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Summary

Anti-consumerism is a doctrine that aims to discourage excessive consumption because of its damaging effect on the environment. It can either focus on creating psychic costs for consumers (a 'stick') or psychic benefits for non-consumers (a 'carrot'). This paper examines the impact of these two approaches on competition and welfare. The competitive effect is comparable in both cases – anti-consumerism (weakly) reduces competitive pressure as well as prices, outputs and profits. In terms of consumer and social welfare, however, the carrot performs strictly better than the stick.

Keywords: Anti-Consumerism, Stick and Carrot, Environmental Externalities

JEL classification: D11, L13, Q50, Q58

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Anti-Consumerism: Stick or Carrot?*

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May 10, 2024

Abstract

Anti-consumerism is a doctrine that aims to discourage excessive consumption because of its damaging effect on the environment. It can either focus on creating psychic costs for consumers (a 'stick') or psychic benefits for non-consumers (a 'carrot'). This paper examines the impact of these two approaches on competition and welfare. The competitive effect is comparable in both cases – anti-consumerism (weakly) reduces competitive pressure as well as prices, outputs and profits. In terms of consumer and social welfare, however, the carrot performs strictly better than the stick.

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"Nothing is enough for the man to whom enough is too little." —Epicurus

1 Introduction

Reducing worldwide emissions to counter climate change has recently become one of the most impellent humankind's challenges. Such an ambitious objective calls for joint efforts from a broad range of stakeholders, including companies, governmental and nongovernmental organizations, but also citizens. Indeed, it is increasingly recognized that individuals, alongside with organizations, must be encouraged to limit their consumption levels to meet environmental goals.[1]

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[1]See, *e.g.*, Rogelj *et al.* (2015) and Millar *et al.* (2017).

With this in mind, anti-consumerism (or anti-consumption) ideologies may serve as a backbone of environmental policies by leading citizens toward more sustainable consumption habits.[2] Simply put, anti-consumerism is a doctrine that combats excessive consumption for its perilous consequences. It is promoted by both private and public institutions and has many faces.[3]

On Black Friday in 2011, for instance, the popular clothing brand *Patagonia* launched its "Don't buy This Jacket" campaign arguing that:[4]

> *...to address the issue of consumerism [...] and lighten our environmental footprint, everyone needs to consume less.*

This message received widespread attention and acted as a public call to reduce consumption.[5] As another example, the European Commission recently kicked off the *ReSet the Trend* campaign to engage young Europeans in a battle against fast fashion. With an eye on stimulating sustainable clothing production, it stated:[6]

> *Fast fashion depletes our resources [...] let's make fast fashion out of fashion.*

In principle, there are two different ways to design an anti-consumerism campaign. One is to try to stigmatize consumers, which creates a *psychic cost*. For example, a governmental agency may attempt to raise awareness of the negative aspects of meat consumption, which can create a sense of guilt and even disgust.[7] Such a 'stick' effectively reduces the gain from consumption. Alternatively, one could focus on rewarding non-buyers, which creates a *psychic benefit* or 'warm-glow' utility.[8] For example, those who abstain from consumption may take some pride in personally contributing to society's sustainability challenges. Such a 'carrot' effectively raises the gain from nonconsumption.

Taking an economic perspective, anti-consumerism affects the willingness to pay or purchase a product or service. Specifically, by discouraging consumption, it potentially reduces demand, which in turn is likely to have an effect on strategic firm behavior and the welfare of consumers and society as a whole. A key issue is then how to best achieve the objective of lowering consumption levels? Should one advocate a stick approach or a carrot approach instead? It is this issue that we take up in this paper.

We address these and related questions within the context of Hotelling's spatial differentiation model, where two firms compete in prices and are confronted with an anti-consumerism campaign. As is well-known,

[2]The term *consumerism* is attributed to John Bugas, the number two of Ford Motor Company, who introduced it in one of its public speeches in 1955. Since then, its antonym, *anti-consumerism*, has been used to indicate any ideology against the excessive consumption typical of mature capitalistic societies. Henceforth, we will use the terms *anti-consumerism* and *anti-consumption* interchangeably.

[3]As pointed out by Chatzidakis and Lee (2013) and Makri *et al.* (2020), a clear conceptualization of anti-consumption is currently missing and most studies view this phenomenon either as an individual attitude or lifestyle (*e.g.*, in Hélène Cherrier and Murray (2007) and Galvagno (2011), a motivation (*e.g.*, in Iyer and Muncy (2009), Lee *et al.* (2009a), Sandıkcı and Ekici (2009), Helene Cherrier *et al.* (2011), and García-de-Frutos *et al.* (2018)) or simply as a practice (*e.g.*, in Helene Cherrier (2009)).

[4]See www.patagonia.com/stories/dont-buy-this-jacket-black-friday-and-the-new-york-times/story-18615.html.

[5]See Hwang *et al.* (2016) and Yoon *et al.* (2020).

[6]The European Commission (2023).

[7]See, for example, the experimental study by Palomo-Vélez *et al.* (2018).

[8]See, *e.g.*, Andreoni (1990).

this setting allows for different types of market situations, ranging from intense competition to (local) monopoly. We provide a complete equilibrium characterization and systematically evaluate the effect of a 'stick' and a 'carrot' on the equilibrium outcomes.

Our main findings are as follows. Both the stick and the carrot approach have a comparable effect on market competition. Specifically, anti-consumerism (weakly) reduces competitive pressure independent of the policy's design ('stick' or 'carrot'). If the market is competitive and the campaign sufficiently effective, then those who are least eager to obtain the product prefer the outside option of 'not consuming'. Anti-consumerism thus potentially transforms competitive markets into (local) monopolies by lowering demand. This demand reduction yields both lower production levels and lower prices, which in turn puts a downward pressure on firms' profitability.

As to consumer and social welfare, a stick negatively affects the utility of consumers who still buy the product. At the same time, it provides no direct benefit for those who forgo consumption. The (weak) reduction in demand has a negative effect on both prices and profits so that firms are worse off too. Taken together, a stick policy is then generally harmful for societal welfare, albeit with one notable exception. If production creates substantial externalities (*e.g.*, emissions) and lowering production yields sufficiently large externality savings, then a stick policy may induce an increase of social welfare. In that case, the cost savings more than make up for the loss in consumer and producer surplus.

By contrast, the impact of a carrot policy on welfare can be positive, even net of externalities. With this approach, consumer surplus can increase when the reduction in aggregate demand is not too big. The reason is that a carrot, although it does not affect the gross utility of consumption, may lead to lower prices. Somewhat paradoxically, therefore, consumers in this case are better off than before the launch of an anti-consumerism campaign. A carrot policy may also have a positive effect on social welfare, even when it leads to a substantial reduction in aggregate demand. Although consumers and producers face a negative direct effect (*i.e.*, both consumer and producer surplus are lower after the launch of the campaign), this may be more than compensated for by the psychic benefits for non-buyers and the externality savings.

Comparing a stick policy with a carrot policy, we show that the carrot performs strictly better than the stick, both in terms of consumer surplus and the welfare of society as a whole. Given that one aims to promote anti-consumerism, therefore, the carrot approach is preferable to the stick approach.

