Salience and Online Sales: The Role of Brand Image Concerns*

Markus Dertwinkel-Kalt† Mats Köster‡

University of Cologne DICE

First version: May 2017

This version: January 2018

Abstract

We provide a novel intuition for the observation that many brand manufacturers have restricted their retailers' ability to resell brand products online. Our approach builds on models of salience according to which price disparities across distribution channels guide a consumer's attention toward prices and lower her appreciation for quality. Thus, absent vertical restraints, one out of two distortions—a quality or a participation distortion—can arise in equilibrium. The quality distortion occurs if the manufacturer provides either an inefficiently low quality under price salience or an inefficiently high quality in order to prevent price salience. The participation distortion arises as offline sales might be entirely abandoned in order to prevent prices from becoming salient. Both distortions are ruled out if vertical restraints are imposed. As opposed to the current EU legislation that considers a range of vertical restraints as being hardcore restrictions of competition per se, we show that these constraints can be socially desirable if salience effects are taken into account.

JEL-Classification: D21, K21, L42.

Keywords: Salience; Online Sales; Antitrust; Vertical Restraints; Distribution Channels.

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*We thank Justus Haucap, Paul Heidhues, David Heine, Fabian Herweg, Matthias Hunold, Roman Inderst, Johannes Johnen, Botond Kőszegi, Johannes Münster, Hans-Theo Normann, Nicolas de Roos, Frank Schlütter, Wendelin Schnedler, Heiner Schumacher, Urs Schweizer, Ran Spiegler, Tim Thomes, Alexander Westkamp, and Christian Wey for valuable comments and suggestions. We also thank seminar participants at the universities of Bonn, Cologne, Düsseldorf, and Paderborn as well as conference participants at LEOH 2017 (Cologne). Mats Köster gratefully acknowledges financial support through the Graduate Programme Competition Economics (GRK 1974) of the German Science Foundation (DFG).

†University of Cologne, Albertus-Magnus-Platz, 50923 Cologne, Germany. Email: mdertwin@uni-koeln.de.

‡HHU Düsseldorf (DICE), Universitätsstr. 1, 40225 Düsseldorf, Germany. Email: mats.koester@hhu.de.

1 Introduction

Thanks to digitalization e-commerce is on the rise. Online sales have been steadily increasing, amounting in 2016 to \$395 billion (11.7% of overall sales) in the United States and \$1.9 trillion (8.7% of total retail spending) worldwide.[1] Many retailers offer their products *both* offline in brick-and-mortar stores and online via own online stores or platforms such as *Amazon*, *ebay*, *Newegg*, *Alibaba*, or *Mercado Libre*. Online sales offer two main advantages. First, they allow a reduction in retail costs for service and personnel. Second, they reduce shopping time and allow geographical distance to be overcome, both of which may enlarge the customer base. Therefore, online sales should have a positive impact both on a manufacturer's profit and on social welfare.

Nevertheless, manufacturers have gone to great lengths to restrain internet sales, often claiming that low internet prices harm their brand's image. Along these lines, "protecting my company's brand image" was mentioned as the "biggest e-commerce-related challenge" in a 2015 survey on 347 brand manufacturers which ranged in size from more than \$10 billion in annual sales to less than \$100 million.[2] In practice, for instance, sports article manufacturer *adidas* revised its guidelines for online sales in 2012, thereby directly banning the sale of adidas products via open marketplaces on the internet in order to protect its brand's image.[3] Recently, suitcase producer *Samsonite* also obliged retail firms in Germany to give up online sales (e.g., through platforms such as Amazon or ebay), starting from July 1, 2017.[4] *Gardena* and *Bosch* have engaged in dual pricing (i.e., charging a different wholesale price for units intended to be sold online than for those to be sold offline) by providing rebates to local retailers contingent on the quantities offered in their brick-and-mortar-stores.[5] *Recticel Schlafkomfort* has engaged in

[1]See the official report by the U.S. Commerce Department, `https://www.census.gov/retail/mrts/www/data/pdf/ec_current.pdf`, and the e-commerce report by Statista, `https://www.statista.com/statistics/379046/worldwide-retail-e-commerce-sales` (both downloaded on Sept. 12, 2017).

[2]`http://go.channeladvisor.com/rs/485-FSD-368/images/us-e-commerce-for-branded-mfctrers-suppliers-rep.pdf` (downloaded on Sept. 12, 2017).

[3]See `http://www.bundeskartellamt.de/SharedDocs/Entscheidung/EN/Fallberichte/Kartellverbot/2014/B3-137-12.pdf?__blob=publicationFile&v=2` (downloaded on Sept. 12, 2017).

[4]See, for instance, `http://www.lebensmittelzeitung.net/politik/Online-Plattformverbote-Samsonite-will-Amazon-fuer-sich-allein-129923` (downloaded on Sept. 12, 2017).

[5]See, for instance, `http://www.bundeskartellamt.de/SharedDocs/Entscheidung/DE/Fallberichte/Kartellverbot/2013/B05-144-13.pdf?__blob=publicationFile&v=3` (downloaded on Sept. 12, 2017).

resale price maintenance (RPM) in order to prevent cheap online sales.[6] While these examples relate to Germany, similar restraints have been undertaken by manufacturers (e.g., *Nike*) across the globe.[7] According to the German cartel office, how this use of vertical restraints in order to protect a brand's image should be assessed is a key question (Bundeskartellamt, 2013, p. 27).

