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Regulating Deceptive Environmental Claims in the Canadian Context: What Is so Special About Greenwashing?

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Julien Olivier Beaulieu

Student ID number: 597294

Supervisor: prof. dr. Dirk Schindler

Second reader: prof. dr. Bauke Visser

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List of abbreviations

Abbreviations of terms in the text

CA – *Competition Act*
CCB – *Canada's Competition Bureau*
CFIA – *Canadian Food Inspection Agency*
GHG – *Greenhouse gas*
NZC – *Canada's Net-Zero Challenge*

Identification of symbols used in the model

α – *Welfare weight of consumers under the balancing weight social welfare function*
β – *Probaxbility of verification by the regulator*
γ – *Welfare weight of firms under the balancing weight social welfare function*
δ – *Discount rate of risk-averse firms*
ζ – *Impact of non-financial considerations on producer surplus*
θ_j – *Degree of pollution aversion of consumer "j"*
θ_{HN} – *Location of the consumer indifferent between a carbon intensive and intermediate good*
θ_{NL} – *Location of the consumer indifferent between a low carbon and an intermediate good*
κ – *Advertising costs*
$\pi_{t,i}$ – *Profits of firm "t" with type "i"*
ϕ – *Probability that the U firm is assigned a carbon intensive good*
ψ_j – *Consumer beliefs*
ω – *Probability that the result of a verification is accurate*
b – *Amount of the fine*
C_t – *Fixed costs of the "t" firm*
CS – *Consumer surplus*
e_i – *Quantity of pollution emitted by the good of type "i"*
ES – *Enforcement costs borne by society*
g – *Fixed auditing costs*
i – *Pollution type, which can either be low carbon, intermediate carbon or high carbon*
j – *Index of consumers*
k – *Enforcement costs*
K – *Denotes the firm with a publicly known, low-carbon type*
L – *Denotes the low-carbon pollution type*
p_i – *Price of the good with the pollution type "i"*
PS – *Producer surplus*
q_t – *Quantity supplied by the "t" firm*
SW – Social welfare
t – *Index of firms*
U – *Denotes the firm with the privately known type, which can either by low or high-carbon*
$U_{j,i}$ – *Utility of consumer "j" purchasing a good of type "i"*
v – *Consumers' intrinsic valuation for the goods*
x – *Denotes the local maximum at to the U firm's indifference point*
y – *Denotes the local maximum at the U firm's indifference point*
Z – *Quantity of aggregate pollution*

1. Introduction: Greenwashing and the rise of climate-related corporate claims

By all accounts, climate change is a major issue: according to the Intergovernmental Panel on Climate Change, a 2°C global warming would have severe effects, including extreme heat waves, heavy droughts, heavy precipitation and associated flooding events – which could be even more drastic in more pessimistic warming scenarios (Intergovernmental Panel on Climate Change, 2018, 2021). In light of these threats, firms have been increasingly engaging on climate change, voluntarily setting net zero targets, developing and advertising low carbon products, and disclosing climate-related information to stakeholders (Beaulieu, 2022, p.10[1]). However, there is evidence suggesting that some of these climate-related claims may be false or misleading. For example, according to a 2021 review of 81 early adopters of "science-based" net-zero targets, almost half of these firms were short of meeting one or more of their targets (Giesekam et al., 2021). Similarly, a 2022 report by Net Zero Tracker on the status and trends of net zero target setting indicated that about two-thirds of voluntary corporate pledges did not meet minimum procedural standards for target setting (Net Zero Tracker, 2022, p.6).

Many jurisdictions regulate environmental claims to the public through consumer protection laws that prohibit deceptive marketing claims, such as Canada's *Competition Act* (CA) (Beaulieu, 2021). These statutes are typically laws of general application, which means that they are meant to apply to a wide range of corporate claims, including claims relating to the environmental performance of products and organizations (Beaulieu, 2021). As an example, among the four climate-related complaints filed with the federal consumer protection watchdog in Canada in 2020-2022, two have led to formal investigations (Ecojustice, 2022; Greenpeace, 2021; Centre québécois du droit de l'environnement, 2021; Canadian Association of Physicians for the Environment, 2022). Along the same lines, at least 47 climate-related greenwashing matters have been initiated in the United States, Australia, France, the Netherlands, the United Kingdom, Australia, Italy, New Zealand, Denmark, and South Korea between 2008 and 2022, either before state courts or non-judicial adjudicating bodies (Benjamin et al., 2022).

Given the number of climate-related greenwashing complaints and legal proceedings initiated around the world under existing legal frameworks, one may wonder whether there is a need to adopt a distinct approach and develop new regulatory tools to deal with greenwashing. After all, most of the theoretical literature on deceptive marketing does not distinguish greenwashing from

[1] Throughout the draft, sentences with references to Beaulieu, 2022 are direct excerpts from this source, which is a document I prepared in parellel and concurrently to this thesis.

other types of deceptive marketing (see for example: Wu & Geylani, 2020; Hattori & Higashida, 2014; Baumann and Rasch, 2020; Rhodes and Wilson, 2018; Baksi, Bose and Xiang, 2017; Glaeser and Ujhelyi, 2005; and Corts, 2014). Is there anything special about greenwashing to justify a tailored policy approach? The answer might come from the fact that environmental claims have one major distinctive characteristic: they have the potential to distort the consumption of goods that generate environmental externalities (Cornes and Sandler, 1996; Ferraro et al., 2005; Uchida, 2007). Assuming that these externalities cannot be entirely internalized through carbon taxation or other mechanisms, establishing socially optimal policies to tackle greenwashing may require making second-best scenarios, which would not be necessary in traditional deceptive marketing cases involving purely private goods (Bennear and Stavins, 2007). This distinction will be the main focus of this thesis.

Against this backdrop, the purpose of this thesis is to assess whether greenwashing requires a different regulatory treatment than other types of deceptive corporate claims under Canada's consumer protection regime. To achieve this goal, Baumann and Rasch's (2020) and Hattori and Higashida's (2014) deceptive marketing models will be built upon and extended using some of Uchida (2007)'s assumptions about the consumption of goods that generate environmental externalities. For simplicity, this thesis will focus on one type of environmental claims, namely claims about the carbon footprint of goods. As discussed in section 2.2, these claims relate to the credence characteristics of environmental goods. As such, they constitute one of the clearest cases of information asymmetry between firms and consumers. Furthermore, carbon intensive goods constitute a useful example of goods generating environmental externalities. Besides, the existence of political constraints preventing the implementation of optimal carbon pricing schemes has been documented, which makes the integration of second-best considerations particularly realistic for climate-related claims (Jenkins, 2017).

The model set forth herein assumes that two firms supply vertically differentiated goods. One firm supplies a good of publicly known, intermediate environmental quality, whereas the other firm supplies a good of exogenous, privately known environmental quality – which can either be low or high. There is a continuum of consumers with heterogenous, uniformly distributed preferences for environmental quality, who all consume one unit of goods. Production generates quantities of a public bad – pollution – which decreases with environmental quality. Consumers derive utility from consumption, but disutility from pollution through two channels. First, consumers dislike purchasing polluting goods (a lower quality good is less valuable than a higher quality good). The importance of this channel depends on each consumer's type. Second, consumers are affected by

the aggregate quantity of environmental pollution, which affects all consumers equally. Environmental quality is a credence characteristic, which means that consumers cannot verify privately known quality on their own. Furthermore, consumers are naïve, which means that they assume that all marketing claims are true unless the regulator tells them otherwise. A regulatory agency may verify the claims of the firm with privately known quality. If deceptive marketing takes place and is uncovered, this firm has to bear the agency's enforcement costs and pay a fine. The firm will engage in deceptive marketing if it expects higher profits from this strategy than from letting consumers assume its type. Consumers choose the goods to maximize their utility, firms compete in prices to maximize their profits, and the law enforcement agency sets the probability of verification to maximize a utilitarian social welfare function.

It is demonstrated that greenwashing increases the consumption of carbon intensive goods relative to intermediate carbon goods. In the absence of regulation, this shift in the consumption mix leads to an unambiguous social welfare loss through an increase in aggregate pollution, a public bad, and through a loss in consumer surplus arising from the gap between the perceived and real quality of the goods purchased by consumers. This social welfare loss may justify the establishment of a law enforcement agency that verifies marketing claims and imposes fines to offenders if the social benefits of preventing greenwashing exceed the social costs of law enforcement. For certain degrees of regulatory stringency, the threat of law enforcement will be sufficient to deter greenwashing entirely. Before that point, an increase in the degree of regulatory stringency will uncover some cases of greenwashing, but not all of them. Depending on the parameter values, it may be that it is socially optimal to allow some greenwashing to take place if the enforcement costs arising from a more stringent regime are greater than the corresponding benefits. The presence of pollution as both a public bad and a characteristic that influences consumers' valuation for the goods implies that, all else equal, the benefits of preventing deceptive marketing will be higher for greenwashing cases than for generic deceptive marketing cases involving purely private, vertically differentiated goods. As such, in a second-best context, greenwashing will allow a greater degree of regulatory stringency than deceptive marketing cases involving purely private goods. While Canada's legal framework currently does not reflect these considerations, they should inform the Government of Canada's ongoing review of the regulatory framework.

This thesis comprises 8 sections. Section 2 summarizes a few necessary theoretical concepts. Section 3 reviews the literature on greenwashing, as well as the Canadian regulatory framework. Section 4 develops the key assumptions of a theoretical model, describing the behavior of firms,

consumers, and the law enforcer[2]. Section 5 solves the model and identifies under which conditions law enforcement is optimal. In section 6, key extensions of the model are discussed. In section 7, the model is used to evaluate alternative policy instruments. Section 8 concludes.

2. Theoretical foundations

In this section, a high-level description of the phenomenon of greenwashing is first provided, credence characteristics are described, and environmental claims are distinguished from other types of corporate claims on credence characteristics. These explanations will support the assumptions used to build the model in section 4.

2.1 Defining greenwashing

Many definitions of the term "greenwashing" have been proposed in the literature. For example, Lyon and Montgomery (2015, p.226) define the phenomenon as "any communication that misleads people into adopting overly positive beliefs about an organization's environmental performance, practices, or products". According to this definition, greenwashing would take place when there is a disconnect between the image projected by an organization and its real business practices.[3] Greenwashing can either relate to an organization as a whole or to the characteristics of specific products (Torelli et al., 2020), and deceptive environmental claims may take different forms, such as the provision of false, vague or ambiguous information, and the omission of important information (de Freitas Netto et al., 2020).[4] For instance, misleading claims can include the selective disclosure of information portraying a firm in a positive way, without displaying complementary negative information that would contextualise and temper the positive information being shared (Gatti et al., 2019; Huang et al., 2015; Connelly et al., 2011).[5]

Communication about environmental performance can be part of a firm's strategy to increase its

[2] Different terms are used to refer to the law enforcer in this thesis, including 'regulator', 'enforcer', and 'law enforcement agency'. These terms are used interchangeably.
[3] Testa et al. (2018, p.288) formulate a similar definition, describing greenwashing as "an external projection of a positive image of a firm, which is not reflected in its internal behaviors regarding environmental issues." Seele and Gatti (2017, p.248), on the other hand, define greenwashing as "a co-creation of an external accusation toward an organization with regard to presenting a misleading green message." The accusational aspect of greenwashing is key for the authors, for whom a misleading claim does not constitute greenwashing until an accusation has been formulated.
[4] The authors also refer to "executional greenwashing", which is the association of a product or firm with images evoking nature, such as using green colors in advertisements (de Freitas Netto et al., 2020, p.7).
[5] For example, in October 2022, the British bank HSBC was blamed by the Advertising Standards Authority, the UK advertising industry's self-regulation body, for misleading consumers about the environmental attributes of its activities (Makortoff, 2022). The claims related to two ads that promoted the bank's positive climate actions but omitted information about the banks' financing of carbon-intensive industries (Makortoff, 2022).

legitimacy before consumers, investors, and other stakeholders, or differentiate its products, and ultimately influence its financial performance (Brouhle et al., 2009; Seele and Gatti, 2017). Deceptive corporate claims can distort stakeholders' decisions by falsely or misleadingly attributing attributes to certain goods in a context of information asymmetry, including with respect to purchases, employment, and investment (Alniacik et al., 2011). Greenwashing may also distort the perception of future corporate claims by a firm, as accusations of greenwashing changes how consumers perceive green corporate claims (Seele and Gatti, 2017; Torelli et al., 2020). In a situation of information asymmetry, stakeholders cannot distinguish real from unsubstantiated messages (Seele and Gatti, 2017). Green corporate claims allow firms to signal their environmental value to consumers. When there is an accusation of greenwashing, the signal's reliability is distorted, negatively impacting the firm's legitimacy (Seele and Gatti, 2017). The fear of greenwashing accusations (which have a negative impact on firms' legitimacy) can have a chilling effect on green claims and green differentiation because of consumer skepticism (Gatti et al., 2019). For example, a 2022 review of the net-zero targets of 1,200 global firms indicated that 23% of them decided not to publish their climate progress to avoid accusations of greenwashing, a practice called "green-hushing" (South Pole, 2022).[6]

2.2 Credence characteristics and informational instruments

Deceptive environmental marketing typically involves claims that are difficult to verify for consumers, such as the quantity of pollution generated during a good's production. These characteristics are credence characteristics, namely characteristics that cannot be directly observed by consumers, even after the purchase of a good or its normal use (Darby and Karni, 1973; Church, 1994; Baksi, Bose and Xiang, 2017). By definition, the repeat purchase of a good does not allow consumers to acquire additional information on its credence characteristics (Darby and Karni, 1973; Church, 1994). Credence characteristics can be distinguished from experience characteristics, which are revealed following the use of a good, and search characteristics, which are revealed following consumer spending on search costs (Darby and Karni, 1973; Church, 1994). Other examples of goods displaying credence characteristics include repair services for the defects of durable goods or health care, for which quality is hardly observable by consumers unless an expert provides information about it (Darby and Karni, 1973).

[6] In the context of this thesis, the term green-hushing will be used to refer to the case where a firm refrains from disclosing its higher quality type to pass of as supplying lower quality products.

The environmental characteristics of a product sometimes qualify as credence characteristics, especially when environmental quality does not depend on the material properties of the good itself (Hamilton and Zilberman, 2006). As noted by de Freitas Netto et al. (2020), environmental claims may be product-specific, but they can also relate to a firm's activities as a whole, including production processes and disposal methods.[7] When the information about credence characteristics is costly to acquire, consumers find themselves in a situation of information asymmetry (Darby and Karni, 1973). In this context, consumers must rely on signals being communicated by the firm itself or third parties, which creates the possibility of consumer fraud (Darby and Karni, 1973; Church, 1994). Consumers may discount the information provided to them if the signal they receive is not deemed credible (Church, 1994). The effect of the signal therefore depends on its credibility and on consumer's understanding of the information (Delmas and Grant, 2014; Baksi, Bose and Xiang, 2017). For example, consumers may be skeptical about signals sent by firms, as they form expectations about the risk of deceptive marketing (Church, 1994). Consumers may also misunderstand certain corporate claims, creating confusion (Baksi, Bose and Xiang, 2017; Abrams, 2010).[8]

Various information disclosure instruments have been developed to regulate environmental corporate claims (Bemelmans-Videc et al., 1998; Huang et al., 2015). As described by Uchida (2007), these policies aim at alleviating information asymmetries by ensuring that firms disclose reliable information about the environmental attributes of their products, such as their pollution footprint. Examples of such instruments include the creation of state-sponsored eco-labeling schemes for products that meet certain environmental thresholds, voluntary disclosure programs where market participants get public recognition for joining the program, and mandatory information disclosure requirements (Uchida, 2007). These tools do not force firms to adopt certain business practices but aim at improving the credibility of the information disclosed by firms on environmental performance, empowering stakeholders to make undistorted consumption, investment, and policymaking decisions (Bemelmans-Videc et al., 1998; Huang et al., 2015).

These policy instruments, which have been classified as third-generation environment regulation tools, must be distinguished from first generation command-and-control instruments, which include permits, product bans, and industrial standards and specifications that mandate or prohibit precise corporate practices (Bemelmans-Videc et al., 1998; Huang et al., 2015), and from second

[7] For example, two apples may be physically identical, but the production process used to grow one of them may be more polluting than for the other, resulting in different levels of environmental quality between the apples.
[8] For example, Campbell et al. (2015, p.1) find that consumers tend to misperceive the unregulated labels "eco-friendly" and "sustainable" and conflate them with the regulated "organic" label.

generation market-based instruments, such as environmental taxes, emission trading systems and environmental subsidies, which aim at creating financial incentives for firms to adopt particular corporate practices (Bemelmans-Videc et al., 1998; Huang et al., 2015). However, informational instruments are often combined with other types of policy tools, such as minimum quality standards specified by regulations or subsidies to incentivize firms to produce certain types of goods (Baksi, Bose and Xiang, 2017). For example, even in the presence of state-sponsored certification scheme, some products might be subject to minimum quality standards specified by regulation.

While informational instruments do not prescribe particular corporate activities, they may increase the costs of communicating deceptive information to stakeholders (Darby and Karni, 1973). For example, consumer protection legislation may provide for monetary penalties in case of false or misleading advertising by firms.[9] Similarly, firms that fail to meet the requirements of a certification scheme may be delisted and lose the privilege to advertise their activities as compliant with the scheme's requirements. As such, these instruments focus on ensuring that the information disclosed to stakeholders is accurate, without guaranteeing whether the information will be used and integrated into stakeholders' decisions. As will be seen in section 3.3, the establishment of a consumer protection regime enforced by a law enforcement agency is the informational instrument privileged in Canada to tackle greenwashing. It is therefore the policy instrument that will be studied for the purposes of this thesis.

2.3 Impure public goods

Environmental claims often relate to impure public goods, i.e., goods that combine the characteristics of a private good (exclusivity and rivalry), and a public good (non-exclusivity and non-rivalry) (Ferraro et al., 2005; Cornes and Sandler, 1996).[10] Another way to describe impure public goods is to see them as private goods that generate public goods as positive externalities (Oakland, 1987). An example of a product displaying these characteristics is rain forest honey, which offers private health benefits to the consumer but also social benefits through ecosystem and biodiversity protection (Ferraro, Uchida, and Conrad, 2005).[11]

[9] See for example the *Competition Act*, R.S.C., 1985, c. C-34, s. 74.01.
[10] According to the classic theory on public goods, market mechanisms will supply a sub-optimal quantity of public goods if exclusion costs are excessively high, such that price mechanisms cannot ensure their efficient provision (Oakland, 1987). Under these conditions, the aggregate marginal benefits of public goods will exceed their marginal costs, but their marginal private benefits will not (Oakland, 1987).
[11] Other examples include the production of green electricity, which provides benefits to the consumer through energy consumption and social benefits through a reduction in GHG emissions (Kotchen, 2005), and organic wine, which

Some authors have referred to impure public goods that offer environmental benefits as "green goods" (Kotchen, 2005; Ferraro et al., 2005; Hamilton and Zilberman, 2006; Delmas and Grant, 2014). Green goods display environmental characteristics that generate both private and social benefits.[12] Kotchen (2005), for example, develops a general model of environmental goods consumption where every consumer enjoys the public benefits of the other consumers' green goods consumption. Consumers may have a higher marginal willingness to pay for green goods than their low environmental quality substitutes if green goods provide additional private benefits, like positive effects on health or a longer lifecycle. Consumers may also prefer green goods for altruistic reasons (Andreoni, 1989; Uchida, 2007; Delmas and Grant, 2014).

Green goods differ from pure public goods as individual consumers have an egoistic incentive to purchase them in addition to their aggregate contribution to social welfare. As indicated by Oakland (1987), this will typically result in a sub-optimal supply of impure public goods from a social welfare perspective. This situation must be distinguished from the case of pure public goods, where the supply of goods is reduced to zero. For example, it might be that consumers value low carbon goods more than carbon intensive goods, but not sufficiently to prevent any carbon intensive goods to be produced in the marketplace. If the production of carbon intensive goods generates environmental externalities that are not priced through carbon taxation or other mechanisms, markets for green goods would not by themselves be sufficient to reach a socially optimal level of pollution.[13]

Greenwashing can hamper the production of green goods if it leads to an increase in the consumption of low environmental quality goods relative to true green goods. If these distortions lead to a greater production and consumption of goods with harmful environmental impacts, such as pollution, greenwashing can amplify the generation of environmental externalities. If these externalities are not subject to environmental taxation or other internalization mechanisms, the distorted production mix can translate into a market failure where social costs are not borne by the economic agents at their origin. Section 5 explores this possibility further.

provides both private health benefits to individual consumers and social benefits through ecosystem and biodiversity protection (Delmas and Grant, 2014).