The vastly growing literature dealing with issues of anti-consumption mainly takes a marketing, sociological or psychological perspective.[9] In particular, there is a variety of movements highlighting the problematic features of excessive consumption. The *zero waste* and the *minimalists* are among the most prominent anti-consumption movements.[10] Minimalism focuses on owning less. Pangarkar *et al.* (2021) identify four types of *minimalism*: (i) *voluntary simplicity*, which opposes conspicuous consumption advocating frugality and self-control in consumption practices; (ii) *reduced consumption*, which simply implies a reduction in consumption, without boycotting or giving up on consumption completely; (iii) *anti-consumption*, which

[9]See, *e.g.*, Makri *et al.* (2020) for an extensive survey.
[10]See, *e.g.*, Lee and Ahn (2016) and Meissner (2019).

works as a strong dislike and dismissal of consumption practices, mostly for idealistic reasons;[11] and (iv) *inconspicuous minimalism* where individuals decide to exclusively buy products with designs, materials, logos and styles which are discrete in appearance.[12]

A phenomenon closely connected to anti-consumerism is *brand avoidance*. Lee *et al.* (2009b) distinguish three types of *brand avoidance*: (i) *experiential brand avoidance*, due to a gap between consumers' expectations and experienced brand performance; (ii) *identity brand avoidance*, due to the incongruence between a brand's symbolic meaning and the individual's self-identity, and (iii) *moral brand avoidance*, motivated by ideological incompatibility of the brand with consumers' main political and socio-economic beliefs. It is further worth noting that governments and nongovernmental organizations are also attempting to affect consumers with specific policies such as green nudges, education as well as product design, waste management, and promotion or demotion of particular goods.[13]

Several recent economic studies consider models with vertically differentiated goods in which firms offer both a 'brown' and a 'green' variant (see, *e.g.*, Moraga-Gonzalez and Padron-Fumero (2002); Rodríguez-Ibeas (2003); Harstad (2012); Deltas *et al.* (2013)). Within these types of setting, consumers typically (partially) internalize the environmental damages generated by the consumption of polluting goods.[14] Espinola-Arredondo and Zhao (2012), for example, study a spatial duopoly where products differ in their degree of pollution. Within this context, it is shown how standard environmental regulations (*e.g.*, taxes and subsidies) may be welfare-enhancing. Recent work by Mantovani and Vergari (2017), Marini *et al.* (2022), and Maccarrone *et al.* (2023) employs vertical differentiation models to study how environmentalist and anti-hedonistic campaigns may affect consumers' decisions to buy brown or green products. Among other things, these contributions highlight some potential adverse effects of such policies.

Our study is further related to the Law and Economics field and, in particular, to work on optimal enforcement. Generally speaking, governments may employ punitive policies (*sanctions*) to deter noncompliance with social and legal norms or, instead, a reward system which provides positive incentives toward the desired behavior. Whether a stick or carrot approach is preferred typically depends on personal traits and contexts, with a balanced strategy often being the most reasonable and effective choice, considering factors like fairness and proportionality while upholding individual rights and societal values.[15] When it comes to anti-consumerism, however, our findings suggest the carrot to be strictly preferable to the stick.

The next section introduces the model. In Section 3, we assess the impact of a stick or carrot policy on market competition. Section 4 deals with consumer surplus, whereas Section 5 focuses on social welfare. Section 6 concludes. All computations and proofs are relegated to the appendix.

[11] See, *e.g.*, Zavestoski (2002) and Seegebarth *et al.* (2016). Iyer and Muncy (2009) break down anti-consumption behavior further into four sub-categories, including consumers (i) who care for the environment, (ii) who prefer a simple and uncomplicated life without material pursuits, (iii) who avoid specific brands unrespectful to the environment, and (iv) who boycott only certain brands not matching their specific principles and ways of life.

[12] See, *e.g.*, Berger and Ward (2010), Li *et al.* (2012), Eckhardt *et al.* (2015), and Seo and Buchanan-Oliver (2019).

[13] See, *e.g.*, Stehfest *et al.* (2009), Creutzig *et al.* (2016), Moberg *et al.* (2019) and Abbott and Sumaila (2019).

[14] See, *e.g.*, Bansal and Gangopadhyay (2003), Amacher *et al.* (2004), and Lombardini-Riipinen (2005).

[15] See, e.g., Balch (1980), De Geest and Dari-Mattiacci (2013), and Galle (2013).

2 The Model

To analyze the impact of anti-consumerism on market competition and welfare, we employ Hotelling's classic spatial differentiation model.[16] There are two price-setting suppliers, firm 1 and firm 2, which are located at the extremes of a unit interval. Without loss of generality, we assume that firm 1 is located at 0 and firm 2 is located at 1. Suppliers produce to order at a common marginal cost c and choose prices simultaneously to maximize profit.

Firm i's profit function is:

$$\Pi_i(p_i, p_j) = (p_i - c) \cdot D_i(p_i, p_j), \; i = 1, 2 \text{ and } i \neq j, \tag{1}$$

where D_i is its demand, which is a function of the own price, p_i, and the price of the rival, p_j. Demand comes from a continuum of consumers with unit demand who are uniformly distributed over the interval with a mass normalized to one. The gross surplus from consumption is denoted by v, which is assumed to exceed the unit cost of production, *i.e.*, $v > c$.

In addition to paying a price, a buyer based at $x \in [0, 1]$ incurs a transportation cost of $t > 0$ per unit of distance. The parameter t captures the degree of (spatial) product differentiation and can be interpreted as a disutility. The utility function of a consumer located at $x \in [0, 1]$ is then given by:

$$U(x) = \begin{cases} v - p_1 - t \cdot x \text{ when she buys firm 1's product at a price of } p_1, \\ v - p_2 - t \cdot (1 - x) \text{ when she buys firm 2's product at a price of } p_2, \\ 0 \text{ otherwise.} \end{cases} \tag{2}$$

We now proceed with analyzing the situation absent an anti-consumerism campaign, which serves as a benchmark for the ensuing stick and carrot analyses.

2.1 Price, Output, and Profit: A Benchmark

As is well-known, the parameter values in combination with the price choices may give rise to different types of market situations. Specifically, following Bacchiega *et al.* (2023) and Yousefimanesh *et al.* (2023), one can distinguish three different cases:[17]

[α] Competitive pricing: $p_1 + p_2 < 2v - t$;

[κ] Market-sharing pricing: $p_1 + p_2 = 2v - t$;

[μ] Monopolistic pricing: $p_1 + p_2 > 2v - t$.

To facilitate our analysis, it is useful to break down the second case further by delineating two types of market-sharing pricing. If $v \in [c + t, c + \frac{6}{5}t)$, then we speak of *monopolistic market-sharing* and indicate this with κ_1. If $v \in (c + \frac{6}{5}t, c + \frac{3}{2}t]$, then we use the term *competitive market-sharing* and denote this by κ_2.

[16] See Hotelling (1929).

[17] The symbol that we use to indicate a case is the first letter of the Greek translation. Furthermore, it is worth noting that, strictly speaking, there is a forth 'predatory pricing situation' where one of the firms prices so low that it captures the entire market. We exclude this possibility from our analysis. For a detailed discussion, see Yousefimanesh *et al.* (2023).

Figure 1 gives a graphical illustration of the different possibilities.

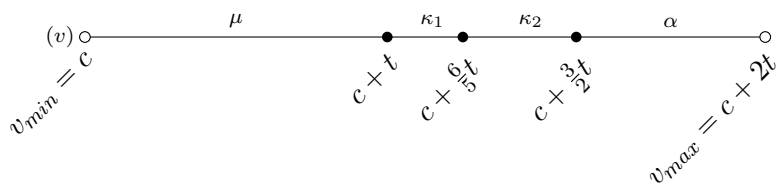

Figure 1: *Pricing regions in the benchmark.*

Starting from the left, there is the absolute lower bound where gross surplus v equals marginal cost of production c. Up until $v = c+t$, the market is 'uncovered' so that firms operate as (local) monopolists. There is market-sharing pricing between $v = c + t$ and $v = c + \frac{3}{2}t$. If $v \in [c + t, c + \frac{6}{5}t)$, then there is monopolistic market-sharing, whereas there is competitive market-sharing when $v \in (c + \frac{6}{5}t, c + \frac{3}{2}t]$. Last, if the valuation for the product is large enough (*i.e.*, $v > c + \frac{3}{2}t$), then there is competitive pricing. This holds until the upper bound, $v = c + 2t$, which derives from the assumption that none of the firms captures the entire market.

We now have all ingredients available to specify the benchmark prices, outputs, and profits. Table 1 provides a complete overview of the equilibrium values.