We show that this widespread puzzle can be explained by the psychologically founded *contrast effect* (e.g., Schkade and Kahneman, 1998; Dunn *et al.*, 2003) whereby consumers focus on that choice dimension (e.g., quality or price) along which available offers differ the most. Accordingly, if a product's price varies across distribution channels, consumers focus more on its price and less on its quality. The relevance of contrast effects for similar purchase decisions has been supported both in the lab (Dertwinkel-Kalt *et al.*, 2017b) and in the field (Hastings and Shapiro, 2013). In order to model the contrast effect, we build on recent approaches by Kőszegi and Szeidl (2013) and Bordalo *et al.* (2013b), which predict that a consumer's willingness-to-pay for a brand product is reduced in the presence of price disparities across distribution channels. Thereby, these approaches suggest a novel externality that discounts in one channel have on consumers in another channel, namely consumers' offline willingness-to-pay can be affected by lower online prices. We establish that a manufacturer may restrain online sales in order to prevent its product from being sold at different prices in different channels. Altogether, our model captures the manufacturers' line of reasoning, that online sales can be detrimental to brand image.

Brand image is a multi-layered concept. The business dictionary defines brand image as the "impression in the consumers' mind of a brand's [...] real and imaginary qualities and shortcomings."[8] Thus, brand image relates to the positive characteristics consumers identify a brand with, and it partly reflects a brand product's objective and partly the product's perceived quality. In our approach, cheap online sales affect both components of brand image. The contrast effect predicts that a consumer's perceived quality decreases due to price disparities across channels and, as a consequence, the manufacturer also has lower incentives to provide actual quality. Thus, when stating that cheap online sales harm brand image, we in fact mean

[6]See `http://www.bundeskartellamt.de/SharedDocs/Meldung/EN/Pressemitteilungen/2014/22_08_2014_Matratzen.html` (downloaded on Sept. 12, 2017).

[7]See, for instance, `https://www.bloomberg.com/news/articles/2017-06-21/amazon-said-to-sell-nike-shoes-directly-through-brand-registry` (accessed on 16 Nov 2017).

[8]`http://www.businessdictionary.com/definition/brand-image.html` (downloaded on Sept. 12, 2017)

that both components—the objective and the perceived quality of the brand—decrease likewise.

We analyze a manufacturer's optimal product specification and wholesale tariff when he supplies a number of retailers that serve final consumers via two channels: the online and the offline. We assume that in a *price-salient environment*—as induced by a variation in retail prices across channels—consumers are willing to pay less for a product of a given quality. We show that in our model unrestricted online sales can indeed harm the brand's image, which appears puzzling through the lens of the classical model. As a consequence, we provide a novel explanation for the frequent implementation of vertical restraints on internet sales. Importantly, we find that in our model resale price maintenance and dual pricing are never problematic from a social welfare point of view while a ban on online sales can be socially harmful, especially if the manufacturer does not operate an own online store.

We assume that the on- and the offline channels differ with respect to their demand and/or cost characteristics. While we suppose that competition in the online channel is perfect, retailers may have some market power offline. In addition, we assume that retailers have to cover higher retail costs for offline sales. Finally, we suppose that consumers are heterogeneous with respect to their preferences for online shopping, so that it is efficient to serve some consumers via brick-and-mortar stores (the *offline consumers*) and others via the internet (the *online consumers*).

Absent vertical restraints, one of two salience distortions can arise in equilibrium: a *quality distortion* or a *participation distortion.* On the one hand, a quality distortion occurs if prices are salient in equilibrium. In such a *price salient equilibrium* retail prices vary across channels and therefore attract much attention. This deteriorates the consumer's valuation for high-quality goods and harms the brand's image. In response, the manufacturer provides an inefficiently low quality. On the other hand, the manufacturer may distort the product's quality in order to *prevent* a price variation across channels and thus a price-salient environment. In such an *excessive branding equilibrium* the manufacturer leaves the retailers a considerable share of joint profits to make them partially internalize the negative effect of cheap online sales on the consumers' willingness-to-pay. Since price salience lowers overall profits more if the provided quality is high, the manufacturer distorts the product's quality upward. We show that an excessive branding equilibrium occurs if and only if the share of online consumers is low. A price salient equilibrium may exist for intermediate shares of online consumers. If the share of online consumers is large enough, only online stores will be operated in equilibrium. In such an *online equilibrium* the manufacturer offers a contract that does not allow retailers to profitably serve offline consumers. Since only one channel is operating here, prices are non-salient. As a stronger salience bias implies lower manufacturer profits in a price salient and an excessive branding, but not in an online equilibrium, the latter becomes relatively more attractive due to salience. Thus, relative to the rational benchmark, fewer consumers might be served in equilibrium (i.e., a participation distortion arises).

Vertical restraints allow the manufacturer to avoid salience distortions. By preventing a price variation across distribution channels, restraints on internet sales can circumvent the adverse salience effects arising from cheap online sales. Just like third-degree price discrimination, dual pricing enables the manufacturer to enforce high online prices and to maximize and extract industry profits. Alternatively, resale price maintenance or bans on online sales ensure the supply of the efficient product specification and can enhance not only the manufacturer's profit but also social welfare. In particular, if the manufacturer runs an own online store, a direct ban on online sales improves social welfare. Altogether, allowing for vertical restraints eliminates both salience distortions and is likely to increase social welfare.