[12] For our purposes, goods the supply of which generates less pollution than their private substitutes will be included in this category.

[13] Furthermore, the consumption of green goods may lead to a crowding out of the provision of pure environmental public goods (Kotchen, 2006). For example, some authors have argued that corporate climate commitments could hinder public support for enhanced environmental laws and carbon pricing and ultimately crowd out mandatory emission reduction measures (Dyke et al., 2021).

2.4 Second-best considerations

As described at section 2.2, deceptive marketing originates from the inability of consumers to verify the validity of claims about credence characteristics in a context of information asymmetry, a form of market failure. Market failures result in allocative inefficiencies in the market (Biely and van Passel, 2022). In addition to information asymmetries, they include externalities, missing markets, public goods, and the lack of adequate property rights (Biely and van Passel, 2022). Some of these failures coexist and interact with each other (Biely and van Passel, 2022). For example, market power may contribute to reducing environmental externalities by slowing down economic output, therefore mitigating pollutant emissions (Biely and van Passel, 2022). Similarly, costly environmental certification processes may also constitute a barrier to entry for smaller firms willing to fulfill the demand for high environmental quality products, enhancing the market power held by incumbent firms (Biely and van Passel, 2022). Nevertheless, in a first-best world, distinct policy instruments should be used to tackle different market failures, such as the internalization of environmental externalities through carbon taxation and the alleviation of informational asymmetries between firms and consumers through informational instruments.

In a second-best world, however, using distinct policy instruments for separate market failures might not be possible (Bennear and Stavins, 2007). Second-best scenarios occur when exogenous constraints prevent the implement of first-best policy instruments (Bennear and Stavins, 2007). As explained by Bennear and Stavins (2007), the existence of a constraint impeding the achievement of one Pareto optimality conditions may imply that meeting the other optimality conditions will not be welfare enhancing. Examples of such constraints include the lack of political support or opposition by influent stakeholders for a particular policy instrument, and administrative capacity constraints (Bennar and Stavins, 2007). If these constraints cannot be alleviated, the development of second-best policy instruments can be justified. For example, second-best policy instruments have been extensively studied in the context of the interactions between environmental policy and distortions stemming from labor and capital taxation (Bennar and Stavins, 2007). In this situation, revenues raised through environmental taxes may allow governments to cut the distortionary taxes on labor and capital income (Bennar and Stavins, 2007). As will be explored further in section 5, there are reasons to believe that greenwashing policies could involve similar second-best considerations under given assumptions.

3. Literature review and regulatory framework

This section reviews the literature on deceptive marketing and informational policy instruments and provides a summary of the Canadian legal landscape applicable to deceptive marketing.

3.1 Theoretical literature on informational instruments

Informational policy instruments have been the subject of a vast number of theoretical studies (see for example Glaeser and Ujhelyi, 2005; Wu and Geylani, 2022; Corts, 2014). As summarized below, most theoretical models developed in the literature involve the development of a two-stage game model involving vertically differentiated products, where one firm is providing high quality goods and the other is providing low quality goods. Information about firms' status is typically private, allowing them to mislead consumers about the true quality of their goods. The authors then introduce various informational instruments to see their impact on consumer surplus, firm profits, and social welfare. The models vary in terms of assumptions about consumers' beliefs, the number of firms, the number of firm types (e.g., continuous, or binary), the ability of firms to change the quality of their products over time, the ability of consumers to update their beliefs, and the types of policy instruments studied. However, few of them consider the impure public good characteristics of goods with environmental attributes.

For example, Hattori and Higashida (2014) set up an oligopoly model of price and advertising competition between two vertically differentiated firms to evaluate the effect of different policies on social welfare. In their setting, one firm offers a low quality good, and the other offers a high quality good. Quality is exogenously given, cannot be changed in the short run. and is a credence characteristic (e.g., the effects of a product on health). Both firms may deceive consumers by pretending that their product's quality is higher than its true quality.[14] The market may not be entirely covered, consumers purchase at most one unit of goods, and they have uniformly distributed, heterogenous preferences for quality. The authors also assume that consumers are naïve: they believe that all advertising is credible. Consumer surplus depends on the intrinsic value of the good purchased (identical for all goods), the good's true quality, the degree of misinformation on this quality, and the good's price. Firms first decide which level of quality to advertise to consumers, and then compete in prices. After solving the model, the authors evaluate the welfare effects of greater misinformation by firms. Misinformation by the low-quality firm unambiguously decreases the revenues of the high-quality firm (through lower price and quantity)

[14] This assumption leads to interesting results, as more disinformation by one firm may offset some of the effects of the other firm's misinformation.

but has ambiguous effects on the revenues of the low-quality firm. Moreover, this type of misinformation has three effects on consumer surplus: first, it results in more price competition (as the goods appear more similar), which drives down the prices paid by consumers; second, some consumers shift from purchasing the high quality good towards the low quality good; third, some consumers who would not have purchased any good but for the misinformation choose to buy high quality good as it now sells at a lower price. The authors show that in the aggregate, for great amounts of misinformation, the overall effect of a small reduction in misinformation about the low quality good is welfare improving. A similar analysis is conducted for misinformation on the high quality good, with positive effects on the revenues of both firms (as the goods become increasingly different, price competition alleviates, while the quantities purchased increase for both goods), and ambiguous effects for consumer surplus (negative effect of price increases; ambiguous effect of substitution of one good for the other; and negative effect on consumers who would not have bought goods but for the misinformation). In the aggregate, for some parameter values, a decrease in misinformation about the high-quality good leads to consumer benefits that exceed the firms' losses. The authors show that when misinformation sent by each firm are strategic complements and where misinformation reduces social welfare, government can improve welfare by introducing a policy that will increase the cost of misinformation for either firm.

Baksi, Bose and Xiang (2017) build a similar oligopoly model of vertical product differentiation to evaluate the effects of deceptive advertising on the quality of credence goods. In this model, products are differentiated into so-called green, natural, and brown goods.[15] Green goods rely on third-party labels to certify their high level of quality; natural goods rely on self-labelling to signal their intermediate level of quality; and brown goods are goods of conventional quality that comply with minimum quality standards. As in Hattori and Higashida (2014), consumers are heterogenous in terms of quality preferences. Consumers overestimate the quality of intermediate goods based on an exogenous parameter. However, consumers accurately assess the natural and brown goods' quality. The market is not entirely covered. A two-stage game takes place, where consumers first choose whether to invest in quality, and then compete in price (Bertrand) or in quality (Cournot). The extent of misinformation to consumers is exogenous, and firms therebefore do not decide whether to deceive consumers – but they decide which type of goods to offer, which will determine their fixed costs. In both Bertrand and Cournot competition, greater quality

[15] Note that in this model, green goods are simply private goods with high environmental quality, and not impure public goods like in the model set forth herein.

overestimation benefits the intermediate quality firm, as it faces higher demand for its products, which are misleadingly perceived as having higher quality than reality. The intermediate quality firm is also incentivized to increase its product's quality, as the overestimation increases the marginal profitability of quality. An increase in the misperception of consumers increases the demand for the natural good and drives its profits upwards. In addition, it drives the quality of the green good upwards and the quality of the brown good downwards, as both the low quality and high-quality firms want to alleviate the intensity of price competition. Consumer surplus increases because on an improvement in the average quality of goods, but social welfare only increase for price competition. The authors conclude that the benefits of consumer misperception for the intermediate firm may explain why deceptive marketing often takes place in the form of misleading self-labelling.

Baumann and Rasch (2020) set up a Hotelling model that assumes the coexistence of rational and naïve consumers, replicating the fact that only a portion of consumers might actually be misled by deceptive corporate claims, with the rest of the consumers rejecting the signal sent by firms regarding the quality of their products. In their model, a duopoly of firms competes in prices. One firm supplies goods of publicly known, standard quality, whereas the other firm supplies goods of privately known quality – which can either be standard or high. The authors account for three types of law enforcement regimes. First, they assume an ex-post welfare-maximizing regulator can verify the truthfulness of corporate claims and impose the payment of fines and enforcement costs by the offender in case of breach. Second, they assume that verification may be initiated by a "narrowly focussed" agency aiming at maximizing ex post consumer welfare only. Third, they provide for verification instituted by a profit-maximizing competitor. In the absence of verification mechanisms, the authors find that false or misleading advertising distorts consumption choices by creating a wedge between prices and product quality expectations. In the model, the share of naïve versus rational consumers has important implications, as consumer surplus decreases with an increase in the proportion of naïve consumers. This effect takes place through two channels. First, a greater share of naïve consumers means that more numerous consumers will be deceived, which lowers aggregate consumer welfare. Second, deceptive marketing alleviates the degree of price competition, and a greater share of naïve consumers will accentuate this effect. Furthermore, for a specific probability of high-quality goods, deceptive marketing results in two different types of distortions. First, by falsely claiming higher quality, the firm with the privately known type charges higher prices, which leads rational consumers to reduce their consumption of that firm's product. Second, in the absence of verification, naïve

consumers believe the higher quality claim and overestimate the probability that a good is of high quality. This may lead them to over-consume or under-consume the goods supplied by the firm with the privately known type, depending on the price difference between firms. As such, the authors conclude that the optimal law enforcement regime depends on the share of rational and naïve consumers in the population and the level of enforcement costs.

Uchida (2007) builds a duopoly model of vertical product differentiation to evaluate the conditions under which information disclosure policies are optimal. As in other models, firms produce differentiated products in respect of quality (here, environmental performance), but production is accompanied by the emission of a pollutant. Total pollution depends on the environmental quality of the products and the quantity produced. Aggregate pollution is a public bad that affects all consumers. Environmental quality is assumed to be a credence characteristic: consumers' beliefs about quality rely on firms' signalling. Eco-labelling is binary: it only proves that environmental quality has reached a specific threshold. Because quality is costly, consumers will assume that in the absence of label, the product has the minimal level of environmental quality. If no information is disclosed, consumers assume the environmental quality at the minimum standard. However, firms can purchase a cleaning technology that reduces the environmental footprint of their product. There is a continuum of naïve consumers with heterogenous environmental preferences, but they all demand at most one unit of the goods. The market may not be entirely covered, which means that some consumers with a weaker preference for environmental quality may not purchase any goods. Firms will decide to apply for the quality label depending on the threshold for certification. Uchida shows that under the conditions of the model, eco-labelling has two effects on the environment. First, it decreases aggregate pollution, as it incentivizes firms to invest in environmental quality up to the certification threshold. This leads to a greater quantity of products with a smaller environmental impact to be supplied. Second, it increases aggregate demand by attracting new consumers who would not have purchased goods but for the eco-label. The entry of these new consumers means that more goods are consumed in the aggregate. These two effects offset each other, the former dominating the latter for certain parameter values. In this case, information disclosure policies contribute to social welfare. Similar results are obtained with full information (instead of binary) disclosure. Uchida's model is informative as it captures the "impure public good" characteristics of high environmental quality goods. However, it does not provide for consumer skepticism, consumer learning, and punishment of firms formulating deceptive claims.

This thesis will mainly build upon the literature summarized above, especially Baumann and Rasch (2020) and Hattori and Higashida (2014) to model a duopoly of differentiated firms where one firm supplies good of a publicly known quality and the other supplies goods of unknown quality, with some key changes in the model's assumptions to reflect Uchida's (2007) modelling of pollution as a public bad. This thesis will contribute to the theoretical literature on deceptive marketing by developing one of the first theoretical models that distinguish greenwashing from other types of deceptive marketing.[16]

3.2 Empirical literature review on greenwashing

Empirical research on corporate greenwashing has mainly focussed on the financial and non-financial effects of this behavior on firm performance. For instance, Ioannou et al. (2022) estimated the effect of greenwashing on consumer satisfaction among a sample of U.S. public firms. The authors constructed a sample of 202 U.S. publicly traded firms for 2008-2016 using data from the American Customer Satisfaction Index, data on green product innovation from Thomson Reuters' ASSET 4 database, and accounting and financial data from WorldScope. As the ASSET 4 database provided various datapoints on firm policies, declarations, and claims, and on implementation and actions, the authors were able to construct a greenwashing index that captured the difference between corporate claims and corporate conduct. The index measured greenwashing by observing the gap between a firm's policies and implementation actions using several data points. Then, the authors conducted a series of panel regressions with firm- and year-fixed effects to examine the correlation between the greenwashing index and the customer satisfaction index. The study showed that greenwashing firms tend to have lower customer satisfaction ratings compared to their more honest peers, which suggests not only a negative effect of greenwashing on firm performance, but also that consumers are able to identify the firms' deceptive declarations and punish them accordingly.

Similarly, Walker and Wan (2012) evaluated the effect of greenwashing on the financial performance of a sample of Canadian firms. The authors reviewed the websites of 103 Canadian companies active in four industries, namely the chemical energy, mining, and forestry sectors, with publicly available websites. They attributed codes for each company based on the information disclosed on environmental performance: when information pertained to substantive actions or symbolic actions taken by a firm, it was coded as such. Greenwashing was measured as the difference between substantive and symbolic actions. Data on the sampled firms' financial

[16] As noted above, Uchida (2007) does not account for the possibility of deceptive claims by firms.

performance was obtained from Compustat or in annual reports available on the firms' websites. The authors looked at the correlation between their greenwashing index and financial performance using an ordinary least-squares regression. They found a negative relationship between greenwashing and financial performance, suggesting that shareholders do monitor and sanction firms that do not substantiate their environmental claims.

Along the same lines, Testa et al. (2018) evaluated the effect of greenwashing on the financial performance of a large sample of publicly traded firms from various industries and countries. The authors relied on a panel of 3,490 publicly traded firms from 58 countries and 19 industrial sectors. Financial and environmental data was collected from Thomson Reuters DataStream for the period 2002 to 2014. To measure greenwashing, the authors built a green practice index capturing the environmental performance of a firm based on key environmental KPIs, a green communication index capturing the extent to which environmental considerations are mentioned in the firm's strategic documents and reporting, and a discrepancy index capturing the difference between the other two indices. The authors looked at the correlation between their discrepancy index and a proxy of financial performance using pooled ordinary least squares with heteroscedasticity and autocorrelation consistent standard errors. The authors found that greenwashing does not have positive effects on financial performance, but also that it does not translate into substantial sanctioning by the market. These results contrast with the obtained by Ioannou et al. (2022) and Walker and Wan (2022), which supported a negative effect of greenwashing on firm performance (as opposed to a neutral effect).

In a recent paper, Li et al. (2022) estimated the effect of greenwashing on corporate financial performance using a sample of Chinese-listed firms. In line with previous papers from the literature, the authors created a greenwashing index based on a content analysis of the sampled firms' sustainability reports. Then, the authors looked at the correlation between their greenwashing index and a proxy of financial performance using five different fixed-effect panel regression models. The authors found a positive relationship between greenwashing (measured through the index) and financial performance (measured through returns on assets), which contradicts previous results from previous studies, such as Testa et al. (2018) and Walker and Wan (2012). However, the authors stressed that these results may be driven by the particular institutional context of China, where the environmental regulation framework is still in its early days.

3.3 Canadian regulatory landscape

The model that will be developed in section 4 replicates the Canadian deceptive marketing regulatory framework, which is summarized in this section. In Canada, the main regulatory instrument that applies to voluntary marketing claims by firms is the *Competition Act* (the CA), which prohibits representations that are false or misleading in a material respect[17] and unsubstantiated performance claims (*Competition Act*, s.52 and s.74.01; Beaulieu, 2022, p.30).[18] The CA does not define what could qualify as a false or misleading statement under the statute, and does not set out the conditions for a test to be considered adequate and proper (Beaulieu, 2022, p.30).[19] Moreover, the CA's deceptive marketing provisions do not require the existence of a product or a commercial transaction to be applicable – the deceptive promotion of any commercial interest whatsoever may constitute a breach of the statute's provisions (Beaulieu, 2022, p.30). This means that the CA may apply to both product-level and company-level claims.

The CA is enforced by the Canadian Competition Bureau (CCB), a federal law enforcement agency. The CCB has broad powers to investigate deceptive marketing claims under the CA, including information gathering powers (*Competition Act*, s. 11 and s.15). At the end of an investigation, if the CCB concludes that a marketing claim is violating the CA, it may do one of three things. First, it may negotiate a consent agreement with the alleged offender, which may lead to the payment by the contravening firm of an administrative monetary penalty, charitable donations, and other corrective measures (*Competition Act*, s.105). Second, it may refer the matter for criminal prosecution (*Competition Act*, s.52). Third, it may seek remedies before the courts for a violation of the CA's administrative deceptive marketing provisions (*Competition Act*, s.74.01).

The CA's deceptive marketing provisions provide for criminal fines and imprisonment, and administrative monetary penalties. Unless a consent agreement is entered into between the CCB and the alleged offender, these sanctions are determined by the courts in light of the submissions

[17] This prohibition is limited to representations that are material, which means that a false or misleading marketing claim about a secondary product characteristic that is not considered as important by consumers may not violate the CA.
[18] See paragraph 74.01(1) of the CA.
[19] Baksi, Bose and Xiang (2017) distinguish self-labelling by firms from labelling/certification by an independent third party. This distinction does not exist under the Canadian framework, as the CCB may consider that a certification is misleading while concluding that a self-label is trutfhul. For example, the CCB recently launched an investigation into the Sustainable Forestry Initiative, a forest certification organization (Ecojustice, 2023).

made by criminal prosecutors (for criminal cases) and the CCB (for administrative cases). As such, sanctions are determined ex-post and are exogenous to the CCB.[20]

The CA does not include provisions that expressly address greenwashing, and the CCB has not issued detailed technical guidelines about the adequate substantiation and formulation of climate-related corporate claims (Beaulieu, 2022, p.35). There is therefore some degree of uncertainty regarding how the CA would apply to climate-related corporate claims (Beaulieu, 2022, p.36).[21] Furthermore, greenwashing is not among the agency's enforcement priorities: The CCB's "Strategic Vision" for 2020-2024 and its two most recent "Annual Plans" for 2021-2022 and 2022-2023 do not refer to greenwashing and climate-related corporate claims (Competition Bureau, 2020a, 2020b, 2022c; Beaulieu, 2022, p.33).[22]

4. The basic model

In this section, a theoretical model that replicates Canada's regulatory landscape regarding deceptive marketing claims is developed, as described at section 3.3.

4.1 Firms

Assume a duopoly of risk-neutral, profit-maximizing firms supplying vertically differentiated products that are characterized by different carbon footprints.[23] Firms maximize profits by setting the prices of goods. Following Uchida (2007), the production of a good is accompanied by the

[20] The principles that shall guide the courts when determining criminal sentences are listed at sections 718.1-718.21 of the *Criminal Code* (1985). For instance, criminal sentences must reflect the "gravity of the offence" and the "degree of responsibility of the offender" (*Criminal Code*, s.718.1). For organizations, sentences may also reflect any benefits that the organization has gained from committing the offence, and the cost of investigation and prosecution by public authorities (*Criminal Code*, s.718.21). Imprisonment under s.52 of the CA may not exceed 14 years, but criminal penalties are not subject to a ceiling (*Competition Act*, s.52). Administrative monetary penalties, on the other hand, shall reflect a non-exclusive list of aggravating or mitigating factors listed at section 74.1, which include the geographic scope of the conduct, its frequency and duration, the importance of the false or misleading representations, the vulnerability of the group of persons who were impacted, and the financial situation of the person being sanctioned (Competition Act, s.74.1). For organizations, administrative monetary penalties for a first breach may not exceed the greater of C$10 million (C$15 million for subsequent contraventions), three times the benefit derived from the illegal conduct, or, if that latter amount cannot be reasonably be assessed, 3% of the organization's global annual turnover (Competition Act, s.74.1).

