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Corporate Social Responsibility by Joint Agreement

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Abstract

Industry-wide voluntary agreements are touted as a means for corporations to take more corporate social responsibility (CSR). We study what type of joint CSR agreement induces firms to increase CSR efforts in a model of oligopolistic competition with differentiated products. Consumers have a willingness to pay for more responsibly manufactured products. Firms are driven by profit, and possibly by intrinsic motivation, to invest in costly CSR efforts. We find that co-operative agreements directly on the level of CSR *reduce* CSR efforts compared to competition. Such agreements throttle both for-profit and intrinsic motivations for CSR. CSR efforts only increase if agreements are permitted *solely* on output. Such production agreements, however, reduce total welfare in the market and raise antitrust concerns. Taking externalities into account may help to justify a production agreement under a total welfare standard, but not agreements on CSR directly. Moreover, simply requiring a higher CSR level by regulation while preserving competition always gives higher within-market welfare.

Keywords: CSR, voluntary agreement, cartel, competition policy, externalities, regulation

JEL Codes: K21, L13, L40, Q01

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1 Introduction

There is a growing realization that certain social objectives, such as diverting climate change, assuring fair trade that respects human rights, and promoting public health, urgently require drastic measures that governments often fail to take. With this realization have come appeals that corporations should take more social responsibility and serve wider stakeholder interests beyond mere shareholder value. A prominent recent call is that competitors best do this jointly, by coordinating their corporate social responsibility (CSR) activities. Nidumolu et al. (2014) claim that business collaboration is imperative to advancing sustainability. Kotchen and Segerson (2019) advocate voluntary collective agreements to solve commons problems in natural resource sectors such as forestry and fishery. Henderson (2020) calls for such "industry-wide cooperation" to stop environmental degradation and economic inequality. Permitting industry-wide CSR agreements is expected by these proponents to induce impactful corporate social responsibility efforts.

There have been several initiatives in recent years of companies joining together for good causes such as guarding against child labor and deforestation, or reducing the wasteful use of water and plastics. The Business Roundtable in 2019 united close to two hundred companies to "share a fundamental commitment to all of our stakeholders", including the environment.[1] Examples include chocolate producers wanting to agree together to improve the livelihoods of cocoa farmer under the tutelage of the Fair Trade Advocacy Office, fashion labels joining to ban garment production involving sweatshops with the Fair Wear Foundation, and a recent joint pledge by truck manufacturers to phase out diesel engines by 2040 under the umbrella of automaker association ACEA.[2] Earlier examples of collaboration to induce CSR efforts are given in Lyon and Maxwell (2004) and Peloza and Falkenberg (2009).

In this paper, we study what type(s) of joint CSR agreements amongst competitors can be expected to indeed advance CSR activities. The public interests to which CSR aims to contribute can require central coordination. Where governments fail to provide such coordination – for lack of legal instruments, information or political power – private coordination may be a solution. On the other hand, growing consumer appreciation and willingness to pay for products that are produced and sold more responsibly have elevated CSR as a dimension of product and corporate image differentiation. Companies increasingly recognize that consumers turn away from products that are seen as unjust, unfair and unsustainably manufactured.[3] This allows firms to monetize a comparative advantage in CSR on their rivals. Bansal and Roth (2000) and Porter and Kramer (2006) identified the strategic CSR business model, on which a large literature has developed since. Consumers wanting to buy from firms that are

[1] Statement on the Purpose of a Corporation, 19 August, 2019. Obtained from https://www.businessroundtable.org/business-roundtable-redefines-the-purpose-of-a-corporation-to-promote-an-economy-that-serves-all-americans

[2] See respectively www.fairtrade-advocacy.org, www.fairwear.org and www.acea.be.

[3] See, for example, Iannuzzi (2017).

serious about their CSR is a fast growing force that compels corporations to take more responsibility for environmental and social objectives.[4]

If CSR allows firms to differentiate themselves, then joint agreements on CSR efforts amongst firms in the same industry eliminate one aspect of competition amongst them. For this reason, cooperative CSR initiatives raise antitrust concerns, which have been noted to discourage or block such initiatives.[5] Competition law scholars have pointed at possibilities to exempt agreements that promote CSR benefits from cartel law.[6] Under the U.S. statutes on competition, the pursuit of wider public interests has little traction as an antitrust defense. Indeed, car manufacturers that agreed with the State of California to increase standards above the Federal standards for tailpipe emissions were promptly investigated for collusion.[7] In Europe there may be more legal leeway, but there are few precedents to date beyond washing machines and powders.[8] Proponents of deploying market power in the fight against climate change are calling for more guidance on when sustainability agreements may be permitted.[9]

The central premise of advocates of allowing joint agreements to promote CSR, is that corporations will take *more* social responsibility when they face *less* competition. It resonates with a literature that attributes erosion of social responsibility to market competition. Shleifer (2004) gives some examples of ethical behavior that can be undermined by competitive pressures and the need to cut cost. Falk and Szech (2013) and Bartling et al. (2015) find experimental evidence suggesting that intrinsic CSR behavior may be eroded in market settings – even though the number of competing subjects has no significant effect on that erosion.[10]

[4]Servaes and Tamayo (2013) stress the role of customer awareness, and in particular reputation, as a responsible company. Delmas and Colgan (2018) point out that while consumers' willingness to pay for CSR out of pure altruism may be small, it is boosted by perceived features such as improved performance, health attributes, savings, status and peer pressure.

[5]Henderson (2020), making a case in Chapter 6 for sustainable palm oil in which all firms agree "pre-competitive" to buy sustainable oil and push for sanctions against those of their competitors who do not behave accordingly, notes that there may be antitrust issues (page 169, footnote 16). For more examples see Schinkel and Treuren (2021).

[6]See Scott (2016) for cartel exemption possibilities under U.S. antitrust law, and Holmes (2020) under European competition law.

[7]See Hovenkamp (2019).

[8]In *CECED* (1999), the European Commission allowed washing machine producers to agree to take their least energy-efficient models collectively off the market. Yet the avoided emissions, though substantial, were not pivotal to the decision. Instead, the Commission concluded that a typical consumer would be compensated for the increased purchase costs of a more energy-efficient washing machines by the savings on his electricity bills. See *CECED* (1999), recital 56 and Ahmed and Segerson (2011). Some years later, in the complementary market for household laundry detergents, an accredited industry initiative to promote more sustainable washing powders became a cover for price collusion in *Consumer Detergents* (2011).

[9]See most of the contributions in Holmes et al. (2021).

[10]Ziegler et al. (2020) show that erosion of morals in lab experiments is larger in multi-unit markets than in single-unit markets. In contrast to this literature, Gomez-Martinez et al. (2019) find that consumer and managerial values are more important drivers of socially responsible behaviour in the lab than coordination.

Yet empirical studies on the relationship between market competition and CSR efforts suggests predominantly the opposite. Delmas and Montes-Sancho (2010) critically assess a voluntary agreement in the U.S. on climate. Du et al. (2011) identify CSR as a challenger's competitive weapon against a market leader. Fernández-Kranz and Santaló (2010) and Flammer (2015b) establish with variations in import duties and market concentration that stronger competition increases CSR efforts at the firm level. Simon and Prince (2016) find that a reduction in industrial concentration in the U.S. is associated with lower toxic releases at the factory level. Aghion et al. (2020) report that firms more frequently engage in green innovation if consumers prefer sustainability, and increasingly so in more competitive markets. Ding et al. (2020) directly link antitrust policy to sustainability by showing that stricter competition law regimes are associated with higher CSR, and that this link is stronger in countries with higher scores on a social norms index that weighs several factors including consumers' attitudes towards the environment and human rights.

Theoretical work also finds little evidence for a negative relation between CSR efforts and competition. Schinkel and Spiegel (2017) show that when consumers have a willingness to pay for more sustainable products, firms have stronger incentives to promote sustainability in competition than when they can make sustainability agreements. Dewatripont and Tirole (2020) study a variety of market models to conclude that whether competition is green or grey depends on the effect of "cutting ethical corners" on demand. But when prices are determined by an unconstrained market mechanism, they find that the intensity of competition has no effect on ethical behavior.

We study different types of joint CSR agreements in a model of oligopolistic competition with goods that are differentiated, including by the CSR efforts of their manufacturer. Consumers prefer to buy from companies that are committed to CSR and have a higher willingness to pay for their products. Numerous studies support this assumption. Casadesus-Masanell et al. (2009) report that people pay more for T-shirts made with organic cotton. Eichholtz et al. (2010) document a higher willingness to pay for office buildings with sustainability labels. In a survey of the literature, Kitzmueller and Shimshack (2012) conclude that willingness to pay in general positively depends on the degree of CSR a firm engages in. Flammer (2015a) finds sales growth after companies adopt CSR proposals by shareholders. Delmas and Colgan (2018) give many examples of this, in particular with eco-labels.

Reasons why firms may act responsibly range from purely profit motivation to purely intrinsic motivation.[11] We assume that firms base their business decisions, including their CSR efforts, first and foremost on profit. A pronounced CSR profile allows a company to attract more customers and charge higher prices. Early contribution on strategic CSR as a for-profit product differentiation strategy are Baron (2001)

[11] Bénabou and Tirole (2010). The debate on whether companies should pursue CSR objectives is old and polarized, see Friedman (1970). Magill et al. (2015) show that instructing firms to maximize stakeholder value can reduce negative externalities on their workers and consumers.

and McWilliams and Siegel (2001). For-profit CSR comprises a substantial part of the literature.[12] Fernández-Kranz and Santaló (2010) and Flammer (2015b) interpret their findings that CSR increases with more product market competition as consistent with CSR being strategic, since lower profit in competition leaves less scope for intrinsic CSR investments. Calveras and Ganuza (2018) find that CSR can serve as a tool for a firm's product differentiation strategy.[13]

In addition to these immediate for-profit objectives, companies can also have more sophisticated intrinsic reasons to invest in CSR. In surveys, executives indeed report both financial and intrinsic motives for engaging in CSR.[14] Baron (2007) studies social entrepreneurship out of "warm-glow" preferences. Hart and Zingales (2017a,b) point out that firms are right to pursue CSR objectives that contribute negatively to monetary profit when their shareholders are prosocial. Forward looking corporations may be of the view that contributing to society builds goodwill and a reputation that will pay-off in the long-run even when immediate demand is small. For example, Unilever CEO Paul Polman was convinced that a company can only be successful when in pace with society.[15] He explained how a socially driven mission aligns with core business in a *Harvard Business Review* interview titled "Captain Planet":

> "For proper long-term planning, you've got to take your externalities into account, in order to be close to society. It's clear that if companies build this thinking into their business models and plan carefully, it will accelerate growth." (*op. cit.* p.114)

A similar view may motivate large investment funds, such as Blackrock and Vanguard, to make public commitments to reduce emissions.[16] Such reasons for companies to put weight on social issues beyond their explicit profit motive, we capture in our model by a direct "intrinsic" motivation for CSR efforts. This can also include leadership by CEOs who are personally passionate about CSR and powerful enough to influence their company's decision making. Chatterji and Toffel (2019) refer to such efforts as "CEO activism".

CSR efforts have implications for a company's costs. Many of the motivating calls for collaborative CSR concern the need for firms to make a transition, for example by implementing known alternative methods of production, such as installing CO2 filters in factories, improving workplace safety, setting up a sustainable forest cycle, or building more spacious housing for their livestock. Such transitions come at a fixed cost that increases with the level of CSR efforts. The cost of attracting capital for

[12] See Kitzmueller and Shimshack (2012) for an overview.

[13] Bagnoli and Watts (2003), Kotchen (2006), and Besley and Ghatak (2007) show how for-profit companies investing in CSR can be a form of private public goods provision. See also Schinkel and Tóth (2019).

[14] See Graafland and Mazereeuw-Van der Duijn Schouten (2012).

[15] See Henderson (2020), in which Polman's corporate sustainability plans feature extensively, and Smith (2019).

[16] See Azar et al. (2021) and Kerber (2021).

such investments can be lower for firms with a stronger CSR profile, which can have fixed and variable cost implications. Firms with better CSR scores are found to have better access to capital and cheaper equity financing, due to growing reluctance of consumers and investors to fund gray production.[17] CSR efforts may also affect the marginal costs of production. Typically, concrete steps such as paying fairer wages and applying biological pesticides will increase per unit production costs. CSR efforts can also decrease marginal costs of production. Sustainable sourcing can giving higher yields, for example in agriculture and forestry, and employees are found willing to accept lower wages working for a company that has a socially driven mission.[18]

In our model, each firm first commits to a CSR level, and subsequently decides how much to produce. We analyze the effects of joint agreements on CSR efforts, production and prices when firms make these agreements about their CSR efforts, about their production volumes, or about both. A robust finding is that joint agreements that involve CSR levels directly – either agreements on CSR efforts alone or together with coordinated production – *reduce* CSR efforts compared to competition. This is true for any positive willingness to pay for CSR, no matter how little. The reason is that CSR coordination eliminates CSR as a dimension of competition, which allows firms to jointly profit from lower CSR investment costs. If CSR is to be increased by collaboration, only permitting coordination of output volumes (or prices) delivers. It increases the total rents from CSR investments, while maintaining competition for a larger share of those rents by each firm investing more in CSR.

These findings hold irrespective of the strength of companies' intrinsic motivation for CSR. In fact, intrinsic motivation magnifies our polar results. CSR coordination reduces the additional CSR due to intrinsic motivation because the loss of profit from increasing CSR effort beyond the profit maximizing level is larger for firms who jointly decide on CSR. Joint agreements on CSR throttle both for-profit and intrinsic motivation for corporate social responsibility. Therefore, if the social objective is to promote CSR by joint agreements, only coordination of output (or price) should be permitted.

Output (and price) agreements, however, are particularly problematic under the antitrust laws. Moreover, whenever firms have an incentive to form such agreements, we find that they necessarily reduce welfare. The current requirement under European competition law for obtaining a cartel exemption for an anticompetitive horizontal agreement is full compensation of the consumers of the products concerned. Yet compensation of consumers is not possible, as no joint agreement exists that simultaneously increases CSR levels, consumer welfare ánd profit over the competitive situation. Our findings on welfare imply that the compensation requirement must be relaxed if CSR is to be promoted by joint (output or price) agreement.

One possibility is to also take benefits outside the relevant market, such as externalities, into account.[19] When production causes negative externalities to non-consumers,

[17] See Sharfman and Fernando (2008), El Ghoul et al. (2011), and Cheng et al. (2014).

[18] Additionally, Flammer (2015a) reports higher labor productivity. See Polman's HBR interview (2012, p.114) on increased yield, and de Bettignies et al. (2020) on green human resource management.

[19] This has been proposed recently by the Dutch competition authority (Authority for Consumers

and CSR efforts reduce those externalities, another reason arises to favor production agreements over agreements on CSR directly. Production agreements decrease negative productions externalities, while CSR agreements, resulting in lower output and less CSR, do not. Allowing consumers to be harmed while valuing non-consumer benefits is not standard practice in competition policy, however. Such out-of-market-benefits are also very complex to assess. We show that government regulation is likely the better alternative. For any level of CSR, welfare is higher when that level is simply required by government regulation from companies remaining in competition, than when it is provided by exempting a production agreement from cartel law.