Benchmark	*Monopoly*	*Monopolistic Market-Sharing*	*Competitive Market-Sharing*	*Competition*
p_1^*	$\frac{v+c}{2}$	$\left[\frac{v+c}{2}, \frac{3v-2t-c}{2}\right]$	$\left[\frac{2v+c}{3}, \frac{4v-3t-c}{3}\right]$	$c+t$
p_2^*	$\frac{v+c}{2}$	$\left[\frac{v+c}{2}, \frac{3v-2t-c}{2}\right]$	$\left[\frac{2v+c}{3}, \frac{4v-3t-c}{3}\right]$	$c+t$
D_1^*	$\frac{v-c}{2t}$	$\left[\frac{2t-(v-c)}{2t}, \frac{v-c}{2t}\right]$	$\left[\frac{v-c}{3t}, \frac{3t-(v-c)}{3t}\right]$	$\frac{1}{2}$
D_2^*	$\frac{v-c}{2t}$	$\left[\frac{2t-(v-c)}{2t}, \frac{v-c}{2t}\right]$	$\left[\frac{v-c}{3t}, \frac{3t-(v-c)}{3t}\right]$	$\frac{1}{2}$
Π_1^*	$\frac{(v-c)^2}{4t}$	$\left[\frac{(v-c-2t)\cdot(2t-3(v-c))}{4t}, \frac{(v-c)^2}{4t}\right]$	$\left[\frac{2(v-c)^2}{9t}, \frac{(v-c-3t)\cdot(3t-4(v-c))}{9t}\right]$	$\frac{1}{2}t$
Π_2^*	$\frac{(v-c)^2}{4t}$	$\left[\frac{(v-c-2t)\cdot(2t-3(v-c))}{4t}, \frac{(v-c)^2}{4t}\right]$	$\left[\frac{2(v-c)^2}{9t}, \frac{(v-c-3t)\cdot(3t-4(v-c))}{9t}\right]$	$\frac{1}{2}t$

Table 1: Equilibrium prices, outputs, and profits in the benchmark.

Table 1 reveals an equilibrium pricing pattern as visualized in Figure 2.

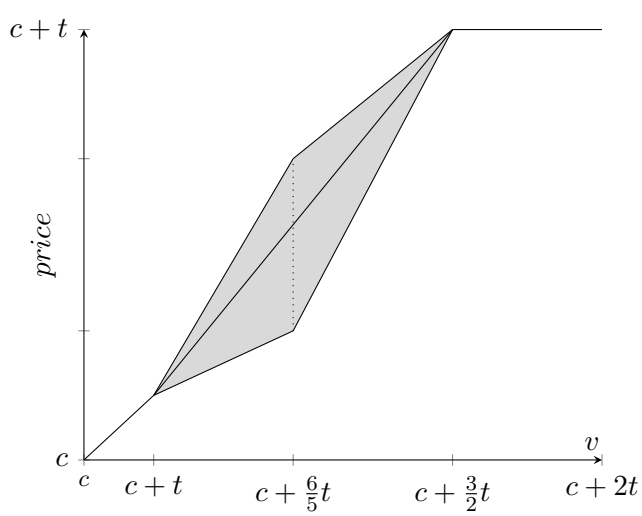

Figure 2: *Equilibrium pricing pattern.*

Prices are lowest under (local) monopoly. In that case, the valuation for the product is so low that consumers which are least eager to obtain it (*i.e.*, the ones located in the middle) choose the outside option. These customers do prefer to purchase when v exceeds the threshold $c+t$. Under market-sharing pricing (*i.e.*, $v \in \left[c+t, c+\frac{3}{2}t\right]$), prices are increasing over the entire range and higher than under monopoly. Specifically, in this case there is a range of equilibrium prices. The difference between the lowest and highest equilibrium price increases over the range $\left[c+t, c+\frac{6}{5}t\right)$, whereas this difference decreases over the range $\left(c+\frac{6}{5}t, c+\frac{3}{2}t\right]$. Maximal equilibrium price dispersion may therefore occur at $v = c+\frac{6}{5}t$. When v exceeds the threshold $c+\frac{3}{2}t$, the market is in the competitive region. Under competitive pricing, prices are independent of the valuation and given by $c+t$. This is the highest possible benchmark equilibrium price.

As to demand, under competitive pricing this is constant and given by $\frac{1}{2}$ for each firm. With market-sharing, it depends on the degree of price dispersion. Firms share the market equally at equal prices. If prices differ, then it is the higher-priced firm that has the lower market share. Under monopoly, there is a positive relation between price and demand. That is, an increase in the valuation for the product leads to higher demand, which results in higher equilibrium prices.

Finally, it can be easily verified that equilibrium profits are monotonically increasing in v. That is, profits under market-sharing pricing exceed profits under monopoly pricing. Moreover, profits under competitive pricing are higher than with market sharing for all equilibrium specifications.

2.2 Consumer Surplus and Social Welfare: A Benchmark

Let us now consider the welfare of consumers and of society at large. Consumer surplus (CS) is given by buyers' joint utility and computed as follows:

$$CS = \int_0^{x_1} U(x)dx + \int_{x_2}^{1} U(x)dx. \tag{3}$$

The boundary values x_1 and x_2 depend on which market situation applies. Under competitive pricing, the equilibrium is such that $x_1 = x_2 = \frac{1}{2}$, *i.e.*, each firm serves half the market. With market-sharing $x_1 + x_2 = 1$, but market shares may differ. Finally, under local monopoly it holds that $x_1 = x_2$ and $x_1 + x_2 < 1$.

Social welfare (W) is given by:

$$W = CS + N + \Pi_1 + \Pi_2 - E, \tag{4}$$

where N represents non-buyers' surplus. Note that, by the above utility specification (2), N equals zero in the benchmark. Externalities from production (*e.g.*, emissions) are captured by the function $E : D \mapsto \mathbb{R}_+$, where $D = D_1 + D_2$ is total output. It is assumed that E is a continuously increasing function on $[0, 1]$ with $E(0) = 0$ and $E(1) < \infty$. In what follows, let e and e_u denote the equilibrium externality when the market is 'covered' (*i.e.*, when $D = 1$) and 'uncovered' (*i.e.*, when $D < 1$), respectively. Note that this implies $e > e_u$.

Table 2 provides an overview of consumer surplus and social welfare in the benchmark equilibrium.

Benchmark	CS^*	W^*
Monopoly	$\frac{(v-c)^2}{4t}$	$\frac{3(v-c)^2}{4t} - e_u$
Mon. MS	$\left[\frac{1}{4}t, \frac{(v-c)\cdot(v-c-2t)}{4t} + \frac{1}{2}t\right]$	$\left[\frac{(v-c)\cdot(6t-(v-c))}{4t} - \frac{1}{2}t - e, v - c - \frac{1}{4}t - e\right]$
Comp. MS	$\left[\frac{1}{4}t, \frac{(v-c)\cdot(v-c-3t)}{9t} + \frac{1}{2}t\right]$	$\left[\frac{(v-c)\cdot(12t+c-v)}{9t} - \frac{1}{2}t - e, v - c - \frac{1}{4}t - e\right]$
Competition	$v - c - \frac{5}{4}t$	$v - c - \frac{1}{4}t - e$

Table 2: Consumer surplus and social welfare in the benchmark.

Consumer surplus is in the range $[0, \frac{3}{4}t]$, where the lower bound is at $v_{min} = c$ and the upper bound is at $v_{max} = c + 2t$. It is larger under competition than under monopoly. Interestingly, under market-sharing its value critically depends on the price difference. In this region, the minimum value is $\frac{1}{4}t$, which is obtained at equal prices (*i.e.*, $p_1^* = p_2^* = v - \frac{1}{2}$). Note that this is the same value as on the boundary between monopoly and market-sharing (*i.e.*, when $v = c + t$) and market-sharing and competition (*i.e.*, when $v = c + \frac{3}{2}t$). Under market-sharing, consumer surplus positively depends on the price difference. This is because buyers benefit from lower prices and the lower-priced firm has the larger market share. Given that the market is covered, price dispersion thus works to the advantage of consumers. The maximum value of $\frac{13}{50}t$ ($> \frac{1}{4}t$) is obtained on the boundary between monopolistic and competitive market-sharing (*i.e.*, when $v = c + \frac{6}{5}t$).