[21] For example, the threshold beyond which the CCB would consider that a climate-related corporate claim is misleading or has not been sufficiently substantiated has not been precisely defined by the agency (Beaulieu, 2022, p.36). This source of uncertainty will be discussed further at 6.1.2.

[22] The 2022-2023 Annual Plan did announce that the organization would host a summit on the enforcement of the CA with respect to the socalled "green" economy. This event took place in the fall of 2022 but did not lead to any announcement about upcoming enforcement initiatives concerning greenwashing.

[23] These assumptions are similar to Baumann and Rasch (2020), with the distinction that the model set forth herein provides for environmental differentiation, whereas Baumann and Rasch (2020) only refer to quality, without specifying in respect of which qualitative attributes differentiation takes place. Furthermore, Baumann and Rasch also assume that firms are also differentiated on the basis of their location, as in a Hotelling model. This type of differentiation is not introduced here.

emission of a quantity of pollution e_i that depends on the good' carbon footprint, where $i \in \{L, N, H\}$.[24] Goods of different types are identical expect in their environmental dimension. Firms are denoted by $t \in \{K, U\}$. The K firm offers a quantity q_K of a product of publicly known[25] intermediate carbon footprint (N). The U firm offers a quantity q_U of a product of publicly unknown carbon footprint, which can either be high (H) or low (L).[26] The U firm's type is randomly assigned. The probability that the U firm offers a carbon intensive good is given by ϕ (this possibility is denoted by the subscript 1, or "scenario 1") and the probability that it offers a low-carbon good is given by $(1 - \phi)$ (denoted by the subscript 2, or "scenario 2"). (Wu and Geylani, 2020). As in Wu and Geylani (2020), Hattori and Higashida (2014) and Rhodes and Wilson (2018), quality is exogenously given and investments in quality are not possible.[27] Firms are in a sector where capacity constraints are mild, production can easily be adjusted, and firms compete in prices (Baksi, Bose and Xiang, 2017).

As shown at (1), the carbon intensive (low-carbon) good generates the greatest (lowest) quantity of pollution per unit produced. The production of the intermediate carbon good generates a lower (higher) quantity of pollution per unit produced than the carbon intensive (low-carbon) good.[28]

$$e_L < e_N < e_H \tag{1}$$

Aggregate pollution Z is a public bad affecting all consumers, capturing the "impure public good" characteristics of higher environmental quality goods (Uchida, 2007). As shown at (2), aggregate pollution is the sum of the pollution arising from the quantities supplied by firms.

$$Z = e_i q_U + e_L q_K \tag{2}$$

[24] Here, as in Baksi, Bose and Xiang (2017), it is assumed that three types of goods are available: high quality, intermediate quality, and low quality. Quality is captured by the pollution profile e_i of each good.

[25] This assumption could be justified, for example, by the fact that some firms participate to credible certification schemes that guarantee the quality of their products to the public.

[26] Baumann and Rasch (2020) assume that the K firm supplies low quality goods or standard quality goods. This assumption is altered here, as it is assumed that the K firm supplies either high carbon or low carbon goods. Hamilton and Zilberman (2006) justify the existence of discrete types of goods by the assumption that different production technologies exist in the market. Each of these technologies allows firms to produce goods that are exactly identical but for their different pollution profile. A similar reasoning can be applied here.

[27] To justify this assumption, Hattori and Higashida (2014) argue that consumer products are often subject to both a MQS and a certification scheme, which determine the quality level of goods. Ronen (1991) and Baksi, Bose and Xiang (2017) both provide for a two-stage game where firms decide whether to invest in quality differentiation in the first stage, and then compete in prices. In the current setting, the focus is not on investments in quality, but on communication about quality. As such, one could imagine that the first stage of the game has already occurred, and that firms are now at the stage of determining whether to communicate their type (only the U firm makes this determination) and setting their prices.

[28] This ordering ensures that there is always some degree of differentiation between the two firms, with the aim of replicating the situation obtained when investments in quality are endogenous. Arora and Gangopadhyay (1995, p.307) formally prove that in Bertrand duopoly with non-homogenous consumers, firms will always choose quality differentiation over quality homogeneity, as it allows them to price the goods beyond their marginal costs. Similar results are obtained by Motta (1993).

The social costs of pollution are not borne by firms. In other words, an exogenous constraint prevents the taxation of environmental externalities.[29] This assumption will allow second-best effects to be examined in context of the current regulatory framework.

As in Baumann and Rasch (2020), the K firm does not advertise its type, which is publicly known, and the U firm chooses whether to advertise its type, and whether to do it truthfully. Advertising is assumed to be costless (Baumann and Rasch, 2020; Rhodes and Wilson, 2018). Consumers and the K firm assume that the U firm is always advertising its type truthfully unless the law enforcer says otherwise.[30] As in standard in the quality differentiation literature (Motta, 1993; Uchida, 2007; Arora and Gangopadhyay, 1995; Hattori and Higashida, 2014; Baksi, Bose and Xiang, 2017), firms' constant variable costs are assumed to be zero.[31] Fixed costs depend on environmental quality and increase at a marginally increasing rate as pollution decreases (Baksi, Bose and Xiang, 2017; Hattori and Higashida, 2014). This is explained by the assumption that the production of less polluting goods requires purchasing more sophisticated technologies, which come at a higher price.[32] As such, a firm's fixed costs of supplying a low carbon good are higher than those of a firm supplying a carbon intensive good.[33]

$$C_t = C_t(e_i); C_t'(e_i) < 0;\ C_t''(e_i)\ > 0 \tag{3}$$

In the absence of enforcement, the firms' profit function corresponds to inequality (4). Producer

[29] This assumption is consistent with the Canadian context, as GHG emissions are only partially internalized under the different provincial and federal carbon pricing regimes. In practice, only a fraction of Canada's GHG emissions are reported and priced. To calculate the price of carbon, Canada assumes a social cost for GHG emissions of C$50 per ton of CO2 equivalents (in 2019 dollars). As acknowledged by the federal government, however, the social costs of climate change exceed this value (Government of Canada, 2022e, p.2). For example, a meta-analysis conducted in 2019 reported estimates of the social of carbon of $US112.86 (approximately C$156) per ton of CO2 under the assumption of a pure rate of time preference of 3% (Wang et al., 2019). For example, Canada's carbon pricing programs in 2020 covered approximately 78% of the country's 2018 GHG emissions, mainly because of exemptions granted to large emitters (11% of national emissions) and categories of emissions excluded from the programs, like land use emissions (9% of national emissions) (Sawyer, Stiebert, Gignac, Campney and Beugin, 2021). Only a portion of the GHG emissions from large industrial emitters are subject to the federal carbon price, allegedly because of international competitiveness concerns (Sawyer, Stiebert, Gignac, Campney and Beugin, 2021). Moreover, even for the facilities that are subject to it, the carbon price currently paid is approximately a third of the estimated social cost of carbon (Government of Canada, 2022e, p.2; Wang et al., 2019).

[30] Baumann and Rasch (2020) assume the existence of two types of consumers: "naïve" consumers that always believe corporate claims unless the law enforcer says otherwise; and "rational" consumers that form expectations about the possibility of deceptive claims. Baumann and Rasch's (2020) main contribution is to examine the impacts of changing the proportion of each type of consumer in the population. As this is not the focus of this thesis, it will be assumed that there is only one type of consumers, namely "naïve" consumers.

[31] Baksi, Bose and Xiang (2017, p.384, footnote 17), relying on previous papers from the literature, justify this by assuming that quality improvement is principally driven by fixed costs, such as investments in a technology that allows the production of higher quality goods, without major changes in the marginal costs.

[32] Hamilton and Zilberman (2006) also assume that costs are increasing with pollution abatement. However, they assume that one portion of firms' costs is identical across firms, and the other depends on their pollution abatement technology. Furthermore, they assume positive, constant marginal costs (as opposed to fixed costs).

[33] It is assumed that these different cost functions do not allow firms to signal their type through differential pricing (Corts, 2014).

surplus will simply be equal to the sum of firms' profits (Uchida, 2007). The focus of this thesis is on cases where a market exists for both higher and lower quality environmental goods, such that consumers have the option to purchase either type. As such, as in Baksi and Bose (2007, p.416), parameters are assumed to take values such that both firms generate non-negative profits in the absence of law enforcement, and that two types of differentiated goods are always available for consumers. This assumption is reflected in inequality (4).

$$\pi_{t,i} = p_i q_t - C_i \geq 0 \Leftrightarrow p_i q_t \geq C_i \quad (4)$$

Both firms and the regulator know the true cost of supplying each type of good. As such, when the U firm deceives consumers about its true type, it must set prices as if it was supplying the type of goods it pretends to be selling to avoid revealing its true type. Firms will deceive consumers if this strategy yields greater marginal private benefits than marginal private costs (Hamilton and Zilberman, 2006, p.633).[34]

4.2 Consumers

There is a continuum of j utility-maximizing consumers with heterogenous environmental preferences who all demand one unit of the goods. Consumers are assumed to be naïve: they do not know the state of the world (i.e., whether the U firm is supplying high or low carbon goods) and they believe that all corporate claims that have not been declared false or misleading by the regulator are true (Uchida, 2007; Glaeser and Ujhelyi, 2010; Hattori and Higashida, 2014). Furthermore, they believe that the regulator's verification process is flawless.[35] Environmental quality is assumed to be a credence characteristic: consumers' beliefs about quality rely on the U firm's signalling about its type. As such, consumers cannot verify the quality of a good.

All consumers experience disutility from the presence of pollution in the environment, as it constitutes a public bad. However, some consumers also experience disutility from personally causing pollution through their consumption decisions. This disutility depends on individual consumers' preferences, i.e., degree of "pollution aversion".[36] Pollution is therefore an impure

[34] Here, the extent of misinformation is radically different than in Hattori and Higashida (2014), as the order of perceived qualities is reversed by the deceptive marketing. In Hattori and Higashida (2013, p.3), the true quality of a good is given by s_k and perceived quality is given by $\hat{s}_k = s_k - e_k$, where $k \in \{l, h\}$. Under their model, even if there is consumer misinformation, it will always be that $\hat{s}_l > \hat{s}_h$ and $s_l > s_h$. As such, the respective positioning of the higher and lower quality firms will not be changed by misinformation.
[35] This assumption will be loosened at section 6.3.
[36] This situation is analogous to the utility gain associated with altruistic charitable donations, which yield both direct private utility (from the warm glow feeling arising from the impression of doing "good") and indirect public utility (from the contribution to a public good) (Uchida, 2007; Andreoni, 1989).

public bad that generates externalities that are only partially internalized by consumers, who get disutility from both the pollution generated by their own consumption choices and from the social costs associated with aggregate pollution (Hamilton and Zilberman, 2006).[37] In other words, individuals bear both the disutility of their personal consumption of a polluting good and the disutility from the aggregate consumption of polluting goods in the population (Oakland, 1987). Similar to Uchida (2007), consumers' utility function is given by equation (5), where there is separability of utility in prices and quality (Tirole, 1988, p.96):

$$U_{j,i} = v - \theta_j e_i - p_i - Z \tag{5}$$

where v is the intrinsic value of the goods (identical for all types of goods and all types of consumers), θ_j reflects each consumers' degree of pollution aversion, p_i is the price of the goods paid by the consumers, with $i \in \{L, N, H\}$, e_i is the true pollution generated by the good and Z is the aggregate quantity of pollution. As in Baumann and Rasch (2020), it is assumed that the value of v is sufficiently high so that all consumers purchase one unit of goods, irrespective of their price, such that the market is entirely covered. A consumer with a high θ_j gets greater disutility from consuming a polluting good than a consumer with a low θ_j. Consumers' environmental preferences are heterogenous and uniformly distributed on the interval $\theta_j \in [0, \bar{\theta}]$, where $\bar{\theta}$ is normalized to 1 without loss of generality (Ronnen, 1991; Hamilton and Zilberman, 2006; Baksi, Bose and Xian, 2017).

Assuming equal welfare weights across consumers, real consumer surplus is simply the sum of consumers' individual utility functions (Uchida, 2007; Hattori and Higashida, 2014; Baksi, Bose and Xiang, 2017).

$$CS = \int_0^1 U_{j,i}\, d\theta = \int_0^1 (v - \theta_j e_i - p_i - Z) d\theta \tag{6}$$

Equation (6) captures the real consumer surplus, which may be different than the perceived consumer surplus when consumers are misled about the true type of the good purchased (Glaeser and Ujhelyi, 2010; Hattori and Higashida, 2014; Baksi, Bose and Xiang, 2017). Given the assumption of covered market, v and Z are the same for all consumers. Equation (6) can therefore be rewritten as follows.

[37] As argued by Church (1994), it is difficult to know to which extent consumers would voluntarily internalize environmental externalities generated by their consumption choices if they were made aware of them. Advertising itself may impact consumers' willingness to prioritize goods with smaller environmental impacts. It is therefore assumed that consumers attribute some private value to the environmental quality of the goods they purchase, but not sufficiently to entirely internalize external environmental costs.

$$CS = \int_0^1 U_{j,i}\, d\theta = (v - Z) - \int_0^1 (\theta_j e_i + p_i) d\theta \quad (7)$$

The right-hand side of equation (7) includes four components: the aggregate utility gain corresponding to the intrinsic value of the goods v, which is the same for all consumers and types of goods; the aggregate utility loss arising from the aggregate social cost of pollution Z, which is also identical for all consumers; the utility loss corresponding to consumers' personal aversion for polluting goods, which depends on individual consumers' degree of pollution aversion θ_j and the pollution profile of the good they purchase, e_i; and the utility loss arising from the payment of the good's price, p_i. Only the first component has a positive effect on consumer surplus, as $v > 0$. Except for the consumer who is indifferent about pollution ($\theta_j = 0$), the three last components of equation (7) all have a negative effect on consumer surplus, as $Z > 0$ (given the assumption of covered market), $e_i > 0$ (all types of goods generate pollution); $p_i > 0$ (positive prices are required for firms to make non-negative profits).[38]

The U firm holds private information on the quality of its good, but consumers and the K firm do not. As such, consumers must rely on the information being communicated to them to form beliefs about the U firm's type. Consumers are considered indifferent between purchasing one or another type of good when they derive the same level of utility from buying either type of goods (Hamilton and Zilberman, 2006). When goods are vertically differentiated, for a same price, consumers with a lower degree of pollution aversion than the indifferent consumer will prefer purchasing goods with a higher carbon footprint, whereas consumers with a higher pollution aversion than the indifferent consumer will opt for goods with a lower carbon footprint. As such, if the U firm was to sell a carbon intensive good at the same price as the K firm sells a low-carbon good, the K firm would capture the entire market but for the consumer who does not care at all about a good's environmental characteristics ($\theta_j = 0$) (Wauthy, 1996).

When the U firm is supplying a carbon intensive good, a consumer is considered indifferent between a low carbon good and the carbon intensive good when he or she derives the same level of utility from buying either type of goods (Hamilton and Zilberman, 2006, p.630). The location of the indifferent consumer, denoted by θ_{HN}, is therefore characterized as follows:

$$U_{j,H} = U_{j,N} \quad (8)$$

[38] In future sections, the aggregate social cost of pollution will also be referred to as "indirect pollution costs", whereas the disutility arising from consumers' personal aversion for polluting goods will be referred to as "direct pollution costs".

$$v - \theta_j e_H - p_H - Z = v - \theta_j e_N - p_N - Z \quad (9)$$

$$\theta_{HN} = \frac{p_H - p_N}{e_N - e_H} \quad (10)$$

Following the same reasoning, when the U firm is supplying a low carbon good, the location of the indifferent consumer, then denoted by θ_{NL}, is characterized as follows:

$$\theta_{NL} = \frac{p_N - p_L}{e_L - e_N} \quad (11)$$

4.3 Law enforcement agency

A public consumer protection agency can investigate marketing claims if it suspects that a firm is breaching the law by making false corporate claims. The law enforcer's policy goal is to maximize total expected social welfare (SW), which corresponds to maximizing an expected utilitarian social welfare function where consumer welfare (CS) and producer surplus (PS) are summed, and any enforcement costs borne by society (ES) are subtracted, without attributing them different welfare weights across groups or within groups (Adler, 2019).[39]

$$E[SW] = \phi(CS_1 + PS_1 - ES_1) + (1 - \phi)(CS_2 + PS_2 - ES_2) \quad (12)$$

The choice of this social welfare function is consistent with other papers from the literature (Uchida, 2007; Hattori and Higashida, 2014; Baksi, Bose and Xiang, 2017; Wu and Geylani, 2020). This social welfare function is also aligned with the "total surplus standard" defined by the Supreme Court of Canada (SCC) in respect of the CA's efficiencies defence (Supreme Court of Canada, 2015). Additional information on the SCC's interpretation of this standard is provided in Appendix A. While the total surplus standard is used here, the balancing weight standard, which is also recognized by the SCC as a valid social welfare function in some cases, will be considered in section 6.1. (Supreme Court of Canada, 2015).

The amount of the fine b that will be imposed to the U firm if deceptive marketing is uncovered is exogenous and strictly positive.[40] To maximize expected social welfare, the law enforcement agency therefore sets the probability β that it verifies a claim.

[39] For example, there is no social preference for consumer welfare as opposed to producer surplus, but also no social preference for consumers with a higher or lower degree of pollution aversion. Note that the enforcement costs borne by the U firm are included in the calculation of the U firm's profits and impact social welfare through a decrease in producer surplus.

[40] This reflects the fact that it is the courts (and not the CCB) that are responsible to determine the sanctions imposed in a particular case, which shall reflect the criteria set in the CA, the *Criminal Code* and the jurisprudence. Past

$$\max_{\beta} E[SW] \tag{13}$$

The regulator does not know the U firm's true type unless it verifies it, but it knows the fixed costs of selling each type of good. The probability that the agency verifies a claim is given by $\beta \in [0,1]$. When $\beta = 1$, the U firm's claims are systematically audited (but not its silence). A verification by the regulator reveals the U firm's true type.[41] If a claim is found to be false by the agency, a fine b is imposed to the U firm. As in Corts (2014), it is assumed that fines are not dissipative of social welfare: the imposition of a fine leads to a direct transfer from the firm to the regulator at no efficiency costs, other than through enforcement costs. Furthermore, verification is flawless: it systematically reveals the U firm's type (Baumann and Rasch, 2020).

The regulator only verifies corporate claims. In other words, the regulator may only investigate cases where the U firm advertises its good as low carbon (potential "greenwashing" cases) but will never examine cases where the U firm remains silent to let consumers believe that it is supplying a carbon intensive good.[42] This is consistent with Canada's legal framework, as the CA only applies to representations made to the public, and not to the absence of representations (*Competition Act*, s.52 and s.74.01).

The probability of verification and the amount of the fines is public information, and they are determined before firms and consumers make decisions. As such, the agency cannot adapt its behavior in reaction to these decisions and impose different fines than initially announced after

sanctions imposed by the courts are public, which allows firms to have a general idea of the amounts of the fines that may imposed for a given breach of the CA, in light of the factors identified in the CA and the *Criminal Code*. In the model, there is theoretically no limit to the value of parameter b. This is a simplification of reality: as decribed at section 3.3, the CA does provide for maximum fines in certain circumstances. One may wonder why the government would not set infinitely high fines in the CA to deter violations of the law. As discussed by Corts (2014), under some conditions, it may be optimal so set extreme fines if there are no costs associated with increasing the fines. Agents decide whether to comply with the law based on the benefits of breaching the law, the probability of getting caught if they breach the law; and the fine imposed if they get caught. If an increase in the probability of verification leads to greater enforcement costs, but an increase in the value of the fines does not involve any costs, the regulator should minimize the costly verifications and increase the value of the costless fines. However, in some cases, the imposition of higher fines will involve a trade-off, such as in the case where the verification process is not flawless (Baumann and Rasch, 2020). Furthermore, as noted by Baksi and Bose (2007, p.421), practically speaking, social conventions may prevent the imposition of extreme sanctions. In Corts' (2014) setting, it would not be desirable to set infinitely high fines if there are costs associated with legal compliance, such as information acquisition (i.e., learning) costs. In this case, imperfect legal compliance may be socially optimal. In some other cases, an increase of the detection rate and an increase in the value of penalties will be substitutable. For example, in Allingham and Sandmo's (1972) model, an increase in the probability of detection of income tax evasion and an increase in the penalty rate imposed when tax evasion is detected are considered as policy substitutes, as they both lead to more honest tax declarations (i.e., increase in the fraction of the real income that is declared).