Our analysis of CSR agreements is in line with the literature on Research Joint Ventures (RJVs), where firms coordinate investments in cost-reducing R&D and subsequently compete in the output market. Seminal contributions are d'Aspremont and Jacquemin (1988), Suzumura (1992), and Kamien et al. (1992). RJV's can increase R&D investments above competitive levels if spillovers of one firm's innovation benefits the other firms, so that unilateral investments are discouraged. For this reason, there is a broad exemption clause available for RJVs, that extends also to cooperative research into more socially responsible and environmentally friendly production methods. However, with limited spillovers, competition is found to be the stronger driver of R&D. Importantly, CSR initiatives of the kind discussed in this paper have little or no spillovers from one company to another. Instead, they are primarily about firms transitioning to higher CSR levels by implementing existing technologies or more responsible ways of doing business.

Our model extends in various directions on Schinkel and Spiegel (2017), who study the effects of collaboration on sustainability efforts in a duopoly semi-collusion model. The semi-collusion literature allows for analyses of markets in which competitors cooperate in one dimension of competition, while competing in the other. Fershtman and Gandal (1994) and Brod and Shivakumar (1999) analyze the effects of cost-reducing R&D in RJVs between two firms in this setting. Cooperation in the output market and competition in the investment stage increase R&D but not necessarily profit. In more complex extended models, including to n-firms, Matsui (1989) studies investments in capacity, Fershtman and Pakes (2000) in product quality, and Symeonidis (2000) in advertising. Our application is to CSR efforts, allowing for any number of firms, with varying consumer willingness to pay for the improved product brand image, and additional firm intrinsic motivation to invest in CSR. We also consider partial agreements – by a subset of competitors, both on CSR and quantities – with findings that are in line with recent work on mergers where firms select both prices and R&D, as in Federico et al. (2018), Motta and Tarantino (2017), and Bourreau et al. (2021).

The remainder of the paper is organized as follows. In the next section we introduce our model of competition in CSR efforts and quantities. In Section 3, we analyze what level of CSR results under different types of joint agreement. In Section 4, we study welfare effects. In Section 5, we discuss how production agreements that advance

and Markets, 2021). See Schinkel and Treuren (2021) for a critical review.

CSR efforts may qualify for an antitrust exemption, despite harming consumers, by taking wider, out-of-market-efficiencies into account. Section 6 concludes. Proofs of all propositions are in Appendix A. Robustness analyses in case of price-setting instead of quantity-setting, alternate preferences and associated demand in which price and CSR increases trade off differently in consumer welfare, and partial CSR agreements that do not involve all competitors, are discussed in Appendices B to D.

2 A model of strategic CSR investments

Consider a market in which n firms, labeled $i = 1, ..., n$, each sell a product that is differentiated, including by the firm's standard of corporate social responsibility (CSR) $v_i \geq 0$. An increase in v_i can represent, for example, that firm i's product is manufactured using fewer natural resources, lower emissions production technologies, or a higher standard of care for workers and farm animals in the supply chain. The preferences of a representative consumer over these products, consumed in quantities $\mathbf{q} = q_1, ..., q_n$, are described by utility function

$$U(\mathbf{q}, \mathbf{v}, m) = \sum_{i=1}^{n}(\alpha + v_i)q_i - \frac{1}{2}\left(\sum_{i=1}^{n} q_i^2 + 2\gamma \sum_{i=1}^{n}\sum_{i>j} q_i q_j\right) + m, \tag{1}$$

in which $\mathbf{v} = v_1, ..., v_n$ are the firms' CSR levels, $\alpha > 0$ is a utility parameter, $\gamma \in (0, 1)$ measures the degree of symmetric horizontal product differentiation on other dimensions than CSR, and $m \geq 0$ is expenditure on any other goods.[20]

These preferences yield the following demand system from maximizing $U(\mathbf{q}, \mathbf{v}, m)$ subject to the budget constraint $\sum_{i=1}^{n} p_i q_i + m \leq I$, where p_i is the price of good i and I is representative income

$$p_i(\mathbf{q}, v_i) = \alpha + v_i - q_i - \gamma \sum_{i \neq j}^{n} q_j, \quad i = 1, ..., n. \tag{2}$$

Market demand captures that consumers are willing to pay more for products of firms that invest in higher CSR levels by v_i increasing the intercepts. Note that higher values of γ reflect that consumers consider the products to be closer substitutes.

For companies, investing in the transition to a higher level of CSR can be a profitable strategy. Let $\frac{tv_i^2}{2}$ be firm i's fixed cost of CSR effort v_i ($t \geq 1$). Regular marginal cost of production are c for all producers. Firm i's profit then is given by

$$\pi_i(\mathbf{q}, v_i) = \left(\alpha + v_i - q_i - \gamma \sum_{i \neq j}^{n} q_j - c\right) q_i - \frac{tv_i^2}{2}, \tag{3}$$

[20] See Choné and Linnemer (2020) for a recent overview of this widely used preference structure, originally proposed in Shubik and Levitan (1980).

Note that CSR effort v_i can be interpreted as the net effect of willingness to pay for CSR and CSR-induced marginal cost changes on firm i's price-cost margin $p_i - c$. In Section 3.2 we extend the model to varying willingness to pay for CSR, and allow CSR efforts to affect the marginal cost of production.

Firms are for-profit organizations, if only under the pressure of shareholders and investors. They determine their CSR and production levels strategically by maximizing (3). While this is a reasonable baseline assumption, in the domain of socially responsible behavior firms may be motivated also by other objectives, ranging from a leader's genuine intrinsic willingness to do good to reputational gains not directly reflected in willingness to pay for CSR. In Section 3.3 we study the effects of additional intrinsic motivation for CSR by adding a firm's CSR efforts into it's objective function.

The interaction between the n firms involves two stages. In Stage 1, firms simultaneously choose their CSR efforts, which are assumed to be fully observable by consumers and firms. In Stage 2, given their CSR levels $\mathbf{v}$, firms simultaneously decide how much to produce. Note that our sequential setup implies that all firms have committed to their CSR efforts by the time they decide on production (or prices for that matter). In our motivating examples, strategic company commitment to transit into more sustainable sourcing and manufacturing precedes production volume and sales decisions. A company's CSR investments – such as investments in cleaner technology or filters – are costly to reverse and have strategic commitment value.[21]

As all firms are identical, we focus on symmetric pure strategy solutions. In normal competition, each firm i selects both strategic variables v_i and q_i independently, taking its rivals' decisions as given. This non-cooperative benchmark is denoted by superscript $*$, its unique Nash-equilibrium by (v^*, q^*). Firms compete on CSR in the sense that a firm, by increasing its CSR efforts, makes itself relatively more attractive to consumers to purchase from, allowing it to steal customers from its competitors. This business stealing-effect induces companies to invest more in CSR. We note that when competition is more intense (for high values γ and n), this can be such a strong force that the firms are whipped up to invest more in CSR than the social optimum that maximizes within-market welfare. Since the starting point of the initiatives to allow collaborations is that CSR efforts are too low in competition and need stimulation, we are most interested in markets in which higher CSR levels increase total within-market welfare. Proposition 7 in Section 4 specifies general conditions under which this is the case. Nonetheless, all of our results are derived for all parameter values.

[21] In Appendix B, we show that our results carry through if firms select prices in Stage 2 instead of quantities. Whether the Stage 2 agreement is about output or price, in either case the drive to steal customers by trying to set a higher CSR level gets stronger when the margin on these customers is larger.

3 Joint agreements to promote CSR

To study whether and how allowing companies to make voluntary joint agreements can increase their CSR efforts, we compare CSR levels and output under three types of agreements to the benchmark where no agreements are allowed. First, in a "CSR agreement" (csr) the firms cooperatively decide on the CSR efforts they each take and subsequently compete on quantities. This is the type of agreement that is proposed in practice to stimulate CSR, as set out in Section 1. The U.S. Business Roundtable and the European *CECED* case are examples. Cooperation is on CSR efforts, while competition is to remain on quantities (and prices). The symmetric solution is indicated by (v^{csr}, q^{csr}).

Second, in a "production agreement" (p) firms coordinate their output volumes, while still deciding on their CSR efforts independently. This is the opposite of a CSR agreement and essentially a classic cartel. Note however that since the firms compete also in CSR efforts, competition is not fully eliminated under this type of agreement. To the best of our knowledge, none of the advocates of using joint agreements to stimulate higher CSR efforts has so far advocated sole output coordination. The symmetric solution is indicated by (v^p, q^p).

Third, in a "full agreement" (f) the firms decide cooperatively on both their CSR levels and their output, thereby fully eliminating competition. While this is not what is currently proposed, it may result in practice because allowing firms to coordinate one dimension of competition may give them a forum for discussion that they can abuse to agree on the other dimensions as well. For a competition authority, it will be particularly difficult to monitor and assure that the firms it allows to exchange commercially sensitivity information for the purpose of coordinating their CSR efforts do not misuse that permission to secretly coordinate output (or prices) as well. It has been documented that well-intended cooperation can slide to hard core collusion, for example, for research joint ventures.[22] The symmetric solution is indicated by $\left(v^f, q^f\right)$.

In the main text, we study market-wide agreements in which all competitors participate. Exempted from cartel law, these agreements can in principle be contracted and made legally binding before a court. Therefore, even though their anticompetitive nature will typically create incentives for the members of these agreements to deviate, with different CSR efforts and production volumes than agreed upon, such defection would constitute a breach of contract that sufficiently large liabilities can prevent. This means that adherence to any agreement can be secured, so that we can follow the literature on semi-collusion and ignore the classic problems of internal and external stability that play in illegal market coordination.[23]

We begin by analyzing the baselines model in Section 3.1. In Sections 3.2 and 3.3, we subsequently show that our main result on the ranking of CSR efforts across the

[22]Duso et al. (2014) find that cartel infringement follow in markets that were previously allowed to form RJVs. *Consumer Detergents* (2011) is a case in point.

[23]Freeriding on voluntary collective agreements is studied in Ahmed and Segerson (2011), Brau and Carraro (2011), and Kotchen and Segerson (2019).

three types of joint agreements is robust to low willingness to pay with consumers for CSR, CSR efforts affecting the marginal cost of production, and firms being intrinsically motivated to invest in CSR in addition to their for-profit motives.

3.1 Effective joint agreements

Our main finding is that the CSR levels resulting from the three different types of joint CSR agreements compare as follows to the non-cooperative CSR level v^*, for all parameter values (α, γ, c, t, n).

Proposition 1. $v^p > v^* > v^f > v^{csr}$.

Proof. See Appendix A. ■

Proposition 1 states that allowing agreements that directly involve CSR efforts leads to lower CSR levels than would result in the non-cooperative benchmark. When two firms both increase CSR efforts, their business stealing effects cancel out, but the costs of increased CSR efforts remain. When coordinating their CSR levels, firms therefore reduce their CSR efforts and save on their investment costs. In contrast, a production agreement is found to raise CSR efforts compared to the non-cooperative benchmark. A production agreement increases price-cost margins in the second stage of the game. These higher rents give the firms stronger business stealing incentives for investing in CSR in the first stage, as each additional customer is now worth more.

Proposition 1 holds for a wide class of demand systems. To see this, consider the reduced form profit in Stage 1 for any firm i

$$\pi_i(\mathbf{q}(\mathbf{v}), v_i), \tag{4}$$

where $\mathbf{q}(\mathbf{v}) = q_1(\mathbf{v}), \ldots, q_n(\mathbf{v})$ are the conditional quantities, conditional on the choices of CSR in Stage 1, that solve Stage 2. In all four regimes $r \in \{*, csr, p, f\}$, firm i picks v_i to maximize

$$\pi_i(\mathbf{q}(\mathbf{v}), v_i) + \psi \sum_{i \neq j}^{n} \pi_j(\mathbf{q}(\mathbf{v}), v_j), \tag{5}$$

where $\psi = 1$ if CSR levels are chosen cooperatively in Stage 1 (in $r = csr$ or $r = f$) and $\psi = 0$ otherwise (in $r = *$ or $r = p$).

If firms select quantities non-cooperatively in the Stage 2, then $\forall i$, $\frac{\partial \pi_i}{\partial q_i} = 0$ and $q_i(\mathbf{v}) = q_i^*(\mathbf{v})$, where $q_i^*(\mathbf{v})$ is the Nash-equilibrium conditional quantity. If firms select quantities cooperatively in Stage 2, then, $\sum_i \frac{\partial \pi_i}{\partial q_j} = 0$ $\forall j$, and $q_i(\mathbf{v}) = q_i^c(\mathbf{v})$, where $q_i^c(\mathbf{v})$ is the cooperative conditional quantity (in either $r = p$ or $r = f$, that is). The

first-order condition for firm i choosing v_i in the non-cooperative benchmark is

$$\sum_{i \neq j}^{n} \frac{\partial \pi_i}{\partial q_j} \frac{\partial q_j^*}{\partial v_i} + \frac{\partial \pi_i}{\partial v_i} = 0. \tag{6}$$

For a CSR agreement, it is

$$\sum_{i \neq j}^{n} \frac{\partial \pi_i}{\partial q_j} \frac{\partial q_j^*}{\partial v_i} + \frac{\partial \pi_i}{\partial v_i} + \sum_{i \neq j}^{n} \left(\sum_{i \neq j \neq k}^{n} \frac{\partial \pi_j}{\partial q_k} \frac{\partial q_k^*}{\partial v_i} + \frac{\partial \pi_j}{\partial q_i} \frac{\partial q_i^*}{\partial v_i} \right) = 0, \tag{7}$$

for a production agreement

$$\sum_{i \neq j}^{n} \frac{\partial \pi_i}{\partial q_j} \frac{\partial q_j^c}{\partial v_i} + \frac{\partial \pi_i}{\partial v_i} + \frac{\partial \pi_i}{\partial q_i} \frac{\partial q_i^c}{\partial v_i} = 0, \tag{8}$$

and for a full agreement

$$\frac{\partial \pi_i}{\partial v_i} = 0. \tag{9}$$

Equation (6) reveals the two incentives to invest in CSR that exist in the non-cooperative benchmark. The first term in equation (6) is the business stealing effect. By increasing its CSR level, a firm becomes relatively more attractive to consumers, and the quantity of all other firms decreases as a result. The second term in equation (6) is the demand effect, best seen in equation (2). Increasing its CSR level allows a firm to increase its price, holding quantity constant. Because firms select quantities to maximize their conditional profit in Stage 2, $\frac{\partial \pi_i}{\partial q_i} = 0 \ \forall i$, implying that each firm ignores the effect of CSR investment on own profit mediated by changes in own quantity.

The terms in brackets in equation (7) show the additional (dis)incentives to invest in CSR that exist for a CSR agreement. For $n \geq 3$, the business stealing effect imposes both positive and negative externalities on the profit of the firms in a CSR agreement. Firm i's investment in CSR decreases firm j's profit by increasing firm i's quantity, but increases firm j's profit by reducing quantities of all firms k ($i \neq j \neq k$). If $|\frac{\partial \pi_j}{\partial q_i} \frac{\partial q_i^*}{\partial v_i}| > \sum_{i \neq j \neq k}^{n} |\frac{\partial \pi_j}{\partial q_k} \frac{\partial q_k^*}{\partial v_i}|$, the negative externality dominates and a CSR agreement reduces CSR levels compared to the non-cooperative benchmark. Intuitively, the requirement for $v^* > v^{csr}$ is that firm i's CSR level influences firm i's quantity sufficiently more than it influences the quantity of all other firms.