Our analysis challenges the current practice in European competition law according to which the aforementioned vertical restraints on internet sales are prohibited. The European Commission treats all these practices as hardcore restrictions of intra-brand competition *per se*, or, more precisely, as an infringement by object of Article 101(1) of the Treaty on the Functioning of the European Union, meaning that these practices give rise to a strong presumption of illegality under EU competition law. Accordingly, firms like *adidas* or *Samsonite* were immediately obliged to revert their restrictions on online sales. In contrast, antitrust authorities in the United States decide upon restrictions on distribution channels on a case-by-case basis (see OECD, 2013, and Haucap and Stühmeier, 2016). In the latest sector inquiry on e-commerce, the European Commission has also argued for a more lenient, case-based approach (EC, 2017). Our analysis supports this view by providing a new rationale for vertical restraints on internet sales, suggesting that manufacturers often impose a certain restraint only if it is socially desirable.

We proceed as follows. In Section 2, we introduce our model. In Section 3, we provide the equilibrium analysis in the absence of vertical restraints. In Section 4, we discuss the effects of vertical restraints on the equilibrium outcome. In Section 5, we show the robustness of our findings. In Section 6, we review the related literature. Finally, Section 7 concludes.

2 Model

2.1 Basic Setup

Suppose a manufacturer (he) produces some good of quality $q \in [\underline{q}, \overline{q}] \subseteq \mathbb{R}_+$ at unit cost $c(q)$ and sells it to $N \geq 2$ retailers—each of which is located in a different area—at a uniform, linear wholesale price $w \geq 0$. Each retailer i (she) can operate a brick-and-mortar store (i.e., an offline store), which is located in area i, and/or an online store. While retailers incur unit retail costs of $r > 0$ for offline sales, the retail costs for online sales are set to zero.

There is a unit mass of consumers (equally distributed over the areas) who buy at most one unit. For those consumers in area i, we refer to the brick-and-mortar store located in area i as their *local* store. For analytical convenience, we assume that consumers observe all offers and can buy in each store. When shopping online or when shopping in their local store, no transaction costs arise. If a consumer shops in a brick-and-mortar store located in a different area, transportation costs of $t \geq 0$ accrue.[9] The market structure is illustrated in Figure 1.

A consumer's valuation for a product of quality q is given by $v(q)$, where $v(\underline{q}) > 0$, $v'(\cdot) > 0$ and $v''(\cdot) \leq 0$. We distinguish two types of consumers who differ with respect to their shopping preferences. A share $1 - \alpha \in (0, 1)$ of consumers incur some disutility $l > r$ from online purchases. We call these consumers the *offline consumers* as it is efficient to serve them offline. The remaining share of consumers, α, are indifferent between on- and offline shopping. Due to offline retail costs, it is efficient to serve these consumers online, so that we call this group the *online consumers*. Accordingly, we say that *all consumers are served efficiently* if and only if offline consumers buy at their local brick-and-mortar store and online consumers buy online. Absent salience effects, both consumer types obtain a consumption utility of $v(q) - p_{i,\text{off}}$ when purchasing at their local store, and $v(q) - p_{j,\text{off}} - t$ when buying in a foreign brick-and-mortar store. Purchasing at retailer i's online store yields a consumption utility of $v(q) - p_{i,\text{on}}$ to online consumers and a consumption utility of $v(q) - p_{i,\text{on}} - l$ to offline consumers. Not buying the product gives consumption utility zero.

[9] It is straightforward to show that our results generalize to the case of retailer-region-specific transportation costs where a consumer in area j incurs costs $t_{i,j} \geq 0$ when buying at retailer i's brick-and-mortar store. Thereby, our model also allows for competition being stronger among certain retailers (e.g., those located close to each other) than among others (e.g., retailers located further apart from each other).

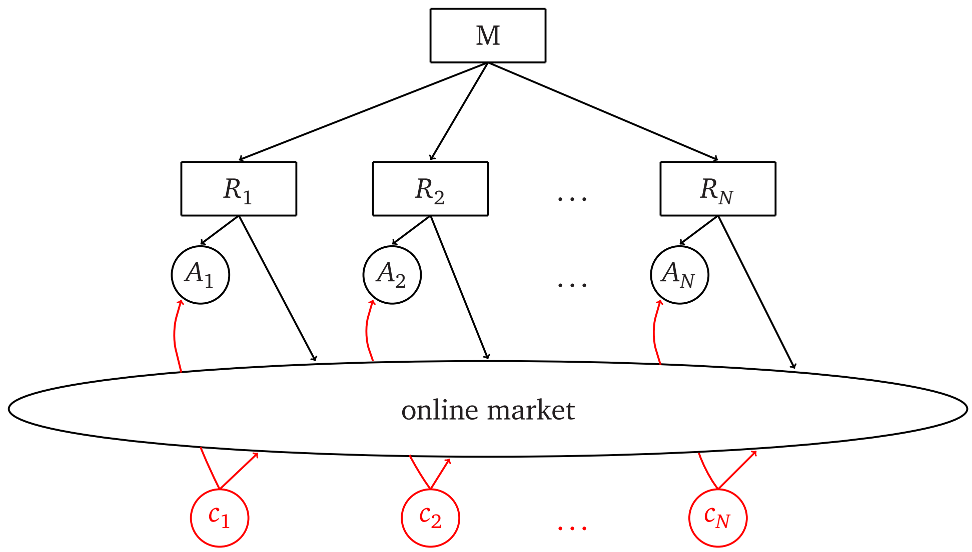

Figure 1: *The manufacturer M sells his product to N retailers, where retailer R_i is located in area A_i. Consumers located in area A_i (i.e., the group c_i) can buy in each on- and offline store. Red arrows indicate purchase opportunities for which no transaction costs arise.*

