and social planner make *exactly the same* production decision and give positive amounts (or is indifferent) to the public good. Formally,

Theorem 2 (Efficient Abatement). (1) *The manager chooses the socially optimal quantity q^* iff the public good is corporately fundable; otherwise, the firm overproduces (i.e., $q \in (q^*, \hat{q})$).* (2) *Furthermore, the manager provisions strictly positive amounts of the public good iff the inequality in* Equation (7) *is strict.*

Theorem 2 offers tight conditions under which the manager produces the socially optimal level of output. If, at this level of output, shareholders would have the manager contribute anything at all to the public good, then his incentives are aligned with the planner's in terms of output. Although the preferences of shareholders and society at large diverge in terms of the amount of profits to divert to the public good, they agree about how much abatement to undertake. To see why, notice that there are two ways to buy a unit of the public good: directly through the diversion of profits or indirectly through abatement. The price of the direct channel always equals 1, whereas the price of the abatement channel, $\pi'(q)/\psi'(q)$, varies depending on the level of production. The abatement channel is cheaper whenever $q > q^*$ and more expensive otherwise. The corporate fundability condition ensures that both manager and planner desire more public good than can be *efficiently* provided using the abatement channel alone; hence, both exhaust the gains from this channel and then turn to the direct channel to achieve their public goods targets. In short, provided the public good is sufficiently desirable, government intervention is unnecessary to solve the "missing market" problem of the production externality.

Linkage Between Abatement and Profit Diversion. We have highlighted two distinct levers by which a manager may provide public goods for the benefit of his shareholders: (1) directly, through diversion of profits, and (2) indirectly, through pollution abatement via restricted production. The former lever offers one mechanism (among others in the literature) to solve the free-rider problem among shareholders, whereas the latter offers a potentially more cost-effective method of providing public goods.

How important is it that the manager control both of these levers? One might imagine that the two choices are entirely separate, and hence removing one lever from the manager's control would not affect his operation of the other. Suppose that the manager were banned from diverting profits to the public good, just as Friedman advocated. Obviously, this worsens shareholder payoffs due to free-riding. But it does more than this. Barring the manager from profit diversion distorts his production decision: The manager now optimally pares back production to a level *below* the social optimum, q^*. Constraining one lever induces a strategic response in employing the other. Formally:

Proposition 5. *Suppose that individual fundability holds and the manager cannot divert profits. The manager optimally distorts output downwards compared with the social optimum. The more widely held the firm, the larger the distortion. Formally, let q_n be the manager's optimal output when there are n shareholders, then $\frac{d(q^*-q_n)}{dn} > 0$, while $q_1 = q^*$.*

Why does the manager reduce output relative to the social optimum when he is barred from diverting profits? The key is that his shareholders still suffer from the free-rider problem; thus, managerial actions that increase public goods enhance welfare. The manager's only available lever to increase the level of public goods is via output reduction. To see why such abatement is optimal, consider a setting where the manager slightly decreases output below the social optimum. Abatement costs each shareholder $\frac{1}{n}\pi'(q^*)u_c$ but benefits this individual by $\psi'(q^*)u_g$ owing to the increase in public goods. Because shareholders give such that $u_c = u_g$ in equilibrium and $\pi'(q^*) = \psi'(q^*)$ by definition, it then follows that the marginal benefit of abatement, which is independent of the number of shareholders, exceeds the marginal cost, which is decreasing in n. Because shareholders task the manager with maximizing their aggregate welfare, this trade-off is worthwhile.

Note however that it would be more cost-efficient to pay for the public goods directly, because the implicit price of public goods via abatement, $\pi'(q)/\psi'(q)$, exceeds that from direct contribution, which equals 1. Unfortunately, the manager lacks the direct contribution lever and substitutes abatement in its stead. However, if the game timing changes, such that the manager chooses and shareholders observe production before shareholders contribute, such that the manager can commit, socially optimal production again is obtained (see Online Appendix B.4).

When corporate fundability fails, the manager has no interest in diverting profits when producing at q^*, as the public goods level is already too high. Increasing production raises consumption at the cost of the public good, a perfectly acceptable trade-off. Indeed, because the manager does not divert profits in this situation, he chooses precisely the same output as when the additional lever was present. Nevertheless, although the manager's output choice is higher than the socially optimal in this case, it remains below the profit-maximizing level.