Net of externalities, social welfare is monotonically increasing in v. This has the implication that social welfare is higher under competitive pricing than under market-sharing pricing since the level of externalities is the same in both situations. Unlike with consumer welfare, there is no non-monotonic pattern in this case, because in the market-sharing region the consumers' gain from lower prices is more than offset by the firms' loss in profits. Whether social welfare in the competitive region exceeds social welfare under monopoly critically depends on the degree of externalities. It is larger (smaller) under competitive pricing than under monopoly pricing when the difference $e - e_u$ is sufficiently small (large).

3 Competition in the Presence of a Stick or Carrot

Having in mind the above benchmark, let us now analyze the impact of an anti-consumerism campaign that either creates a psychic cost (a 'stick') or a psychic reward (a 'carrot') on market competition. The direct impact of the campaign is captured with a parameter $a > 0$. It is assumed that the impact is not too big in that it does not bring the effective gross surplus $v - a$ below marginal cost, *i.e.*, $a \in (0, v - c)$.

A 'stick policy' effectively reduces the benefit of consumption. Those who still buy are worse off. The consumer's utility specification (2) is then adapted in the following way, where the superscript 's' indicates the presence of a stick:

$$U^s(x) = \begin{cases} v - a - p_1 - tx \text{ when she buys firm 1's product at a price of } p_1, \\ v - a - p_2 - t(1-x) \text{ when she buys firm 2's product at a price of } p_2, \\ 0 \text{ otherwise.} \end{cases} \tag{5}$$

By contrast, a 'carrot policy' creates a benefit for those who forgo consuming the good or service. In this

case, the consumer's utility specification (2) is modified as follows:

$$U^c(x) = \begin{cases} v - p_1 - tx \text{ when she buys firm 1's product at a price of } p_1, \\ v - p_2 - t(1-x) \text{ when she buys firm 2's product at a price of } p_2, \\ a \text{ otherwise.} \end{cases} \tag{6}$$

The superscript 'c' indicates the presence of a carrot.

Like in the benchmark, we can distinguish three different pricing regions. Both with a stick and a carrot approach, these are given by:

$[\alpha^s]/[\alpha^c]$ Competitive pricing $p_1 + p_2 < 2\,(v-a) - t$;

$[\kappa^s]/[\kappa^c]$ Market-sharing pricing $p_1 + p_2 = 2\,(v-a) - t$;

$[\mu^s]/[\mu^c]$ Monopolistic pricing $p_1 + p_2 > 2\,(v-a) - t$.

Since the stick and carrot policy have the same impact on the benchmark pricing regions, one *a priori* may expect their effect on prices, outputs, and profits to be the same too. Given that the anti-consumerism campaign is equally effective in both situations, this indeed appears to be the case.

Table 3 is directly comparable to Table 1 and provides an overview of the equilibrium values under either a stick or a carrot policy.

Stick/Carrot	*Monopoly*	*Monopolistic Market-Sharing*	*Competitive Market-Sharing*	*Competition*
p_1^*	$\frac{v-a+c}{2}$	$\left[\frac{v-a+c}{2}, \frac{3(v-a)-2t-c}{2}\right]$	$\left[\frac{2(v-a)+c}{3}, \frac{4(v-a)-3t-c}{3}\right]$	$c+t$
p_2^*	$\frac{v-a+c}{2}$	$[\frac{v-a+c}{2}, \frac{3(v-a)-2t-c}{2}]$	$\left[\frac{2(v-a)+c}{3}, \frac{4(v-a)-3t-c}{3}\right]$	$c+t$
D_1^*	$\frac{v-a-c}{2t}$	$\left[\frac{2t-(v-a-c)}{2t}, \frac{v-a-c}{2t}\right]$	$\left[\frac{v-a-c}{3t}, \frac{3t-(v-a-c)}{3t}\right]$	$\frac{1}{2}$
D_2^*	$\frac{v-a-c}{2t}$	$\left[\frac{2t-(v-a-c)}{2t}, \frac{v-a-c}{2t}\right]$	$\left[\frac{v-a-c}{3t}, \frac{3t-(v-a-c)}{3t}\right]$	$\frac{1}{2}$
Π_1^*	$\frac{(v-a-c)^2}{4t}$	$\left[\frac{(v-a-c-2t)\cdot(2t-3(v-a-c))}{4t}, \frac{(v-a-c)^2}{4t}\right]$	$\left[\frac{2(v-a-c)^2}{9t}, \frac{(v-a-c-3t)\cdot(3t-4(v-a-c))}{9t}\right]$	$\frac{1}{2}t$
Π_2^*	$\frac{(v-a-c)^2}{4t}$	$\left[\frac{(v-a-c-2t)\cdot(2t-3(v-a-c))}{4t}, \frac{(v-a-c)^2}{4t}\right]$	$\left[\frac{2(v-a-c)^2}{9t}, \frac{(v-a-c-3t)\cdot(3t-4(v-a-c))}{9t}\right]$	$\frac{1}{2}t$

Table 3: Equilibrium prices, outputs, and profits under a stick or carrot policy.

To assess the impact of anti-consumerism, let us start by assuming that the market is competitive prior to the launch of the campaign. We then have the following result.

Proposition 1 *Assume competitive pricing ex ante, i.e.* $v \in (c + 1.5t, c + 2t)$*, and suppose that a stick or carrot policy is introduced:*
(i) If a *is sufficiently small such that there is competitive pricing ex post, then prices, outputs, and profits are not affected.*
(ii) If a *is sufficiently large such that there is market-sharing pricing ex post, then prices and profits are lower than in the benchmark. Aggregate production is not affected.*
(iii) If a *is sufficiently large such that there is monopolistic pricing ex post, then prices, outputs, and profits are lower than in the benchmark.*

This result reveals that the anti-consumerism campaign must be impactful enough to have an effect on strategic firm behavior when the market is competitive. Simply put, consumers will not change their behavior unless the psychic effect created is sufficiently severe. A large enough stick or carrot will induce those least eager to obtain the product to leave the market. The resulting drop in demand leads to a reduction of both price and profit.

The next two results show the effect under market-sharing and monopolistic pricing, respectively.

Corollary 1 *Assume market-sharing pricing ex ante, i.e.* $v \in [c+t, c+\frac{3}{2}t]$*, and suppose that a stick or carrot policy is introduced:*
(i) If a *is sufficiently small such that there is market-sharing pricing ex post, then prices and profits are lower than in the benchmark. Aggregate production is not affected.*
(ii) If a *is sufficiently large such that there is monopolistic pricing ex post, then prices, outputs, and profits are lower than in the benchmark.*

Corollary 2 *Assume monopolistic pricing, i.e.* $v \in (c, c+t)$*. If a stick or carrot policy is introduced, then prices, outputs, and profits are lower than in the benchmark.*

In sum, whether an anti-consumerism campaign creates a psychic cost or a psychic reward, the impact on market competition is the same. Unless the market remains competitive after the launch of the campaign, both a stick and a carrot policy put downward pressure on prices and profits. This leads to a lower aggregate output only if either (i) it 'uncovers' the market, *i.e.*, it induces some consumers to no longer buy the product, or (ii) the market is already 'uncovered' prior to the campaign.

4 Consumer Surplus

Let us now turn to the question of how an anti-consumerism campaign affects consumer surplus as specified in (3) above. Table 4 provides an overview of the surplus equilibrium values under both types of policy.

Consumer Surplus	*Stick*	*Carrot*
Monopoly	$\frac{(v-a-c)^2}{4t}$	$\frac{(v-a-c)\cdot(v+3a-c)}{4t}$
Mon. MS	$\left[\frac{1}{4}t, \frac{(v-a-c)\cdot(v-a-c-2t)}{4t} + \frac{1}{2}t\right]$	$\left[\frac{1}{4}t + a, \frac{(v-a-c)\cdot(v-a-c-2t)}{4t} + \frac{1}{2}t + a\right]$
Comp. MS	$\left[\frac{1}{4}t, \frac{(v-a-c)\cdot(v-a-c-3t)}{9t} + \frac{1}{2}t\right]$	$\left[\frac{1}{4}t + a, \frac{(v-a-c)\cdot(v-a-c-3t)}{9t} + \frac{1}{2}t + a\right]$
Competition	$v - a - c - \frac{5}{4}t$	$v - c - \frac{5}{4}t$

Table 4: Consumer surplus under a stick or carrot policy.