A production agreement sets quantities cooperatively in Stage 2 such that $\sum_{i=1}^{n} \frac{\partial \pi_i}{\partial q_j} = 0 \ \forall j$. This implies that $\frac{\partial \pi_i}{\partial q_i} > 0$, as $\frac{\partial \pi_i}{\partial q_j} < 0$ ($i \neq j$). Firms in a production agreement take into account this positive effect of investing in CSR on own quantity, shown in the final term of equation (8). A production agreement increases price-cost margins, making it more profitable to attract extra consumers by investing in CSR. If $|\frac{\partial q_j^c}{\partial v_i}|$ is not too much smaller than $|\frac{\partial q_j^*}{\partial v_i}|$ ($i \neq j$), then it follows that $v^p > v^*$.

A full agreement controls both quantity and CSR levels, so that it completely eliminates the business stealing effect, and CSR investment is only driven by the demand effect. Equation (9) can be written as $\sum_{i\neq j}^{n}\frac{\partial\pi_i}{\partial q_j}\frac{\partial q_j^*}{\partial v_i}+\frac{\partial\pi_i}{\partial v_i}-\sum_{i\neq j}^{n}\frac{\partial\pi_i}{\partial q_j}\frac{\partial q_j^*}{\partial v_i}=0$. As long as $\frac{\partial\pi_i}{\partial q_j}\frac{\partial q_j^*}{\partial v_i}>0$, comparing equation (6) to equation (9) shows that $v^*>v^f$. If $|\frac{\partial\pi_j}{\partial q_i}\frac{\partial q_i^*}{\partial v_i}|-\sum_{i\neq j\neq k}^{n}|\frac{\partial\pi_j}{\partial q_k}\frac{\partial q_k^*}{\partial v_i}|>|\sum_{i\neq j}^{n}\frac{\partial\pi_i}{\partial q_j}\frac{\partial q_j^*}{\partial v_i}|$, we have $v^f>v^{csr}$. This condition requires firm i's CSR level to influence firm i's demand sufficiently more than the demand of all other firms.

Hence, if raising CSR efforts is the goal, production agreements are the only type of joint agreement to consider allowing. Yet competitors will not voluntarily form a production agreement if competition is too strong in the non-cooperative benchmark, as the following proposition shows. Let $\pi(q^r,v^r)$ denote profit in regime $r\in\{*,csr,p,f\}$, where q^r is the concomitant quantity.

Proposition 2. $\pi(q^p,v^p)>\pi(q^*,v^*)$ for $\gamma\leq\Gamma(n)$, or $\gamma>\Gamma(n)$ and $t>T(\gamma,n)$.

Proof. See Appendix A. ■

Firms only profit from engaging in a production agreement if their products are sufficiently differentiated, or otherwise if investing in CSR is sufficiently expensive.[24] If products are very similar ($\gamma>\Gamma(n)$) or investing in CSR is cheap ($t<T(\gamma,n)$), business stealing incentives are very high in production agreements. This causes firms to engage in a non-profitable 'arms race' in CSR efforts, as in equilibrium business stealing efforts between firms cancel out such that only the costs remain.[25] When companies are allowed to form a production agreement for the purpose of stimulating CSR efforts, they will only voluntarily form one if it does not induce them to invest too much in CSR thereby reducing profit compared to the non-cooperative benchmark.

Finally, we note that $\pi\left(q^f,v^f\right)>\pi\left(q^p,v^p\right)$ and $\pi\left(q^f,v^f\right)>\pi\left(q^{csr},v^{csr}\right)$ always hold, confirming that firms allowed to coordinate on one dimension of competition between them are tempted to try to collude on the other(s) as well. It is straightforward that in a full agreement firms can always replicate the production or CSR agreement outcomes, and do better by restricting respectively their CSR investments and joint output. Such full elimination of competition would be illegal also under the policy to stimulate CSR by voluntary cooperative agreements – and therefore requires secrecy and stabilization against the threat of unilateral defection, entry and exit, which we leave aside. Nevertheless, if the risk of joint initiatives to promote companies taking

[24]The exact expressions for the critical values of product homogeneity $\Gamma(n)$ and CSR costs $T(\gamma,n)$ are tedious and given in the proof of Proposition 2. They depend on n, with the parameter space where a production agreement is beneficial to the firms shrinking as n increases.

[25]The possibility that firms over-invest in either cost-reducing R&D or capacity in a non-cooperative first stage is also found in Fershtman and Gandal (1994), and in Brod and Shivakumar (1999) when spillovers are low or absent.

more CSR sliding into full collusion is not strictly controlled, CSR levels may end up lower than in competition.

3.2 Willingness to pay and CSR-dependent marginal costs

Proponents of allowing firms to coordinate their CSR efforts have argued that collaboration is needed to increase CSR because consumer exhibit low, no, or even negative willingness to pay for the costly CSR efforts. A sufficiently high willingness to pay over CSR-related marginal cost increases would be needed for competition to be a stimulus for CSR efforts.[26] In particular, firms in competition would be held back by a first-mover disadvantage from unilaterally making investments in more responsible manufacturing, as this would decrease those firms' market shares and profitability. Only coordinated CSR investments would be able to break the deadlock.[27] To study the validity of these arguments, we extend the baseline model with varying willingness to pay for CSR and CSR-dependent marginal costs.

Recall that market demand is positively related to CSR because consumers are assumed to be willing to pay more for products of firms with high CSR levels. In the market demand function (2), the price is assumed to increase one-to-one with the level of CSR effort v_i. To see what the effect is of lower or higher willingness to pay for CSR, consider the slightly more general demand system (denoted by superscript δ)

$$p_i^{\delta}(\mathbf{q}, v_i) = \alpha + \beta v_i - q_i - \gamma \sum_{i \neq j}^{n} q_j, \quad i = 1, ..., n, \tag{10}$$

in which $\beta \geq 0$ scales the willingness to pay for CSR, that follows straightforwardly from multiplying v_i in utility (1) by β.

This generalization also allows for the analysis of cases in which CSR investments affect the marginal costs of production. Let the total marginal cost of production at CSR level v_i be given by $c(1 + \kappa v_i)$, in which $\kappa \geq 0$ ($\kappa < 0$) is the increase (decrease) in the marginal costs of production resulting from higher CSR effort. As discussed in Section 1, CSR induced marginal cost changes can be in either direction. While CSR terms such as better working conditions typically increase input costs, sustainable sourcing can increase access to funding and yield, and allow the company to pay lower interest rates and wages.

The profit of each firm i can then be written as

$$\pi_i^{\delta}(\mathbf{q}, v_i) = \left(\alpha + \delta v_i - q_i - \gamma \sum_{i \neq j}^{n} q_j - c \right) q_i - \frac{t v_i^2}{2}, \tag{11}$$

where $\delta \equiv \beta - \kappa c$ is the net effect of willingness to pay for CSR and CSR-induced marginal cost changes on firm i's price-cost margin $p_i - c$. In the basic model that

[26] See Dolmans (2021).

[27] Authority for Consumers and Markets (2021).

underlies Proposition 1, $\delta = 1$ for simplicity. Obviously, for negligible cost increases, small values of δ reflect low willingness to pay for products of companies that take high CSR efforts. The value of δ remains positive as long as any marginal cost increases resulting from a higher CSR efforts are matched by a sufficiently strong consumer willingness to pay for them. Note that when $\delta \leq 0$, CSR levels only enter the profit function as a cost, so that no firm would invest in CSR regardless of the competitive regime.

From comparing CSR levels derived from the profit function in equation (11) across the four regimes, we find that their ranking is maintained – denoting the variation with subscript δ.

Proposition 3. $v_\delta^p > v_\delta^* > v_\delta^f > v_\delta^{csr}$ for all $\delta > 0$.

Proof. See Appendix A. ■

We establish that the ranking op CSR levels given in Proposition 1 holds whenever consumers have at least some positive willingness to pay for more responsibly manufactured products over and above any marginal cost increase from the CSR advance, no matter how little that net willingness to pay is. When this is the case, corporations will each take more CSR efforts in competition than when they can coordinate their CSR actions.

The generality of this result can be seen again from the first-order conditions given in equations (6) to (9): these expressions are identical when $\delta > 0$. Scaling the willingness to pay to CSR simply scales all incentives related to CSR, as is made precise in the following proposition.

Proposition 4. $\frac{\partial(v_\delta^p - v_\delta^*)}{\partial\delta} > 0$, $\frac{\partial(v_\delta^* - v_\delta^f)}{\partial\delta} > 0$, and $\frac{\partial(v_\delta^f - v_\delta^{csr})}{\partial\delta} > 0$ for all $\delta > 0$.

Proof. See Appendix A. ■

As a firm's price-cost margin increases, the differences between CSR levels in the different regimes increase. As δ scales the positive direct effect of CSR levels on profit, it also scales all incentives related to CSR. When δ increases, the business stealing effect of investing in CSR is magnified, further increasing incentives for CSR investments in a production agreement, and further decreasing incentives for CSR investments when firms coordinate such investments. If instead δ decreases, for instance due to increased marginal costs following CSR investments, the CSR levels in the different regimes converge and go to zero once β becomes non-positive.

The conclusion remains that CSR agreement do not stimulate CSR efforts compared to the non-cooperative benchmark: only production agreements do. There simply is no first-mover disadvantage due to "low" willingness to pay for the products and services of companies that take more social responsibility. Whenever firms can monetize their

CSR efforts somewhat, by attracting more business or increasing their margin, even if only little, their incentives to invest in CSR are always stronger when they compete than when they are allowed to make CSR agreements. The crucial insight is that the difference in CSR efforts between competition and CSR cooperation is positive whenever there is a (net) positive willingness to pay. Moreover, if consumers have no positive (net) willingness to pay for CSR ($\delta \leq 0$), coordination can never break any first-mover disadvantage deadlock as firms will never invest in CSR.

3.3 Intrinsic motivation for CSR

To study the extent to which intrinsic motivation for CSR affects our main findings, while by-passing principal-agent complexities or other issues that may be behind this motivation, we simply extend firm i's objective function with an additive term for direct CSR motivation. That is, let firm i maximize

$$\pi_i(\mathbf{q}, v_i) + \theta v_i, \tag{12}$$

in which $\theta \geq 0$ is a scaling parameter that expresses each firm's valuation of CSR for intrinsic reasons and $\pi_i(\mathbf{q}, v_i)$ is given by equation (3).

In Stage 2 of the game, nothing changes compared to the baseline model and the conditional quantities v are still given by $q_i^*(\mathbf{v})$ if firms independently set quantities, and $q_i^c(\mathbf{v})$ if firms jointly set quantities. In Stage 1 of all four competitive regimes, firm i now picks v_i to maximize

$$\pi_i(\mathbf{q}(\mathbf{v}), v_i) + \theta v_i + \psi \sum_{i \neq j}^{n} \left(\pi_j(\mathbf{q}(\mathbf{v}), v_j) + \theta v_j\right), \tag{13}$$

where $\psi = 1$ if CSR levels are chosen cooperatively in Stage 1, and $\psi = 0$ otherwise. It is immediate from (13) that firms will invest more in CSR if they are intrinsically motivated than if they solely maximize profit ($\theta = 0$). The resulting CSR levels, denoted by a subscript I, compare as follows.

Proposition 5. $v_I^p > v_I^* > v_I^f > v_I^{csr}$ for all $\theta > 0$.

Proof. See Appendix A. ■

We find that the ranking of CSR levels across the different competitive regimes is unaffected when firms are also intrinsically motivated to increase CSR. Still the only agreement that will increase CSR levels compared to the non-cooperative benchmark is a production agreement.

The reason for this is as follows. Adding θ to the left-hand side of the first-order conditions given in equations (6) to (9) gives the first-order conditions when firms are also intrinsically motivated. This shows that the added incentive to invest in CSR due

to intrinsic motivation is identical for all competitive regimes. Yet the lost profit from increasing CSR above the profit-maximizing level is not identical. In a production agreement, this lost profit is lowest as $\frac{\partial \pi_i}{\partial q_i} > 0$ and $\frac{\partial q_i^c}{\partial v_i} > 0$, so that the reduction in profit from pushing CSR efforts above the profit-maximizing amount is somewhat mitigated. For a CSR agreement the lost profit of a given CSR increase is highest, as each CSR increase decreases profit for all members of the agreement, which is exactly the externality a CSR agreement is trying to avoid. A CSR agreement will therefore only slightly increase its CSR efforts for a given level of intrinsic motivation. A full agreement combines both effects although the negative externality of CSR on the profit of all other firms in the agreement dominates. To see the generality of this result, note that the above arguments also carry through when intrinsic motivation is a smooth function of CSR, $f(v_i)$, in which case the term $\frac{\partial f(v_i)}{\partial v_i}$ is added to the left-hand side of first-order conditions (6) to (9).

The differences between the CSR levels of the different competitive regimes are increasing in the level of intrinsic motivation, as formalized in the next proposition.

Proposition 6. $\frac{\partial (v_I^p - v_I^*)}{\partial \theta} > 0$, $\frac{\partial (v_I^* - v_I^f)}{\partial \theta} > 0$, and $\frac{\partial (v_I^f - v_I^{csr})}{\partial \theta} > 0$ for all $\theta > 0$.

Proof. See Appendix A. ■

The stronger the direct motivation for CSR, the higher are CSR levels that are selected non-cooperatively compared to CSR levels selected in coordination. The mechanisms underlying this result are those discussed in the previous paragraph. Allowing joint CSR agreements, therefore, is an increasingly ineffective way of inducing CSR efforts when companies' intrinsic motivation becomes a more important driver of CSR efforts. This is true for all finite θ – for some sufficiently high value of which, of course, immediate profit become negative. At best do all regimes converge on the same infinite CSR efforts – and infinite immediate losses – in the limit of θ going to infinity so that for-profit motivation is no longer part of a company's objective. We conclude that joint CSR agreements are never better than the benchmark, not even when corporations are directly motivated to do good, however strongly. The incentives for CSR efforts remain greatest in a production agreement.

4 Consumer and total welfare effects

To analyze the welfare effects of the different types of joint agreements, we return to the baseline model ($\delta = 1$, $\theta = 0$). Consumer welfare follows from substituting demand (2) into utility (1)

$$CS(\mathbf{q}) = \frac{1}{2}\left(\sum_{i=1}^{n} q_i^2 + 2\gamma \sum_{i=1}^{n} \sum_{i>j} q_i q_j\right). \tag{14}$$

Note that CSR does not directly affect consumer surplus because the additional utility from higher CSR efforts in equation (1) is cancelled out by matching price increases in demand (2). In this model, CSR levels only have an indirect effect on consumer welfare, through the way in which the firms' quantities depend on their CSR efforts.[28] As quantities are symmetric, consumer surplus reduces to $CS(q^r) = \frac{n}{2}(\gamma(n-1)+1)(q^r)^2$, where $r \in \{*, csr, p, f\}$, so that the ranking of consumer welfare across different competitive regimes corresponds to the ranking of quantities q^r.[29]

First we establish that joint agreements that fail to increase CSR efforts always harm consumers: $CS\left(q^*\right) > CS\left(q^{csr}\right) > CS\left(q^f\right)$. A full agreement reduces consumer welfare on two accounts compared to the non-cooperative benchmark: it reduces conditional quantities in Stage 2 and CSR levels in Stage 1. A CSR agreement produces the non-cooperative quantity *conditional* on CSR levels in in Stage 2, but reduces CSR levels in Stage 1, reducing consumer welfare on one account compared to the non-cooperative benchmark.