[41] One may wonder if the regulator is better positioned to verify the credence characteristics of goods than consumers. As Corts (2014), it is assumed that the law enforcement agency holds sufficient expertise, time and information to reveal the real quality of goods.

[42] Rhodes and Wilson (2018) also assume that verification only occurs in respect of cases where a firm with a low quality type tries passing off as having a high quality type.

deceptive marketing is detected. Moreover, the agency can only impose monetary penalties, and jail sanctions are impossible.[43] These two assumptions are justified for two reasons. First, imprisonment is never imposed to firms – only to individuals, like the directors and officers that direct an organization to engage in deceptive marketing, or the individuals who deceive consumers about the extent of their professional qualifications. Introducing jail sanctions in the model would require identifying how the possibility of such sanctions influence the behavior of the U firm's agents, and indirectly influences the U firm's behavior, which goes beyond the scope of this thesis. Second, the CCB commits to a list of enforcement priorities on a yearly basis, such that the agency's focus on a given industry is set in advance (Competition Bureau, 2020a, 2020b, 2022c).

As in Baumann and Rasch (2020), the verification process is costly, and enforcement costs are borne by the losing party. For instance, if the agency was to initiate verification proceedings to investigate the U firm's marketing claims and it turned out that the claims were correct, the agency would have to bear the enforcement costs. If the claims turned out to be false, then the U firm would have to bear the enforcement costs. This assumption is consistent with the Canadian legal framework. For example, the latest consent agreement registered with the Competition Tribunal provided that the respondent shall make a payment for "costs incurred by the [CCB] during the course of his investigation into this matter" (Competition Tribunal, 2022, p.6, par.7). Similar clauses were included in the recent consent agreements with True Sports, Inc. and Facebook, Inc., among others (Competition Tribunal, 2020a, 2020b). Furthermore, enforcement costs depend on the probability of verification β. First, a greater likeliness of verification implies a greater probability that enforcement costs will be incurred. Second, it is assumed that k is increasing with the probability of enforcement in a strictly positive and convex way. In other words, higher fines imply greater enforcement costs. This assumption is justified by the fact the CCB, as an independent law enforcement agency, is awarded limited resources to achieve its mandate by the government, such that more widespread enforcement actions increase the marginal costs of law

[43] These assumptions are a simplification of reality: As explained at section 3.3, in Canada, sanctions for a violation of the CA's deceptive marketing provisions are determined ex-post by the courts and reflect the particular characteristics of the case at issue. Furthermore, imprisonment for deceptive marketing is possible under the CA. It should be noted that similar simplifications were made by Allingham and Sandmo (1972) in the context of a theoretical assessment of income tax evasion. In the authors' theoretical model, a taxpayer may declare all or part their actual income to the tax authority. Income is exogenously given and unknown from the tax authority, which may investigate the taxpayer's income declaration with a certain probability. If verification takes place and the authority detects tax evasion, the taxpayer must pay a penalty that exceeds the tax payments that would have been due if their real income had been declared. For the purposes of the model, the authors assume that there is no discretion about the determination of the penalty after the tax evasion is detected. As such, fines are determined *ex ante* and not *ex post*, even if the opposite takes place in reality. The authors also assume that only monetary penalties can be imposed and that jail sanctions are impossible, despite such sanctions being possible for fraudulent declarations to tax authorities. Similar assumptions are introduced in the model set forth herein.

enforcement.[44] No enforcement costs are charged in the absence of verification, such that $k(0) = 0$.

$$k(\beta) \geq 0\ ;\ k'(\beta) > 0;\ k''(b) > 0 \qquad (14)$$

In the current setting, enforcement costs are incurred every time verification takes place: the greater the probability of verification, the greater the enforcement costs that will be incurred (Baumann and Rasch, 2020). Whether these costs are borne by the U firm or the regulator does not matter for total social welfare: assuming that consumer surplus and producer surplus are given the same social welfare weight, any transfer from one group to the other through the payment of fines or enforcement costs will be welfare-neutral (Corts, 2014). This situation implies a trade-off between the benefits and the costs of law enforcement when determining the optimal regulatory stringency.

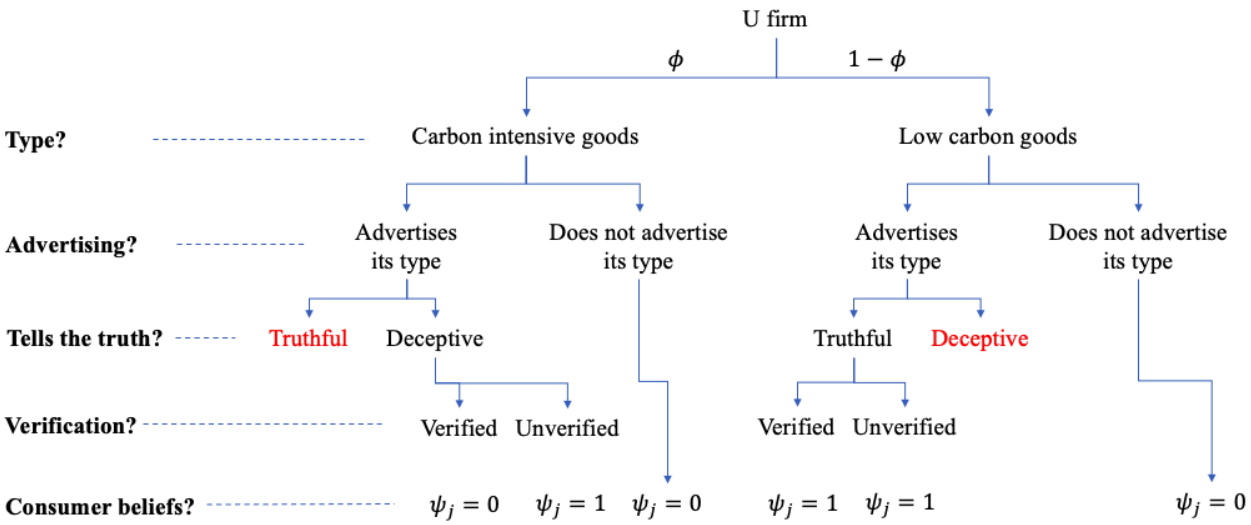
5. Two-stage game

After acknowledging its type, the U firm decides whether to advertise its type; and, if it does advertise its type, whether to mislead consumers about that type. If the U firm decides to advertise its type, it may be verified by the regulator with probability β. Figure 1 below summarizes the different possible scenarios and the resulting consumer beliefs, ψ_j. When $\psi_j = 0$, consumers believe that the U firm supplies a carbon intensive good; when $\psi_j = 1$, they believe that the U firm supplies a low carbon good (Baumann and Rasch, 2020). It is assumed that consumers will expect that a good is carbon intensive if no information is communicated about it. In other words, if the U firm does not communicate on its good' environmental characteristics, it will be perceived as having poor environmental quality, even if it may not be the case (Polinsky and Shavell, 2012; Delmas and Grant, 2014; Testa et al., 2018; Li, Li, Seppänen and Koivumäki, 2022). As a result, there is no reason for the U firm to advertise that it is selling a carbon intensive good: it may simply remain silent and let consumers infer the goods' type. It is therefore impossible that the U firm truthfully advertises that it supplies a carbon intensive good, and this scenario is colored in red in Figure 1. The U firm will either deceive consumers or will not advertise its type at all (Polinsky and Shavell, 2012).[45]

[44] One could assume that an increase in the verification probability requires hiring expensive external investigators to conduct verifications on behalf of the CCB, or that it requires paying costly extra hours to employees.
[45] Polinsky and Shavell (2012) argue that firms are incentivized to disclose positive information to consumers about their type and to prevent the disclosure of unfavourable information. However, consumers are aware of this situation and draw conclusions from a firm's silence. In Polinksy and Shavell (2012), the lack of disclosure can either be

Theoretically, even if it assigned a low-carbon type, the U firm could still want to pass of as supplying a carbon intensive good. However, it is impossible that the U firm deceptively advertises a low carbon good as carbon intensive (this scenario is also colored in red in Figure 1). This is because consumers know that the U firm would remain silent if it truly supplied a low carbon good. Consequently, if the U firm advertised its good as carbon intensive, it would reveal that it is in fact selling a low carbon good. If it wants to pass as supplying a carbon intensive good, the U firm should simply refrain from advertising and remain silent. This could occur if there was an incentive for the U firm to pretend that it sells a carbon intensive good.[46]

Figure 1: Summary of scenarios under the basic model (own figure).[47]



A verification can only be initiated when the U firm advertises its good's type, which can lead to two outcomes: either the verification reveals that the U firm made a deceptive representation, in which case the U firm has to pay for the law enforcement costs and a fine, or it reveals that the advertising was truthful, in which case the regulator bears the law enforcement costs. The outcome of the verification leads consumers to update their beliefs about the U firm's type. Consumption decisions take place after the verification has occurred. Consumption choices will depend on the prices of goods, consumers' marginal willingness to pay for different qualities of goods, the U firm's advertising strategy, the initiation of a verification proceeding, and consumers' resulting

explained by the fact that a firm did not acquire information on its type or by the fact that it decided not to disclose it. As opposed to Polinsky and Shavell's (2012) model, in which the acquisition by a firm of information on its type is costly, it is assumed here that the U firm knows its type from the start, without having to incur information acquisition costs. As such, it may not be that the U firm would keep from disclosing its type because it would not know it.

[46] Section 5 analyzes whether this can be a profitable strategy for the U firm for some parameter values.

[47] All figures in this thesis originate from the author. However, the design of the figures are inspired by Figure 1 of Baumann and Rasch (2020, p.1220).

beliefs. First, the regulator sets the regulatory stringency by determining the probability of verification. Second, the U firm learns its type, and decides whether to mislead consumers, considering the regulatory stringency. Third, verification may take place. Fourth, firms set their prices, taking each other's type as given. Finally, consumers make their consumption decisions. The model is solved by backward induction.[48]

5.1 Solving the model in the absence of law enforcement

The model is first solved in the absence of law enforcement to identify under which conditions greenwashing is a profitable strategy for the U firm, and to show the effect of this behavior on social welfare when it is unconstrained. This requires looking at two main scenarios: the case where the U firm is assigned a carbon intensive good (scenario 1), and the case where it is assigned a low carbon good (scenario 2).

5.1.1 First scenario – U firm assigned the carbon intensive good (probability ϕ)

In the first scenario, which is denoted by the subscript 1, the U firm is assigned the carbon intensive good, and it must decide whether to remain silent (1^a) or falsely pretend that it is supplying a low carbon good (1^b). In the case that the U firm remains silent (1^a), the demand for each good can be derived from equation (10), which provides the location of the indifferent consumer θ_{HN}.

$$q_K = 1 - \theta_{HL} = 1 - \frac{p_H - p_N}{e_N - e_H} \tag{15}$$

$$q_U = \theta_{HL} = \frac{p_H - p_N}{e_N - e_H} \tag{16}$$

Equations (15) and (16) imply that the least pollution averse consumers in the population will buy a carbon intensive good from the U firm, whereas the most pollution averse consumers will purchase an intermediate carbon good from the K firm. For given carbon footprints, the demand for each good is decreasing in its own price and increasing in the competitor's price. To obtain

[48] This sequencing of decisions (i.e., the misinformation decision taking place before the price setting decision) is aligned with the order of decisions in Baumann and Rasch (2020), Hattori and Higashida (2014), and Glaeser and Ujhelyi (2010). As noted in Baumann and Rasch (2020, p.1220), this may reflect the situation where firms first introduce a new type of goods to the public, then get noticed and potentially investigated by the regulator, and finally the goods start being commercialized to the public. Rhodes and Wilson (2018), on the other hand, assume that a monopolist reports its type at the same time as it sets its price; however, they assume that consumers make their consumption decisions before the regulatory verifies the monopolist's claims. As such, even if deceptive marketing is uncovered, it still harms to consumers.

the firms' profit functions, we substitute q_t in equation (4) by the demand addressed by each firm obtained from equations (15) and (16), for each firm respectively:

$$\pi_{1^a,K} = p_N(q_k) - C_N = p_N - \frac{p_H p_N}{e_N - e_H} + \frac{p_N^2}{e_N - e_H} - C_N \tag{17}$$

$$\pi_{1^a,U} = p_H\left(\frac{p_H - p_N}{e_N - e_H}\right) - C_H = \frac{p_H^2}{e_N - e_H} - \frac{p_H p_N}{e_N - e_H} - C_H \tag{18}$$

Each firm maximizes profits by setting the price of type of goods it supplies, taking the price of the other type as given. Taking the first order conditions for each firm yields the optimal price for each good. First, for the K firm:

$$\frac{\partial \pi_{1^a,K}}{\partial p_N} = 1 - \frac{p_H}{e_N - e_H} + \frac{2p_N}{e_N - e_H} = 0 \tag{19}$$

$$p_N = \frac{p_H - e_N + e_H}{2} \tag{20}$$

Second, for the U firm:

$$\frac{\partial \pi_{1^a,U}}{\partial p_H} = \frac{2p_H}{e_N - e_H} - \frac{p_N}{e_N - e_H} = 0 \tag{21}$$

$$p_H = \frac{1}{2}p_N \tag{22}$$

In both cases, it can be easily seen that the second order sufficient conditions are met. The optimal price of the carbon intensive good (22) can be substituted in the expression for the optimal price of the intermediate carbon good (20) to obtain equation (23):

$$p_N = \frac{2}{3}(e_H - e_N) \tag{23}$$

Similarly, the optimal price of the intermediate carbon good can be substituted in the expression for the optimal price of the low carbon good as follows:

$$p_H = \frac{1}{2}p_N = \frac{1}{3}(e_H - e_N) \tag{24}$$

As shown by equation (26), the ratio between the price of the two goods will always be 1:2. For both goods, the optimal price is increasing in the degree of differentiation between the two goods. In other words, the intensity of price competition alleviates as the goods become more different.[49]

[49] This result is consistent with similar conclusions from the literature, including Ronnen (1991) and Baksi, Bose and Xiang (2017).

Now that the expressions for the optimal prices have been derived, it is possible to substitute these expressions in equation (10) to obtain the location of the indifferent consumer.

$$\theta_{HN} = \frac{p_H - p_N}{e_N - e_H} = \frac{\left(\frac{1}{3}(e_H - e_N)\right) - \left(\frac{2}{3}(e_H - e_N)\right)}{e_N - e_H} = \frac{1}{3} \tag{25}$$

The demand addressed by each firm can be derived by substituting equation (25) in equations (15) and (16) as follows:

$$q_K = 1 - \theta_{HN} = \frac{2}{3} \tag{26}$$

$$q_U = \frac{1}{3} \tag{27}$$

The K firm is servicing the two thirds of consumers with the highest degree pollution aversion. On the other hand, the U firm is serving a third of the addressable market, which corresponds to the third of the consumers with the lowest degree of pollution aversion. Substituting the equations (24) and (27) in the profit equation for the K firm and substituting equations (23) and (26) in the profit equation for the U firm yields equations (28) and (29)[50]:

$$\pi_{1^a,K} = p_N q_N - C_N = \frac{4}{9}(e_H - e_N) - C_N \tag{28}$$

$$\pi_{1^a,U} = p_H q_U - C_H = \frac{1}{9}(e_H - e_N) - C_H \tag{29}$$

Equations (28) and (29) both comprise two terms: the first term represents each firm's gross revenues and the second corresponds to each firm's fixed costs. Gross revenues (and, therefore, firm profits) are increasing in the degree of differentiation between the two goods through the effect on price competition. The K firm is making four times as much revenues as the U firm, which is not surprising given that the price of the intermediate carbon good is twice the price of the carbon intensive good, and the K firm's market share is double the market share of the U firm. As such, for a same change in the degree of quality differentiation, the effect on revenues is greater for the K firm than for the U firm. Moreover, firm profits respectively decrease in each firm's own fixed costs. Total producer surplus corresponds to the sum of firm profits.

$$PS_{1^a} = \pi_{1^a,K} + \pi_{1^a,U} = \frac{5}{9}(e_H - e_N) - C_N - C_H \tag{30}$$

[50] Recall that under inequality (4), parameter values are such that $\frac{4}{9}(e_H - e_N) \geq C_N$ and $\frac{1}{9}(e_H - e_N) \geq C_H$.

The level of aggregate pollution can be derived by substituting in equation (2) the expressions for the quantities supplied by each firm obtained from equations (26) and (27):

$$Z_{1^a} = e_H q_U + e_N q_K = \frac{1}{3} e_H + \frac{2}{3} e_N \tag{31}$$

Consumer surplus is given by the sum of the surplus of consumers purchasing the carbon intensive good and consumers purchasing the low carbon good, respectively. Consumer surplus is obtained by substituting in equation (7) the results obtained at equations (23) and (24) for the optimal prices and equations (26) and (27) for the demand addressed by each firm.

$$CS_{1^a} = \left(v - \frac{1}{3} e_H - \frac{2}{3} e_N\right) - \int_0^{\frac{1}{3}} \left(\theta_j e_H + \frac{1}{3}(e_H - e_N)\right) d\theta - \int_{\frac{1}{3}}^{1} \left(\theta_j e_N + \frac{2}{3}(e_H - e_N)\right) d\theta \tag{32}$$

All consumers get the same utility gain from the intrinsic value of the goods v, and the same utility loss arising from the aggregate social cost of pollution Z (the indirect pollution costs). However, the direct pollution costs and the utility loss arising from the payment for the goods vary among consumers depending on the type of good purchased and the consumers' degree of pollution aversion. For the one third of consumers who purchase the carbon intensive good, these two components of consumer surplus can be calculated as follows:

$$\int_0^{\frac{1}{3}} \left(\theta_j e_H + \frac{1}{3}(e_H - e_N)\right) d\theta = \frac{1}{2}\left(\frac{1}{3}\right)^2 e_H + \frac{1}{3}\left(\frac{1}{3}\right)(e_H - e_N) = \frac{1}{18} e_H + \frac{1}{9}(e_H - e_N) \tag{33}$$

Similarly, for the two thirds of consumers who purchase the intermediate carbon good:

$$\int_{\frac{1}{3}}^{1} (\theta_j e_N + \frac{2}{3}(e_H - e_N)) d\theta = \frac{8}{18} e_N + \frac{4}{9}(e_H - e_N) \tag{34}$$

The right-hand side of both equations (33) and (34) comprises two terms: the direct pollution costs and the utility loss arising from the payment of the goods' prices. The coefficient of the first term is greater in equation (34) than in equation (33), as there is a greater share of consumers purchasing the intermediate carbon good. However, the marginal direct pollution costs are greater in equation (34), as the marginal pollution of the carbon intensive good is greater than the marginal pollution of the intermediate carbon good ($e_H > e_N$). The fact that the payments for the goods are greater for the intermediate carbon good is not surprising, as $p_N > p_H$ and $q_K > q_U$. The results obtained at equations (33) and (34) can be substituted in equation (35) to obtain the expression for the consumer surplus in equilibrium.

$$CS_{1^a} = v - \frac{1}{3}e_H - \frac{2}{3}e_N - \frac{1}{18}e_H - \frac{8}{18}e_N - \frac{5}{9}(e_H - e_N) \quad (35)$$

Pursuant to equation (12), social welfare is given by the sum of consumer surplus (equation 35) and producer surplus (equation 30), which are allocated the same welfare weight.[51] As the payment for the goods appears in both equations with inverse signs (it is simply a transfer from consumers to firms), it gets cancelled out in the social welfare equation. Social welfare is therefore the difference between consumers' intrinsic valuation for the goods and indirect pollution costs, direct pollution costs, and firms' respective costs. As shown by equation (36), social welfare for scenario 1^b is increasing in consumers' intrinsic valuation for the goods v and decreasing in goods' pollution profiles and firms' costs.