Stick

Since a stick policy reduces the benefit of consumption, one *a priori* may expect this approach to lead to a lower consumer surplus. The following two findings confirm this, albeit with one notable exception.

Proposition 2 *Suppose that a stick policy is introduced that does not induce a switch in pricing regions.*
(i) Consumer surplus under competitive and monopolistic pricing is lower than in the benchmark. Consumer surplus under monopolistic market-sharing pricing is weakly lower than in the benchmark.
(ii) Consumer surplus under competitive market-sharing pricing is weakly higher than in the benchmark.

Clearly, when the market is competitive *ex ante* and remains competitive *ex post*, the stick is detrimental to consumer welfare. This is because all buyers still prefer to purchase at the same price (see Table 3) even though their valuation for the product has been reduced. The stick policy brings down consumer surplus also when the market is monopolistic. As with competition, those who still buy are worse off. Additionally, those who did not receive much utility from consumption *ex ante* may prefer the outside option *ex post*. Indeed, a stick policy in this case induces some customers to leave the market, which too lowers consumer surplus.

The stick has a more subtle impact on consumer surplus under market-sharing pricing. Indeed, if there is competitive market-sharing *ex ante* and the stick policy is such that there is competitive market-sharing *ex post*, then the welfare of consumers *increases*. In this case, there are three distinct factors that simultaneously affect consumer surplus. First, each consumer still prefers to buy the product, but now experiences a psychic cost when doing so. This decreases the benefit of consumption. Second, the range of equilibrium prices narrows (see Table 3) and the price difference decreases.[18] This, too, has a negative effect on consumer welfare. Third and lastly, the reduction in gross surplus creates a downward pressure on (equilibrium) prices, which works to the advantage of consumers. In the competitive market-sharing region, the positive 'price effect' dominates the negative 'surplus and dispersion effect' so that consumer welfare is higher than in the benchmark. By contrast, in the monopolistic market-sharing region, the 'surplus and dispersion effect' dominates the 'price effect'. In this case, therefore, a stick campaign reduces consumer welfare.

Finally, recall that what type of pricing applies critically depends on the level of gross surplus v (see Figure 1). Since a stick policy directly affects gross surplus (it changes from v to $v - a$), it potentially brings about a switch to another pricing region. For example, a competitive market may turn into a monopolistic one when the campaign is sufficiently effective. In light of the preceding analysis, this always leads to a reduction of consumer welfare with one notable exception. If v is above, but sufficiently close to, $c + \frac{3}{2}t$ *ex ante* and $v - a$ is sufficiently close to $c + \frac{6}{5}t$ *ex post*, then the 'price effect' dominates the 'surplus effect', which implies an increase in consumer surplus. The next corollary loosely summarizes this finding.

Corollary 3 *Suppose that a stick policy is introduced that does induce a switch in pricing regions. Consumer surplus may increase only when the stick policy brings the market from the competitive into the market-sharing region.*

Carrot

Let us now evaluate the carrot's effect on consumer surplus. The following proposition is directly comparable to Proposition 2 and shows the impact of a carrot policy on consumer welfare when it does not result in a switch in pricing regions.

[18] Note that this effect is absent when the benchmark prices are identical.

Proposition 3 *Suppose that a carrot policy is introduced that does not induce a switch in pricing regions.*
(i) Consumer surplus under competitive pricing is the same as in the benchmark.
(ii) Consumer surplus under market-sharing is higher than in the benchmark.
(iii) If a is sufficiently large (small), then consumer surplus under monopolistic pricing is lower (higher) than in the benchmark.

Consumer surplus is the same as in the benchmark under competitive pricing. This is because, after the launch of the campaign, all buyers still purchase the product at the same price (see Table 1 and Table 3) and enjoy the same gross surplus. Unlike with the stick policy, there is no psychic cost in this case. For a given equilibrium price configuration, consumer welfare is higher than in the benchmark under market-sharing pricing. The reason is that, in this case, the carrot policy incentivizes firms to charge lower prices (see Table 1 and Table 3). Given that gross surplus remains unaffected and all consumers buy *ex ante* as well as *ex post*, this implies an increase in consumer surplus. Finally, under monopolistic pricing, whether consumer surplus is lower or higher than in the benchmark critically depends on the effectiveness of the anti-consumerism campaign. In this case, there are two opposing effects. On the one hand, the carrot leads to lower prices. On the other hand, it induces consumers to leave the market. This negative demand effect dominates the positive price effect when a is sufficiently high and *vice versa*.

Comparison

Finally, let us conclude this section by comparing the stick and carrot policy. The next result shows that consumer surplus is unambiguously higher with a carrot approach.

Theorem 1 *For any given level of anti-consumerism, consumer surplus is larger under a carrot policy than under a stick policy.*

The intuition underlying this finding is as follows. Both policies have the same effect on prices (Table 3), but a different effect on gross surplus. The stick policy reduces gross surplus, whereas it is unaffected with a carrot approach. Combining the 'price effect' and the 'surplus effect' yields the conclusion in Theorem 1.

5 Social Welfare

How does anti-consumerism affect the welfare of society as a whole? In this section, we address this question and compare the impact of a stick and a carrot policy on total welfare as given by (4) above. Table 5 provides an overview of the equilibrium values.

Social Welfare	*Stick*	*Carrot*
Monopoly	$\frac{3(v-a-c)^2}{4t} - e_u^s$	$\frac{3(v-a-c)^2}{4t} - e_u^c + a$
Mon. MS	$\left[\frac{(v-a-c)\cdot(6t-(v-a-c))}{4t} - \frac{1}{2}t - e, v - c - \frac{1}{4}t - e - a\right]$	$\left[\frac{(v-a-c)\cdot(6t-(v-a-c))}{4t} - \frac{1}{2}t - e + a, v - c - \frac{1}{4}t - e\right]$
Comp. MS	$\left[\frac{(v-a-c)\cdot(12t-(v-a-c))}{9t} - \frac{1}{2}t - e, v - c - \frac{1}{4}t - e - a\right]$	$\left[\frac{(v-a-c)\cdot(12t-(v-a-c))}{9t} - \frac{1}{2}t - e + a, v - c - \frac{1}{4}t - e\right]$
Competition	$v - c - \frac{1}{4}t - e - a$	$v - c - \frac{1}{4}t - e$

Table 5: Social welfare under a stick or carrot policy.

Stick

Starting with the stick, the next result shows the impact of this approach on social welfare.

Proposition 4 *Suppose that a stick policy is introduced that does not induce a switch in pricing regions.*
(i) Social welfare under competitive and market-sharing pricing is lower than in the benchmark.
(ii) If the externality reduction is sufficiently small (large), then social welfare under monopolistic pricing is lower (higher) than in the benchmark.

In the competitive pricing region, the stick has no effect on profits (Proposition 1), but it lowers consumer surplus (Proposition 2). As the market remains 'covered', there is neither non-buyer surplus, nor a reduction of the negative externality. Taken together, this implies that social welfare goes down in this case. The story is pretty much the same with monopolistic market-sharing, but for the profit effect. In this situation, a stick policy leads to a reduction of profits (Corollary 1), which reinforces the negative impact on social welfare. With competitive market-sharing, the effect on consumer surplus is positive (Proposition 2). This, however, is more than offset by the decrease in profits (Proposition 1). Finally, under monopolistic pricing, the impact critically depends on the externality. Net of externalities, the stick policy reduces social welfare since both profits and consumer surplus are lower than in the benchmark and there is no benefit for non-buyers. Yet, this negative effect can potentially be offset by the decrease in externalities. That is, if the reduction in externality resulting from the decrease in outputs is sufficiently large, then the overall effect on social welfare is positive.