To compare a CSR agreement to a full agreement, first note that if CSR efforts are identical across firms and equal to v, conditional quantities are given by

$$q^*(v) = \frac{A+v}{\gamma(n-1)+2} \text{ and } q^c(v) = \frac{A+v}{2(\gamma(n-1)+1)} \tag{15}$$

where $q^*(v)$ is the conditional quantity if firms select quantities non-cooperatively in Stage 2, $q^c(v)$ is the conditional quantity if firms select quantities cooperatively in Stage 2, and $A = \alpha - c$. The difference in consumer surplus between a CSR agreement and the non-cooperative benchmark can be written as $|\frac{\partial CS}{\partial q}\frac{\partial q^*}{\partial v}\Delta v^{csr}|$, where Δv^{csr} is $v^{csr} - v^* < 0$, and the difference in consumer surplus between a full agreement and the non-cooperative benchmark can be written as $|\frac{\partial CS}{\partial q}(\frac{\partial q^c}{\partial v}\Delta v^f + \Delta q^f)|$, where Δv^f is $v^f - v^* < 0$ and Δq^f is $q^f(v^*) - q^*(v^*) < 0$. As long as $|\frac{\partial q^*}{\partial v}\Delta v^{csr}| < |\frac{\partial q^c}{\partial v}\Delta v^f + \Delta q^f|$, a full agreement reduces consumer surplus by more than a CSR agreement. In essence, unless benchmark quantities react very strongly to changes in CSR, a full agreement reduces consumers surplus by more than a CSR agreement.

Second, we note that the ranking of profit across these three regimes is opposite to that of consumer surplus for all parameter values: $\pi(q^f, v^f) > \pi(q^{csr}, v^{csr}) > \pi(q^*, v^*)$. Combined as total welfare in the market, defined for regime r as

$$W(q^r, v^r) = CS(q^r) + n\pi(q^r, v^r).$$

Let $W(q^*(v), v)$ denote welfare when all firms set quantities non-cooperatively and identical CSR levels v. We find that welfare compares as follows.

[28] For this reason, consumer surplus expression (14) follows equivalently from substituting demand (10) into the corresponding utility function (1), in which v_i is multiplied by β. Consumer surplus, that is, does not directly depend on the willingness to pay of consumers for CSR efforts.

[29] In Appendix C, we show that our findings on welfare are robust to allowing CSR levels to directly influence consumer welfare.

Proposition 7. $W(q^*, v^*) > W(q^{csr}, v^{csr}) > W(q^f, v^f)$ and $\frac{\partial W(q^*(v),v)}{\partial v}|_{v=v^*} > (<)0$ if $\gamma < (>)\, \Gamma'(n)$.

Proof. See Appendix A. ■

Unsurprisingly, given Proposition 1, competition is unambiguously the superior regime amongst these three: it produces both higher CSR efforts and higher output, hence higher total within-market welfare. Proposition 7 also makes more precise in what sense competition should not be too strong, as mentioned in the introduction. When products are relatively homogeneous, beyond a critical level that decreases in the number of firms (n), it is no longer possible to improve within-market total welfare by inducing more investments in CSR. That is, only when competition is sufficiently imperfect is the optimal CSR level in the market higher than the level in the non-cooperative benchmark.[30]

In case of production agreements, there is a trade-off: consumers benefit from increased CSR efforts, but are harmed from reduced output and therefore higher prices. However, we find that welfare is never served by allowing voluntary production agreements either. While a production agreement increases CSR efforts, it reduces consumer welfare compared to competition, except for a small set of well-chosen duopolies in which the firms would not voluntarily form the agreement. The following set of results establishes this.

Proposition 8. $CS(q^*) > CS(q^p)$, unless $n = 2$ and $t < \frac{4-2\gamma+\gamma^2}{2(1-\gamma)(4-\gamma^2)}$, in which case $CS(q^*) < CS(q^p)$ and $\pi(q^*, v^*) > \pi(q^p, v^p)$.

Proof. See Appendix A. ■

The first part of the proposition states that only when there are two firms and investing in CSR is sufficiently cheap, which is more often the case when goods are very similar (γ close to 1), does a production agreement increase consumer welfare compared to the non-cooperative benchmark. In all other cases, consumers are worse off with a production agreement, despite the higher CSR levels.

The intuition is as follows. A production agreement creates two opposing effects on consumer surplus. From Proposition 1 we know that in all cases $\Delta v^p = v^p - v^* > 0$. Comparing conditional quantities (15) above shows that a production agreement reduces output conditional on CSR levels, and therefore $\Delta q^p = q^c(v^*) - q^*(v^*) < 0$. The total difference in consumer surplus between a production agreement and the non-cooperative benchmark is therefore given by $|\frac{\partial CS}{\partial q}(\frac{\partial q^c}{\partial v}\Delta v^p + \Delta q^p)|$. In a duopoly, if

[30] We note that the socially optimal level of CSR is loss-making for the firms. The social optimum requires prices to equal marginal costs, and therefore firms make a loss after taking into account the fixed costs of CSR investment.

goods are similar and investing in CSR is cheap, $t < \frac{4-2\gamma+\gamma^2}{2(1-\gamma)(4-\gamma^2)}$, the business stealing effect is very strong and Δv^p becomes so large that the net effect on consumer surplus is positive. However, as n increases, the responsiveness of quantity to CSR levels diminishes and even when Δv^{pc} is high, consumers are worse off compared to the non-cooperative benchmark.

To see the consumer welfare trade-off, note that the difference in total quantity between a production agreement and the non-cooperative benchmark, conditional on a fixed CSR level $\overline{v}$ is given by

$$n(q^*(\overline{v}) - q^c(\overline{v})) = (A + \overline{v})\frac{\gamma n(n-1)}{2(\gamma(n-1)+2)(\gamma(n-1)+1)} \tag{16}$$

which monotonically increases to $(A + \overline{v})\frac{1}{2\gamma}$ as n goes to infinity. This implies that a production agreement hurts consumers by reducing conditional quantities regardless of market size, and that this negative effect on consumer surplus increases in n. From Proposition 1 we know that $v^p > v^*$, but whether this also results in increased consumer surplus depends on the responsiveness of quantity to CSR levels in both competitive regimes. The conditional quantities in equations (15) show that output is less responsive to CSR levels in a production agreement than in the non-cooperative benchmark, and that this difference in responsiveness is increasing in n. In a duopoly, the responsiveness of quantity to CSR levels is highest, so high in fact that when investing is sufficiently cheap a production agreement's CSR level might lead to a higher quantity compared to the non-cooperative benchmark. However, as n increases the responsiveness of quantity to CSR levels quickly drops off, and the reduction of conditional quantities eventually dominates the increase in CSR levels.

The trade-off between higher CSR levels and lower conditional quantities holds generally, but the tipping point at $n = 2$ is specific to this model.[31] In these specific cases in which consumer could benefit from a production agreement, however, the companies prefer to compete instead, as business stealing incentives in a production agreement are so strong that over-investing in CSR reduces profit. The only output agreements that simultaneously increase CSR efforts and consumer welfare, therefore, will not be voluntarily engaged in by companies.

We conclude that no CSR agreement exists that simultaneously increases CSR efforts, consumer welfare and profit compared to the non-cooperative benchmark. Therefore, unconditionally allowing firms to coordinate their output volumes in order to advance CSR always decreases consumer surplus. In fact, in the baseline model, production agreements do not generate surplus wealth at all.

Proposition 9. $W(q^*, v^*) > W(q^p, v^p)$.

[31] In Appendix B we find that the tipping point occurs before $n = 2$ when firms set prices instead of quantities in Stage 2, so that a production agreement can never increase consumer surplus compared to the non-cooperative benchmark.

Proof. See Appendix A. ■

Propositions 7 and 9 together show that all types of joint agreements always reduce total within-market welfare. The reason is straightforward: any reduction of competition inescapably creates a deadweight loss.

5 Exempting joint agreements from antitrust

With joint output (or price) agreements being the only effective means to stimulate CSR efforts, antitrust laws are a major obstacle to firm-led CSR initiatives. However, some competition authorities are opening up the idea of allowing, under conditions, anticompetitive agreements that promote CSR objectives. Most advanced in this respect is a framework to exempt sustainability agreements from the European cartel prohibition, Article 101 of the Treaty. Article 101 specifies four cumulative requirements for such an exemption.[32] In essence, the advance of CSR should be (i) concrete and objectively measurable "economic progress", benefits of which (ii) consumers should receive "a fair share" of. The restrictions of competition should be (iii) "not indispensable" for attaining the objectives, and should (iv) not eliminate competition on all dimensions in the market. In this section, we consider these requirements in light of our findings on joint agreements.

The focus of competition authorities that are open to permitting joint agreements, if they stimulate CSR, has so far been exclusively on agreements about CSR directly. Yet these we have found to *reduce* CSR efforts. At first sight, CSR agreements may appear sympathetic and traditional price cartels damaging, but some reflection on the company's incentives has led to the insight that the opposite is in fact the case. Only production agreements can generate concrete CSR benefits, provided that consumers have some, if only little appreciation for the type of CSR efforts advanced – and otherwise no agreement can. Therefore, if cartel law exemptions on CSR grounds are to be considered at all, it must be for production agreements, not CSR agreements. In principle, this should be possible under the European Treaty conditions.

The second requirement, that consumers benefit, is more problematic. In its current interpretation in case law, the buyers of the products concerned are to be fully compensated, on average, for any anticompetitive effects that they suffer because of the agreement, by the benefits that the agreement brings about.[33] Consumers should, in other words, not be worse off with the agreement in place. However, we find that no joint agreements exist that both increase CSR and consumer welfare, and that the companies would voluntarily engage in. Competition authorities would therefore always need to strictly demand compensation from firms that it allows to form a production agreement, and ensure that this compensation is indeed delivered to consumers for as long as the agreement is exempted. This changes the agencies' market oversight

[32]These exemption conditions are given in Article 101(3) TFEU.

[33]See European Commission (2004) at recital 85/87.

role fundamentally and requires information that they do not typically have available. Identifying genuine and effective CSR agreements, and monitoring them permanently, will be demanding on time and budget, and crowd out other important competition enforcement objectives. The policy therefore presents a risk of abuse by companies colluding under the guise of corporate social responsibility.

Having said that, our model does offer a direct mechanism to make consumers indifferent: they can be given monetary compensation out of the firms' post-agreement profit directly via m in utility function (1). However, by Proposition 9 there is no surplus wealth for full consumer compensation: total within-market welfare is lower under the production agreement than in competition. Compensation by redistributing profit is therefore not possible. In addition, requiring compensation would also undermine the incentives to invest in CSR, as the business stealing incentive is reduced.

A competition authority that wants to accommodate a production agreement for the purpose of inducing CSR efforts will have to give up the requirement that consumers are to be fully compensated, and add benefits of the agreement to others, who are not buyers of the products concerned. This is the approach of the Dutch competition authority ACM – with a focus on "sustainability agreements".[34] The agency interprets "a fair share" as benefits that can be less than fully compensating and adds "out-of-market-efficiencies" or "externality benefits" that would be obtained by third parties to the agreement. The latter are easily many, since CSR efforts that reduce negative externalities, such as pollution or unfair trading, will be appreciated by many non-buyers who value CSR more than the actual consumers.[35]

To see the effects of including negative out-of-market externalities in our analysis, consider as externality

$$E(\mathbf{q}, \mathbf{v}) = \sum_{i=1}^{n} \frac{q_i}{v_i}. \tag{17}$$

This expression has the appealing feature that for each firm, the increase of the negative externality due to producing one more unit of output is decreasing in that firm's CSR level. In addition, the marginal positive effect of a firm's CSR level on the externality that its production generates is decreasing in that firm's CSR level. The reduction in externalities in regime r compared to the externalities caused in the non-cooperative benchmark is $\Delta E(q^r, v^r) = n(\frac{q^*}{v^*} - \frac{q^r}{v^r})$. These compare across the different competitive regimes as follows.

Proposition 10. $\Delta E(q^p, v^p) > 0 > \Delta E(q^f, v^f) > \Delta E(q^{csr}, v^{csr})$.

Proof. See Appendix A. ■

[34] Authority for Consumers and Markets (2021). Several other antitrust agencies are following suit.

[35] In fact, so rich are benefits elsewhere likely to be, that a risk of this "citizens' welfare standard" is that it will become hard for the competition authority to say "no" to production agreements at all. See Schinkel and Treuren (2021) for an elaborate discussion.

Adding out-of-market externality benefits does not justify joint agreements on CSR directly. CSR agreements increase negative externalities compared to the non-cooperative benchmark. Only production agreements decrease negative externalities. This is intuitive, since a production agreement was found to be the only type of joint agreement that increases CSR efforts, while it reduces conditional quantities at the same time. $\Delta E\left(q^p, v^p\right) > 0$ holds as long as externalities are increasing in output and decreasing in CSR. CSR agreements and full agreements also reduce output, but they decrease CSR levels. Which effect on negative externalities dominates depends on the relative weights that are given in the externality function to changes in CSR levels and changes in output. $\Delta E\left(q^{csr}, v^{csr}\right) < 0$ and $\Delta E\left(q^f, v^f\right) < 0$ hold more generally for externalities that increase in output and decrease in CSR efforts, as long as the externality is a function of $\frac{q^r}{v^r}$. The conclusion remains that if a joint agreement is to be exempted from cartel law at all, it better be a production agreement. Adding out-of-market-efficiencies does not help to justify the exemption of CSR agreements.

The third requirement for a cartel exemption states that some competition must remain under the agreement, for example on the dimensions of price, brand image or technological development. Importantly, our result that production agreements can increase CSR efforts holds *provided* that competition on CSR remains, which should satisfy this requirement. In practice, agreements aimed at improving CSR efforts often involve only a subset of all firms in the market, leaving a competitive fringe. The existence of remaining competition in CSR efforts and output affects the incentives of the competitors that do make joint agreements.

In Appendix D we show that our main findings on joint agreements still hold for partial agreements involving m firms that leave remaining fringe competition ($m < n$). Residual competition simply reduces the possibilities for firms to benefit from an agreement. This causes all outcomes to lie in between the non-cooperative outcome and the outcome with a market-wide agreement. Therefore, partial agreements on CSR reduce CSR and output compared to the benchmark, but by less than market-wide agreements directly on CSR. Likewise, partial agreements on production increase CSR and reduce conditional quantities compared to the benchmark, but by less that market-wide production agreements. Still, no agreement can profitably increase CSR levels and consumer welfare.

Finally, the fourth condition for a cartel exemption under Article 101(3) TFEU is that the restriction of competition must be necessary to obtain the benefits, in this case CSR benefits. In practice, the interpretation of this requirement has been rather narrow – it suffices that the agreement does not go beyond what is necessary to generate the projected increase in CSR efforts compared to competition. This we have found to be the case only for production agreements. The condition may also be read wider, as a broad duty of the competition authority to consider and give priority to alternative ways in which the projected CSR benefits could be achieved – in particular government regulation. In that case, a simple and far superior solution to excusing collusion exists in regulation.

For any industry-wide regulated CSR level $v > 0$, let $W(q^*(v), v)$ be within-market

welfare if the conditional quantities are set non-cooperatively, and let $W(q^c(v), v)$ be within-market welfare if the conditional quantities are set cooperatively (in either a production agreement or a full agreement).[36] We then obtain the following result.

Proposition 11. $W(q^*(v), v) > W(q^c(v), v)$ for all $v > 0$.