We have shown that giving the manager the right to divert profits not only solves shareholders' free-rider problem, but it also enables him to optimally choose the same output as the planner. However, the dependence

is not bilateral—the manager's power as commitment device to ameliorate free riding does not depend on his control over production. Indeed our baseline model of Section 2, from which we derived Theorem 1 and Corollary 1, abstracted from production altogether.

The prior literature makes the extreme assumption that shareholders only care about private consumption. Here, we allow shareholders to also enjoy the same (composite) public good as nonshareholding citizens, albeit perhaps to differing degrees. Although shareholders solve the free-rider problem amongst themselves, independent of nonshareholder preferences, to the extent that the interests of shareholders diverge from nonshareholders, the benefit they derive from shareholder coordination may be limited. For example, shareholders may care intensely about the environment, whereas nonshareholders might primarily care about working conditions. The firm will "solve" the first problem but pay little attention to the second. This divergence of interests does not impact efficient production abatement—production is socially optimal so long as nonshareholders' utility does not strictly decrease when shareholders' preferred component of public goods increases.

If society were comprised of a single individual, then free-riding would not be a concern—it only arises when there are more than one. So, one might analogize that optimal production is similarly easy to achieve under monopoly, but when firms compete, might they not free-ride in their production decisions so that total output (and consequent pollution) is too high? In a companion article (Morgan and Tumlinson 2018), we consider the opposite case: We study a perfectly competitive small open economy where managers of many competing firms produce the pollution generating good, and the world market determines its price. Our efficient abatement result carries through in this setting—both the number and production of firms is socially optimal.

4. Technology Subsidies

In this section, we examine another policy consequence of the (monopoly) model. The U.S. government devotes billions of dollars each year to subsidizing basic research. Often, this funding is targeted toward technological breakthroughs deemed to have significant social benefits. Recent "cleantech" initiatives in the energy sector are prime examples. Suppose that the government could choose to subsidize technology development to either (1) make production cheaper or (2) make it cleaner. A government worried about emissions would likely opt for the latter. Indeed, subsidizing cheaper production would seem to only exacerbate the pollution problem by generating higher output. This, however, ignores the connection between production technology and the manager's contract. The following proposition shows that, when the corporate fundability condition holds, the two investment strategies are *neutral* with respect to public goods provision. This implies that society may be better off investing in technology that makes production cheaper rather than cleaner, if developing the former technology is less expensive.

In order to make the two technology changes comparable, consider the following. Suppose that, under the cleaner technology, firm emissions from output q reduce cleanup costs by a given amount. For instance, a coal-fired power plant might reduce the amount of harmful pollutants emitted per kilowatt of power generated by installing scrubbers on its smokestacks. Alternatively, it might install a labor-reducing fuel-delivery system, and for every level of output, the value of the labor savings exactly equals value of the reduced pollution in cost-to-cleanup terms. Under both regimes both regimes, the firm incurs the same fixed costs—the technological improvements only matter when the firm is actively producing. Formally, let $\hat{\psi}$ and $\hat{\pi}$ denote the cleaner and more efficient technology, respectively. Then, $\pi(0) = \hat{\pi}(0)$ and for all q less than the profit-maximizing quantity $(\forall q : \hat{\pi}'(q) \geq 0)$

$$\hat{\pi}(q) - \pi(q) = \psi(q) - \hat{\psi}(q),$$

or, expressed in marginal terms,

$$\hat{\pi}'(q) - \pi'(q) = \psi'(q) - \hat{\psi}'(q). \tag{9}$$

Our next result establishes the neutrality of comparable technological changes.

Proposition 6 (Technological Neutrality). *Suppose corporate fundability holds. Then, firm output is identical under the cleaner or cheaper technology. Furthermore, total public goods are identical under the two technology improvements.*

The underlying intuition analogizes to the familiar trade-off between more revenues and lower costs. The corporate fundability condition ensures that the manager chooses output where marginal profit equals the marginal externality—that is, $\pi' = \psi'$. This is equivalent to choosing q to maximize $\pi(q) - \psi(q)$, where $\pi(q)$ may be viewed as a revenue function and $\psi(q)$ as a cost function. Under this view, the cleaner technology represents a reduction in marginal costs, whereas the cheaper technology represents an identical increase in marginal revenues. Because the manager only cares about the net of revenues and costs, both changes have the *same* effect on "profits" and hence output. The manager also chooses between consumption and public goods along the budget curve induced by the output decision. Because the relative price, and, indeed, the budget set itself, is unaffected by choice of the technological change, the final choice of consumption and public goods provision is also identical under the two schemes.