We assume that consumers are *salient thinkers* who maximize not the consumption utility, but the *salience-weighted* utility that depends on the choice context. The choice context is captured by the salient thinker's *consideration set*, that is, the set of options she has on her mind when making the purchase decision. We assume that consumers consider all product offers. A salient thinker discounts the choice dimension—quality or price—that is less salient within her consideration set by some parameter $0 < \delta < 1$.[10] Following Kőszegi and Szeidl (2013), we assume that the dimension is salient along which the options in a consumer's consideration set vary more. If all the options (i.e., all price-quality pairs) that a consumer considers are identical, neither quality nor price is salient and salience-weighted utility coincides with consumption utility. If there is variance in only one dimension, this dimension is salient. As we consider a market with one manufacturer and one product specification there is no variance in the quality dimension, so that consumers either focus on price, or quality and price are equally salient. A price-salient environment indeed occurs if and only if different prices are set in the different

[10]Bordalo *et al.* (2012, 2013b) have proposed this *discrete* variant of modeling salience distortions. In contrast, Kőszegi and Szeidl (2013) propose an approach where salience weights are continuous in the attributes' salience. In Appendix E, we show that our qualitative results replicate if salience weights are not discrete but continuous.

stores. This captures the psychologically founded *contrast effect* according to which a strong contrast among options along a particular dimension attracts attention. Table 1 summarizes the salience-weighted utility under price salience for any consumer-store combination.

	local offline store	foreign offline store	online store
offline consumers	$\delta v(q) - p$	$\delta v(q) - p - t$	$\delta v(q) - p - l$
online consumers	$\delta v(q) - p$	$\delta v(q) - p - t$	$\delta v(q) - p$

Table 1: *Salience-weighted utility under price salience for retail price* $p \in [w, v(q)]$ *and quality* $q \in [\underline{q}, \overline{q}]$*. If prices are non-salient, salience-weighted utility coincides with consumption utility.*

We restrict our analysis to the case where salience distortions are not implausibly strong.

Assumption 1 (Salience Distortion)**.** $\delta > \max\left\{1 - \left(\frac{N-1}{N}\right) \cdot \frac{r}{v(\overline{q})},\ 1 - \frac{l-r}{v(\overline{q})},\ \frac{r}{v(\underline{q})}\right\}$.

The first part of this assumption ensures that if a given wholesale price allows a retailer to profitably sell the product offline, it also allows for profitable online sales even under price salience. In other words, retail costs outweigh the adverse effect of price salience on the consumers' willingness-to-pay. Otherwise, the manufacturer could always prevent a price-salient environment simply by charging a sufficiently high wholesale price, so that a meaningful discussion of vertical restraints on online sales becomes obsolete. The second part implies that it is more profitable to serve offline consumers offline while the price is salient than via the online channel without price salience. Hence, salience effects do not overturn the firms' preference of where to serve a specific consumer, which allows us to analyze a market in which both channels co-exist also under salience. Along this line, the third part ensures that retailers can profitably operate their brick-and-mortar stores at a wholesale price of zero, even if prices are salient.

The timing of the game is as follows:

1. Stage: The manufacturer sets a quality level $q \in [\underline{q}, \overline{q}]$.

2. Stage: The manufacturer sets a linear wholesale price $w = w(q) \geq 0$.

3. Stage: Given q and w, each retailer simultaneously chooses her set of distribution channels $C_i \subseteq \{\text{on}, \text{off}\}$, and, for any $k \in C_i$, a retail price $p_{i,k} \geq 0$.

4. Stage: If a consumer observes at least one offer, she decides whether (and, if she observes two or more offers, also where) to buy the product.

Since we analyze a game of complete information, we solve for the set of subgame-perfect equilibria. For expositional simplicity, we impose the following five tie-breaking assumptions. First, if a consumer is indifferent between purchasing or not purchasing, she purchases. Second, when being indifferent between purchasing on- and offline, online consumers buy online and offline consumers buy offline. Third, if a consumer is indifferent between buying offline in the local store or in a foreign store, she buys in the local store. Fourth, if some retailers set the same online price, they all serve the same number of consumers at their online stores. Fifth, if a retailer is indifferent between serving an (additional) market or not, she serves the (additional) market; that is, for a given profit retailers want to maximize their demand.

In the following, we denote an equilibrium in the third-stage continuation game as a *retail equilibrium*. Notably, for certain wholesale prices, there exist multiple retail equilibria. We therefore adopt the widespread equilibrium selection criterion of payoff-dominance, whereby the retailers select the retail equilibrium with the highest retailer profits if there are multiple equilibria in the third-stage continuation game (for a recent application, see, Johnen, 2017).