Proof. See Appendix A. ■

The proposition establishes that for any CSR level, total within-market welfare is always higher when that CSR level is simply required from firms that remain in competition, for example by regulation, than when it is provided by firms that coordinate their output. The advance in CSR efforts that would result from a production agreement ($v^p > v^*$), the government can simply demand by regulating CSR levels. Hence, there is no necessity to restrict competition to stimulate CSR. On the contrary: it is an inferior tool, since any level of CSR that government deems an improvement ($v > v^*$) it better simply imposes than left to an output-coordinating agreement. We do note that, since a regulated CSR level does not induce the same output restriction as a production agreement would, the reduction of negative externalities will typically be less with regulation than with a production agreement. Yet governments can easily be more ambitious and set higher CSR goals to account for externalities.

6 Concluding remarks

Whenever consumers are more inclined to buy from companies with a stronger CSR profile, joint agreements on CSR turn out to reduce CSR efforts. The reason is that by showing CSR, firms steal business from their rivals, and this dimension of competition is eliminated by firms jointly deciding on their costly CSR efforts. If incentives to invest in CSR need strengthening by reducing competition at all, coordination should not be permitted on CSR efforts directly, but only on output (or prices). Collusion on the output market stimulates CSR efforts indirectly: it increases profit per consumer, which makes it even more attractive for the firms competing for that profit to heighten their CSR profile and attract additional customers. Neither low willingness to pay for CSR with consumers, nor intrinsic motivations for CSR with firms provide reason to think that companies will increase their CSR investments if they can jointly decide on them. There is also no reason to expect more CSR efforts from private coordination if there is no or negative willingness to pay for CSR.

CSR agreements are better avoided altogether if the goal is to stimulate firms to take more responsibility for environmental and social objectives. These findings are in stark contrast to the popular calls in the business literature and practice, where it is

[36] Obviously, first allowing a CSR agreement and then regulating it to a higher CSR level makes little sense. With regulation, only the conditional quantities are relevant.

suggested that collaboration would be imperative to stimulate CSR efforts. The policy paradox is that society can only induce companies to invest more in CSR than they do in competition by allowing them to reap the benefits of their additional CSR efforts. Output agreements, however, raise competition law concerns and reduce the sum of consumer welfare and profit in the market, so that consumers cannot be compensated for their antitrust damage. The latter is a requirement under the going interpretation of the European Treaty articles on horizontal agreements that therefore cannot be met.

CSR by its nature can have wider benefits than just within-market welfare, where it reduces negative production externalities such as pollution or human rights violations. Taking these out-of-market efficiencies into account may help to justify voluntary production agreements in particular, as they increase CSR efforts and reduce output.[37] However, permitting production agreements on these grounds is unprecedented in competition policy and comes with major risks. By blurring the bright-line rule against hard core price fixing, deterrence may be undermined. A competition agency that does exempt a market agreement, must permanently monitor that the companies involved indeed deliver on CSR and do not overcharge their customers. It will become increasingly difficult for the agency to know the but-for CSR efforts that would have been, had competition been preserved. In addition to such greenwashing concerns, joint agreements on one aspect of competition are known to spill over to other aspects, and even other markets.

If companies are sincere in their statements that they are discouraged to pursue CSR initiatives by antitrust liability concerns, then the question rises why they do not lobby regulators for implementation of higher CSR standards – rather than competition agencies for permission to reduce competition. Indeed, voluntary agreements have been identified as a possible strategic means to preempt future regulation.[38] Government regulation seems to be superior to collaborative self-regulation. Before rushing ahead to relax the cartel laws on the basis of an unproven claim that collaboration would be needed to advance CSR, more comparative study of alternative public and private regulatory approaches to CSR stimulation should be done.

Corporate social responsibility can and has to play an important role in resolving pressing social problems, such as climate change and unfair business practices, that require urgent and drastic action that governments often fail to take. There is no compelling evidence that business collaboration in restraint of competition would help this cause. Instead, growing consumer awareness, and increasing willingness to buy from and invest in companies that are serious about their CSR, are ever stronger motivators for firms to differentiate themselves from their competitors. CSR is a business model and a hopeful gathering force for more responsible corporate behavior. Competition

[37]The latter effect appeals to claims that fighting climate change requires reducing "overconsumption" (Wiedmann et al., 2020).

[38]Lutz et al. (2000) show how self-regulated quality standards can weaken and delay better regulation. Innes and Sam (2008) finds that firms voluntarily reduce pollution in an attempt to relax future regulatory scrutiny. Malhotra et al. (2019) argue that firms can use modest private regulation to preempt more stringent public regulations.

strengthens these incentives to do well by doing good, and is therefore an engine for corporate social performance. It should be given free rein and not be throttled by corporate collaboration that risks collusion. While voluntary collective agreements have their merits in other contexts, for example in reaping R&D synergies, we contribute that agreements on CSR weaken competition as an important driver of corporate social efforts.

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Appendices

A Proofs of propositions

Proof of Proposition 1. (Effective joint agreements) Define $A = \alpha - c$, $\beta_1 = \gamma(n-1)+2$, $\beta_2 = \gamma(n-2)+2$, and $\beta_3 = \gamma(n-3)+2$. In Stage 2, firms in the non-cooperative benchmark or a CSR agreement maximize (3) with respect to q_i, resulting in Nash-equilibrium conditional quantities

$$q_i^*(\mathbf{v}) = \frac{\beta_2(A+v_i) - \gamma\sum_{i\neq j}^{n}(A+v_j)}{(2-\gamma)\beta_1}, \quad i = 1, ..., n, \tag{18}$$

while firms in a production agreement or a full agreement choose quantities to maximize the sum of members' profit, conditional on $\mathbf{v}$, resulting in conditional quantities (superscript c for "coordinated")

$$q_i^c(\mathbf{v}) = \frac{(1-\gamma)A + (\beta_2 - 1)v_i - \gamma\sum_{i\neq j}^{n} v_j}{2(1-\gamma)(\beta_1 - 1)}, \quad i = 1, ..., n. \tag{19}$$

In Stage 1, firms in the non-cooperative benchmark pick v_i to maximize $\pi_i(\mathbf{q}^*(\mathbf{v}), v_i)$, resulting in Nash-equilibrium CSR level

$$v^* = A\frac{2\beta_2}{t(2-\gamma)\beta_1^2 - 2\beta_2}. \tag{20}$$

Firms in a CSR agreement select $\mathbf{v}$ to maximize $\sum_{i=1}^{n}\pi_i(\mathbf{q}^*(\mathbf{v}), v_i)$ in Stage 1, resulting in CSR level

$$v^{csr} = A\frac{2}{t\beta_1^2 - 2}. \tag{21}$$

Members of a production agreement determine v_i by maximizing $\pi_i(\mathbf{q}^c(\mathbf{v}), v_i)$, so that the CSR level is

$$v^p = A\frac{\beta_3}{4t(1-\gamma)(\beta_1 - 1) - \beta_3}. \tag{22}$$

A full agreement chooses $\mathbf{v}$ to maximize $\sum_{i=1}^{n}\pi_i(\mathbf{q}^c(\mathbf{v}), v_i)$ in Stage 1. The resulting CSR level is

$$v^f = A\frac{1}{2t(\beta_1 - 1) - 1}. \tag{23}$$

Note that conditional quantities (18) and (19) are symmetric by implication. To ensure that all second-order conditions hold, and restricting our attention to interior solutions, in all proofs in this appendix we impose $8t(1-\gamma)^2(\beta_1 - 1) - \beta_3^2 > 0$. The ranking

follows from

$$\begin{aligned} v^p - v^* &= A\frac{\gamma^2 t(n-1)(4n+2\gamma(n-1)(n-2)-\gamma^2(n-1)(n-3))}{(4t(1-\gamma)(\beta_1-1)-\beta_3)(t(2-\gamma)\beta_1^2-2\beta_2)} > 0, \\ v^* - v^f &= A\frac{\gamma t(1-n)(4+\gamma(2+\gamma)(n-1))}{(2t(\beta_1-1)-1)(t(2-\gamma)\beta_1^2-2\beta_2)} > 0, \text{ and} \\ v^f - v^{csr} &= A\frac{t(\beta_1-2)^2}{(2t(\beta_1-1)-1)(t\beta_1^2-2)} > 0. \blacksquare \end{aligned}$$

Proof of Proposition 2. (Profitability) Benchmark profit $\pi(q^*, v^*)$ is obtained by substituting equations (20) and (18) into equation (3). Profit in a production agreement, $\pi(q^p, v^p)$, is obtained by substituting (22) and (19) into equation (3). Comparing $\pi(q^*, v^*)$ to $\pi(q^p, v^p)$ shows that $\pi(q^p, v^p) > \pi(q^*, v^*)$ if $\gamma \leq \Gamma(n)$ or $\gamma > \Gamma(n)$ and $t > T(\gamma, n)$, and $\pi(q^*, v^*) \geq \pi(q^p, v^p)$ otherwise. Here, $T(\gamma, n)$ is given by

$$\begin{aligned} T(\gamma,n) = \frac{1}{16}[&\frac{16(1-2n)}{n^2(\gamma-2)^2} - \frac{16(n-1)}{n^3(\gamma-2)} + \frac{(1+n)^2}{n(\gamma-1)^2} + \frac{n(n(n-5)+3)+1}{n^2(\gamma-1)} + \frac{(n-1)^2}{n^2(\beta_1-1)} + \frac{16}{n^2\beta_1^2} + \frac{16(n-1)^2}{n^3\beta_1} \\ &+ \sqrt{\frac{\gamma^2(4n+2\gamma(n-1)(n-2)-\gamma^2(n-1)(n-3))^2(\rho(\gamma,n))}{(\gamma-2)^4(\gamma-1)^4(\beta_1-1)^2\beta_1^4}}], \end{aligned}$$

$$\begin{aligned} \rho(\gamma,n) = &256 + 128\gamma(4n-7) + 16\gamma^2(76 + n(21n-88)) + 80\gamma^3(n-1)(n(n-8)+10) + 4\gamma^4(n-1)(n(n-31)+102) \\ &- 4\gamma^5(n-1)^2(n(n-13)_14) + \gamma^6(n^2-4n+3)^2. \end{aligned}$$

and $\Gamma(n)$ is given by the 4th smallest root of the following polynomial in x

$$\begin{aligned} f(x) = &32 + x(64n-192) + x^2(24n^2-368n+472) + x^3(-8n^3-192n^2+792n-640) + x^4(-4n^4-20n^3+402n^2-896n+526) \\ &+ x^5(4n^4+60n^3-372n^2+580n^n-272) + x^6(-n^4-40n^3+162n^2-200n+79) + x^7(8n^3-24n^2+24n-8). \end{aligned}$$

■

Proof of Proposition 3. (Willingness to pay) In Stage 2, firms in the non-cooperative benchmark or a CSR agreement maximize (11) with respect to q_i, resulting in Nash-equilibrium conditional quantities

$$q^*_{\delta,i}(\mathbf{v}) = \frac{\beta_2(A+\delta v_i) - \gamma\sum_{i\neq j}^n (A+\delta v_j)}{(2-\gamma)\beta_1}, \quad i = 1, ..., n, \tag{24}$$

while firms in a production agreement or a full agreement choose quantities to maximize the sum of members' profit, conditional on $\mathbf{v}$, resulting in conditional quantities

$$q^c_{\delta,i}(\mathbf{v}) = \frac{(\beta_2-1)(A+\delta v_i) - \gamma\sum_{i\neq j}^n (A+\delta v_j)}{2(1-\gamma)(\beta_1-1)} \quad i = 1, ..., n. \tag{25}$$

Let $\mathbf{q}^*_\delta = q^*_{\delta,1}(\mathbf{v}), q^*_{\delta,2}(\mathbf{v}), \ldots, q^*_{\delta,n}(\mathbf{v})$. In Stage 1, firms in the non-cooperative benchmark pick v_i to maximize $\pi_i(\mathbf{q}^*_\delta(\mathbf{v}), v_i)$, resulting in Nash-equilibrium CSR level

$$v^*_\delta = A\frac{2\delta\beta_2}{t(2-\gamma)\beta_1^2 - 2\delta^2\beta_2}. \tag{26}$$

A CSR agreement chooses $\mathbf{v}$ to maximize $\sum_{i=1}^{n} \pi_i(\mathbf{q}_\delta^*(\mathbf{v}), v_i)$ in Stage 1, so that the CSR level is

$$v_\delta^{csr} = A\frac{2\delta}{t\beta_1^2 - 2\delta^2}. \tag{27}$$

Let $\mathbf{q}_\delta^c = q_{\delta,1}^c(\mathbf{v}), q_{\delta,2}^c(\mathbf{v}), \ldots, q_{\delta,n}^c(\mathbf{v})$. Members of a production agreement determine v_i by maximizing $\pi_i(\mathbf{q}_\delta^c(\mathbf{v}), v_i)$, so that the CSR level is

$$v_\delta^{p} = A\frac{\delta\beta_3}{4t(1-\gamma)(\beta_1 - 1) - \delta^2\beta_3}. \tag{28}$$

Finally, a full agreement chooses $\mathbf{v}$ to maximize $\sum_{i=1}^{n} \pi_i(\mathbf{q}_\delta^c(\mathbf{v}), v_i)$ in Stage 1. The resulting CSR level is

$$v_\delta^{f} = A\frac{\delta}{2t(\beta_1 - 1) - 1}. \tag{29}$$

The ranking follows from

$$\begin{aligned}
v_\delta^p - v_\delta^* &= \delta A\frac{\gamma^2 t(n-1)(4n + 2\gamma(n-1)(n-2) - \gamma^2(n-1)(n-3))}{(4t\,(1-\gamma)\,(\beta_1 - 1) - \delta^2\beta_3)(t(2-\gamma)\beta_1^2 - 2\delta^2\beta_2)} > 0, \\
v_\delta^* - v_\delta^f &= \delta A\frac{\gamma t(1-n)(4 + \gamma(2+\gamma)(n-1))}{(2t(\beta_1 - 1) - \delta^2)(t(2-\gamma)\beta_1^2 - 2\delta^2\beta_2)} > 0, \text{ and} \\
v_\delta^f - v_\delta^{csr} &= \delta A\frac{t(\beta_1 - 2)^2}{(2t(\beta_1 - 1) - \delta^2)(t\beta_1^2 - 2\delta^2)} > 0. \ \blacksquare
\end{aligned}$$

Proof of Proposition 4. (Polarization in willingness to pay) The difference $v_\delta^p - v_\delta^*$ is constructed from equations (28) and (26). Taking the derivative with respect to δ gives

$$\frac{\partial(v_\delta^p - v_\delta^*)}{\partial\delta} = \frac{A\beta_3(4t(1-\gamma)(\beta_1 - 1) + \delta^2\beta_3)}{(4t(\gamma-1)(\beta_1 - 1) + \delta^2\beta_3)^2} + \frac{2A\beta_2(t(\gamma-2)\beta_1^2 - 2\delta^2\beta_2)}{(t(\gamma-2)\beta_1^2 + 2\delta^2\beta_2)^2} > 0.$$

The difference $v_\delta^* - v_\delta^f$ is constructed from equations (26) and (29). Taking the derivative with respect to δ gives

$$\frac{\partial(v_\delta^* - v_\delta^f)}{\partial\delta} = \frac{2A\beta_2(t(2-\gamma)\beta_1^2 + 2\delta^2\beta_2)}{(t(\gamma-2)\beta_1^2 + 2\delta^2\beta_2)^2} - \frac{A(\delta^2 + 2t(\beta_1 - 1))}{(\delta^2 - 2t(\beta_1 - 1))^2} > 0.$$

The difference $v_\delta^f - v_\delta^{csr}$ is constructed from equations (29) and (27). Taking the derivative with respect to δ gives

$$\frac{\partial(v_\delta^f - v_\delta^{csr})}{\partial\delta} = \frac{A(\delta^2 + 2t(\beta_1 - 1))}{(\delta^2 - 2t(\beta_1 - 1))^2} - \frac{2A(t\beta_1^2 + 2\delta^2)}{(t\beta_1^2 - 2\delta^2)^2} > 0. \ \blacksquare$$

Proof of Proposition 5. (Intrinsic motivation) Intrinsic motivation does not affect the conditional quantities that solve Stage 2 of the game. In Stage 2, firm i in the non-cooperative benchmark or a CSR agreement maximizes objective function (12) with respect to q_i, resulting in conditional quantity given by equation (18). Firm i in a production agreement or a full agreement choose quantities to maximize $\sum_{i=1}^{n}(\pi_i(\mathbf{q}, v_i) + \theta v_i)$ resulting in conditional quantity given by equation (19).