$$SW_{1^a} = v - \frac{20}{18}e_N - \frac{7}{18}e_H - C_N - C_H \quad (36)$$

We now turn to the case that the U firm deceptively advertises the goods as low carbon (1^b). In this case (the "greenwashing" case), verification of the claims by the regulator takes place with probability β. The model must be solved following the same steps as for scenario 1^a, with three major differences. First, from consumers' perspective, the U firm and the K firm's quality ordering is inverted, as the U firm (K firm) is now supplying the less (more) polluting good. Second, the U firm is now incurring costs that do not reflect the type of the good it pretends to be selling. Third, consumers are making their consumption choices on the basis of perceived utility, which is different from the real utility gained from consuming the U firm's good. The demand for each good can be derived from (11), which provides the location of the indifferent consumer θ_{NL}.

$$q_U = 1 - \theta_{NL} = 1 - \frac{p_N - p_L}{e_L - e_N} \quad (37)$$

$$q_K = \theta_{NL} = \frac{p_N - p_L}{e_L - e_N} \quad (38)$$

The K firm is now serving the third of consumers with the lowest degree of pollution aversion, and the U firm is servicing the two thirds of consumers with the highest degree pollution aversion. The profit functions can be derived by substituting these quantities in the profit functions, where the fixed costs of the U firm are its true costs C_H.

$$\pi_{1^b,U} = p_H(q_U) - C_H = p_L - \frac{p_N p_L}{e_L - e_N} + \frac{p_L^2}{e_L - e_N} - C_H \quad (39)$$

[51] In this case, verification does not take place and no enforcement costs are borne by society, such that $ES = 0$.

$$\pi_{1^b,K} = p_N(q_K) - C_N = \frac{p_N^2}{e_L - e_N} - \frac{p_N p_L}{e_L - e_N} - C_N \quad (40)$$

As in scenario 1^a, each firm maximizes profits by setting the price of type of goods it supplies, taking the price of the other type as given. As previously indicated, the K firm assumes that the U firm is telling the truth as long as deceptive marketing is not uncovered. Taking the first order conditions for each firm yields the optimal price for each good. First, for the U firm:

$$\frac{\partial \pi_{1^b,U}}{\partial p_L} = 1 - \frac{p_N}{e_L - e_N} + \frac{2p_L}{e_L - e_N} = 0 \quad (41)$$

$$p_L = \frac{p_N - e_L + e_N}{2} \quad (42)$$

Second, for the K firm:

$$\frac{\partial \pi_K}{\partial p_N} = \frac{2p_N}{e_L - e_N} - \frac{p_L}{e_L - e_N} = 0 \quad (43)$$

$$p_N = \frac{1}{2} p_L \quad (44)$$

In both cases, it can easily be seen that the second order sufficient conditions are met. The optimal price of each type of goods can be obtained by substitution:

$$p_L = \frac{2}{3}(e_N - e_L) \quad (45)$$

$$p_N = \frac{1}{3}(e_N - e_L) \quad (46)$$

Substituting the expressions obtained at equations (45) and (46) in equation (11), which provides the location of the indifferent consumer θ_{NL}, it is found that the location of the indifferent consumer is the same as in scenario 1^a. The demand addressed by each firm follows from this result.

$$\theta_{NL} = \frac{p_N - p_L}{e_L - e_N} = \frac{1}{3} \quad (47)$$

$$q_U = \frac{2}{3} \quad (48)$$

$$q_K = \frac{1}{3} \quad (49)$$

The U firm is incurring the same costs as it would if it remained silent. In addition, greenwashing doubles the portion of total demand serviced by the U firm compared to scenario 1^a. However,

the effect of greenwashing on the U firm's price is ambiguous, as equation (45) will only exceed equation (24) for parameter values such that inequality (50) holds:

$$\frac{2}{3}(e_N - e_L) > \frac{1}{3}(e_H - e_N) \tag{50}$$

Inequality (50) can be rewritten as inequality (51). This inequality only holds when the difference between e_N and e_L is more than half of the difference between e_H and e_N[52], which results from the fact that a lower degree of differentiation between the goods increases price competition. When e_H and e_N are highly differentiated relative to e_N and e_L, price competition is alleviated in scenario 1^a, which means that higher prices can be charged to consumers, limiting the price effect of greenwashing.

$$2(e_N - e_L) - (e_H - e_N) > 0 \tag{51}$$

The K firm is also incurring the same costs as in scenario 1^a, but it is servicing a smaller portion of total demand. The effect of greenwashing on the price of the intermediate carbon good is also ambiguous, as equation (46) will only exceed equation (23) for parameter values such that inequality (52), which can be rewritten into inequality (53), holds:

$$\frac{1}{3}(e_N - e_L) > \frac{2}{3}(e_H - e_N) \tag{52}$$

$$(e_N - e_L) - 2(e_H - e_N) > 0 \tag{53}$$

This inequality holds when the difference between e_N and e_L is more than twice the difference between e_H and e_N. The reasoning behind this result is the same for inequalities (53) and (51). Inequality (51) will hold if inequality (53) holds, but the opposite will not be true.[53] Under greenwashing with no verification, firm profits and producer surplus become[54]:

$$\pi_{1^b,U} = p_L q_U - C_H = \frac{4}{9}(e_N - e_L) - C_H \tag{64}$$

$$\pi_{1^b,K} = p_N q_N - C_N = \frac{1}{9}(e_N - e_L) - C_N \tag{65}$$

$$PS_{1^b} = \pi_{1^a,K} + \pi_{1^a,U} = \frac{5}{9}(e_N - e_L) - C_N - C_H \tag{66}$$

The level of aggregate pollution can be derived by substituting in equation (2) the expressions for the quantities supplied by each firm obtained from equations (48) and (49). The aggregate quantity

[52] For example, inequality (51) would hold for parameter values $e_i = \{1; 2; 3\}$ but not for parameter values $e_i = \{1; 2; 10\}$.

[53] For example, both inequalities would hold for parameter values $e_i = \{1; 5; 6\}$ but only inequality (51) would hold for parameter values $e_i = \{1; 2; 3\}$.

[54] Recall that under inequality (4), parameter values are such that $\frac{4}{9}(e_N - e_L) \geq C_H$; $\frac{1}{9}(e_N - e_L) \geq C_N$.

of pollution is greater than in scenario 1^a, as a greater portion of consumers purchase the carbon intensive good relative to the intermediate carbon good.

$$Z_{1^b} = e_N q_K + e_L q_U = \frac{1}{3}e_N + \frac{2}{3}e_H \tag{67}$$

As before, consumer surplus for 1^b is obtained by substituting in equation (7) the results obtained at equations (45) and (46) for the optimal prices and equations (48) and (49) for the demand addressed by each firm. In this case, real consumer surplus is different from perceived consumer surplus (which will calculated in the assessment of scenario 2^a).

$$CS_{1^b} = \left(v - Z_{1^b}\right) - \int_0^{\frac{1}{3}} (\theta_j e_N + p_N) d\theta - \int_{\frac{1}{3}}^{1} (\theta_j e_H + p_L) d\theta \tag{68}$$

$$CS_{1^b} = \left(v - \frac{2}{3}e_H - \frac{1}{3}e_N\right) - \int_0^{\frac{1}{3}} (\theta_j e_N + \frac{1}{3}(e_N - e_L)) d\theta - \int_{\frac{1}{3}}^{1} (\theta_j e_H + \frac{2}{3}(e_N - e_L)) d\theta \tag{69}$$

As before, all consumers get the same utility gain from the intrinsic value of the goods v, and the same utility loss arising from the aggregate social cost of pollution Z (the indirect pollution costs), which is now greater than in scenario 1^a. The effect of greenwashing on the price of each good is ambiguous, as discussed above. Furthermore, the effect of greenwashing on direct pollution costs will vary across consumers. For the one third of consumers who purchase an intermediate carbon good, these two last components of consumer surplus can be calculated as follows:

$$\int_0^{\frac{1}{3}} \left(\theta_j e_N + \frac{1}{3}(e_N - e_L)\right) d\theta = \frac{1}{18}e_N + \frac{1}{9}(e_N - e_L) \tag{70}$$

Similarly, for the two thirds of consumers purchasing the U firm's carbon intensive good:

$$\int_{\frac{1}{3}}^{1} \left(\theta_j e_H + \frac{2}{3}(e_N - e_L)\right) d\theta = \frac{8}{18}e_H + \frac{4}{9}(e_N - e_L) \tag{71}$$

Consumers who purchase a good from the U firm pay the price of the low carbon good while incurring the higher direct pollution costs of the carbon intensive good. The results obtained at equations (70) and (71) can be substituted in equation (69) to obtain the expression for the consumer surplus in equilibrium.

$$CS_{1^b} = v - \frac{2}{3}e_H - \frac{1}{3}e_N - \frac{8}{18}e_H - \frac{1}{18}e_N - \frac{5}{9}(e_N - e_L) \tag{72}$$

Social welfare for scenario 1^b is obtained by summing equations (66) and (72), where firms revenues and the payment of the goods' prices cancel out. As in scenario 1^a, social welfare is increasing in consumers' intrinsic valuation for the goods v and decreasing in the goods' pollution profiles and the firms' costs.

$$SW_{1^b} = v - \frac{2}{3}e_H - \frac{1}{3}e_N - \frac{8}{18}e_H - \frac{1}{18}e_N - C_N - C_H \tag{73}$$

$$SW_{1^b} = v - \frac{20}{18}e_H - \frac{7}{18}e_N - C_N - C_H \tag{74}$$

We are now in a position to examine under which conditions greenwashing is a profitable strategy for the U firm when it is assigned a carbon intensive good. By misleading consumers and selling a carbon intensive good at the price of a low carbon good, the U firm is able to double its market share, from $\frac{1}{3}$ to $\frac{2}{3}$, leading to an equivalent decrease in the K firm's market share from $\frac{2}{3}$ to $\frac{1}{3}$, without any change in the costs incurred by each firm. However, the effect of greenwashing on the prices charged by each firm is ambiguous, as demonstrated by inequalities (51) and (53). Greenwashing may result in a positive effect on one or both of the goods' prices, depending on parameter values. For the U firm, the overall difference in profits is captured by:

$$\Delta\pi_{1,U} = \left(\frac{4}{9}(e_N - e_L) - C_H\right) - \left(\frac{1}{9}(e_H - e_N) - C_H\right) = \frac{1}{9}\left(4(e_N - e_L) - (e_H - e_N)\right) \tag{75}$$

Greenwashing will lead to an increase in the U firm's profits if $\Delta\pi_{1,U} > 0$, which can be rearranged as follows:

$$4(e_N - e_L) > (e_H - e_N) \tag{76}$$

Inequality (94) indicates that greenwashing will be a profitable strategy for the U firm if the difference between e_N and e_L is at least greater than one quarter of the difference between e_H and e_N. This means that greenwashing may be a profitable strategy for small degrees of differentiation of e_N and e_L relative to the differentiation between e_H and e_N.[55] Given that greenwashing is the phenomenon of interest for this thesis, the focus will be on the cases where deceptive marketing is a profitable strategy for the U firm.[56] Inequality (76) will therefore be assumed to be true.

5.1.2 Second scenario – U firm assigned the low carbon good (probability $(1 - \phi)$)

In the second scenario, which is denoted by the subscript 2, the U firm has to decide whether to truthfully advertise its good as low carbon or remain silent, in which case consumers will assume

[55] For example, inequality (94) would hold for parameter values $e_i = \{1; 3; 10\}$.
[56] This approach draws from Hamilton and Zilberman (2006), who also restrict their attention to the case of interest.

it is supplying a carbon intensive good. The scenario where the U firm truthfully advertises its low carbon type is highly similar to scenario 1^a, with one important nuance: the U firm is now supplying the higher quality good, whereas the K firm is supplying the lower quality good. The results obtained in scenario 1^a still hold, with the K firm being substituted for the U firm (and vice-versa), the low carbon good L replacing the intermediate carbon good N, and the intermediate carbon good N replacing the carbon intensive good H. Prices, quantities, firm profits, and producer surplus are given by equations (77) to (86), which are simply adapted from the corresponding equations for scenario 1^a.

$$p_L = \frac{2}{3}(e_N - e_L) \tag{77}$$

$$p_N = \frac{1}{3}(e_N - e_L) \tag{78}$$

$$q_U = \frac{2}{3} \tag{79}$$

$$q_K = \frac{1}{3} \tag{80}$$

$$\pi_{2^a,U} = \frac{4}{9}(e_N - e_L) - C_L \tag{81}$$

$$\pi_{2^a,K} = \frac{1}{9}(e_N - e_L) - C_N \tag{82}$$

$$PS_{2^a} = \pi_{2^a,K} + \pi_{2^a,U} = \frac{5}{9}(e_N - e_L) - C_L - C_N \tag{83}$$

$$Z_{2^a} = \frac{2}{3}e_L + \frac{1}{3}e_N \tag{84}$$

$$CS_{2^a} = v - \frac{2}{3}e_L - \frac{1}{3}e_N - \frac{1}{18}e_N - \frac{8}{18}e_L - \frac{5}{9}(e_N - e_L) \tag{85}$$

$$SW_{2^a} = v - \frac{20}{18}e_L - \frac{7}{18}e_N - C_L - C_N \tag{86}$$

Theoretically, the U firm could also remain silent, which would misleadingly signal that it is supplying a carbon intensive good to consumers. In this case, the U firm would refrain from disclosing its higher quality type to pass of as supplying lower quality products. Given the U firm's silence, consumers would assume that it is supplying a carbon intensive good. Solving the model would yield similar results as in scenario 1^a, the only difference being that the U firm

would incur the higher costs of supplying a low carbon good. The optimal prices of each good, the location of the indifferent consumer, and the demand addressed by each firm would be the same as in the scenario 1^a. However, this case can only occur if inequality (76) does not hold, as formally shown in Appendix B. As such, it may never be that green-hushing and greenwashing are both a profitable strategy for the same parameter values. Given our assumption that greenwashing will take place, only scenario 2^a will be relevant for our purposes.[57].

5.1.3 Combining the scenarios to evaluate expected social welfare

In the absence of law enforcement and assuming that greenwashing is a profitable strategy for the U firm, expected social welfare can be obtained by combining equations 74 and 86.

$$E[SW] = \phi\left(v - \frac{20}{18}e_H - \frac{7}{18}e_N - C_N - C_H\right) + (1-\phi)\left(v - \frac{20}{18}e_L - \frac{7}{18}e_N - C_L - C_N\right) \quad (87)$$

Equation (87) shows that truthful advertising by the U firm takes place with probability $(1-\phi)$, and that greenwashing takes place with probability ϕ. As such, greenwashing will only impact social welfare with probability ϕ in the absence of law enforcement. The change in social welfare resulting from greenwashing is given by comparing social welfare when the U firm tells the truth about its type (1^a) with social welfare when it pretends to be supplying a low carbon good (1^b). This change is captured by the following equation, where $\beta = 0$ given the assumption that no verification takes place[58]:

$$\Delta SW = \phi\left(SW_{1^b} - SW_{1^a}\right) = \phi\left(\left(CS_{1^b} - CS_{1^a}\right) + \left(PS_{1^b} - PS_{1^a}\right)\right) \quad (88)$$

The first component of equation (88) is the change in consumer surplus. Consumer surplus is affected by greenwashing through three channels. First, greenwashing results in a net increase in aggregate pollution, $\Delta Z_1 = \frac{1}{3}(e_H - e_N)$, compared to the case where the U firm reveals its true type, which harms consumers through indirect pollution costs. Second, there is a change in the type of goods purchased by the one third of consumers with the weakest degree of pollution aversion, who (unintentionally) switch from purchasing a carbon intensive good to purchasing an

[57] As it stands now, the CA's deceptive marketing framework does not apply to cases of green-hushing. As explained in section 3.3, the CA only regulates representations made to the public, and does not apply to cases where a firm refrains from disclosing any material information about its goods' characteristics. As such, in the following sections, the focus will only be on greenwashing, i.e., on cases where inequality (94) holds, and inequality (103) does not. For similar reasons, Hattori and Higashida (2014) also assume a certain parameter value to exclude from their analysis the cases where consumers misperceive that goods have a lower quality than reality. Along the same lines, Rhodes and Wilson (2018, p.354) introduce a restriction in their model such that a firm with a high-quality type will always make a truthful claim to focus on deceptive marketing by the low-quality firm.

[58] Note that greenwashing does not impact social welfare in scenario 2, which therefore does not appear at (88).

intermediate carbon good. These consumers face lower direct pollution costs, which decrease (in the aggregate) from $\frac{1}{18}e_H$ to $\frac{1}{18}e_N$.[59] However, as the effect of greenwashing on prices is ambiguous (see inequalities (51) and (53)), the overall effect of greenwashing on these consumers' welfare is ambiguous. Third, there is a change in the type of goods purchased by the two thirds of consumers with the highest degree of pollution aversion, who (unintentionally) switch from purchasing an intermediate carbon good towards a carbon intensive good. These consumers face higher direct pollution costs, which increase (in the aggregate) from $\frac{8}{18}e_N$ to $\frac{8}{18}e_H$. Again, given the ambiguous impact of greenwashing on prices, greenwashing has an ambiguous overall effect on these consumers.

The aggregate effect of greenwashing on consumer welfare is captured equation (89) below, which can be simplified into equation (90). This effect is ambiguous, as the first and the second terms of equation (90) have inverse signs.

$$\Delta CS_1 = -\frac{1}{3}(e_H - e_N) - \frac{7}{18}(e_H - e_N) + \frac{5}{9}\big((e_N - e_L) - (e_H - e_N)\big) \tag{89}$$

$$\Delta CS_1 = -\frac{23}{18}(e_H - e_N) + \frac{5}{9}(e_N - e_L) \tag{90}$$

The second component of equation (90) is the change in producer surplus for the U firm and the K firm. The effect on the U firm's profits has already been expressed at equation (75). For the K firm, the overall difference in profits is captured by the following equation:

$$\Delta\pi_{1,K} = \left(\frac{1}{9}(e_N - e_L) - C_N\right) - \left(\frac{4}{9}(e_H - e_N) - C_N\right) = \frac{1}{9}\big((e_N - e_L) - 4(e_H - e_N)\big) \tag{91}$$

Greenwashing will lead to an increase in the K firm's profits if $\Delta\pi_{1,K} > 0$, which can be rearranged as follows using (91):

$$e_N - e_L > 4(e_H - e_N) \tag{92}$$

Inequality (92) indicates that greenwashing by the U firm will have positive impacts on the K firm if the difference between e_N and e_L is at least greater than four times the difference between e_H

[59] This corresponds to the aggregate effect for all consumers of that category. Given that there are more consumers who wish to purchase higher quality goods that lower quality in equilibrium, for a same marginal effect on consumers, the size of the effect on consumers of the one third will be smaller than for the two other thirds.

and e_N.[60] The overall effect of greenwashing on producer surplus is identified by combining equations (75) and (91).

$$\Delta PS_1 = \frac{5}{9}\big((e_N - e_L) - (e_H - e_N)\big) \tag{93}$$

It is now possible to evaluate the effect of greenwashing on social welfare in the absence of law enforcement. Recall that the respective effects of the price changes on producer and consumer surplus cancel out, such that they do not impact social welfare. As a result, the net effect of greenwashing on social welfare is negative in the scenario 1. This is entirely driven by the increase in the direct and indirect pollution costs that harm consumers. As shown by inequality (95), the greater the degree of differentiation between the intermediate carbon good and the carbon intensive good, the greater the social welfare loss.

$$\Delta SW = \phi\left(\left(v - \frac{7}{18}e_N - \frac{20}{18}e_H - C_N - C_H\right) - \left(v - \frac{20}{18}e_N - \frac{7}{18}e_H - C_N - C_H\right)\right) \tag{94}$$

$$\Delta SW = \phi\left(\frac{13}{18}(e_N - e_H)\right) < 0 \tag{95}$$

In summary, when it takes place, greenwashing distorts consumers' decisions, leading to an increase in the consumption of the carbon intensive good relative to the intermediate carbon good. As shown by inequality (95), the overall effect of greenwashing on social welfare is negative in the model, as greenwashing results in social costs by inducing an increase in direct and indirect pollution that harm consumers.[61] This is a key characteristic of the model, as it shows that greenwashing impacts social welfare through an additional, distinctive channel. While direct costs would be observable for other types of quality differentiation, indirect costs are unique to deceptive marketing cases involving impure public goods.