We assume that the cost function satisfies the standard Inada conditions: (i) $c(\underline{q}) = 0$ and $\lim_{q \to \overline{q}} c(q) = \infty$, (ii) $c'(\underline{q}) = 0$ and $c'(q) > 0$ for all $q \in (\underline{q}, \overline{q})$, and (iii) $c''(q) > 0$ for all $q \in [\underline{q}, \overline{q})$. This guarantees that the manufacturer's problem in the first stage has an interior solution.

Following the literature (see, e.g., Kőszegi and Szeidl, 2013), we assume that consumer surplus is determined by consumption utility. Accordingly, denote as $q^* := \arg\max_q [v(q) - c(q)]$ the *efficient* quality level, which is implicitly given by $v'(q^*) = c'(q^*)$.

2.2 Discussion of Modeling Assumptions

Next, we discuss the essential assumptions of our model, namely the consumer types, offline retail costs, the upstream market structure, the contrast effect, and the specification of the consumers' consideration set.

Consumer Types. In order to meaningfully discuss product distribution across two channels we need at least two different consumer types. We impose the canonical assumption that for each channel there is a consumer type that is efficiently served via this channel. While we assume that *online consumers* are indifferent between purchasing off- and online, our results hold true if these consumers have a slight but strict preference for either on- or offline purchases. Indeed, our results only rely on the plausible heterogeneity that it is efficient to serve some consumers offline and other consumers online. This assumption is also supported by Duch-Brown *et al.* (2017) who have empirically studied preferences for on- and offline shopping. Their results suggest that there are two groups of consumers, one of which strongly prefers to buy offline while the other prefers to purchase online. Notably, our qualitative insights are also robust to adding a minority of consumers who are not affected by salience, *either* because they shop exclusively offline (online) and are therefore not aware of online (offline) prices *or* because they are simply not susceptible to the contrast effect.

Retail Costs. Typically, offline retail costs are higher than online retail costs (Lieber and Syverson, 2012). Unlike online stores, brick-and-mortar-stores need attractive locations, and thereby face high property prices or rents. Also service and personnel costs are typically higher for brick-and-mortar-stores. While we assume that offline retail costs are strictly positive and online retail costs are equal to zero, our qualitative results continue to hold as long as online retail costs are positive, but sufficiently lower than offline retail costs. Our insights also hold true if in addition fixed retail costs are positive, but not too large.

Upstream Monopolist. We assume that there is an upstream monopolist. This restriction is justified given the purpose of our study, as antitrust authorities are concerned about the adverse effects of vertical restraints on intra-brand competition. By focusing on a single manufacturer, we abstract from inter-brand competition and can single out the precise effect of vertical restraints on intra-brand competition.

Contrast Effect. The contrast effect represents our main behavioral assumption. Accordingly, attention is guided toward a choice dimension along which the available options differ greatly. The contrast effect is the central ingredient of recent models on stimulus-driven attention by Kőszegi and Szeidl (2013) and Bordalo *et al.* (2013b), but the underlying idea that contrast attracts attention has been formalized in previous models (for a more detailed discussion, see Kőszegi and Szeidl, 2013). Already Tversky (1969) and Rubinstein (1988) have proposed models of binary choice according to which decision makers neglect small contrasts between options. Tversky (1972) suggests that options are iteratively eliminated, based on the choice dimension in which available alternatives differ most. Regret theory (Loomes and Sugden, 1982; Bell, 1982) expands a standard utility function over lotteries by a regret-rejoice term that increases in the contrast of outcomes within a certain state of the world. The contrast effect is also in line with various empirical observations (e.g., Schkade and Kahneman, 1998; Dunn *et al.*, 2003) and has been supported by recent lab experiments (e.g., Dertwinkel-Kalt *et al.*, 2017a,b).

Consideration Set. In order to solve the model, we need to decide for one specification of the consideration set. As previous work does not give much guidance on the composition of the consideration set, we will impose certain assumptions that are canonical in our context but are plausible even in more general setups.

First, we assume that consumers are aware of a good's on- and offline prices. Importantly, all of our results also hold if the online consumers are not aware of the offline offers. In addition, our results do not change if offline consumers are only aware of the online offers and their local offline offer, but not of the offers in foreign brick-and-mortar-stores.[11] Thus, our results hold as long as at least the offline consumers' consideration set contains the offers in both channels.

Other products, on the other hand, are assumed to be not included in the consumer's consideration set.[12] This assumption is canonical in our model, as it builds on a monopolist manufacturer producing only a single product. We argue in the following that it is also warranted in a broader model that encompasses further product specifications. To begin with, this assumption is supported by the marketing literature on the product category that our study focuses on, that is, on high-quality brand products. Successful brands have a very high value which is mainly driven by reputation and consumer loyalty (Aaker, 2014, Chapter 2). Marketing studies have found that a majority of the consumer group that is relevant for a particular brand manufacturer

[11] We regard it as a plausible assumption that offline consumers are aware of online offers, as online information is quickly and easily accessible. Recent consumer surveys find that prior to offline shopping consumers often browse the respective goods online (see, e.g., the *Retail Dive Consumer Survey* at `http://www.retaildive.com/news/why-researching-online-shopping-offline-is-the-new-norm/442754/`, downloaded on Sept. 12, 2017).