In Stage 1, firms in the non-cooperative benchmark pick v_i to maximize $\pi_i(\mathbf{q}^*(\mathbf{v}), v_i) + \theta v_i$, resulting in Nash-equilibrium CSR level

$$v_I^* = v^* + \frac{(2-\gamma)\beta_1^2\theta}{t(2-\gamma)\beta_1^2 - 2\beta_2} = \frac{2\beta_2 A + (2-\gamma)\beta_1^2\theta}{t(2-\gamma)\beta_1^2 - 2\beta_2}. \tag{30}$$

Firms in a CSR agreement choose $\mathbf{v}$ to maximize $\sum_{i=1}^{n}(\pi_i(\mathbf{q}^*(\mathbf{v}), v_i) + \theta v_i)$ in Stage 1, with the resulting CSR level given by

$$v_I^{csr} = v^{csr} + \frac{\beta_1^2\theta}{t\beta_1^2 - 2} = \frac{2A + \beta_1^2\theta}{t\beta_1^2 - 2}. \tag{31}$$

The members of a production agreement determine v_i by maximizing $\pi_i(\mathbf{q}^c(\mathbf{v}), v_i) + \theta v_i$, so that the CSR level is

$$v_I^p = v^p + \frac{4(1-\gamma)(\beta_1 - 1)\theta}{4t(1-\gamma)(\beta_1 - 1) - \beta_3} = \frac{\beta_3 A + 4(1-\gamma)(\beta_1 - 1)\theta}{4t(1-\gamma)(\beta_1 - 1) - \beta_3}. \tag{32}$$

Finally, firms in a full agreement choose $\mathbf{v}$ to maximize $\sum_{i=1}^{n}(\pi_i(\mathbf{q}^c(\mathbf{v}), v_i) + \theta v_i)$ in Stage 1. The resulting CSR level is

$$v_I^f = v^f + \frac{2(\beta_1 - 1)\theta}{2t(\beta_1 - 1) - 1} = \frac{A + 2(\beta_1 - 1)\theta}{2t(\beta_1 - 1) - 1}. \tag{33}$$

The ranking follows from

$$\begin{aligned}
v_I^p - v_I^* &= (At + \theta)\frac{\gamma^2(n-1)(\gamma^2(n-1)(n-3) - 2\gamma(n-1)(n-2) - 4n)}{(4t(\gamma-1)(\beta_1-1) + \beta_3)(t(2-\gamma)\beta_1^2 - 2\beta_2)} > 0, \\
v_I^* - v_I^f &= (At + \theta)\frac{\gamma(n-1)(\gamma(2+\gamma)(n-1) + 4)}{(2t(\beta_1-1) - 1)(t(2-\gamma)\beta_1^2 - 2\beta_2)} > 0, \text{ and} \\
v_I^f - v_I^{csr} &= (At + \theta)\frac{\gamma^2(n-1)^2}{(2t(\beta_1-1) - 1)(t\beta_1^2 - 2)} > 0. \ \blacksquare
\end{aligned}$$

Proof of Proposition 6. (Polarization in intrinsic motivation) The difference $v_I^p - v_I^*$ is constructed from equations (32) and (30). Taking the derivative with respect to θ gives

$$\frac{\partial(v_I^p - v_I^*)}{\partial\theta} = \frac{\gamma^2(n-1)(4n + 2\gamma(n-1)(n-2) - \gamma^2(n-1)(n-3))}{(4t(\gamma-1)(\beta_1-1) + \beta_3)(t(\gamma-2)\beta_1^2 + 2\beta_2)} > 0.$$

The difference $v_I^* - v_I^f$ is constructed from equations (30) and (33). Taking the derivative with respect to θ gives

$$\frac{\partial(v_I^* - v_I^f)}{\partial\theta} = \frac{\gamma(1-n)(\gamma(2+\gamma)(n-1)+4)}{(2t(\beta_1-1)-1)(t(\gamma-2)\beta_1^2+2\beta_2)} > 0.$$

The difference $v_I^f - v_I^{csr}$ is constructed from equations (33) and (31). Taking the derivative with respect to θ gives

$$\frac{\partial(v_I^f - v_I^{csr})}{\partial\theta} = \frac{\gamma^2(n-1)^2}{(2t(\beta_1-1)-1)(t\beta_1^2-2)} > 0. \blacksquare$$

Proof of Proposition 7. (Welfare CSR agreements) Substituting equations (18) and (20) into equations (3) and (14), and then adding total profit of all firms to consumer surplus gives Nash-equilibrium welfare in the non-cooperative benchmark

$$W(q^*, v^*) = A^2 nt \frac{t(\gamma-2)^2(\beta_1+1)\beta_1^2 - 4\beta_2^2}{2(t(\gamma-2)\beta_1^2+2\beta_2)^2}. \tag{34}$$

Substituting equations (18) and (21) into equations (3) and (14), and then adding total profit of all firms to consumer surplus gives welfare in a CSR agreement

$$W(q^{csr}, v^{csr}) = A^2 nt \frac{t(\beta_1+1)\beta_1^2 - 4}{2(t\beta_1^2-2)^2}. \tag{35}$$

Substituting equations (19) and (23) into equations (3) and (14), and then adding total profit of all firms to consumer surplus gives welfare in a full agreement

$$W(q^f, v^f) = A^2 nt \frac{3t(\beta_1-1)-1}{2(2t(\beta_1-1)-1)^2}. \tag{36}$$

Straightforward calculations deliver $W(q^*, v^*) - W(q^{csr}, v^{csr}) > 0$, and $W(q^{csr}, v^{csr}) - W(q^f, v^f) > 0$.

Imposing $v_i = v\ \forall i$, substituting equation (18) into equation (3) and equation (14), and adding total profit of all firms to consumer surplus gives

$$W(q^*(v), v) = \frac{n(3A^2 + 6Av + \gamma(n-1)(A+v)^2 - (t\beta_1^2-3)v^2)}{2\beta_1^2}. \tag{37}$$

Taking the derivative of equation (37) with respect to v, and then imposing $v = v^*$ gives

$$\frac{\partial W(q^*(v), v)}{\partial v}|_{v=v^*} = Ant \frac{\gamma(\beta_1-1)-2}{t(\gamma-2)\beta_1^2+2\beta_2},$$

where $\frac{\partial W(q^*(v),v)}{\partial v}|_{v=v^*} \geq 0$ if $\gamma \leq \Gamma'$, $\frac{\partial W(q^*(v),v)}{\partial v}|_{v=v^*} < 0$ if $\gamma > \Gamma'$, and $\Gamma' = \frac{1}{2}\sqrt{\frac{8n-7}{(n-1)^2}} - \frac{1}{2(n-1)}$. $\blacksquare$

Proof of Proposition 8. (Consumer welfare production agreement) In competitive regime r, $r \in \{*, csr, p, f\}$, consumer surplus (14) can be written as $CS(q^r) = \frac{n}{2}(\gamma(n-1)+1)(q^r)^2$ as quantities and CSR levels are symmetric. Therefore, the ranking of consumer surpluses is equivalent to that of quantities. We have

$$q^p - q^* = At\frac{\gamma(1-n)(2t(\gamma-2)(\gamma-1)\beta_1 + \gamma(\gamma-2)(n-3)-4)}{(4t(\gamma-1)(\beta_1-1)+\beta_3)(t(\gamma-2)\beta_1^2+2\beta_2)},$$

which is always negative for $n > 2$, and positive for $n = 2$ as long as $t < \frac{4-2\gamma+\gamma^2}{2(1-\gamma)(4-\gamma^2)}$. Nash-equilibrium profit of a firm in the non-cooperative benchmark follows from substituting equations (18) and (20) into equation (3)

$$\pi(q^*, v^*) = A^2 t\frac{t(\gamma-2)^2\beta_1^2 - 2\beta_2^2}{(t(\gamma-2)\beta_1^2+2\beta_2)^2}. \tag{38}$$

Profit of a firm in a production agreement follows from substituting equations (19) and (22) into equation (3)

$$\pi(q^p, v^p) = A^2 t\frac{8t(\gamma-1)^2(\beta_1-1)-\beta_3^2}{2(4t(\gamma-1)(\beta_1-1)+\beta_3)^2}. \tag{39}$$

Imposing $n = 2$ and $t < \frac{4-2\gamma+\gamma^2}{2(1-\gamma)(4-\gamma^2)}$ gives $\pi(q^*, v^*) > \pi(q^p, v^p)$. ■

Proof of Proposition 9. (Welfare production agreement) Substituting equations (19) and (22) into equations (3) and (14), and then adding total profit of all firms to consumer surplus gives welfare in a production agreement

$$W(q^p, v^p) = A^2 nt\frac{12t(\gamma-1)^2(\beta_1-1)-\beta_3^2}{2(4t(\gamma-1)(\beta_1-1)+\beta_3)^2}. \tag{40}$$

Comparing equation (34) to equation (40) shows that $W(q^*, v^*) > W(q^p, v^p)$. ■

Proof of Proposition 10. (Externalities) We have $E(q^r, v^r) = n\frac{q^r}{v^r}$, $r \in \{*, csr, p, f\}$, as quantities and CSR levels are symmetric, so that the ranking of externalities across competitive regimes corresponds to the ranking of the ratio of quantity to CSR level. Substituting equations (18) to (23) in $E(q^r, v^r)$ and taking differences gives

$$\begin{aligned}
E(q^{csr}, v^{csr}) - E(q^f, v^f) &= \frac{\gamma tn(n-1)}{2} > 0, \\
E(q^f, v^f) - E(q^*, v^*) &= \frac{\gamma^2 tn(n-1)}{2\beta_2} > 0, \text{ and} \\
E(q^*, v^*) - E(q^p, v^p) &= \frac{\gamma tn(n-1)(\gamma(2-\gamma)(n-3)+4)}{2\beta_2\beta_3} > 0,
\end{aligned}$$

from which the ranking follows. ■

Proof of Proposition 11. (Regulation) Substituting equation (18) into equations (3) and (14), imposing $v_i = v \ \forall i$, and adding total profit of all firms to consumer surplus, gives welfare when quantities are chosen non-cooperatively and CSR levels are regulated to v

$$W(q^*(v), v) = n\frac{3A^2 + 6Av + (3 - 4t(\beta_1 - 1))v^2}{8(\beta_1 - 1)}. \tag{41}$$

Substituting equation (19) into equations (3) and (14), imposing $v_i = v \ \forall i$, and adding total profit of all firms to consumer surplus, gives welfare when quantities are chosen cooperatively and CSR levels are regulated to v

$$W(q^c(v), v) = n\frac{3A^2 + 6Av + \gamma(n-1)(A+v)^2 + (3 - t\beta_1^2)v^2}{2\beta_1^2}. \tag{42}$$

Subtracting equation (42) from equation (41) gives

$$W(q^*(v), v) - W(q^c(v), v) = (A+v)^2\frac{\gamma n(n-1)(\beta_1 + 2)}{8(\beta_1 - 1)\beta_1^2} > 0. \ \blacksquare$$

B Price setting

In this appendix, we verify that our results on CSR levels carry through when firms set prices in Stage 2 instead of quantities. An agreement in Stage 2 only, now titled a "price agreement", remains the sole agreement that increases CSR levels compared to the non-cooperative benchmark. As in the baseline model, price agreements increase CSR because coordination in the product market increases the profit margin per consumer, increasing incentives to attract additional consumers by investing in CSR. Consumer welfare results are different when firms set prices in Stage 2 of the game. In this setting, all agreements always reduce consumer welfare. The reason is primarily that, with price setting, the non-cooperative benchmark becomes more competitive and consumer welfare increases compared to the quantity setting benchmark in the main text. Therefore, the reduction in consumer welfare due to a price agreement increasing conditional prices can never be offset by higher CSR levels. As with quantity setting, taking out-of-market externalities into account can justify a price agreement on total welfare grounds when firms set prices in Stage 2, as long as the externalities get sufficient weight in the welfare function.

We start by deriving the profit function of the price setting game. Summing over all firms, demand (2) is

$$\sum_{i=1}^{n} p_i = \sum_{i=1}^{n}(\alpha + v_i) - (\beta_1 - 1)\sum_{i=1}^{n} q_i. \tag{43}$$

Noting that $\sum_{i\neq j}^{n} q_j = \sum_{k=1}^{n} q_k - q_i$, and substituting for $\sum_{i\neq j}^{n} q_j$ into equation (2), the quantity of each firm i can be written as

$$q_i(\mathbf{p}, \mathbf{v}) = \frac{(\beta_2 - 1)(\alpha + v_i - p_i) - \gamma\sum_{i\neq j}^{n}(\alpha + v_j - p_j)}{(1-\gamma)(\beta_1 - 1)}, \tag{44}$$

where $\mathbf{p} = p_1, p_2, \ldots, p_n$. The profit of each firm i is given by

$$\pi_i(\mathbf{p}, \mathbf{v}) = (p_i - c)\left(\frac{(\beta_2 - 1)(\alpha + v_i - p_i) - \gamma \sum_{i \neq j}^{n}(\alpha + v_j - p_j)}{(1-\gamma)(\beta_1 - 1)}\right) - \frac{t v_i^2}{2}. \tag{45}$$

Equation (45) makes clear that each firm's profit is directly affected by the CSR levels of all other firms, in contrast to the quantity setting game where profit (3) depends only on the other firms' CSR levels indirectly through the conditional quantities that solve Stage 2 of the game. Firms play a two-stage game. In Stage 1 each firm selects its CSR level v_i. In Stage 2, given CSR levels $\mathbf{v}$, each firm selects its price p_i.

Comparing CSR levels – denoting the price setting game with subscript B – across the four competitive regimes gives.

Proposition B1 $v_B^p > v_B^* > v_B^f > v_B^{csr}$.