5. Conclusion

We have shown that when shareholders care about the public good, even if only to the extent that the public good personally affects themselves and not others, and these preferences are reflected in the manager's contract, then firms abandon profit/dividend maximization in favor of more socially responsible choices. In particular, a firm will refrain, to some degree, from production that harms the stock of the public good and may divert some of its profits towards repairing the damage to the public good caused by its production. When shareholders care sufficiently that they personally would contribute to the public good, the firm's activities become even more laudable—production occurs at the same level that a utilitarian social planner would choose, despite the fact that the manager's contract only reflects the preferences of shareholders and not the public at large. In addition, the firm diverts profits to increase the public good—its profits are lower, its shareholders are poorer—and this is precisely as its shareholders intend.

There is considerable evidence of many of the activities predicted by the model. Shareholders are strongly voicing their preferences concerning the social behavior of firms, not merely fringe groups with token holdings, but large institutional investors. The New York City Comptroller's Office, representing the pensions of over a half-million beneficiaries and current employees, spearheaded the campaign that led Intel, Apple, Microsoft, and Hewlett-Packard to address environmental and human rights issues in their supply chains in 2012.[22] Firms are altering or reducing their production so as to limit negative environmental or social impacts, and these distortions are genuinely costly. In Intel's case, hundreds of millions of dollars have been spent on water conservation and green energy. Apple agreed to split the costs of improving working conditions in the plants of its main manufacturing partner, FoxConn—moves that nearly halved the subcontractor's profit margins.[23]

Firms also routinely divert profits toward activities that offset some of the damage caused by their activities. For example, Barrick Gold's operations in its Pueblo Viejo mine, located in the Dominican Republic, created environmental damages estimated to cost $75 million to rehabilitate. Despite being obliged to pay only half the cost of the cleanup and to remediate at Dominican standards, Barrick voluntarily paid the full cleanup cost, performed to international standards, and even cleaned up nearby areas only indirectly affected by the mine. These voluntary efforts cost shareholders at least $37 million in foregone profits.[24]

Although these impressive activities suggest that the modeled forces are at work, to some extent, at some real firms, such prosocial behavior is hardly ubiquitous. This shortfall can be measured on a different scale as well. Taken literally, the model predicts little need for regulatory efforts on the part of agencies like the Environmental Protection Agency. Likewise, it predicts little need for carbon-pricing schemes like cap and trade. Yet the scientific consensus is that efforts to date to reduce carbon emissions are insufficient to halt, or even slow, the rapid accumulation of greenhouse gases in the atmosphere and the resultant rise in the earth's temperature. Regulatory intervention was (and is) needed to ensure against catastrophic seismic activity from the extraction of shale oil and gas. Thus, it seems clear that the sharpest predictions of the model are not borne out, by and large. Thus, one might be tempted to conclude that studying such settings theoretically serves little purpose.

Like other sharp results that fail in the real world, such as the revenue equivalence theorem (RET), the exercise represents a starting point from which to examine the various assumptions required to obtain the outcome. In the case of the RET, one needs things like risk-neutrality and the absence of asymmetries among agents—conditions unlikely to hold in practice. In our case, we require that the fundability condition hold, and, perhaps even more importantly, we require the ability of shareholders to write forcing contracts commanding the manager to adhere to their tastes. Shareholders must also solve a coordination problem to determine what those tastes are in the first place. Managers must know the profit and externality function with precision.[25] And so on, as needed to study our "frictionless" world.