[12] Following the literature that studies the role of salience in the context of industrial organization (e.g., Bordalo *et al.*, 2016; Inderst and Obradovits, 2016b; Apffelstaedt and Mechtenberg, 2017; Herweg *et al.*, 2017), we further assume that the outside option is not included in the consideration set and therefore does not affect salience. It seems plausible to assume that a consumer perceives the prices at which the product is offered in a different way than the "zero price" that can be associated with not buying the product. In this sense, the fictious price of the outside option is unlikely to affect salience in the same manner as the posted prices of regular offers do. It is not even clear whether the outside option of not buying the product is perceived as having different choice dimensions. In particular, we are not aware of any experimental or empirical study that would indicate that the outside option affects salience.

does not consider low-quality substitutes as viable alternatives.[13] In addition, brands heavily invest into being perceived as non-substitutable. Along these lines, the marketing literature (see, e.g., Aaker, 2014, Chapter 11) claims that successful brands are loved by some (who are loyal to the brand and do not consider potential substitute products) rather than liked by many (who consider the brand product as one product among many). Thus, marketing studies support our assumption that for the relevant group of consumers the primary decision is whether (and where) to buy a particular brand product.

Since low-quality goods are not contained in the consideration set, in our model quality salience cannot occur. Nevertheless, we mirror the trade-off between price being relatively more important (under price salience) and quality being relatively more important (if price is not salient). This is the same trade-off as in a model where price- and quality-salience are contrasted. If close substitutes (offered by the same or a different brand producer) are included in the consideration set, our analysis would not change by much as these products would not induce much contrast in quality. A strong contrast in quality could only be induced by products of a very low quality. But such a low-quality product is unlikely to represent a proper substitute and therefore it is unlikely to be considered at all. Thus, we regard it as a plausible assumption of our model that the contrast effect does not render quality salient in this setup.

Also, it does not seem to be the case that stores intend to make quality salient by offering a set of products that largely contrast in the quality dimension. In practice, retailers often avoid presenting low-quality products in the same context as brand products, thereby keeping quality homogeneous among their product line. If retailers indeed sell low-quality substitutes, these are hidden on low shelves or placed in some remote corner of the store as they are tailored to a different clientele. Even department stores comprise separate brand shops for major brands such as *Levis*, *Nike*, or *Apple*. So both retailers and manufacturers also in practice apparently restrain a consumer's consideration set to products of a similar quality.

One reason why retailers try to avoid a large contrast in quality among the considered goods might be that quality differences between products go hand in hand with price differences. Since prices are often better quantifiable than qualities, price differences might attract more attention than quality differences. Arguably, a choice dimension attracts *economic salience* as modeled by

[13]For instance, even after a successful market entry and gain of a considerable market share, *Hyundai* is not considered at all by a large majority of consumers when thinking of which car to buy (Aaker, 2014, Chapter 15).

Kőszegi and Szeidl (2013) and Bordalo *et al.* (2013b) especially if it is quantifiable, such as price. If cheap low-quality products were included in the consideration set, the contrast in the prices of the brand product and the cheap alternative might attract attention, thereby mitigating the consumers' willingness-to-pay for quality. Here, quality salience cannot easily be induced by extending the contrast in offered qualities, but rather by the arrangement of the products or the store environment (e.g., background music, scents, or colors). This type of salience is not included in the underlying models but is complementary to economic salience.[14,15]

3 Equilibrium Analysis

In this section, we first describe the equilibrium in a classical model with rational consumers in order to highlight the basic trade-off a manufacturer faces absent salience effects. Subsequently, we derive the equilibrium outcome of our game with salient thinkers.

Preliminaries. Suppose consumers accord with the classical model and maximize consumption utility. Then, the manufacturer faces a trade-off between charging a high wholesale price and serving only online consumers or charging a low wholesale price and serving all consumers.

Consider first the case in which the manufacturer wants all consumers to be served in equilibrium. Since retailers incur per-customer retail costs of $r > 0$ when selling the product via their brick-and-mortar stores and offline consumers obtain a disutility of $l > r$ from online purchases, the manufacturer cannot charge a wholesale price that exceeds $v(q) - r$. If $w = v(q) - r$, retailer i is able to break even on offline sales by charging a retail price $p_{i,\text{off}} = v(q)$. In addition, a standard Bertrand argument implies that competition drives down online prices to cost (i.e.,

[14] In their basic model, Apffelstaedt and Mechtenberg (2017) analyze a related setup where the choice of the store context (e.g., one where quality is highlighted) is independent of the product line. Frydman and Mormann (2017) provide experimental evidence supporting the complementary role of *visual salience*.

[15] The presumption that the salience of non-numerical quality dimensions is less responsive to a change in the respective quality range can be easily tested experimentally. In a first treatment, subjects are exposed to a specific brand product and state their willingness-to-pay for that product. In a second treatment, subjects are exposed to the same brand product alongside a low-quality substitute (or a broken variant of the brand product) is presented. This second, low-quality product expands the quality range and should therefore increase the subjects' willingness-to-pay for the brand product if the contrast effect also applies to the quality dimension.

$p_{i,\text{on}} = w$), so that in equilibrium online consumers buy via the online channel. As a consequence, all consumers are served efficiently and the manufacturer earns $v(q) - r - c(q)$. If the manufacturer instead wants only online consumers to be served in equilibrium, he could charge a wholesale price up to $v(q)$. By charging a wholesale price of $w = v(q)$, the manufacturer can earn $\alpha \cdot [v(q) - c(q)]$. In either case, the manufacturer chooses the efficient quality $q = q^*$.