Proof. In Stage 2, firms in the non-cooperative benchmark or a CSR agreement maximize (45) with respect to p_i, resulting in Nash-equilibrium conditional price of firm i

$$p_i^*(\mathbf{v}) = \frac{(\beta_3(\beta_2 - 1) + \gamma(1-\gamma))(\alpha + v_i) - \gamma(\beta_2 - 1)\sum_{i \neq j}^{n}(\alpha + v_j) + (\gamma(2n-3) + 2)(\beta_2 - 1)c}{(\gamma(2n-3) + 2)\beta_3}, \tag{46}$$

while firms in a price agreement or a full agreement choose prices to maximize the sum of members' profit, conditional on $\mathbf{v}$, resulting in conditional price

$$p_i^c(v_i) = \frac{\alpha + v_i + k}{2}, \quad i = 1, ..., n. \tag{47}$$

Let $\mathbf{p}^*(\mathbf{v}) = p_1^*(\mathbf{v}), p_2^*(\mathbf{v}), \ldots, p_n^*(\mathbf{v})$. In Stage 1, firms in the non-cooperative benchmark pick v_i to maximize $\pi_i(\mathbf{p}^*(\mathbf{v}), \mathbf{v})$, resulting in Nash-equilibrium CSR level

$$v_B^* = A\frac{2(\gamma(n-2)+1)(\gamma^2 n^2 - 5\gamma^2 n + 5\gamma^2 + 3\gamma n - 6\gamma + 2)}{t(\gamma(2n-3)+2)(\beta_1 - 1)\beta_3^2 - 2(\gamma(n-2)+1)(\gamma^2 n^2 - 5\gamma^2 n + 5\gamma^2 + 3\gamma n - 6\gamma + 2)}. \tag{48}$$

Firms in a CSR agreement select $\mathbf{v}$ to maximize $\sum_{i=1}^{n} \pi_i(\mathbf{p}^*(\mathbf{v}), \mathbf{v})$ in Stage 1, resulting in CSR level

$$v_B^{csr} = A\frac{2(1-\gamma)(\beta_2 - 1)}{t(\beta_1 - 1)\beta_3^2 - 2(1-\gamma)(\beta_2 - 1)}. \tag{49}$$

Let $\mathbf{p}^c(\mathbf{v}) = p_1^c(v_1), p_2^c(v_2), \ldots, p_n^c(v_n)$. Members of a price agreement determine v_i by maximizing $\pi_i(\mathbf{p}^c(\mathbf{v}), \mathbf{v})$, so that the CSR level is

$$v_B^p = A\frac{\beta_3}{4t(1-\gamma)(\beta_1 - 1) - \beta_3}. \tag{50}$$

A full agreement chooses $\mathbf{v}$ to maximize $\sum_{i=1}^{n} \pi_i(\mathbf{p}^c(\mathbf{v}), \mathbf{v})$ in Stage 1. The resulting CSR level is

$$v_B^f = A\frac{1}{2t(\beta_1 - 1) - 1}. \tag{51}$$

Note that conditional prices (46) and (47) are symmetric by implication. To ensure that all second-order conditions hold, and restricting our attention to interior solutions, in all proofs in this appendix we impose $8t(1-\gamma)^2(\beta_1 - 1) - \beta_3^2 > 0$. The ranking follows from

$$\begin{aligned}
v_B^p - v_B^* &= A\frac{t\gamma^2(1-n)(\beta_1-1)(\gamma^2(n(n-2)(2n-7)-1)+2\gamma n(3n-7)+4n)}{(4t(\gamma-1)(\beta_1-1)+\beta_3)(t(\gamma(2n-3)+2)(\beta_1-1)\beta_3^2-2(\beta_2-1)(\gamma(n(\gamma(n-5)+3)+5\gamma-6)+2))} > 0, \\
v_B^* - v_B^f &= A\frac{t\gamma(n-1)(\beta_1-1)(\gamma(n(\gamma(2n-11)+6)+13\gamma-14)+4)}{(2t(\beta_1-1)-1)(t(\gamma(2n-3)+2)(\beta_1-1)\beta_3^2-2(\beta_2-1)(\gamma(n(\gamma(n-5)+3)+5\gamma-6)+2))} > 0, \text{ and} \\
v_B^f - v_B^{csr} &= A\frac{t\gamma^2(n-1)^2(\beta_1-1)}{(2t(\beta_1-1)-1)(t(\beta_1-1)\beta_3^2+2(\gamma-1)(\beta_2-1))} > 0.
\end{aligned}$$

■

Proposition B1 verifies that the ranking of CSR levels across competitive agreements is unaffected by whether firms select prices or quantities in Stage 2. The business stealing effect is the driving force behind Proposition B1, just like it was behind Proposition 1 when firms set quantities in Stage 2 of the game. The intuition is also identical, and discussed in Section 3.1 of the main text.

As a CSR agreement does not adjust conditional prices, and by Proposition B1 reduces CSR levels compared to the benchmark, consumer welfare always decreases with a CSR agreement. Comparing conditional prices (46) and (47) shows that a full agreement increases conditional prices compared to the benchmark. By Proposition B1 a full agreement reduces CSR levels, so that consumer welfare is reduced on two accounts compared to the benchmark. As a results, the ranking of consumer welfare obtained in the main text is also valid when firms set prices instead of quantities. Denote quantity when firms set prices by subscript B.

Proposition B2. $CS(q_B^*) > CS(q_B^{csr}) > CS(q_B^f)$.

Proof. In competitive regime r, consumer surplus (14) can be written as $CS(q^r) = \frac{n}{2}(\gamma(n-1)+1)(q^r)^2$ as both quantities and CSR levels are symmetric. Therefore, the ranking of consumer surpluses is equivalent to that of quantities. The ranking follows from

$$q_B^* - q_B^{csr} = A\frac{2t\gamma(n-1)(\beta_2-1)^2\beta_3}{(t(\beta_1-1)\beta_3^2+2(\gamma-1)(\beta_2-1))(t(\gamma(2n-3)+2)(\beta_1-1)\beta_3^2-2(\beta_2-1)(\gamma(n(\gamma(n-5)+3)+5\gamma-6)+2))} > 0,$$

and

$$q_B^{csr} - q_B^f = A\frac{t\gamma(n-1)(t(\beta_1-1)\beta_3-\gamma(n-2)-1)}{(t(\beta_1-1)\beta_3^2+2(\gamma-1)(\beta_2-1))(2t(\beta_1-1)-1)} > 0.$$

■

Compared to the non-cooperative benchmark, a price agreement increases conditional prices in Stage 2 and increases CSR levels in Stage 1. Which of these two forces dominates is *a priori* unclear, and Proposition 8 shows that a production agreement in a duopoly can increase consumer welfare if firms set quantities in Stage 2, investing is very cheap, and goods are sufficiently similar. This result does not generalize to price competition in Stage 2, where a price agreement will always decrease consumer welfare compared to the benchmark.

Proposition B3. $CS(q_B^*) > CS(q_B^p)$.

Proof. The ranking follows from

$$q_B^* - q_B^p = A\frac{t\gamma(n-1)(2t(\gamma-1)(\gamma(2n-3)+2)(\beta_1-1)\beta_3+(\beta_2-1)(n(\gamma(2n-9)+6)+7\gamma-10))}{(4t(\gamma-1)(\beta_1-1)+\beta_3)(t(\gamma(2n-3)+2)(\beta_1-1)\beta_3^2-2(\beta_2-1)(\gamma(n(\gamma(n-5)+3)+5\gamma-6)+2)} > 0.$$

■

The reason why a price agreement in which firms jointly select conditional prices can never benefit consumers is primarily that the non-cooperative benchmark produces more consumer surplus when firms select prices in Stage 2 than when firms select quantities in Stage 2. Since prices are strategic complements and quantities are strategic substitutes, price setting generates a more competitive benchmark outcome with more output than quantity setting. As a price agreement reduces quantities and increases CSR compared to the benchmark, also when firms set prices could total welfare increase if out-of-market externalities such as those given in equation (17) are taken into account.

C Alternate consumer preferences

In this appendix we show that our consumer welfare results are robust to altering the preference structure to allow for a direct effect of CSR on consumer welfare. When firms jointly select CSR levels, our consumer welfare results are general as long as consumer welfare depends positively on both output and CSR levels. This is because both a CSR agreement and a full agreement decrease output and CSR efforts compared to the non-cooperative benchmark. A production agreement always increases CSR levels compared to the non-cooperative benchmark, and decreases conditional quantities. The net effect of these two opposing forces on consumer surplus therefore depends on the demand structure and underlying preferences that are assumed.

In our baseline quasi-linear quadratic utility model, CSR levels only indirectly influence consumer welfare, through the effect of CSR levels on quantities. To shed light on the robustness of our consumer welfare comparison between a production agreement and the non-cooperative benchmark, we therefore revisit this comparison in the context of Salop's (1979) model of product differentiation. In this model, consumer welfare is directly and positively influenced by CSR levels. The results are in line with

those obtained in the main text: a (partial) production agreement always increases CSR levels compared to the non-cooperative benchmark, but only increases consumer welfare when goods are very similar, and investing is very cheap.

As in our baseline model, these results are mainly driven by business stealing incentives. Firms can capture a larger market share by investing in CSR in Stage 1. Given that a production agreement results in higher conditional prices in Stage 2, capturing an additional consumers is more profitable in a production agreement that in the non-cooperative benchmark. When investing is cheap and products are similar, this business stealing incentive becomes so strong in a production agreement that the positive direct effect of increased CSR levels on consumer welfare can more than compensate for the reduction in conditional prices.

Assume that all firms, and a unit mass of consumers, are equidistantly located on a circle with circumference $L > 0$. Firms play a two-stage game. In Stage 1, firm i sets CSR level v_i at cost $\frac{tv_i^2}{2}$. In Stage 2, each firm i selects price p_i. The consumer located at x buys one unit of the good from the firm i that maximizes her indirect utility

$$V_i = \alpha + v_i - \tau|l_i - x| - p_i, \tag{52}$$

where $\tau > 0$ is the unit transportation cost of the consumer, l_i is the location of firm i and $\alpha > 0$ is a utility parameter.[39] The quasi-linear utility function of the representative consumer given in equation (1) results in direct effects of CSR changes on consumer welfare being exactly offset by price changes. In contrast, in the indirect utility function given in equation (52) the direct effects of CSR levels and prices are what determine consumer welfare.

The location of the consumer indifferent between consuming firm i's product, or the product of its neighbour firm j, is

$$\hat{x}_{ij} = \frac{(v_i - v_j) - (p_i - p_j)}{2\tau} + \frac{L}{6}. \tag{53}$$

The profit of each firm i then depends on the prices and CSR levels of its two neighbours j and k

$$\pi_i = (p_i - c)(\hat{x}_{ij} + \hat{x}_{ik}) - \frac{tv_i^2}{2}. \tag{54}$$

We analyze the case of three firms for tractability reasons. In Stage 2 of the non-cooperative benchmark each firm i selects p_i to maximize profit (54), resulting in conditional price $p_i^*(v_i, v_j, v_k)$. In Stage 1 of the non-cooperative benchmark each firm i selects v_i to maximize $\pi_i(p_i^*(v_i, v_j, v_k), p_j^*(v_i, v_j, v_k), p_k^*(v_i, v_j, v_k), v_i, v_j, v_k)$. Denote the resulting price and CSR level as p_S^* and v_S^*, respectively. Focus on a partial production agreement where two firms, without loss of generality firm 1 and firm 2, form a production agreement, and firm 3 does not participate in the agreement. In Stage 2 of a production agreement, firms 1 and 2 select p_1 and p_2 to maximize $\pi_1 + \pi_2$, while firm 3

[39]The standard assumption that each consumer buys one unit implies that α must be sufficiently large such that utility (52) is positive for all consumers.

selects p_3 to maximize π_3, resulting in conditional prices $p_1^c(v_1, v_2, v_3)$, $p_2^c(v_1, v_2, v_3)$, and $p_3^{**}(v_1, v_2, v_3)$. In Stage 1 of a production agreement, each firm i selects v_i to maximize $\pi_i(p_1^c(v_1, v_2, v_3), p_2^c(v_1, v_2, v_3), p_3^{**}(v_1, v_2, v_3), v_1, v_2, v_3)$.

Denote the resulting price and CSR level of the two firms in the production agreement as p_S^p and v_S^p, respectively. CSR levels of insiders and firms in the non-cooperative benchmark compare as follows (denoted by subscript S).

Proposition C1 $v_S^p > v_S^*$.

Proof. The Nash-equilibrium conditional price of firm i in the non-cooperative benchmark is

$$p_i^* = c + \frac{5L\tau + 6v_i - 3\sum_{i \neq j}^{n} v_j}{15}, \tag{55}$$

The conditional price of firm 1 in a production agreement is

$$p_1^c = c + \frac{(20L\tau + 15v_1 - 3v_2 - 12v_3)}{36}, \tag{56}$$

and the conditional price of firm 2 by symmetry results when subscripts 1 and 2 are exchanged in equation (56). The conditional price of firm 3, not participating in the production agreement, is

$$p_3^{**} = c + \frac{(8L\tau + 6v_3 - 3\sum_{i \neq 3}^{n} v_i)}{18}. \tag{57}$$

The Nash-equilibrium CSR level in the non-cooperative benchmark is

$$v_S^* = \frac{4L}{15t}. \tag{58}$$

The CSR level of a production agreement insider is

$$v_S^p = \frac{2L(5t\tau - 2)}{3t(9t\tau - 4)}. \tag{59}$$

In all proofs in this appendix, we consider parameter values such that an interior solution is guaranteed and the second-order conditions are satisfied: α large enough so that all consumers buy, and $t\tau > \frac{1}{2}$. The ranking follows from

$$v_S^p - v_S^* = \frac{2L(7t\tau - 2)}{15t(9t\tau - 4)} > 0. \ \blacksquare$$

Proposition C1 is in line with the baseline model: firms in a production agreement always increase CSR levels compared to the non-cooperative benchmark. By increasing conditional prices in the Stage 2, firms in a production agreement increase the incentive to invest as servicing an additional consumer is more profitable. Prices of insiders and firms in the non-cooperative benchmark compare as follows.

Proposition C2 $p_S^p > p_S^*$.

Proof. Substituting v_S^* into equation (55) gives

$$p_S^* = k + \frac{L\tau}{3}. \tag{60}$$

Substituting v_S^p and the Nash-equilibrium CSR level of firm 3 in a production agreement into equation (56) gives

$$p_S^p = k + \frac{L\tau(5t\tau - 2)}{9t\tau - 4}. \tag{61}$$

The ranking follows from

$$p_S^p - p_S^* = \frac{2L\tau(3t\tau - 1)}{3(9t\tau - 4)} > 0. \ \blacksquare$$

Proposition C2 states that firms in a production agreement always increase prices compared to the non-cooperative benchmark. Like in the baseline model, we see that a production agreement increases consumer welfare by increasing CSR levels, but decreases consumer welfare by increasing prices. The next two propositions investigate the net effect on consumer welfare of a production agreement. First, note from equation (52) that the net effect of v_i and p_i on a consumer who purchases from firm i is $v_i - p_i$. This net effect on utility compares as follows across production agreement insiders and firms in the non-cooperative benchmark.

Proposition C3 $v_S^* - p_S^* > v_S^p - p_S^p$ unless $\tau < \frac{1}{15}(6 + \sqrt{6})$ and $t < \frac{1}{5}\sqrt{\frac{2}{3\tau^2}} + \frac{2}{5\tau}$.