By the preceding logic, a stick policy that induces a switch in pricing regions can only be beneficial for social welfare when (i) it reduces aggregate production, and (ii) this reduction yields sufficient externality cost savings. The next corollary summarizes this finding.

Corollary 4 *Suppose that a stick policy is introduced that does induce a switch in pricing regions. Social welfare increases only when the stick policy brings the market into the monopolistic pricing region and the reduction in externalities is sufficiently large.*

Carrot

Let us now turn to the impact of a carrot policy on social welfare. Note that in this case there is a benefit of nonconsumption. Specifically, non-buyer surplus is given by:

$$N = a \cdot (1 - D)\,. \tag{7}$$

Figure 3 provides a graphical illustration.

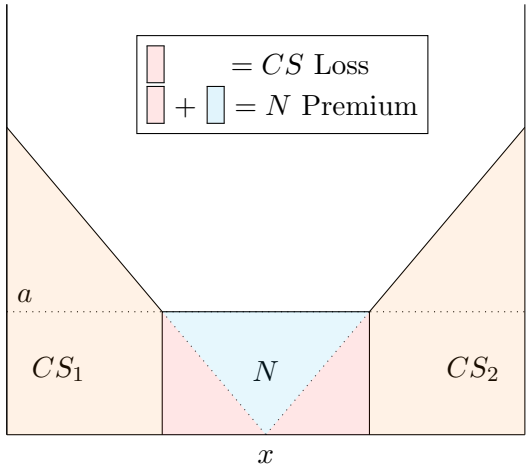

Figure 3: *Consumer and non-buyer surplus under a carrot policy.*

The next result is comparable to Proposition 4 and describes the impact of a carrot policy on social welfare.

Proposition 5 *Suppose that a carrot policy is introduced that does not induce a switch in pricing regions.*
(i) Social welfare under competitive pricing is the same as in the benchmark.
(ii) Social welfare under competitive market-sharing pricing is weakly lower than in the benchmark.
(iii) Social welfare under monopolistic market-sharing pricing is weakly higher than in the benchmark.
(iv) If a is sufficiently large, then social welfare under monopolistic pricing is higher than in the benchmark.

There is no effect under competitive pricing, because there is no effect on profits (Proposition 1) or consumer surplus (Proposition 3). Moreover, since the market remains 'covered', there is no change in non-buyer surplus or the level of externalities. The latter two factors do also not change under market-sharing pricing. Yet, consumer surplus increases (Proposition 3) and profits decrease (Proposition 1). In this case, the net effect critically depends on the level of price dispersion.

If prices are identical, then the carrot results in a monetary transfer from producers to consumers and social welfare is the same as in the benchmark. If prices differ, then the carrot reduces equilibrium price dispersion. One can verify that price dispersion is beneficial for consumer welfare and harmful for aggregate profits. Under competitive market-sharing pricing, the reduced price difference has a larger effect on consumers than on producers. As a result, social welfare is lower than in the benchmark. By contrast, under monopolistic market-sharing pricing, the effect on profits outweighs the effect on consumer surplus. In this case, therefore, social welfare is higher than in the benchmark.

Finally, under monopolistic pricing, the carrot is always beneficial for social welfare provided that it is sufficiently big. The reason is that there is a threshold above which the non-buyer surplus and externality cost savings are large enough to outweigh the combined loss in profits (Corollary 2) and consumer surplus (Proposition 3).

Comparison

As with consumer surplus, let us conclude this section by comparing the stick and carrot policy. A casual glimpse at Table 5 reveals the carrot to dominate the stick in terms of social welfare.

Theorem 2 *For any given level of anti-consumerism, social welfare is larger under a carrot policy than under a stick policy.*

The policy implication is thus crystal clear. If one aims to promote an anti-consumerism campaign, then the carrot is the preferred mode of action.

6 Concluding Remarks

Anti-consumerism is a doctrine that is recently gaining *momentum*. With an eye on the current environmental challenges, it aims to discourage excessive consumption. Given that this affects consumers, producers and society as a whole, a key question is how to best pursue this goal. Anti-consumerism could focus on buyers by creating psychic costs for those who consume. Alternatively, it may attempt to create psychic benefits for those who forgo buying a product or service. In this paper, we showed that the effect of both approaches on market competition is comparable. Independent of whether one uses a 'stick' or a 'carrot', anti-consumerism (weakly) reduces competitive pressure and leads to (weakly) lower prices, outputs and profits. The impact on welfare differs, however. Indeed, both consumers and society at large are better off with a carrot approach.

In terms of policy implications, our findings thus show that the 'carrot' should be strictly preferred to the 'stick'. This leaves the question of whether an anti-consumerism 'carrot' campaign should be preferred to no campaign at all. Our analysis suggests this question to be everything but trivial. Although such a campaign (weakly) lowers firm profits, its effect on consumer and social welfare critically depends on the market situation absent anti-consumerism. For example, if gross surplus is significant, then the carrot must be significant too to have an impact. Indeed, when goods are considered 'essential' and consumers have limited outside options, the carrot may be insufficient to affect consumer decisions. By contrast, a carrot always has an effect when gross surplus is sufficiently small. Taken together, this suggests a positive relationship between the effectiveness of an anti-consumerism 'carrot' campaign and the price elasticity of market demand. This, arguably, is an important issue that warrants a more detailed assessment. We leave this for future research.

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Appendix A: Derivation of Table Values

In this subsection, we explain how one can derive the equilibrium values in Tables 1-5.

Competitive and Monopolistic Pricing

Nash equilibrium prices in the *monopolistic* and *competitive* pricing regions can be computed as in the textbook Hotelling model. Firms' demand functions are obtained by identifying the location of consumers who are indifferent between buying good 1 and not buying ($U_1(x) = 0$), which gives $x_1 = (v - p_1)/t$, between buying good 2 and not buying ($U_2(x) = 0$), which gives $x_2 = 1 - (v - p_2)/t$, or between buying good 1 and good 2 ($U_1(x) = U_2(x)$), which gives $x_3 = (p_2 - p_1 + t)/2t$. In the presence of an anti-consumerism campaign, under both a stick and a carrot policy, one obtains $x_1 = (v - p_1 - a)/t$, $x_2 = 1 - (v - p_1 - a)/t$, and $x_3 = (p_2 - p_1 + t)/2t$ instead. Excluding corner solutions, demand for the products of firm 1 is then given by $D_1 = \min\{x_1, x_3\}$, whereas for firm 2 it is given by $D_2 = 1 - \max\{x_2, x_3\}$.

Recall that a firm's profit function is:

$$\Pi_i(p_i, p_j) = (p_i - c) \cdot D_i(p_i, p_j), \ i = 1, 2 \text{ and } j \neq i.$$

It is straightforward to check that the profit functions are concave. Specifically, the second-order conditions are satisfied for $t > 0$, which also guarantees that the equilibrium prices exceed costs, *i.e.*, $p_i^* > c$, for $i = 1, 2$, both for the benchmark and for the stick and carrot cases. The first-order conditions, therefore, suffice to determine the equilibrium prices reported in Table 1 and 3.

Turning to welfare, recall that consumer surplus is given by:

$$CS = \int_0^{x_1} U(x)\mathrm{d}x + \int_{x_2}^1 U(x)\mathrm{d}x.$$

Both in the benchmark as well as with anti-consumerism, it suffices to consider the equilibrium prices in the utility functions as well as in the integrals' extrema, which depends on what case applies. To illustrate, consumer surplus under a carrot policy in the monopolistic pricing region is:

$$CS^c = \int_0^{x_1} U^c(x)\mathrm{d}x + \int_{x_2}^1 U^c(x)\mathrm{d}x.$$

It is noteworthy that one can derive the same value geometrically. For instance, in case of a carrot policy in the monopolistic pricing region, it holds that:

$$CS^c = \frac{x_1}{2}\left[U_1^c(0) + a\right] + \frac{x_2}{2}\left[U_2^c(1) + a\right].$$

Both approaches yield:

$$CS^c = \frac{(v - a - c) \cdot (v + 3a - c)}{4t}.$$

Social welfare is obtained by adding equilibrium profits, consumer and non-buyer surplus, and subtracting the negative production externalities.