5.2 Introducing law enforcement in the model

We now introduce the possibility that the U firm be verified with probability β when it claims to be supplying a low carbon good. If this claim is found to be false (like in scenario 1^a), the U firm has to pay a fine b and enforcement costs $k(\beta)$. Alternatively, if the claim is found to be true (like in scenario 2^a), no fines are imposed, and enforcement costs are borne by society. This section examines how law enforcement impacts the U firm's decisions and social welfare.

[60] This means that for some cases, greenwashing will be profit-enhancing for both firms (e.g., $e_i = \{1; 10; 11\}$), but for other cases only the U firm will benefit (e.g., $e_i = \{1; 3; 10\}$).
[61] In Uchida (2007), an increase in the quantity of pollution was also associated with an unambiguous decrease in social welfare, as aggregate pollution entered in each consumer's utility function.

5.2.1 Impact of introducing law enforcement on the U firm's strategy

When it is assigned the low carbon good (the scenario 2), the U firm will always tell the truth, and verification by the regulator will never uncover deceptive claims. As such, prices, quantities, profits, consumer welfare and producer welfare will not be altered by the introduction of law enforcement in scenario 2, irrespective of the degree of regulatory stringency. Social welfare in the scenario 2 will be impacted by the introduction of socially costly enforcement costs (with will be incurred with probability β), but these will be borne by society.

When it is assigned the carbon intensive good (the scenario 1), the U firm will take into consideration the probability that it gets verified and the value of the fine and enforcement costs it will have to bear if it gets caught (Baksi and Bose, 2007). In other words, the U firm will decide whether to deceive consumers given the expected costs of verification and the consumers' purchasing decisions if the deception is revealed (Darby and Karni, 1973). As assumed at section 5.1.1, greenwashing is a profitable strategy in the absence of law enforcement, but that conclusion may not hold otherwise. For sufficient values of β, $k(\beta)$ and b, the U firm may be deterred by the threat of law enforcement and decide to remain silent, in which case it will make profits $\pi_{1^a,U}$ with certainty. The U firm will be indifferent between greenwashing and remaining silent if the two strategies lead to the same (expected) profits, taking β, b and $k(\beta)$ as given. The subscript x is added to denote the value of β at the indifference point.

$$\pi_{1^a,U} = \beta_x\left(\pi_{1^a,U} - k(\beta_x) - b\right) + (1-\beta_x)\pi_{1^b,U} \tag{96}$$

Equation (96) can be rearranged to show that the U firm will be indifferent if the expected gain from greenwashing is equal to the expected payment of the fine and enforcement costs.[62]

$$(1-\beta_x)\left(\pi_{1^a,U} - \pi_{1^b,U}\right) = \beta_x(-k(\beta_x) - b) \tag{97}$$

If the right-hand side of equation (97) is greater than the left-hand side, the deterrent effect of expected verification costs will dominate the expected gain in profits from greenwashing, and the U firm will remain silent. In this case, verification will not take place in the scenario 1, as the U firm will not advertise its type, and the U firm's profits will be equal to $\pi_{1^a,U}$. However, if the right-hand side of equation (97) is smaller than the left-hand side, the threat of law enforcement will be insufficient to deter the U firm from greenwashing in the scenario 1. Two things may happen in this case. First, verification may occur with probability $\beta < \beta_x$: the U firm's deceptive marketing will be revealed, consumers will update their beliefs, and the U firm will have to pay a

[62] Note that $\pi_{1^a,U} - \pi_{1^b,U} < 0$, as the U firm's profits under greenwashing are greater than when it remains silent.

fine and the enforcement costs. If verification occurs, solving the model for scenario 1 yields the exact same results as in the scenario 1^a shown at 5.1.1, with the difference that the U firm also has to pay a fine (socially neutral) and the enforcement costs (socially costly). This is analogous to an increase in the U firm's fixed costs by $b + k(\beta)$. Second, if verification does not occur (with probability $(1-\beta) > (1-\beta_x)$), consumers will make their consumption decisions based on the deceptive signal sent by the U firm, which results in a difference between real and perceived utility from purchasing goods from the U firm. In the absence of verification, the U firm is able to charge the price of the low carbon good without incurring the higher fixed costs associated with their production. If verification does not occur, solving the model for scenario 1 yields the same results as in the scenario 1^b shown at 5.1.1.

A marginal increase in the probability of enforcement will therefore have different effects on the U firm depending on whether it pushes it beyond the indifference point formulated at equation (97) or not. To illustrate that point, assume a marginal increase in the probability of verification β such that $\beta_x > \beta > 0$, and such that greenwashing remains the most profitable strategy. If the U firm maintains its strategy to greenwash under these conditions, its expected profits become:

$$E[\pi_{1,U}] = \beta(\pi_{1^a,U} - k(\beta) - b) + (1-\beta)\pi_{1^b,U} \tag{98}$$

As long as the indifference point is not exceeded, a marginal increase in the probability of enforcement β will not change the U firm's decision to greenwash, but it will reduce its expected profits. Greenwashing will be uncovered with probability β, but some greenwashing will still take place with probability $(1-\beta)$. Equation (99) shows that the impact of a marginal increase in β on the U firm's expected profits is negative (recall that $\pi_{1^a,U} - \pi_{1^b,U} < 0$).

$$\frac{\partial E[\pi_{1,U}]}{\partial \beta} = (\pi_{1^a,U} - \pi_{1^b,U}) - k(\beta) - \beta k'(\beta) - b < 0 \tag{99}$$

As long as β is such that $\beta_x > \beta > 0$, increasing the verification probability impacts the U firm's profits through three channels: first, it decreases the probability that the U firm generates the higher profits associated with greenwashing; second, it increases the probability that the U firm pays the fine b and the enforcement costs $k(\beta)$; third, it increases the enforcement costs borne by the U firm when it gets verified.

Then, assume a marginal increase in β such that the indifference point is exceeded. At the indifference point, a marginal increase in the regulatory stringency will make the U firm shift from greenwashing to silence, greenwashing will stop entirely, and verification will stop taking

place in the scenario 1. At this indifference point, this shift will be welfare neutral for the U firm (this is the definition of indifference). Moreover, beyond the indifference point, an increase in the regulatory stringency will have no impact on the U firm, as the U firm will not be making claims in the scenario 1.

$$\frac{\partial \pi_{1^a,U}}{\partial \beta} = 0 \tag{100}$$

In sum, a marginal increase in the verification probability will always have a negative impact of the U firm's profits until the indifference point is reached. Beyond the indifference point, increasing the verification probability will have no impact on the U firm's profits.

5.2.2 Impact of introducing law enforcement on expected social welfare

To maximize expected social welfare, the law enforcement agency sets the probability β that it verifies a claim. As previously shown, greenwashing has negative effects on social welfare, and it may therefore be welfare improving to put an end to this behavior through law enforcement. However, law enforcement is socially costly, as verification involves enforcement costs that increase with the probability of verification β. The introduction of law enforcement will have different effects on social welfare depending on whether it pushes the U firm beyond the indifference point formulated at equation (97) or not. To illustrate that point, assume that we progressively increase in the probability of verification, starting from $\beta = 0$ up to $\beta = 1$. For values of β such that $\beta_x > \beta \geq 0$, greenwashing is still a dominant strategy, and social welfare will be given by the following equation, which is expanded at equation (102).[63]

$$E[SW] = \phi\left(\beta\left(SW_{1^a} - k(\beta)\right) + (1-\beta)\left(SW_{1^b}\right)\right) + (1-\phi)\left(SW_{2^a} - \beta k(\beta)\right) \tag{101}$$

$$\begin{aligned} E[SW] = \phi\Bigg(&\beta\left(v - \frac{20}{18}e_N - \frac{7}{18}e_H - C_N - C_H - k(\beta)\right) + (1-\beta)\left(v - \frac{20}{18}e_H - \frac{7}{18}e_N - C_N - C_H\right)\Bigg) \\ &+ (1-\phi)\left(v - \frac{20}{18}e_L - \frac{7}{18}e_N - C_L - C_N - \beta k(\beta)\right) \end{aligned} \tag{102}$$

Equation (102) can be rearranged as follows:

$$E[SW] = v - C_N - \beta k(\beta) + \phi\left(\frac{13}{18}\beta(e_H - e_N) - \frac{20}{18}e_H - \frac{7}{18}e_N - C_H\right) + (1-\phi)\left(-\frac{20}{18}e_L - \frac{7}{18}e_N - C_L\right) \tag{103}$$

[63] Consumer surplus and the K firm's profits remain unchanged compared to scenario 1^a, as the prices and quantities supplied by each firm do not depend on the U firm's costs. As the payment of the fines to the regulator is simply a transfer from the U firm to society, its effect on social welfare is neutral. However, the enforcement costs remain, as they result in a producer surplus loss, which translates into an uncompensated social cost.

Equations (101) and (103) can be used to evaluate the impact of a marginal increase in the probability of verification on expected social welfare for values of β where $\beta \geq 0$ and $\beta_x > \beta + d\beta$ such that greenwashing is still a dominant strategy for the U firm (i.e., prior to the U firm's indifference point).

$$\frac{\partial E[SW]}{\partial \beta} = \phi(SW_{1^a} - SW_{1^b}) - k(\beta) - \beta k'(\beta) = \phi\left(\frac{13}{18}(e_H - e_N)\right) - \beta k'(\beta) - k(\beta) \tag{104}$$

Equation (104) shows that such a marginal increase in the value of β prior to the indifference point has two opposite effects. First, it increases social welfare by increasing the probability that socially harmful greenwashing cases be uncovered. This effect will be constant for any marginal increase in verification probability, irrespective of the value of β. Second, it decreases social welfare by increasing the socially harmful enforcement costs borne by firms and society. The size of this effect will increase as the value of β increases, given that enforcement costs increase at a marginally increasing rate with β. Assuming that equation (104) is positive at $\beta = 0$, the overall effect of introducing a marginal degree of law enforcement will be welfare enhancing. Then, as β increases further, as long as the indifference point is not reached, increasing the value of β at the margin will keep generating positive changes in social welfare as long as equation (104) is positive, that is, the (constant) marginal benefits of increasing β are greater than the (increasing) marginal costs. Furthermore, as the partial derivative of equation (104) is negative (see equation (105)), the marginal social benefits of increasing β will eventually become equal to the marginal social costs (see equation (106)) – a point denoted by β_y – unless the indifference point is reached before that.[64]

$$\frac{\partial_2 E[SW]}{\partial \beta} = -2k'(\beta_y) - \beta_y k''(\beta_y) < 0 \tag{105}$$

$$\phi\left(\frac{13}{18}(e_H - e_N)\right) = \beta_y k'(\beta_y) + k(\beta_y) \tag{106}$$

However, eventually a marginal increase in the probability of verification will push the U firm to the indifference point captured by equation (97), i.e., $\beta + d\beta = \beta_x$. At the indifference point, a marginal increase in the regulatory stringency will make the U firm shift from greenwashing to silence, greenwashing will stop entirely, and verification will stop taking place in the scenario 1. In this case, expected social welfare will be given by:

[64] Note that if equation (104) is negative for a marginal increase in β at $\beta = 0$, then it will be optimal to set the probability of verification to zero before the indifference point is reached.

$$E[SW] = \phi\left(v - \frac{20}{18}e_N - \frac{7}{18}e_H - C_N - C_H\right) + (1-\phi)\left(v - \frac{20}{18}e_L - \frac{7}{18}e_N - C_L - C_N - \beta_x k(\beta_x)\right) \quad (107)$$

The marginal gain in social welfare from moving from one state to the other is obtained by calculating the difference between social welfare at the margins of the indifference point.

$$\Delta E[SW] = \phi\left((1-\beta_x)\frac{13}{18}(e_H - e_N) + \beta_x k(\beta_x)\right) \quad (108)$$

Equation (84) shows that there are two sources of social welfare gains arising from a marginal increase in the probability of verification at the indifference point. First, the threat of enforcement is now sufficient to deter all cases of greenwashing, which stops being a profitable strategy for the U firm. This puts an end to the social welfare loss arising from the cases of greenwashing that were not uncovered by the regulator (i.e., the greenwashing cases that were not verified with probability $(1-\beta_x)$). Second, verification stops taking place in the first scenario as the U firm remains silent, such that there is a reduction in the socially costly enforcement costs by $\phi\beta_x k(\beta_x)$. Note that these welfare effects are specific to scenario 1, as verification continues to take place in scenario 2 as before. However, this will also result in a marginal social welfare cost given that the enforcement costs will be marginally higher than before.[65].

Beyond the indifference point (i.e., where $\beta > \beta_x$), the impact of a marginal increase in the probability of verification on expected social welfare is negative, as it increases the enforcements costs borne by society in the scenario 2 without yielding any social benefits.

$$\frac{\partial E[SW]}{\partial \beta} = (1-\phi)\big(-k(b)\big) < 0 \quad (109)$$

5.3 Finding the socially optimal verification probability

The law enforcement agency may act to limit greenwashing by setting $\beta > 0$, taking into consideration the value of the fines, enforcement costs and the expected behavior of firms and consumers. When setting the socially optimal verification probability at the beginning of the game, the law enforcement agency aims at maximizing expected social welfare, considering the social welfare benefits and costs of law enforcement.

$$\max_{\beta} \phi SW_1 + (1-\phi)SW_2 \quad (110)$$

$$\text{where } \beta \geq 0 \quad (111)$$

[65] In other words, the probability of enforcement will be lower, but enforcement itself will be more costly, as the marginal enforcement costs increase with a marginal increase in β.

$$\text{and } SW_1 = \begin{cases} SW_{1^a} \text{ if } \beta > \beta_x \\ \beta\left(SW_{1^a} - k(\beta)\right) + (1-\beta)\left(SW_{1^b}\right) \text{ if } \beta < \beta_x \end{cases} \quad (112)$$

As shown at equation (104), before the U firm's indifference point is reached, an increase in the enforcement probability will increase the probability that greenwashing is uncovered in scenario 1 (a social benefit) while also increasing the enforcement costs in both scenarios (a social cost). Increasing the enforcement probability will be welfare enhancing as long as the benefits of increasing the probability of uncovering greenwashing at the margin are greater than the corresponding social costs.

If $\beta_y > \beta_x$, increases beyond β_x will only lead to a decrease in social welfare, and therefore it will not be socially optimal to set $\beta = \beta_y$. In this case, increasing the enforcement probability will be welfare enhancing as long as the benefits of increasing the probability of uncovering greenwashing at the margin are greater than the corresponding social costs, until β_x is reached. Then, a marginal increase in β will lead to a welfare-enhancing shift in the U firm's behavior, after which further increases in β will be detrimental to social welfare. In this case, the socially optimal verification probability will be to set $\beta = \beta_x$. Under this policy, no greenwashing will take place, as the threat of enforcement will be sufficient to convince the U firm to remain silent.

However, if $\beta_y < \beta_x$, there will be a local maximum at β_y, after which further increases in β will be detrimental to social welfare until β_x is reached. Then, at β_x, a marginal increase in β will generate a discrete jump in social welfare, which reaches a second local maximum, after which further increases in β will be detrimental to social welfare. To determine the socially optimal verification probability in this case, we must compare which of the two local maxima involves the highest level of social welfare. This requires calculating the difference between equation (107) with $\beta = \beta_x$ and equation (103) with $\beta = \beta_y$, the result of which is represented by expression (113) below.

$$\Delta E[SW] = \phi\left(\frac{13}{18}(1-\beta_y)(e_H - e_N)\right) + \left(\beta_y k(\beta_y) - \beta_x k(\beta_x)\right) + \phi\beta_x k(\beta_x) \quad (113)$$

Equation (113) consists of three components. First, it captures the expected social welfare gain $\phi\frac{13}{18}(1-\beta_y)(e_H - e_N)$ associated with the additional cases of greenwashing uncovered in the first scenario when the threat of enforcement prevents greenwashing. When $\beta = \beta_y$, greenwashing will remain hidden with probability $(1-\beta_y)$. A shift towards β_x means that these hidden cases stop taking place in the scenario 1, reducing to zero the expected direct and indirect pollution costs caused by greenwashing. Second, it captures the increase in the enforcement costs

$\left(\beta_y k(\beta_y) - \beta_x k(\beta_x)\right)$ caused by the increase in the value of β (recall that $k'(\beta) > 0$). However, this increase is offset by the third component, which reflects the fact that enforcement costs stop being incurred in the scenario 2. As the marginal enforcement costs increase with a marginal increase in β, enforcement itself will be more costly, but it will now only take place in the scenario 2, with probability $(1 - \phi)$. When the first and the third effects dominate the second one, equation (113) will be positive, and the socially optimal policy will be to set the probability of enforcement at a marginally higher level than the indifference point. In this case, expression (113) can be rewritten into inequality (114).

$$\phi\left(\frac{13}{18}(1 - \beta_y)(e_H - e_N)\right) + \phi\beta_x k(\beta_x) > \beta_x k(\beta_x) \qquad (114)$$

When inequality (114) holds, the socially optimal verification probability will be to set $\beta = \beta_x$. Under this policy, no greenwashing will take place, as the threat of enforcement will be sufficient to convince the U firm to remain silent. If the reverse of inequality (114) holds, however, then it will be socially optimal to set $\beta = \beta_y$ and to allow some greenwashing to take place, as the higher expected enforcement costs of setting $\beta = \beta_x$ will exceed the benefits of preventing greenwashing entirely.

5.4 Distinguishing greenwashing from other deceptive marketing cases

The existence of indirect pollution costs means that, all else equal, the social costs of deceptive marketing will be higher for cases involving impure public goods than for cases involving purely private, vertically differentiated goods. Absent indirect pollution costs, the coefficient $\frac{13}{18}$ would be replaced by the coefficient $\frac{7}{18}$ in equations (106), (108) and (114).[66] In this case, the value β_y for which the marginal benefit of increasing the verification probability is equal to the marginal cost would be lower than at equation (106), as the constant marginal benefit of increasing β would decrease by $\frac{1}{3}$. Similarly, the gain in expected social welfare from increasing the marginal verification probability at the indifference point would be lower than at equations (108) and (114), as preventing greenwashing entirely would not impact social welfare through a reduction of aggregate pollution levels.

[66] This reflects the fact that $\Delta Z_1 = \frac{1}{3}(e_H - e_N)$.

This means that there may be certain degrees of law enforcement that would not be optimal but for the existence of pollution, and that there may be cases where the consideration of indirect pollution costs would impact the selection of the optimal verification probability from β_x to β_x.

In a second-best context, the regulator's enforcement strategy should therefore incorporate the effects of deceptive marketing on the production of environmental externalities when they arise. This is a situation where correcting one market failure, namely imperfect information, can be jointly ameliorating by also providing for the correction of a second market failure, here external environmental costs (Bennear and Stavins, 2007).

Canada's current legal framework under the CA does not reflect these considerations. While the statute may apply to greenwashing, the CA does not provide for a greater probability of verification for cases involving deceptive environmental claims. To address the situation, the CA could be amended to mandate an increase its monitoring of environmental claims. There are reasons to believe that the CCB does not verify the truthfulness of environmental claims more frequently than for other types of marketing claims. For instance, greenwashing is not among the agency's enforcement priorities, as the CCB's "Strategic Vision" for 2020-2024 and its two most recent "Annual Plans" for 2021-2022 and 2022-2023 do not refer to the monitoring of environmental and climate-related corporate claims (Competition Bureau, 2020a, 2020b, 2022c; Beaulieu, 2022, p.33). Similarly, the CCB does not have dedicated teams responsible for the monitoring of environmental claims (Beaulieu, 2022, p.65).[67] A greater focus on environmental claims could be achieved by amending the CA's purpose clause to refer to the importance of incorporating environmental considerations when enforcing the statute. While these changes would not create new powers for the CCB, they would require that the agency's existing capabilities be deployed in alignment with this new set of priorities. In November 2022, the Government of Canada launched a public consultation on the future of competition policy in Canada (Government of Canada, 2022g). This consultation takes place in the context of a comprehensive review of the CA and could lead to substantial amendments to the statute's provisions. This process provides a unique opportunity to implement the policy proposal discussed above.