Proof. Constructing $(v_S^* - p_S^*) - (v_S^p - p_S^p)$ from equations (58) to (61) gives

$$(v_S^* - p_S^*) - (v_S^p - p_S^p) = \frac{2L(3t\tau(5t\tau - 4) + 2)}{15t(9t\tau - 4)},$$

which is greater than 0 unless $\tau < \frac{1}{15}(6 + \sqrt{6})$ and $t < \frac{1}{5}\sqrt{\frac{2}{3\tau^2}} + \frac{2}{5\tau}$. $\blacksquare$

Proposition C3 states that the net utility due to CSR levels and prices offered by an insider in a production agreement is less than the net utility offered by a firm in the non-cooperative benchmark, unless products are very similar in the horizontal sense (τ is small) and investing is cheap (t is small). As in the baseline model, when goods are similar and investing is cheap the business stealing incentives are very large, so that firms in a production agreement invest heavily in CSR. Proposition C3 only investigates the situation for consumers who purchase from either firm 1 or 2 in both competitive regimes. However, the increased conditional prices of the firms in a production agreement causes the market share of firm 3 to increase compared to the non-cooperative benchmark. The next proposition therefore compares total consumer surplus across the two competitive regimes.

Proposition C4 $CS_S^* > CS_S^p$, unless $\tau < \frac{8}{15}$ and $t < \frac{8}{15\tau}$.

Proof. Ignoring travel costs, each consumer in the non-cooperative benchmark has utility $\alpha - v_S^* - p_S^*$, while in a production agreement consumers of firm 1 or 2 have utility $\alpha + v_S^p - p_S^p$, and consumers of firm 3 have utility $\alpha + v_S^{**} - p_S^{**}$. In the non-cooperative benchmark, the indifferent consumers are located halfway between adjacent firms leading to the lowest possible total travel cost: $\frac{\tau L^2}{12}$. With a production agreement, the indifferent consumers between firm 3 and a firm in the agreement are located $\frac{L(3t\tau-1)}{3(9t\tau-4)}$ from the firms 1 and 2, while the indifferent consumer between firms 1 and 2 is located halfway between them, leading to total travel cost: $\frac{L^2\tau(3t\tau(87t\tau-80)+56)}{36(4-9t\tau)^2}$. Summing the difference in utility net of travel costs for all consumers across the two regimes, and the difference in total travel cost, gives the difference in consumer surplus

$$CS_S^p - CS_S^* = L^2 \frac{(8-15t\tau)(t\tau(87t\tau-64)+12)}{90r(4-9t\tau)^2},$$

which is positive if $\tau < \frac{8}{15}$ and $t < \frac{8}{15\tau}$, and negative otherwise. ■

Proposition C4 shows that a production agreement leads to a reduction in consumer welfare in the vast majority of all cases. The results presented in Proposition C3 and Proposition C4 are in line with our results in the baseline model. Although a production agreement will always increase CSR levels compared to the non-cooperative benchmark, consumer welfare typically decreases, unless goods are very similar and investing is very cheap.

D Partial agreements with fringe competition

In this appendix we show that the results from our baseline model extend to partial agreements that consist of m out of the n firms, with the remaining $n-m$ firms forming a competitive fringe ($m < n$). Residual competition reduces the possibilities for firms to benefit from an agreement. This causes all outcomes to lie in between the non-cooperative outcome and the outcome with a market-wide agreement. Therefore, partial agreements on CSR reduce CSR and output compared to the benchmark, but by less than market-wide agreements directly on CSR. Likewise, partial agreements on production increase CSR and reduce conditional quantities compared to the benchmark, but by less that market-wide production agreements. A two-firm production agreement in markets of up to five firms can increase its output compared to the non-cooperative benchmark if investing is very cheap and goods are very similar, but in that case the firms in the production agreement make less profit than they would in the non-cooperative benchmark. No profitable agreement exists that simultaneously increases consumer welfare and CSR compared to the benchmark.

Without loss of generality, let $i = 1, ..., m$ be the firms participating in the agreement, so $i = m+1, ..., n$ are the firms remaining in competition. We refer to members

of the agreement as insiders, and firms in the competitive fringe as outsiders. Firms play the two stage game described in the main text, serving demand (2) at marginal production costs c and CSR investment costs $\frac{tv_i^2}{2}$. Let v_P^r denote the CSR level of a member of a partial agreement in competitive regime $r \in \{csr,\ p,\ f\}$. CSR levels of agreement insiders and firms in the non-cooperative benchmark compare as follows.[40]

Result D1. $v_P^p > v^* > \{v_P^f, v_P^{csr}\}$.

Result D1 states that a partial production agreement is the only partial agreement that increases CSR levels compared to the non-cooperative benchmark.[41] The first-order condition for firm i, who is an insider in a partial CSR agreement, is

$$\sum_{i\neq j}^{n} \frac{\partial \pi_i}{\partial q_j}\frac{\partial q_j^*}{\partial v_i} + \frac{\partial \pi_i}{\partial v_i} + \sum_{i\neq j}^{m}\left(\sum_{i\neq j\neq k}^{n} \frac{\partial \pi_j}{\partial q_k}\frac{\partial q_k^*}{\partial v_i} + \frac{\partial \pi_j}{\partial q_i}\frac{\partial q_i^*}{\partial v_i}\right) = 0. \tag{62}$$

Comparing (62) to (7) shows that each insider in a partial CSR agreement only considers the negative externality of its CSR level on $m-1$, instead of $n-1$, other firms' profit. As m goes to zero, the non-cooperative outcome is approached. As m goes to n, CSR levels converge to those of a market-wide CSR agreement. Therefore, CSR levels are always lower in a partial CSR agreement than in the non-cooperative benchmark, and the extent to which they differ is increasing in the size of the agreement: $v^* > v_P^{csr} > v^{csr}$.

Denote the Nash-equilibrium conditional quantities set by insiders in a partial production agreement or a partial full agreement by $q^{in}(\mathbf{v})$, and the conditional quantities set by outsiders by $q^{out}(\mathbf{v})$.[42] The first-order condition for a firm i, who is an insider in a partial production agreement, is

$$\sum_{i\neq j}^{m} \frac{\partial \pi_i}{\partial q_j}\frac{\partial q_j^{in}}{\partial v_i} + \sum_{k=m+1}^{n} \frac{\partial \pi_i}{\partial q_k}\frac{\partial q_k^{out}}{\partial v_i} + \frac{\partial \pi_i}{\partial v_i} + \frac{\partial \pi_i}{\partial q_i}\frac{\partial q_i^{in}}{\partial v_i} = 0. \tag{63}$$

[40] CSR levels for the general m-of-n setup are extremely lengthy and therefore omitted here. Comparing outcomes across different competitive regimes for all n and m is computationally infeasible. In this section we therefore report results for $3 \leq n \leq 10$ and all $2 \leq m \leq n-1$. Note that these are not simulations: for each n-m combination, results hold for all parameter values of A, γ, and t. As the expressions of quantities and CSR levels are too elaborate to present, we label our comparisons "Results" instead of "Propositions", and omit the proofs. CSR levels that solve the general game and Mathematica syntax for all the results in this section are available upon request. See Treuren and Schinkel (2018) for a more elaborate discussion of partial agreements, including quantities and CSR levels of outsiders and results for $n > 10$. Allowing for $n > 10$, as in Treuren and Schinkel (2018), does not affect the results presented in this appendix.

[41] The curly brackets in Result D1 indicate that the ordering of v_P^f and v_P^{csr} can vary. See Treuren and Schinkel (2018) for a detailed discussion.

[42] $q_i = q^{in}(\mathbf{v})$ and $q_i = q^{out}(\mathbf{v})$ solve $max_{q_i} \sum_{k=1}^{m} \pi_k(\mathbf{q}, v_k)$ for $i = 1, \ldots, m$, and $max_{q_i} \pi_i(\mathbf{q}, v_i)$ for $i = m+1, \ldots, n$.

Comparing equation (63) to equation (8) shows that the only difference between the first-order conditions of a partial and market-wide production agreement is that the conditional quantities in a partial production agreement differ from those in a market-wide production agreement. Because $|\frac{\partial q_i^{in}}{\partial v_i}|$, $|\frac{\partial q_j^{in}}{\partial v_i}|$, $|\frac{\partial q_j^{out}}{\partial v_i}|$ are lowest when m is small, incentives to invest for insiders in a partial production agreement increase with the size of the agreement. When $m = n$, $q^{in}(\mathbf{v}) = q^c(\mathbf{v})$, and equation (63) reduces to equation (8). For all n and m, insiders increase their CSR levels compared to the non-cooperative benchmark because $\frac{\partial \pi_i}{\partial q_i} > 0$: $v^p > v_P^p > v^*$.

The first-order condition for firm i, who is an insider in a partial full agreement, is

$$\frac{\partial \pi_i}{\partial v_i} + \sum_{j=1}^{m} \sum_{k=m+1}^{n} \frac{\partial \pi_j}{\partial q_k} \frac{\partial q_k^{out}}{\partial v_i} = 0. \tag{64}$$

Comparing (64) to (9) shows that an insider in a partial full agreement has an additional incentive to invest in CSR compared to a market-wide full agreement. For each insider i and outsider j we have $\frac{\partial \pi_i}{\partial q_j} < 0$ and $\frac{\partial q_j^{out}}{\partial v_i} < 0$, which shows that investing in CSR increases profit for all insiders by reducing the quantity of outsiders. This effect is larger the smaller is m. As m increases from 0 to n incentives to invest in CSR decrease as the first-order condition for an insider converges from the non-cooperative first-order condition (6) to the market-wide full agreement first-order condition (9): $v^* > v_P^{fc} > v^p$.[43]

Consumer surplus is a function of the quantities of all insiders and outsiders in a partial agreement, as shown by equation (14). As we are interested in the behaviour of insiders, and as in consumer surplus is a function of quantities, we focus on the quantities of insiders as a measure of the agreement's contribution to consumer surplus. Denote by q_P^r the quantity of an agreement insider in competitive regime $r \in \{csr, p, f\}$. Comparing quantities across the benchmark, a CSR agreement, and a full agreement, we obtain the following result.

Result D2. $q^* > q_P^{csr} > q_P^f$.

Result D2 states that allowing insiders to coordinate their CSR levels decreases the quantity they produce compared to the non-cooperative benchmark, regardless of the size of the competitive fringe. A CSR agreement produces the non-cooperative quantity conditional on CSR levels in Stage 2. By Result D1 and the discussion following it, we know that a partial CSR agreement decreases CSR levels compared to the non-cooperative benchmark, and that CSR levels are reduced by more the more firms take part in the agreement. It follows that $q^* > q_P^{csr} > q^{csr}$.

[43] If $|\sum_{i\neq j}^{n} \frac{\partial \pi_i}{\partial q_j} \frac{\partial q_j^*}{\partial v_i}| + \sum_{i\neq j}^{m} \sum_{i\neq j\neq l}^{n} |\frac{\partial \pi_j}{\partial q_l} \frac{\partial q_l^*}{\partial v_i}| - \sum_{i\neq j}^{m} |\frac{\partial \pi_j}{\partial q_i} \frac{\partial q_i^*}{\partial v_i}| > |\sum_{j=1}^{m} \sum_{k=m+1}^{n} \frac{\partial \pi_j}{\partial q_k} \frac{\partial q_k^{out}}{\partial v_i}|$ then $v_P^{csr} > v_P^f$. This happens when consumers view products as close substitutes (γ is close to 1).

Insiders in a partial full agreement reduce quantities both by reducing conditional quantities in Stage 2, and by reducing CSR levels in Stage 1. The first-order condition of an insider in Stage 2 of a partial full agreement or a partial production agreement is

$$\frac{\partial \pi_i}{\partial q_i} + \sum_{i \neq j}^{m} \frac{\partial \pi_j}{\partial q_i} = 0, \tag{65}$$

which shows that an insider's incentive to reduce its conditional quantity compared to the non-cooperative benchmark is increasing in agreement size m, as $\frac{\partial \pi_j}{\partial q_i} < 0$. For insiders in a partial full agreement, by Result D1 we know that the incentive to decrease CSR levels compared to the non-cooperative benchmark also increases in m. It follows that $q^* > q_P^f > q^f$.[44] Quantities of partial production agreement insiders and firms in the non-cooperative benchmark compare as follows.

Result D3. $q^* > q_P^p$ unless $m = 2$, $n \in \{3, 4, 5\}$, and $t < T_P(\gamma, n)$, in which case $\pi^* > \pi_{in}^{pc}$.[45]

Result D3 states that insiders in a partial production agreement will decrease their output compared to the non-cooperative benchmark unless the production agreement consists of two firms, there are no more than three outsiders, investing is very cheap (t is low), and goods are very similar (γ is high). When $q_P^p > q^*$, insiders in a partial production agreement make less profit than firms in the non-cooperative benchmark. Recall that a production agreement increases CSR levels, but reduces conditional quantities, compared to the non-cooperative benchmark. In a market-wide production agreement, the reduction of conditional quantities is increasing in n, as the benchmark quantity is increasing in n. In a partial production agreement, the reduction of conditional quantities is still increasing in n, but equation (65) shows that the reduction of conditional quantities is also increasing in m, such that the reduction of conditional quantities is smallest if both m and n are small. In that case, insiders can increase quantities compared to the non-cooperative benchmark if investing is very cheap and products are very similar. Just as in the market-wide agreement case, these parameters result in the firms engaging in a CSR arms race that leaves firms worse off compared to the non-cooperative benchmark.[46]

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[44] Let $\Delta v_P^{csr} = v_P^{csr} - v^*$, $\Delta v_P^f = v_P^f - v^*$, and $\Delta q^{in} = q^{in}(v^*) - q^*(v^*)$. As $|\frac{\partial q^{in}}{\partial v}\Delta v_P^f + \Delta q^{in}| > |\frac{\partial q^*}{\partial v}\Delta v_P^{csr}|$, we have $q_P^{csr} > q_P^f$.

[45] $T_P(\gamma,3) = \frac{4+5\gamma-2\gamma^2-\gamma^3}{4(2+2\gamma-3\gamma^2-2\gamma^3+\gamma^4)} + \frac{1}{4}\sqrt{\frac{-2\gamma^2-15\gamma^3-16\gamma^4+2\gamma^5-6\gamma^6+\gamma^7}{(\gamma-2)(\gamma^2-1)^2(\gamma^2-2\gamma-2)^2}}$, $T_P(\gamma,4) = \frac{-32-64\gamma+16\gamma^2+30\gamma^3-7\gamma^4-3\gamma^5}{4(4+4\gamma-5\gamma^2+\gamma^3)(-4-4\gamma+5\gamma^2+3\gamma^3)} + \frac{1}{4}\sqrt{\frac{256\gamma^2+1536\gamma^3+2112\gamma^4-416\gamma^5-444\gamma^6+588\gamma^7+61\gamma^8-102\gamma^9+9\gamma^{10}}{(4+4\gamma-5\gamma^2+\gamma^3)^2(-4-4\gamma+5\gamma^2+3\gamma^3)^2}}$, and $T_P(\gamma,5) = \frac{-8-26\gamma-9\gamma^2+16\gamma^3+\gamma^4-4\gamma^5}{4(4+6\gamma-6\gamma^2+\gamma^3)(-1-2\gamma+\gamma^2+2\gamma^3)} + \frac{1}{4}\sqrt{\frac{36\gamma+252\gamma^3+505\gamma^4+132\gamma^5-234\gamma^6+136\gamma^7+129\gamma^8-72\gamma^9+16\gamma^{10}}{(4+6\gamma-6\gamma^2+\gamma^3)^2(-1-2\gamma+\gamma^2+2\gamma^3)^2}}$.

[46] It is noteworthy that for $n > 3$ total quantity will always decrease as outsiders actually reduce quantity in Nash-equilibrium compared to the non-cooperative benchmark. See Treuren and Schinkel (2018) for details.