However, like all models, ours suffers from the fact that none of these assumptions is exactly true in practice, yet studying the frictionless world is still a useful benchmark for directional predictions about the corporate provision of public goods. For instance, the model predicts, implicitly, that as shareholders gain more control over the actions of the manager, the firm will pay more attention to production externalities, which is broadly in line with what we see. The model also predicts that when shareholders are little affected by the firm's polluting activities, there will be little clamor for abatement. This, too, is roughly in line with what is observed. For instance, Grant et al. (2004) find that absentee managed plants in the United States emit more toxins, on average, than other plants. Yet there is a growing sense that firm emissions affect everyone, rather than those who happen to be downwind, expressed most acutely in worries about global warming. Campaigns urging major institutional investors to divest themselves of fossil fuel producers offer a vivid example of these far-reaching concerns. Today's shareholders are far more aware of, and vocal about, the harms from firm production than those of the previous generation. As technological progress continues to make us

ever-more interconnected, and interdependent, there is every reason to believe that public goods will figure even more prominently among the considerations of the next generation of shareholders. Thus, even though the conditions for firms to choose the socially optimal abatement level are unlikely to be borne out in practice, knowing what these conditions are is, nonetheless, valuable for anticipating the effects of such changes.

This growing connection between shareholders' interest in public goods and their exercise of power within the firm requires a rethink of certain government policies. For instance, government spending to clean up pollution must now account for their impact on CSR activities at the firm. Naturally, such grants have a crowding-out effect on firm production of public goods, including abatement activities. Thus, the net impact of such grants is blunted by an offsetting reduction in the social value orientation of firms through shareholder actions.

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Endnotes

[1] Friedman articulates similar sentiments in greater detail in his academic text, *Capitalism and Freedom* (1964).

[2] The SEC's adoption of Rule 14a-8 (the shareholder proposal rule) in 1943 opened the way for direct shareholder activism, but the rise of activist institutional shareholders, especially pension funds in the mid-1980s and more recently hedge funds, has increased shareholder oversight of firm management (Gillan and Starks 2000). Furthermore, the percentage of outside board directors has steadily risen since the early 1970s (Hermalin and Weisbach 1988; Borokhovich et al. 1996, table 1; Dahya and McConnell 2005). Similarly, board-driven CEO turnover has increased since the early 1990s (Kaplan and Minton 2012). Laws like the Sarbanes–Oxley Act (2002) and Dodd–Frank Wall Street Reform (2010) in the United States and Shareholders Rights Directive (2007) in the European Union have increased management accountability to shareholders.

Shareholders are using this power. Proxy fights, once rare, now occur regularly at annual shareholder meetings. For instance, about 300 proxy wars were waged within Fortune 200 companies in 2012 (http://www.proxymonitor.org/Forms/2012Finding3.aspx). Largely, these shareholders request policies reflecting preferences beyond mere profit maximization. In 2012, Ernst & Young predicted that, among shareholder resolutions, "the environmental and social proposals category looks to dominate all other[s]…for a third consecutive year" (Ernst & Young LLP, 2012, *Leading Corporate Sustainability Issues in the 2012 Proxy Season: Is Your Board Prepared?*). Regarding impact, U.S. sustainability organization Ceres observed that of the nearly 110 resolutions it tracked in 2012, 44 resulted in U.S. companies committing to tackle environmental and social risks in their operations and supply chains (http://www.ceres.org/press/press-releases/shareholder-resolutions-spur-u.s.-companies-to-act-on-sustainability-during-2012-proxy-season).

[3] Although modeling heterogeneous shareholder preferences introduces considerable technical complexity, the economic intuitions and core results change very little.

[4] One might worry that in a large public company, each shareholder accounts for only a tiny fraction of holdings and hence cannot influence the manager. In reality, large institutional investors own most shares (see Rydqvist et al. 2014). Such investors can clearly influence the manager.

[5] One might argue that dividends need to be distributed before shareholders can contribute from them to the public good and consume, and thus the timing should be sequential. In fact, dividends are generally paid every quarter, and firms and individuals donors make contributions at various points in the cycle. Hence, no timing is clearly better than another. We follow Bergstrom et al. (1986) and many others by assuming simultaneity, but a sequential timing does not yield qualitatively different results.

[6] Formally, shareholders specify a forcing contract dictating α..

[7] This assumption is innocuous. Online Appendix B.2 relaxes it and shows that the results are unaltered.

[8] There have been many extensions of these models, many of which relax preference assumptions. For example, Bergstrom et al. (1986) divide consumers into contributors or noncontributors to the public good. Their main result (theorem 1) focuses solely on contributors, where marginal analysis obtains. Our various fundability conditions are in the same spirit. They ensure interior solutions and hence allow for marginalist analysis.