We conclude that there exists some threshold value

$$\alpha_R := \frac{v(q^*) - r - c(q^*)}{v(q^*) - c(q^*)} \in (0, 1)$$

such that in equilibrium all consumers are served if and only if $\alpha < \alpha_R$. If the share of online consumers is small, the manufacturer charges a wholesale price that allows retailers to serve offline consumers via their brick-and-mortar stores, so that in equilibrium the market is covered. If, in contrast, the share of online consumers is large, it is profitable to charge a high wholesale price that induces the retailers to only sell the product online.[16]

Equilibrium. Next, we characterize the equilibrium outcome of our model with salient thinkers.

Proposition 1. *There exist some threshold values $0 < \alpha'_S \leq \alpha''_S < 1$ so that the following holds:*

i) Suppose the share of online consumers is small (i.e., $\alpha < \alpha'_S$). Then, in the unique subgame-perfect equilibrium all consumers are served efficiently, no dimension is salient, the manufacturer sets an inefficiently high quality level $q = q^S_{\text{ex}}(\alpha, \delta) > q^*$, and retailers earn strictly positive profits.

ii) Suppose the share of online consumers is at an intermediate level (i.e., $\alpha'_S \leq \alpha < \alpha''_S$). Then, in the unique subgame-perfect equilibrium all consumers are served efficiently, price is salient, the manufacturer sets an inefficiently low quality level $q = q^S_{\text{ps}}(\delta) < q^*$, and retailers earn zero profit.

iii) Suppose the share of online consumers is large (i.e., $\alpha \geq \alpha''_S$). Then, in the unique subgame-perfect equilibrium only online consumers are served, no dimension is salient, the manufacturer sets the efficient quality level $q = q^*$, and retailers earn zero profit.

[16] In Appendix A, we delineate the equilibrium outcome in the classical model under vertical restraints.

Also when taking salience effects into account, the manufacturer wants all consumers to be served in equilibrium if the share of online consumers is sufficiently small (i.e., $\alpha < \alpha''_S$). But in contrast to the rational benchmark, he cannot induce such an equilibrium while charging a wholesale price of $w = v(q) - r$. In order to understand why, note that at this wholesale price we must have $p_{i,\text{off}} = v(q)$. Otherwise, the retailers could not break even on offline sales. Now, suppose that the retailers offer the product online at a price $p_{i,\text{on}} = w$, as is the case in the rational benchmark. Then, the product's price is salient and consumers are willing to pay at most $\delta v(q)$, which in turn implies that offline consumers are not willing to buy at price $p_{i,\text{off}} = v(q)$. If retailers instead charge equal prices across distribution channels, namely $p_{i,\text{on}} = v(q)$, price salience can be avoided and offline consumers are willing to buy at $p_{i,\text{off}} = v(q)$. In this case, retailers break even on offline sales and earn a considerable margin on online sales. But, by Assumption 1, each retailer has an incentive to deviate to a lower online price in order to attract *all* online consumers, although this deviation renders the price salient and makes offline sales unprofitable. Thus, if all consumers are served in equilibrium, the wholesale price cannot be the same as in the rational benchmark, since in this case retailers prefer to drop offline sales.

With only few online consumers in the market (i.e., $\alpha < \alpha'_S$), the manufacturer incentivizes the retailers to charge equal prices across distribution channels. For that, he optimally lowers the wholesale price and leaves the retailers a positive margin on offline sales to make them partially internalize the negative externality of price salience on the consumers' willingness-to-pay. As a result, the retailers voluntarily abstain from charging lower online prices. Yet, the *salience threat*—that is, the retailers' threat to drop offline sales at high wholesale prices—warrants the retailers a considerable share of industry profits in equilibrium. Interestingly, the manufacturer makes online price cuts even less attractive by increasing the product's quality beyond the efficient level, as a retailer's equilibrium profit increases faster in quality than her deviation profit. This follows from the fact that the decrease in a consumer's willingness-to-pay due to price salience, $(1 - \delta)v(q)$, increases in the provided quality q. Hence, we say that in the case of few online consumers—that is, for any $\alpha < \alpha'_S$—an *excessive branding equilibrium* arises.

For intermediate levels of online consumers (i.e., $\alpha'_S \leq \alpha < \alpha''_S$), the manufacturer wants all consumers to be served in equilibrium, but it is either impossible or unprofitable to incentivize retailers to charge equal prices across channels. Since the manufacturer cannot avoid a price-salient environment, he optimally charges a wholesale price that allows retailers to break even on offline sales under price salience. In equilibrium, the online price equals $p_{i,\text{on}} = \delta v(q) - r$ while the offline price equals $p_{i,\text{off}} = \delta v(q)$, which in turn implies that all consumers are served efficiently. In such a *price salient equilibrium* the manufacturer has fewer incentives to invest in quality, so that in equilibrium not only the perceived quality is deteriorated but also the provided quality is inefficiently low.