Market-Sharing Pricing

For the market-sharing pricing region, one can use Theorem 3.6 in Yousefimanesh *et al.* (2023). There, it is shown there is a line segment of price equilibria given by:

$$(p_1^*, p_2^*) = (2v - t - \lambda, \lambda).$$

That is, there is a combination of prices that respect the market-sharing condition. Specifically, λ is such that:

$$\max\{3v + 3c, 8v - 6t - 2c\} \leq 6\lambda \leq \min\{4v + 2c, 9v - 6t - 3c\}.$$

Comparing the upper and lower bound of the above inequality, we find that when $c + t \leq v < c + (6/5)t$, it holds that $(3/2)v - c/2 - t \geq \lambda \geq (v + c)/2$. Plugging these values in the equilibrium prices yields the monopolistic market-sharing pricing range:

$$(p_1^*, p_2^*) \in [\frac{v + c}{2}, \frac{3v - 2t - c}{2}].$$

For any firm's equilibrium price in the interval, the rival's price can be directly obtained from the market-sharing condition, *i.e.*, $p_1 + p_2 = 2v - t$. If $c + (6/5)t < v \leq c + (3/2)t$, then $(2/3)\,v + c/3 \geq \lambda \geq (4/3)\,v - t - c/3$. Plugging these values in the equilibrium prices yields the competitive market-sharing pricing range:

$$(p_1^*, p_2^*) \in [\frac{4v - 3t - c}{3}, \frac{2v + c}{3}].$$

Finally, for $v = c + (6/5)t$, we obtain

$$(p_1^*, p_2^*) \in [c + (3/5)t, c + (4/5)t].$$

Notice that on the boundary of the *competitive* and *monopolistic market-sharing* region (*i.e.* at $v = c + (3/2)t$ and $v = c + t$, respectively), the equilibrium prices are equal to the ones in the *competitive* and *monopolistic* pricing region (*i.e.*, $(p_1^*, p_2^*) = c + t$ and $(p_1^*, p_2^*) = (v + c)/2$), respectively), which establishes the continuity of equilibrium prices in Figure 1.

By plugging the equilibrium prices in the benchmark demand and profit functions, one obtains the range of equilibrium values in the two market-sharing regions κ_1 and κ_2 as presented in Table 1. Analogously, starting from the *market-sharing condition* under stick or carrot, *i.e.*, $p_1 + p_2 = 2(v - a) - t$, the interval for price equilibrium profiles is given by:

$$\max\{\frac{4}{3}(v - a) - \frac{1}{3}c - t, \frac{1}{2}(v - a + c)\} \leq \lambda \leq \min\{\frac{3}{2}(v - a) - \frac{1}{2}c - t, \frac{2}{3}(v - a) + \frac{1}{3}c\}.$$

Therefore, in the *monopolistic market-sharing* region, for $v - c - (6/5)t < a \leq v - c - t$, we obtain

$$(p_1^*, p_2^*) \in [\frac{v - a + c}{2}, \frac{3\,(v - a) - 2t - c}{2}],$$

whereas in the *competitive market-sharing* region, for $v - c - (3/2)t \leq a < v - c - (6/5)t$, we obtain

$$(p_1^*, p_2^*) \in \left[\frac{2(v - a) + c}{3}, \frac{4(v - a) - 3t - c}{3}\right].$$

Finally, for $a = v - c - (6/5)t$, prices are

$$(p_1^*, p_2^*) \in [c + (3/5)t, c + (4/5)t].$$

By substituting the equilibrium prices in the demand and profit functions in the presence of an anti-consumerism campaign, we obtain the range of equilibrium values as presented in Table 3. Finally, it is worth noting that the sum of profits is concave in the entire *market-sharing* region and maximal when firms set equal prices, *i.e.*, when there is no price dispersion.

Recall that consumer surplus is given by:

$$CS = \int_0^{x_1} U(x)\mathrm{d}x + \int_{x_2}^1 U(x)\mathrm{d}x. \tag{8}$$

As indicated above, its value can be computed by substituting the equilibrium prices into the utility functions and the applicable integrals' extrema. Moreover, the *market-sharing conditions*, *i.e.* $p_1 + p_2 = 2v - t$ in the benchmark and $p_1 + p_2 = 2(v - a) - t$ with anti-consumerism, must hold. Using these constraints, one can show that (8) is convex in both prices, reaching its *minimum* when there is no *price dispersion* and firms set equal prices in the *market-sharing* interval. This implies that consumer surplus is highest with maximal *price dispersion*.

A similar rationale applies in case of social welfare, which is concave in the entire market-sharing region. Hence, it is maximal when there is no price dispersion and minimal when prices are on the boundary of the equilibrium price range. These values are reported in Table 5.

Appendix B: Proofs

Proof of Proposition 1.

(i) Both a stick and a carrot policy basically induce an effective reduction of the consumers' gross surplus v of magnitude a. Therefore, if firms are initially in the competitive region (*i.e.*, $v \in (c + 1.5t, c + 2t)$) and the magnitude of the stick or carrot is not big enough to induce a switch in pricing region, equilibrium prices remain unaffected. Consequently, there is no change in output or profit either (see Table 1 and Table 3).

(ii) If the magnitude of the stick or carrot is big enough to induce a shift to the market-sharing region, then prices and profits decrease (see Table 1, Table 3 and Figure 2). Yet, since the market remains 'covered' in this case, aggregate production remains unaffected.

(iii) When the effect of the stick or carrot is sufficiently severe to induce a shift to the monopolistic pricing region, the market 'uncovers'. This demand decrease results in lower prices, output levels, and profits (see Table 1 and Table 3). ■

Proof of Proposition 2. Consumer surplus is computed by using the following formula:

$$CS^s = \int_0^{x_1} U^s(x)\mathrm{d}x + \int_{x_2}^1 U^s(x)\mathrm{d}x.$$

(i) In the competitive pricing region, consumer surplus is harmed by the effect of the *psychic cost*:

$$CS^s - CS = \left(v - a - c - \frac{5}{4}t\right) - \left(v - c - \frac{5}{4}t\right) = -a < 0,$$

In the monopolistic pricing region, there is an additional negative effect of consumers who leave the market:

$$CS^s - CS = \frac{(v-a-c)^2}{4t} - \frac{(v-c)^2}{4t} = -\frac{(2\,(v-c) - a)\,a}{4t} < 0,$$

because $a < 2\,(v - c)$. Finally, in the monopolistic market-sharing region, a stick negatively affects the upper bound of the consumer surplus interval, but it does not affect the lower bound:

$$CS \in \left[\frac{1}{4}t, \frac{(v-c)(v-c-2t)}{4t} + \frac{1}{2}t\right] \text{ and } CS^s \in \left[\frac{1}{4}t, \frac{(v-a-c)(v-a-c-2t)}{4t} + \frac{1}{2}t\right].$$

In this case, therefore, consumer surplus either remains constant (when firms set the same price) or it decreases (when firms set different prices).

(ii) In the competitive market-sharing region, a stick induces an increase in the upper bound of the consumer surplus interval:

$$CS \in \left[\frac{1}{4}t, \frac{(v-c)(v-c-3t)}{9t} + \frac{1}{2}t\right] \text{ and } CS^s \in \left[\frac{1}{4}t, \frac{(v-a-c)(v-a-c-3t)}{9t} + \frac{1}{2}t\right].$$

It is straightforward to check that:

$$(v-a-c)(v-a-c-3t) - (v-c)(v-c-3t) > 0 \text{ for } v \in (c + \frac{6}{5}t, c + \frac{3}{2}t]$$

for any $a > 0$ in this pricing region. In this case, therefore, consumer surplus either remains constant (when firms set the same price) or it increases (when firms set different prices). ■

Proof of Proposition 3.