[9] Other papers do not explicitly assume interior giving, but, instead, impose restrictive preferences that produce interior giving (e.g., Vesterlund 2003).

[10] http://www.ustrust.com/publish/content/application/pdf/GWMOL/USTp_ARMCGDN7_oct_2017.pdf

[11] The most well-known mechanisms are those proposed by Groves and Ledyard (1977), as well as Ledyard (1994), but there are many others. A charity could, in principle, adopt any of these mechanisms to solve the free-rider problem. A government can deter free-riding (tax-evasion) with the threat of force.

[12] Symmetry and uniqueness of bondholders ' contributions follows a proof analogous to that of Lemma 1.

[13] There are other noncore outcomes representing equilibria where $n-2$ or fewer individuals decide to fund and the rest do not. An analogous argument shows that these equilibria do not survive trembles.

[14] An important difference between Bagnoli and Lippman's game and ours is that in their version, any single individual can fully fund the public good. Trembles alone, then, do not suffice to rule out noncore equilibria. Because such individual funding is a dominated strategy, Bagnoli and Lippman tack on a restriction whose trembles consist solely of undominated strategies to rule this case out. Our model, on the other hand, does not need this strengthening of trembling hand perfection, because being a shareholder is strictly preferable at the individual level to the firm not being funded.

[15] An alternative intuition is as follows: Observe that the net effect of such a transaction is merely to shift some amount of the public good into cash. The potential buyer would only receive $1/n^{th}$ of the cash, because the remainder will be distributed to the remaining $n-1$ shareholders. The potential seller must be compensated for the full loss of the public good. Were the firm completely owned by civics, then the level of the public good would be such that $\frac{1}{n}u_c = u_g$. Thus, in this case, if the amount of public good converted to cash were negligible, and the seller received all of the generated cash due a single share ($1/n^{th}$ of the total), she would only be indifferent to the transaction. For any measurable reduction in the public good, the potential seller would strictly reject the deal: $\frac{1}{n}\int u_c < \int u_g$. If any existing shareholders valued public goods less than the potential seller, then $\frac{1}{n}u_c < u_g$, and the potential seller would reject even a negligibly sized trade, much less a larger one. Because these trades already assume that the buyer gives up all cash generated by converting the public good, and sellers are strictly worse off, there can be no mutually beneficial trades.

[16] http://www.spcapitaliq-corporations.com/cms/wp-content/uploads/2014/08/GMI-SPIAS-Institutional-Ownership-Is-There-Smart-Money-Erin-Gibbs.pdf

[17] https://www.forbes.com/sites/andyboynton/2015/07/20/unilevers-paul-polman-ceos-cant-be-slaves-to-shareholders/#186d3ad7561e

[18] Kaul and Luo (2017) show that when a firm's core business has positive externalities for the production of social goods, such synergies may make the firm's provision of these public goods more efficient than alternatives. Here, the situation is quite different—the firm's core business destroys the public good.

[19] One might imagine a model of public goods production where the cost of adding a unit depended on, say, how much money had been spent on public goods provision already. Then, the cost of public goods would depend not only on their level, but *how* that level was achieved. We specifically rule out such path dependencies.

[20] Although other definitions of the socially optimal level of production exist, this one has been common in the literature since Pigou (1920). However, it is important to recognize throughout the analysis that q^* denotes the socially optimal level of production, not the socially optimal level of public goods.

[21] DMRS follows from the concavity of the utility functions and the assumption that consumption and public goods are normal.

[22] http://www.pionline.com/article/20120209/ONLINE/120209850/new-york-city-plans-target-3-tech-firms-for-human-rights-compliance

[23] http://venturebeat.com/2012/05/10/apple-foxconn-to-split-costs-of-improving-factory-working-conditions/

[24] http://barrickbeyondborders.com/environment/2010/04/greener-mining-environmental-clean-up-in-the-dominican-republic-reflects-modern-industry-approach/

[25] A primary objection to implementing so-called Pigouvian taxes (1920) to induce socially optimal output q^* solving $\pi'(q^*) = \psi'(q^*)$ is that the information about the profit function π and the externality function ψ are private to the firm. Although the firm may not know these functional forms, it is not unreasonable to assume that it is better informed than a government with taxing authority.

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