[67] A few years ago, the CCB created the Digital Enforcement and Intelligence Branch, a team of experts focused on enforcing the CA in the digital economy (Beaulieu, 2022, p.65). A similar expert group does not exist in respect of environmental claims.

6. Extensions

This section discusses the impacts of introducing additional or alternative assumptions.[68]

6.1 Using different social welfare functions

As indicated in section 3.3 and in Appendix A, two social welfare functions have been recognized by the SCC in the context of the CA: the total surplus standard, which was relied upon in the sections above, and the balancing weight standard, which attributes a greater welfare weight to consumers than firms.[69] The spirit of this standard can be found in paragraph 74.1(5) of the CA, which sets the factors that can be used to determine the amounts of administrative monetary penalties imposed for deceptive marketing practices. Some of these could be interpreted as reflecting redistributive concerns, including the consideration of "the vulnerability of the class of persons likely to be adversely affected by the conduct" (par. 74.1(5)(c)) and "the financial position of the person against whom the order is made" (par. 74.1(5)(h)). As the SCC did not specify the exact welfare weights to be given to consumers and firms respectively when using the balancing weight standard, it is assumed that the balancing weight social welfare function follows equation (115), where α captures the welfare weight of consumers, and γ captures the welfare weight of firms, where $\alpha + \gamma = 2$ and $\alpha > \gamma > 0$.[70] The restrictions on the sign and the ordering of the parameters respectively ensure that the welfare of consumers and firms is always given at least some positive weight, and that that the welfare weight of consumers is always greater than the welfare weight of firms.

$$E[SW] = \phi(\alpha CS_1 + \gamma PS_1 - ES_1) + (1-\phi)(\alpha CS_2 + \gamma PS_2 - ES_2) \tag{115}$$

In the absence of law enforcement, scenarios 1^a, 1^b and 2^a respectively, yield the following results:

$$SW_{1^a} = \alpha\left(v - \frac{20}{18}e_N - \frac{7}{18}e_H\right) - \gamma(C_N + C_H) - (\alpha - \gamma)\left(\frac{5}{9}(e_H - e_N)\right) \tag{116}$$

$$SW_{1^b} = \alpha\left(v - \frac{20}{18}e_H - \frac{7}{18}e_N\right) - \gamma(C_N + C_H) - (\alpha - \gamma)\left(\frac{5}{9}(e_N - e_L)\right) \tag{117}$$

[68] Note that for all the extensions examined in this section, it is assumed that parameter values are such that greenwashing is taking place, and that green-hushing is not a profitable strategy. Moreover, each extension is examined as an iteration of the basic model, separately from the other extensions.

[69] This standard is different than having a narrowly-focussed law enforcement agency, as introduced by Baumann and Rasch (2020). In the latter case, firm profits are not attributed any welfare weight when setting the optimal policy rule.

[70] A similar social welfare function is examined by Glaeser and Ujhelyi (2005, section 3.2). One could assume that under the total surplus standard, parameters α and γ were each given an equal value of 1.

$$SW_{2^a} = \alpha\left(v - \frac{20}{18}e_L - \frac{7}{18}e_N\right) - \gamma(C_L + C_N) - (\alpha - \gamma)\left(\frac{5}{9}(e_N - e_L)\right) \quad (118)$$

A key difference with the results obtained under the total welfare standard is that the prices paid by consumers and the revenues generated by firms do not cancel out anymore. This component appears in the last term of each equation and increases with the difference in the welfare weights α and γ. This term will always have a negative effect on social welfare, as $\alpha > \gamma$, $e_H > e_N$ and $e_N > e_L$. Another difference is that the fixed costs borne by the firms are given a discounted social welfare weight of $\gamma < 1$, such that their impact on social welfare is smaller than under the total welfare standard. Finally, the welfare weight awarded for the value for the goods v and the direct and indirect pollution costs are given an inflated welfare weight of $\alpha > 1$.

We can now introduce law enforcement in the model using these revised equations as a baseline. Assume a marginal increase in the probability of verification such that $\beta > 0$, and that the deterrent effect of expected verification costs does not dominate the expected gain in profits from greenwashing. In this case, expected social welfare is given by equation (119), where the effect of the payment of the enforcement costs by the U firm with probability $\phi\beta$ is discounted given the lower welfare weight attributed to firms under the balancing weight standard.[71] This equation also reflects the fact that the payment of the fine b by the U firm to society will not be welfare neutral anymore, as its payment by the U firm will be discounted.

$$E[SW] = \phi\left(\beta(SW_{1^a} - \gamma k(\beta) + (1-\gamma)b) + (1-\beta)\left(SW_{1^b}\right)\right) + (1-\phi)\left(SW_{2^a} - \beta k(\beta)\right) \quad (119)$$

Under this new welfare standard, β_y will be achieved when[72]:

$$\phi\left(SW_{1^a} - SW_{1^b}\right) = \gamma k(\beta) - \gamma\beta k'(\beta) + (1-\gamma)b \quad (120)$$

where the values of SW_{1^a} and SW_{1^b} are given by equations (117) and (118). The left-hand side of equation (118) is given by:

$$\phi\Delta SW_1 = \phi\left(\alpha\frac{13}{18}(e_H - e_N) + \frac{5}{9}(\alpha - \gamma)\left((e_H - e_N) - (e_N - e_L)\right)\right) \quad (121)$$

The first term of this expression is the same as obtained at equation (107), multiplied by $\alpha > 1$. Under the balancing weight standard, the effects of indirect and direct pollution costs are multiplied by a factor α, which corresponds to the welfare weight of consumers. These costs are given a greater welfare weight than under the total surplus standard, as consumer surplus has a

[71] No discount is applied when enforcement costs are borne by society (scenario 2) as it has a welfare weight of 1.
[72] Note that this is the same equation as (106), but with different values for SW_{1^a} and SW_{1^b}.

higher relative weight than before. A marginal increase in β will therefore reduce "heavier" social costs than under the total welfare standard. The second term captures the fact that the effect of the change in prices is not welfare neutral anymore. The sign of this component will depend on the relative welfare weights of consumers and firms, and on the difference between the degrees of differentiation of the goods. If greenwashing results in a positive change in producer surplus, there will be an equivalent negative change in consumer surplus. Under the balancing weight standard, the loss of consumer surplus will be attributed a greater weight than the gain in producer surplus.[73] For instance, if the price effect is positive for firms and negative for consumers, there will be an overall negative price effect on social welfare.

The balancing weight social welfare function also impacts the welfare costs of law enforcement, as the payment of the enforcement costs and the fine by the U firm will now be discounted in the social welfare function. Indeed, when law enforcement takes place, enforcement costs $k(\beta)$ will be paid by the U firm with probability ϕ and by society with probability $(1-\phi)$. Under the balancing weight social welfare function, the payment of these costs by society is given an implied welfare weight of 1, compared to $\gamma < 1$ when they are incurred by the U firm. Furthermore, the payment of the fine b, which occurs with probability $\phi\beta$ and results in a transfer from the U firm to society, will also be welfare enhancing, as the U firm's profit loss will be given a lower weight $(\gamma < 1)$ than the corresponding social welfare gain (equal to 1). These considerations attenuate the social welfare costs of increasing law enforcement before the indifference point and will impact the selection of the socially optimal probability of enforcement.

A third welfare function could be considered to incorporate redistributive concerns across consumers, which were previously considered as having identical welfare weights irrespective of their degree of pollution aversion. So far, it has been assumed that θ_j only captures consumers' exogenous preferences for less polluting goods, without any further explanation about the origin of these heterogenous preferences. However, as argued by Tirole (1988, p.96) and reiterated by Motta (1993) and Baksi, Bose and Xiang (2017, footnote 13), θ_j could be construed as corresponding to the inverse of the marginal rate of substitution between income and quality. Under this interpretation, all consumers would have the same valuation for quality, but consumers

[73] The expressions $(e_H - e_N)$ and $(e_N - e_L)$ will both be positive, given the ordering of the pollution profiles. Similarly, $(\alpha - \gamma)$ will also be positive given that consumers are given a greater welfare weight than firms. However, the expression $((e_H - e_N) - (e_N - e_L))$ may be negative depending on the differences in the degrees of differentiation of the goods. If the degree of differentiation between the carbon intensive good and the intermediate good is greater (smaller) than the degree of differentiation between the intermediate good and the low carbon good, the expression will be negative (positive), and the sign of the effect will be negative (positive).

with a higher θ_j would have a higher income and a therefore a lower marginal utility of income. These consumers would have a greater willingness to trade quality (which they value as much as low-θ_j consumers) for income (which they value less than low-θ_j consumers) than their peers. Following Tirole (1988, p.96), consumers' utility function can be rewritten as follows:

$$U_{j,i} = v - e_i - \frac{p_i}{\theta_j} - Z \tag{122}$$

This alternative formulation does not impact the location of the indifferent consumer; as such, solving the model yields the same equilibrium prices and quantities as under the basic model in the absence of law enforcement. However, a redistributive welfare function could attribute a lower welfare weight to consumers with a higher income, which would impact the relative importance of greenwashing's welfare effects. When greenwashing occurs, the two thirds of wealthier consumers substitute an intermediate carbon good for a carbon intensive good, which increases the direct pollution costs they incur. On the other hand, the one third of poorer consumers substitute a carbon intensive good for an intermediate carbon good, which decreases their direct pollution costs. If the wealthier consumers are attributed a smaller welfare weight than poorer ones, then the overall effect of greenwashing on direct pollution costs would be lower under a redistributive social welfare function than under the total surplus standard. However, the effect of the change in prices would be ambiguous, as its sign is driven by the parameter values.

6.2 Introducing advertising costs and non-financial considerations for firms

In the basic setting, it has been assumed that marketing is costless. The introduction of adverting costs κ[74] would only impact the U firm, as the K firm never advertises its type, which is publicly known.[75] In that case, the U firm's indifference condition (previously stated at (96)) for the scenario 1 and the U firm's profit function for the scenario 2 respectively become:

$$\pi_{1^a,U} = \beta_x\left(\pi_{1^a,U} - k(\beta_x) - b\right) + (1-\beta_x)\pi_{1^b,U} - \kappa \tag{1223}$$

$$\pi_{2^a,U} = \frac{4}{9}(e_N - e_L) - C_L - \kappa \tag{124}$$

In both cases, the introduction of advertising costs is analogous to an increase in the U firm's fixed costs. As these fixed costs influence social welfare through producer surplus, advertising costs translate into a social welfare loss in the cases where the U firm advertises its type.

[74] It is assumed that despite the introduction of advertising costs, greenwashing is still more profitable than remaining silent in scenario 1 in the absence of law enforcement.
[75] One could justify this fact by assuming that the K firm's goods are certified by a third-party organization, which publicly discloses the K firm's type at zero costs.

Advertising costs could also influence the U firm's decision to greenwash, as it decreases the value β that would make the U firm indifferent between greenwashing and silence. Therefore, the introduction of advertising will decrease the value β_x required to prevent greenwashing entirely.

Furthermore, the basic setting assumed that firms only care about maximizing their profits. However, there may be a social component in the decision of the firm to mislead consumers or not, such as avoiding reputational concerns or hampering its relationship with its stakeholders. Allingham and Sandmo (1972) follow a similar reasoning in the context of a tax evasion model by introducing a social component in the decision of the taxpayer to make false income declarations.[76] Following Allingham and Sandmo (1972), variable $\zeta > 0$ is introduced to represent the negative reputational effects of being perceived as greenwashing. One could see these reputational effects as the future costs that the U firm will have to bear to convince consumers about the quality of its products in the future. This variable only appears in the U firm's profit function when greenwashing is detected, such that the introduction of ζ is analogous to increasing the amount of the fine b. The introduction of ζ does not increase the enforcement costs $k(\beta)$, but it decreases the regulatory stringency required to prevent greenwashing entirely by impacting the U firm's indifference condition, which becomes:

$$\pi_{1^a,U} = \beta_x\left(\pi_{1^a,U} - k(\beta_x) - b - \zeta\right) + (1-\beta_x)\pi_{1^b,U} - \kappa \tag{125}$$

Therefore, as for the introduction of advertising, the presence of non-financial considerations in the model will decrease the value β_x required to prevent greenwashing entirely.

6.3 Incorporating enforcement flaws

The initial assumption was that the verification process is flawless. However, it could be that certain verifications wrongfully lead the regulator to conclude that some false claims are true, decreasing the probability that the U firm gets sanctioned when it greenwashes. It is assumed that the probability of proper detection of breaches is given by $\omega \in [0,1]$.[77] Another way to interpret this parameter is to consider that $(1-\omega)$ is the probability of faulty verification of the breaches. When verification occurs but (mistakenly) fails to detect greenwashing, society must bear the

[76] For example, being found guilty of tax evasion can have negative effects on one's reputation, in addition to the negative effects of monetary penalties on income (Allingham and Sandmo, 1972).
[77] Enforcement flaws can only lead to a failure to detect a breach. As such, it cannot be that a true claim is mistakenly considered as a false claim by the law enforcement agency.

resulting enforcement costs. Assuming that greenwashing is a dominant strategy over telling the truth, the U firm's expected profits under flawed enforcement will be given by:

$$E[\pi_U] = \phi\left(\beta\left((\omega)\left(\pi_{1^{a},U} - b - k(b)\right) + (1-\omega)\pi_{1^{b},U}\right) + (1-\beta)\pi_{1^{b},U}\right) + (1-\phi)\left(SW_{2^{a}} - \beta k(\beta)\right) \quad (126)$$

When the U firm greenwashes and gets verified, it faces a lower regulatory threat compared to the case where verification is flawless. This is a case of partial detection: even if verification occurs, there is now a possibility that the U firm's deceptive marketing remains undetected. In that case, the enforcement costs will be borne by society.

As opposed to β, ω is exogenous and cannot be influenced by the regulatory agency. Therefore, all else equal, the regulator will have to increase the enforcement probability to achieve the same effective degree of enforcement as under flawless enforcement, which in turn will involve greater enforcement costs. In other words, the U firm will tolerate greater values β before reaching its new indifference point and shifting to silence, as shown by equation (127):

$$\pi_{1^{a},U} = \omega\beta_x\left(\pi_{1^{a},U} - k(\beta_x) - b\right) + (1 - \beta_x\omega)\pi_{1^{b},U} \quad (127)$$

Prior to the indifference point, expected social welfare will be given by the following equation:

$$E[SW] = \phi\left(\beta\left(\omega SW_{1^{a}} + (1-\omega)SW_{1^{b}} - k(\beta)\right) + (1-\beta)\left(SW_{1^{b}}\right)\right) + (1-\phi)\left(SW_{2^{a}} - \beta k(\beta)\right) \quad (128)$$

Flawed enforcement will decrease the value of β_y at which $\frac{\partial E[SW]}{\partial \beta} = 0$, as a marginal increase in the probability of verification prior to the indifference point will lead to smaller benefits than before. Equation (106) would become equation (129), where ω discounts the social benefits of a marginal increase in β:

$$\omega\phi\left(\frac{13}{18}(e_H - e_N)\right) = \beta_y k'(\beta_y) + k(\beta_y) \quad (129)$$

Flawed enforcement may result from a lack of clear enforcement guidelines indicating which legal standards will be applied by the regulatory agency when verifying marketing claims. If this lack of predictability results in a welfare loss, it could support the need for the enforcer to publish enforcement guidelines on environmental claims (Li, Li, Seppänen and Koivumäki, 2022).[78]

[78] In answer to these concerns, some consumer protection agencies have published extensive enforcement guidelines and position statements informing firms of their approach towards climate-related claims and warning them that such claims would be under greater scrutiny in the upcoming years (Beaulieu, 2022, p.66). For instance, the United Kingdom's Competition and Markets Authority recently issued new "green" marketing claims guidelines, and the Dutch Authority for Consumers and Markets published guidelines on sustainability claims (HM Government, undated; Autoriteit Consument & Market, 2021; Beaulieu, 2022, p.66). These guidelines improve the predictability of the standards applied by the agencies when determining whether a corporate claim is deceptive or not. They also

6.4 Pathways for additional extensions

In this section, some additional extensions and alternative assumptions that could be considered to make the model more realistic are briefly summarized – but their full development is left to future research. First, in the model, it was assumed that all consumers are naïve: they take firms' claims as given, unless the result of a verification by the regulator tells otherwise. This assumption might not be realistic, as some consumers may be sceptical about the truthfulness of firms' marketing claims, form expectations about the risk of deceptive marketing, and discount the information communicated by firms (Church, 1994). To reflect these considerations, Baumann and Rasch (2020) assume the coexistence of rational and naïve consumers, and similar assumptions could be introduced herein.[79] Second, it might also be that consumers change their beliefs over time as they learn about cases of greenwashing uncovered by the regulator.[80] It would be possible to set up a two-period model where the decisions of firms in the first period have consequences in the second period. Third, it was assumed that firms operate with zero marginal costs and positive fixed costs. It would be interesting to evaluate whether the results still hold assuming constant, positive marginal costs. Fourth, greenwashing is binary in the model, such that different degrees of disinformation do not exist. Furthermore, it was assumed that only one firm may deceive consumers, such that there cannot be widespread greenwashing among a number of firms in a given industry. These possibilities could be introduced to allow the regulator to modulate the verification probability based on the degree of disinformation by firms (e.g., more obvious, or extreme cases of misinformation would be more likely to be verified).[81] Fifth, as opposed to the current duopoly set-up, it would be possible to assume a monopolist operating in a partially covered market, as in Rhodes and Wilson (2018).[82] Sixth, it could be assumed that

signal that greenwashing is an enforcement priority, which could translate into an increase in the expected probability that a given claim gets verified by the agencies.

[79] Consumers' beliefs may also be influenced by the probability that the regulator verifies firms' claims. With greater institutional oversight, consumers may assume that claims are more likely to be truthful (Connelly et al., 2011; Li, Li, Seppänen and Koivumäki, 2022).

[80] Ultimately, these updated beliefs will influence the perception of the signals sent by firms and may have a chilling effect on green advertising (Gatti et al., 2019). The model only provides for one consumption period, which prevents consumer learning and the imposition of greater penalties for repeated legal violations. If the effect of punishment in the first period carries on to next period, then a looser regulatory stringency may be sufficient to prevent greenwashing.

[81] For example, one could think of a model where a greater degree of misinformation would increase the probability that the U firm gets noticed and investigated by the regulator.

[82] Rhodes and Wilson (2018) develop a model involving a monopolist with randomly assigned, privately known quality, which can be either low or high. The monopolist decides what type of quality to signal to consumers, which have a unit demand. A policymaker systematically reviews the signals after the fact and can punish firms by imposing fines. A marginal increase in the level of deceptive marketing has two effects on social welfare. First, there may be a welfare loss caused by a contraction of the monopolist's output, which results from the loss of credibility of high-quality claims. Second, there is a welfare gain caused by an expansion of the monopolist's output, which follows from the buyers' overestimation of the monopolist's type. The authors conclude that a positive level of false

consumers suppose that the silent firm is supplying goods with a higher quality than it truly is.[83] Seventh, it would be possible to assume that consumers learn the outcome of the verification process after they have purchased the goods.[84] Eighth, environmental characteristics may have more than one dimension, and the model could be altered to introduce a law enforcement regime that requires environmental claims to be representative of all the dimensions of a good's environmental quality.[85]

7. Alternative policy instruments

This thesis has focussed exclusively on the Canadian deceptive marketing framework, namely a generic consumer protection regime relying on verifications by a law enforcement agency. In this section, alternative policy instruments are examined, including how they would work under the model, and the policy implications of introducing such instruments in Canada.