(i) Within the competitive pricing region, a carrot policy does not yield any change of consumer surplus since both gross surplus and equilibrium prices are unaffected. Moreover, the market is 'covered' *ex ante* and remains 'covered'*ex post*. (ii) Within the competitive market-sharing pricing region, the effect is as follows. Comparing the new consumer surplus to the benchmark, we obtain that:

$$CS \in \left[\frac{1}{4}t, \frac{(v-c)(v-c-3t)}{9t} + \frac{1}{2}t\right] \text{ and } CS^c \in \left[\frac{1}{4}t + a, \frac{(v-a-c)(v-a-c-3t)}{9t} + \frac{1}{2}t + a\right],$$

so that both the lower bound and the upper bound shift upward. For the lower bound, this can be observed directly. As to the upper bound, note that:

$$CS^c - CS = \frac{(v-a-c)(v-a-c-3t)}{9t} + \frac{1}{2}t + a - \left(\frac{(v-c)(v-c-3t)}{9t} + \frac{1}{2}t\right).$$

Simplifying gives

$$\frac{1}{9t}a\left(a - 2(v-c) + 12t\right) > 0,$$

which holds for $v \in \left(c + \frac{6}{5}t, c + \frac{3}{2}t\right]$. Turning to the monopolistic market-sharing pricing region, note that:

$$CS \in \left[\frac{1}{4}t, \frac{(v-c)(v-c-2t)}{4t} + \frac{1}{2}t\right] \text{ and } CS^c \in \left[\frac{1}{4}t + a, \frac{(v-a-c)(v-a-c-2t)}{4t} + \frac{1}{2}t + a\right],$$

so that both the lower bound and the upper bound shift upward. For the lower bound, this can be observed directly. As to the upper bound, note that:

$$CS^c - CS = \left(\frac{(v-a-c)(v-a-c-2t)}{4t} + a + \frac{1}{2}t\right) - \left(\frac{(v-c)(v-c-2t)}{4t}\right) + \frac{1}{2}t,$$

Simplifying gives

$$\frac{a}{4t}\left(a + 6t - 2\left(v-c\right)\right) > 0,$$

which holds for $v \in \left[c + t, c + \frac{6}{5}t\right]$.

(iii) With monopolistic pricing, we obtain:

$$CS^c - CS = \frac{\left(v-a-c\right)\left(v+3a-c\right)}{4t} - \frac{\left(v-c\right)^2}{4t} = \frac{1}{4t}a\left(2\left(v-c\right) - 3a\right),$$

which is positive for $a \in \left(v-c-t, 2\left(v-c\right)/3\right)$ and negative for $a \in \left(2\left(v-c\right)/3, v-c\right)$ within the relevant gross surplus range (*i.e.*, $v \in (c, c+t)$). We conclude that if a is sufficiently small (large), then consumer surplus under monopolistic pricing is higher (lower) than in the benchmark. ■

Proof of Theorem 1. This result can be obtained directly by comparing the consumer surplus values in Table 4. ■

Proof of Proposition 4.

(i) By Proposition 1, we know that a stick policy does not alter firm profits and outputs in the competitive

pricing region. Moreover, the effect of a stick in this region is to lower consumer surplus (Proposition 2). Hence, by the definition of social welfare:

$$W = CS + N + \Pi_1 + \Pi_2 - E, \tag{9}$$

and using the fact that N and E remain unchanged in the competitive region, the total effect of a stick on social welfare is negative. Analogously, inside the monopolistic market-sharing pricing region, we know by Corollary 1 that a stick reduces profits and, by Proposition 2, that consumer surplus does not increase. As both N and E are unaffected in this case, social welfare decreases. Finally, in the competitive market-sharing pricing region, we know by Proposition 2 that a stick (weakly) increases consumer surplus and, by Proposition 1, that it leads to a reduction in profits. To see that the latter effect dominates the former, note that by concavity of the social welfare function, social welfare is lowest with maximal price dispersion and highest when prices are equal. Thus, under a stick policy, social welfare ranges within the following interval:

$$SW^s \in [\frac{(v-a-c)\,(12t-(v-a-c))}{9t} - \frac{1}{2}t - e, v - c - \frac{1}{4}t - e - a].$$

It can be easily verified that these values are lower than in the benchmark (*i.e.*, $a = 0$). We conclude that social welfare under competitive and market-sharing pricing is lower than in the benchmark.

(ii) Under monopolistic pricing, both profits and consumer surplus are lower with a stick (Corollary 2 and Proposition 2). Since $N = 0$ in this case, social welfare net of externalities is lower than in the benchmark. This negative impact can only be offset when the reduction in externality costs is sufficiently large. ■

Proof of Proposition 5.

(i) By Proposition 1 and Proposition 3, profits and consumer surplus remain unaffected. Moreover, since the market remains 'covered', N and E do not change either. We conclude that social welfare under competitive pricing is the same as in the benchmark.

(ii) Both N and E remain unaffected under competitive market-sharing pricing too. Yet, profits are lower (Corollary 1) and consumer surplus is higher (Proposition 3) than in the benchmark. To see that the first effect (weakly) dominates the second, note that:

$$SW^c \in [\frac{(v-a-c)\,(12t-(v-a-c))}{9t} - \frac{1}{2}t - e + a, v - c - \frac{1}{4}t - e,$$

whereas in the benchmark:

$$SW \in [\frac{(v-c)\,(12t-(v-c))}{9t} - \frac{1}{2}t - e, v - c - \frac{1}{4}t - e].$$

Although it has the same upper bound (obtained at equal prices), the lower bound is strictly smaller for any $a > 0$, since:

$$SW^c - SW = \frac{(v-a-c)\,(12t-(v-a-c))}{9t} - \frac{1}{2}t - e + a - \left(\frac{(v-c)\,(12t-(v-c))}{9t} - \frac{1}{2}t - e\right),$$

which is equal to

$$-\frac{1}{9t}a\,(a - 2\,(v-c) + 3t)\,.$$

This term is negative when

$$a - 2\left(v - c\right) + 3t > 0,$$

which holds in the competitive market-sharing pricing region, because $v \in (c + 6t/5, c + 3t/2]$.
(iii) In the monopolistic market-sharing pricing region, it also holds that N and E remain unaffected by a carrot policy. Yet, in this case the negative profit effect (Corollary 1) is (weakly) dominated by the positive consumer surplus effect (Proposition 3). To see this, note that:

$$SW^c \in [\frac{(v - a - c)\left(6t - (v - a - c)\right)}{4t} - \frac{1}{2}t - e + a, v - c - \frac{1}{4}t - e],$$

whereas in the benchmark:

$$SW \in [\frac{(v - c)\left(6t - (v - c)\right)}{4t} - \frac{1}{2}t - e, v - c - \frac{1}{4}t - e].$$

Although it has the same upper bound (obtained at equal prices), the lower bound is strictly larger for any $a > 0$, since:

$$SW^c - SW = \frac{(v - a - c)\left(6t - (v - a - c)\right)}{4t} - \frac{1}{2}t - e + a - \left(\frac{(v - c)\left(6t - (v - c)\right)}{4t} - \frac{1}{2}t - e\right)$$

which is equal to

$$\frac{1}{4t}a\left(2(v - c) - a - 2t\right).$$

This term is positive when

$$2(v - c) - a - 2t > 0,$$

which holds, because $v \in (c + t, c + 6t/5]$ and $a \in (v - c - 6t/5, v - c - t)$. That is, for any given v in the relevant range, a must be sufficiently small to remain in the monopolistic market-sharing region.
(iv) Finally, in the monopolistic pricing region:

$$SW^c - SW = \frac{3(v - a - c)^2}{4t} + a - e_u^c - \left(\frac{3(v - c)^2}{4t} - e_u\right),$$

which gives

$$\frac{1}{4t}a\left(3a - 6\left(v - c\right) + 4t\right) - \left(e_u^c - e_u\right).$$

Note that, net of externality savings due to the output reduction, this is positive when

$$\frac{1}{4t}a\left(3a - 6\left(v - c\right) + 4t\right) > 0,$$

which holds for $v \in (c, c + t]$ and $a > \frac{2}{3}t$. If the carrot policy has less impact, then it may still be beneficial for social welfare when the reduction in externality costs is sufficiently large. ■

Proof of Theorem 2. This result follows directly by comparing the social welfare values in Table 5. ■

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