7.1 Establishing a certification process for green claims

Some jurisdictions have established state-sponsored certification schemes that limit the use of certain marketing terms to goods that meet particular technical criteria.[86] In the model, the creation of a mandatory certification scheme would require any firm claiming to be supplying a low carbon good to be certified, which is equivalent to a systematic verification of advertising ($\beta = 1$). This is similar to Hamilton and Zilberman (2006), where all the units supplied by the firm are inspected

advertising will be socially beneficial when the second effect dominates the first effect. In our case, however, deceptive marketing could not translate in an increase in aggregate pollution through a change in the consumption mix, as consumers could only decide whether to consume the goods offered by the monopolist or not. However, deceptive marketing could potentially impact aggregate pollution by reducing the share of consumers who do not purchase any good. This would be similar to Uchida's model (2007), where eco-labelling triggers both an increase in the aggregate demand for goods (resulting in more indirect pollution) and a shift in the consumption mix towards less the polluting good (resulting in less indirect pollution).

[83] This possibility would capture situations where the consumption of goods involves hidden risks or health effects, such that the perception of quality is higher than the real quality, even if the firm is not advertising it. Currently, consumers beliefs about the type of the silent firm are either correct (1^a) or an overestimation of the true quality (1^b). The underestimation case is not provided for.

[84] The model could provide for the compensation of the damages caused to consumers, as in Rhodes and Wilson (2018). This possibility would reflect section 36 of the CA, which allows consumers to seek compensatory damages following a breach of section 52 of the CA.

[85] In the model, the environmental quality of a good was entirely captured by parameter e_i. However, the production of a good may involve several environmental benefits, risks, and impacts, such that environmental quality is better represented by a vector of characteristics $\tilde{e}_i$. As noted by Gatti et al. (2019), greenwashing may involve the disclosure of positive information about some environmental characteristics, overshadowing negative information about other characteristics, which remain undisclosed.

[86] For example, the European Union is currently contemplating amending its "Unfair commercial practices" directive to ban all generic environmental claims towards consumers, such as "environmentally friendly" and "green", except for claims that are subject to an officially recognised eco-labelling scheme (European Commission, 2022, Beaulieu, 2022, p.61). Under the directive, these terms could not be used unless an official eco-labelling standard is developed and sets the substantiation requirements underlying their use (Beaulieu, 2022, p.61).

by a certification authority.[87] This policy is the same as changing the order of the two-stage game: the U firm would first need to get the law enforcement agency's approval before it advertises its carbon footprint and customers make decisions.

In the model, systematic verification of advertising may not be optimal. For instance, beyond the U firm's indifference point, increasing the probability of verification increases the enforcement costs associated with the verification of truthful claims, without bringing any social benefits.

A few state-sponsored eco-labelling schemes already exist in Canada. For example, under the *Safe Food for Canadians Regulations*, products that display an organic claim or the Canada Organic Logo must be certified according to the *Canadian Organic Standards* (Government of Canada, 2021; Beaulieu, 2022, p.60). The Canadian Food Inspection Agency (CFIA) relies on a third-party service delivery model to oversee compliance with the *Canadian Organic Standards* (Beaulieu, 2022, p.60). Under this model, the CFIA accredits certification bodies that verify that operators produce organic products in compliance with the Standards and certify food commodities (Beaulieu, 2022, p.60).

7.2 Establishing an advertising ban

Some jurisdictions have prohibited marketing claims associated with precise categories of products or industrial activities. For example, the Dutch city of Harleem recently announced plans to ban the advertisement of certain types of meat in public spaces, invoking the important climate impact of industrial meat production (Lin Chang, 2022). Similarly, in 2021, the city of Amsterdam announced an advertising ban for fossil fuel and aviation companies in the city's subway stations and city center (Talbot, 2021). In August 2022, France followed suit by announcing new legislation prohibiting the advertising of energy products issued from fossil fuels, such as coal, oil, and gas (Frost, 2022). The introduction of an advertising ban prevents firms from advertising the characteristics of their goods. In the context of information asymmetry, an advertising ban prevents a firm with a low quality good from deceptively advertising its low quality good as high quality, but it also prevents a firm supplying a high quality good from signalling its true type.

In the context of the model, an advertising ban would prevent the U firm from advertising its good, irrespective of its type and the claim's truthfulness. As a result, consumers would always assume that the U firm is supplying a low quality good. Assuming parameter values such that greenwashing would have taken place in the absence of the advertising ban, the ban would prevent

[87] Note that this policy is different than a mandatory disclosure rule, which forces every firm to reveal its type, whether high quality or not.

greenwashing by the U firm in the scenario 1 (i.e., when it supplies a carbon intensive good). However, an advertising ban would also prevent the U firm from truthfully advertising its good in the scenario 2 (i.e., when it supplies a low carbon good).

Assuming that greenwashing would be a profitable strategy in the absence of regulation, that the advertising ban is systematically enforced, that it involves sufficiently high fines to deter any breach, and that enforcement costs are negligible, solving the model yields the following expected profits and expected social welfare.[88]

$$E[\pi_U] = \phi\left(\pi_{U,1^a}\right) + (1-\phi)\left(\pi_{U,2^b}\right) \tag{130}$$

$$E[SW] = \phi(SW_{1^a}) + (1-\phi)\left(SW_{1^b}\right) \tag{131}$$

While the advertising ban would have the benefit of preventing greenwashing entirely in the scenario 1, it would also prevent the U firm from truthfully signalling its low carbon type in the scenario 2, which would involve a social welfare loss. The overall effects of the advertising ban on social welfare will depend on the degree of differentiation of the goods under each scenario, and the probability that each scenario takes place. For some parameter values, the distortions arising from preventing the U firm to truthfully advertise its low-carbon good will exceed those arising from preventing the U firm from misleading consumers about its carbon intensive good. This is consistent with Church (1994), who advocates against an advertising ban because it prevents consumers from distinguishing products on the basis of their attributes.

In Canada, advertising bans have existed for many years in respect of the advertising of products with health-related risks, such as tobacco and pharmaceutical drugs, and advertising aimed at children (Ries and von Tigerstrom, 2011). However, freedom of expression may limit the ability of government to implement this type of restrictions in respect of environmental claims.[89]

[88] See Appendix B for the derivation of $\pi_{U,2^b}$. Note that these assumptions are a significative departure from the assumptions of the main model, such that any welfare comparison between an advertising ban and the deceptive marketing regime established in the main model would be of limited use. The intent here is two illustrate the trade-off that an advertising ban involves, not to compare its effectiveness with the regime proposed in the model. In this case, fines would be imposed whenever advertising takes, irrespective of the content of the ads. The enforcement of an advertising ban is likely to be less costly than enforcement under the basic model, as it simply requires detecting advertising, without having to investigate the ads' truthfulness. This type of ban would be equivalent to setting the U firm's advertising costs to infinity.

[89] For a review of the constitutional constraints associated with advertising bans in Canada, see Ries and von Tigerstrom (2011).

8. Conclusion

An increasing number of greenwashing complaints and legal proceedings have been initiated in Canada over the past years. These matters are typically introduced under the current deceptive marketing legal framework, which prohibits representations that are false or misleading in a material respect but does not include specific provisions on deceptive environmental claims. This generality may not appear surprising given that most of the theoretical literature on the topic does not distinguish greenwashing from other types of deceptive marketing. However, as demonstrated above, environmental claims can distort the consumption of goods that generate environmental externalities, an additional effect on social welfare that can justify a distinctive policy approach when dealing with greenwashing in a second-best setting.

To make this demonstration, Baumann and Rasch's (2020), Hattori and Higashida (2014) and Uchida's (2007) models were built upon to model a duopoly of risk-neutral, profit-maximizing firms competing on prices and supplying vertically differentiated products characterized by different carbon footprints. In the model, firms could supply carbon intensive, intermediate carbon, or carbon intensive goods. The K firm offered a product of publicly known intermediate carbon footprint product, while the U firm offered a product of publicly unknown, randomly assigned carbon footprint that could either by high or low. The production of goods was accompanied by the emission of a quantity of pollution reflecting each good's carbon footprint. Consumers differed in their willingness to pay for low pollution goods, and aggregate pollution was a public bad that affected consumers' utility. A law enforcement agency verified some of the U firm's advertising claims; whenever greenwashing was uncovered by the enforcer, the U firm was required to pay a fine and law enforcement costs.

Solving the model showed that in the absence of law enforcement and for certain degrees of differentiation between the goods, greenwashing takes place and distorts consumers' decisions, leading to an increase in the consumption of the carbon intensive good relative to the intermediate carbon good. Assuming a utilitarian social welfare function where consumers and firms are given an equal welfare weight, this shift in the consumption mix decreases social welfare through two channels. First, it leads to an increase in aggregate pollution, a public bad that harms all consumers equally. This effect is specific to deceptive marketing cases relating to impure public goods. Second, it creates a gap between the perceived and real utility from consuming the goods, as consumers do not obtain the type of goods advertised to them. This effect exists for all cases of deceptive marketing involving purely private, vertically differentiated goods with credence characteristics.

Given that greenwashing is detrimental to social welfare, there should only be law enforcement if the social benefits of preventing greenwashing exceed the social costs of law enforcement. This requires identifying the socially optimal probability of enforcement.

The existence of indirect pollution costs means that, all else equal, the benefits of law enforcement will be higher for greenwashing cases than for generic deceptive marketing cases involving purely private, vertically differentiated goods. As such, greenwashing will allow a greater degree of regulatory stringency. In a second-best context, the regulator's enforcement strategy should therefore incorporate the effects of deceptive marketing on the production of environmental externalities.

The model can be altered to reflect alternative assumptions. For instance, using a balancing weight social welfare function increases the social welfare costs of greenwashing, while decreasing the social welfare costs of law enforcement. Introducing advertising costs and incorporating non-financial considerations for firms increases the costs of deceiving consumers for the greenwashing firm. Finally, the incorporation of enforcement flaws implies that more stringent law enforcement is required to limit or prevent greenwashing.

Alternative informational policy instruments have been introduced in other jurisdictions, and the model can be used to make some observations about them. For example, a certification process for green claims would be similar to systematically verifying the high-quality claims of firms. In addition, some jurisdictions have introduced advertising bans preventing any promotional communication about certain products. This type of instrument may be effective to prevent greenwashing, but its main drawback is that it also prevents the truthful disclosure of higher quality by firms.

Canada's current legal framework under the CA does not reflect the distinctive characteristics of greenwashing compared to deceptive marketing cases relating to purely private, vertically differentiated goods. However, the statute could be amended to set greenwashing as an enforcement priority and establish enforcement teams dedicated to the verification of environmental claims. The ongoing review of the CA would be an ideal opportunity to implement these proposals.

9. Appendices

Appendix A. Application of the total surplus standard by the Supreme Court of Canada

The total surplus standard was endorsed by the SCC in the context of a case involving the CA's merger review provisions. The purpose clause of the CA identifies the goal of promoting the efficiency of the Canadian economy, among other things, but it does not expressly refer to redistributive concerns (*Competition Act*, section 1.1). While it is not defined in the statute, the notion of efficiency has been interpreted by the SCC in the context of section 92 of the CA, which allows the prohibition of a merger that is likely to prevent or lessen competition substantially in a relevant market, and section 96 of the statute, which prevents the prohibition of a merger that is likely to generate gains in efficiency greater than and offsetting its anticompetitive effects (Supreme Court of Canada, 2015). In the *Tervita* decision, the SCC identified two standards that can be used to measure the deadweight loss and the efficiency gains brought about by a merger: the total surplus standard and the balancing weights standard (Supreme Court of Canada, 2015). Under the total surplus standard, producer surplus and consumer surplus are simply aggregated in a utilitarian way (i.e., without any distinction in the welfare weights of firms and consumers) (Supreme Court of Canada, 2015). A merger resulting in a positive total surplus could be allowed under this standard (Supreme Court of Canada, 2015). Under the balancing weight standard, the courts may allocate a lower welfare weight to producer surplus than consumer surplus, notably to take into consideration the "disparity between the incomes of the relevant consumers and shareholders of the merged entity" (Supreme Court of Canada, 2015, par. 97). The Supreme Court of Canada ruled that both standards may be acceptable depending on the circumstances at issue, and that the Competition Tribunal (the lower court responsible for the application of the CA) may decide to use one or the other for a given case (Supreme Court of Canada, 2015). While these standards were not formulated in respect of the CA's deceptive marketing provisions, they do inform on the SCC's definition of efficiency as it appears in the CA's purpose clause, which shall guide the CCB's enforcement actions.

Appendix B. Demonstration that green-hushing and greenwashing cannot both be optimal strategies for the same parameter values

In scenario 2^b, the profit equations of each firm in equilibrium and the producer surplus are given by[90]:

$$\pi_{2^b,K} = p_N q_N - C_N = \frac{4}{9}(e_H - e_N) - C_N \quad \text{(C.1)}$$

$$\pi_{2^b,U} = p_H q_U - C_H = \frac{1}{9}(e_H - e_N) - C_L \quad \text{(C.2)}$$

$$PS_{2^b} = \frac{5}{9}(e_H - e_N) - C_N - C_L \quad \text{(C.3)}$$

Aggregate pollution in this scenario is higher than in scenario 2^a, because a smaller proportion of consumers end up purchasing a low carbon good.

$$Z_{2^b} = \frac{1}{3}e_L + \frac{2}{3}e_N \quad \text{(C.4)}$$

As in scenario 1^b, this scenario involves a difference between real and perceived consumer utility, as consumers do not obtain the type of good that they think they purchased. As usual, all consumers get the same utility gain v, and bear the same indirect pollution costs.

$$CS_{2^b} = \left(v - Z_{2^b}\right) - \int_0^{\frac{1}{3}} (\theta_j e_L + p_H)d\theta - \int_{\frac{1}{3}}^{1} (\theta_j e_N + p_N)d\theta \quad \text{(C.5)}$$

The one third of consumers who purchase a good from the K firm experience lower direct pollution costs than perceived and pay the price of the allegedly carbon intensive good. For these consumers, direct pollution costs and payments for the good can be calculated as follows:

$$\int_0^{\frac{1}{3}} (\theta_j e_L + p_H)d\theta = \frac{1}{18}e_L + \frac{1}{9}(e_H - e_N) \quad \text{(C.6)}$$

Similarly, for the two thirds of consumers who purchase the intermediate carbon good:

$$\int_{\frac{1}{3}}^{1} (\theta_j e_N + \frac{2}{3}(e_H - e_N) = \frac{8}{18}e_N + \frac{4}{9}(e_H - e_N) \quad \text{(C.7)}$$

The results obtained at equations (C.6) and (C.7) can be substituted in equation (C.5) to obtain the expression for the consumer surplus in equilibrium.

[90] Again, given the assumption introduced at inequality (4), $\frac{4}{9}(e_H - e_N) \geq C_N$; $\frac{1}{9}(e_H - e_N) \geq C_L$.

$$CS_{2^b} = v - \frac{1}{3}e_L - \frac{2}{3}e_N - \frac{1}{18}e_L - \frac{8}{18}e_N - \frac{5}{9}(e_H - e_N) \quad \text{(C.8)}$$

Total surplus can be derived by combining equations (C.3) and (C.8), where firm revenues and consumer payments cancel out as usual:

$$SW_{2^b} = v - \frac{20}{18}e_N - \frac{7}{18}e_L - C_N - C_L \quad \text{(C.9)}$$

The change in social welfare resulting from green-hushing is given by comparing total welfare when the U firm tells the truth about its type and total welfare when it stays silent. This change is captured by the following equation, where $\beta, k(b)$ and b are all equal to zero in the absence of law enforcement:

$$\Delta SW_2 = SW_{2^b} - SW_{2^a} = \left(CS_{2^b} - CS_{2^a}\right) + \left(PS_{2^b} - PS_{2^a}\right) \quad \text{(C.10)}$$

As for greenwashing, consumer surplus is affected by green-hushing through three channels. First, green-hushing results in a net increase in aggregate pollution $\Delta Z_2 = \frac{1}{3}(e_N - e_L)$, as a greater share of consumers misleadingly purchase the intermediate carbon good relative to the low carbon good. Second, it leads the one third of consumers with the weakest degree of pollution aversion to purchase a low carbon good instead of an intermediate carbon good. These consumers face lower direct pollution costs, which decrease (in the aggregate) from $\frac{1}{18}e_N$ to $\frac{1}{18}e_L$. They also pay different prices for the goods, from $\frac{1}{9}(e_N - e_L)$ to $\frac{1}{9}(e_H - e_N)$. The sign of this price effect will depend on the difference between the degree of differentiation of the goods. Third, there is also a change in the type of the good purchased by the two thirds of consumers with the highest degree of pollution aversion, who purchase an intermediate carbon good instead of a low carbon good. These consumers face higher direct pollution costs, which increase (in the aggregate) from $\frac{8}{18}e_L$ to $\frac{8}{18}e_N$. They also pay a different price for the good, from $\frac{4}{9}(e_N - e_L)$ to $\frac{4}{9}(e_H - e_N)$, which effect also depends on the degree of differentiation between the goods. The aggregate effect on consumer welfare is captured by the difference between equations (C.8) and (85):

$$\Delta CS_2 = -\frac{10}{18}e_H + \frac{7}{18}e_N + \frac{3}{18}e_L \quad \text{(C.11)}$$

By misleading consumers and selling a low carbon good as a carbon intensive good, the U firm loses half of its market share, which decreases from $\frac{2}{3}$ to $\frac{1}{3}$, while the K firm's market share doubles to $\frac{2}{3}$. However, the effect of green-hushing on firm profits is ambiguous because of the ambiguous

sign of the effect on prices. For the U firm, the overall difference in profits is captured by the following equation:

$$\Delta\pi_{1,U} = \left(\frac{1}{9}(e_H - e_N) - C_L\right) - \left(\frac{4}{9}(e_N - e_L) - C_L\right) = \frac{1}{9}\big((e_H - e_N) - 4(e_N - e_L)\big) \qquad \text{(C.12)}$$

Green-hushing will lead to an increase in the U firm's profits if $\Delta\pi_{2,U} > 0$, which can be expanded as follows from equation (C.12):

$$4(e_N - e_L) < (e_H - e_N) \qquad \text{(C.13)}$$

This result may seem counterintuitive, as one could expect that it is always beneficial for a firm supplying a high quality good to advertise it as such. However, quality differentiation allows firms to charge higher prices to consumers and loosen the intensity of price competition. As such, it may be that the benefits of displaying a higher degree of differentiation exceed the benefits of selling a higher quality good (Motta, 1993). This possibility is captured by inequality (C.13): when the degree of differentiation between the carbon intensive and the intermediate goods is more than four times the degree of differentiation between the intermediate and the low carbon goods, green-hushing is a profitable strategy.[91]

Inequality (C.13) is the reverse of inequality (76). As such, it may never be that green-hushing and greenwashing are both a profitable strategy for the same parameter values. Inequality (C.13) captures both the price and quantity effects of green-hushing on the U firm's profits. Green-hushing has no effects on the firms' costs, as the U firm incurs C_L in either case.

The overall effect of green-hushing on producer surplus is given by the following equation.

$$\Delta PS_2 = \frac{5}{9}\big((e_H - e_N) + (e_N - e_L)\big) \qquad \text{(C.14)}$$

Equations (C.14) and (C.11) can be combined to evaluate the overall effect of green-hushing on social welfare. As for scenario 1, the welfare effects of price changes cancel out. As a result, the net effect of green-hushing on social welfare is negative and driven by the increase in the direct and indirect pollution costs that harm consumers.[92]

$$\Delta SW_2 = \left(v - \frac{7}{18}e_L - \frac{20}{18}e_N - C_N - C_L\right) - \left(v - \frac{20}{18}e_L - \frac{7}{18}e_N - C_L - C_N\right) \qquad \text{(C.15)}$$

[91] This would be the case, for example, for parameter values $e_i = \{1; 2; 7\}$.
[92] Note that despite the negative effects of this practice on social welfare, the introduction of law enforcement would have limited implications on the green-hushing case. As the regulator does not verify silent firms, the U firm would not be verified in this case.

$$\Delta SW_2 = \frac{13}{18}(e_L - e_N) < 0 \qquad \text{(C.16)}$$

As shown by inequality (C.16), the size of the aggregate effect of green-hushing on social welfare is increasing with higher degrees of differentiation between the low carbon good and the intermediate carbon good.

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