If the share of online consumers is sufficiently high (i.e., $\alpha \geq \alpha''_S$), the manufacturer charges a wholesale price $w = v(q)$, so that in equilibrium only online consumers are served. We denote this equilibrium an *online equilibrium*. As in the classical model, if there are only few offline consumers, the manufacturer does not find it worthwhile to lower the wholesale price by the amount of the retail costs in order to enable profitable offline sales. Since the high wholesale price rules out any variation in the retail prices, price salience cannot occur in the respective retail equilibrium. Thus, the manufacturer sets the efficient quality level $q = q^*$.

Finally, note that a price salient equilibrium exists (i.e., $\alpha'_S < \alpha''_S$) as long as the salience effects are not too strong; that is, as long as the salience parameter δ is sufficiently large. Otherwise, price salience causes such a large reduction in profits that the manufacturer will always induce an equilibrium in which prices are non-salient.

Corollary 1. *There exists some $\underline{\delta} < 1$ such that for any $\delta > \underline{\delta}$ a price salient equilibrium exists.*

Key Insights. In the absence of vertical restraints, salience effects may induce two types of inefficiencies. For small shares of online consumers (i.e., $\alpha < \alpha''_S$) a *quality distortion* arises. The manufacturer either produces an excessive quality to prevent a price-salient environment or an insufficient quality in case prices are salient in equilibrium. For a larger share of online consumers (i.e., $\alpha''_S \leq \alpha < \alpha_R$), salience effects result in a *participation distortion*. Under price salience it may not be profitable to operate the brick-and-mortar store anymore and an equilibrium in which only online consumers are served becomes more likely—in the sense of set inclusion—compared to the rational benchmark (i.e., $\alpha''_S < \alpha_R$). Vertical restraints could potentially resolve both types of inefficiencies.

4 Vertical Restraints

In this section, we extend our basic model by assuming that the manufacturer is allowed to impose one of three vertical restraints: a direct ban on online sales (Section 4.1), resale price maintenance (Section 4.2), or dual pricing (Section 4.3). For each of these constraints we derive the respective welfare implications. We also contrast our insights on the effects of the different restraints with the classical model. Throughout the paper we adopt the convention that the manufacturer imposes a vertical restraint if and only if it *strictly* increases his profit.

4.1 A Direct Ban on Online Sales

Whenever the manufacturer wants all consumers to be served in equilibrium, he can strictly increase his profits by prohibiting online sales. Such a direct ban on online sales preempts both types of salience distortions, so that under a ban all consumers are served via their local brick-and-mortar store at the efficient quality level.

Proposition 2. *Suppose the manufacturer is allowed to impose a ban on online sales. Then, for any $\alpha \in (0, \alpha_R)$, the manufacturer prohibits online sales, so that in the unique subgame-perfect equilibrium all consumers are served via their local brick-and-mortar store, no dimension is salient, the manufacturer sets the efficient quality level $q = q^*$, and retailers earn zero profit. For any $\alpha \in [\alpha_R, 1)$, the manufacturer does not impose a ban on online sales and the equilibrium is the same as described in Proposition 1.*

We observe that the manufacturer admits online sales if and only if the share of online consumers is large enough so that even in the classical model without vertical restraints he would induce the retailers to serve only online consumers. If the manufacturer prohibits online sales, he can charge a wholesale price of $w = v(q) - r$ and earn the same profit from serving all consumers as in the classical model without vertical restraints. In addition, the manufacturer's profit from inducing retailers to only sell the product online does not depend on whether consumers are susceptible to salience or not (see Proposition 1). Hence, the manufacturer strictly prefers a ban on online sales if and only if $\alpha < \alpha_R$. Notably, if consumers are not susceptible to the salience bias, the manufacturer would never impose a ban on online sales, as his profits would not suffer from price variations across distribution channels.

Since prohibiting online sales preserves the consumers' appreciation of quality, we provide a rationale for the claim that a ban on online sales indeed allows the protection of a brand's image. Due to the contrast effect, manufacturers may want to ban online sales in order to minimize the variation in retail prices across distribution channels, as consumers would only fully appreciate the brand's quality in the event of a uniform retail price.

In order to analyze the welfare effects of a ban on online sales, we have to introduce some notation. First, denote the equilibrium quality absent a ban on online sales as $q^S = q^S(\alpha, \delta)$. Second, denote as $\Delta_q(\alpha, \delta) := [v(q^*) - c(q^*)] - [v(q^S) - c(q^S)]$ the corresponding loss in welfare due to the quality distortion arising from salience effects.

Proposition 3. *For any $\alpha \in (0, \alpha''_S]$, the manufacturer's ban on online sales (weakly) increases social welfare if and only if $\Delta_q(\alpha, \delta) \geq \alpha \cdot r$. In addition, there exists some $\tilde{\delta} < 1$ such that for any $\delta > \tilde{\delta}$ and $\alpha \leq \alpha''_S$ the manufacturer's ban strictly decreases social welfare. For any $\alpha \in (\alpha''_S, 1)$, the manufacturer imposes a ban on online sales if and only if a ban strictly increases social welfare, that is, if and only if $\alpha''_S < \alpha < \alpha_R$.*

On the one hand, a ban on online sales ensures that the manufacturer will produce the efficient quality, q^*, so that the quality distortion arising from salience effects can be avoided due to a ban. On the other hand, retail costs are inefficiently high under a ban on online sales as online consumers are forced to buy via their local brick-and-mortar store. The welfare implication of a ban depends on which of these effects prevails. Notably, the quality distortion due to salience effects vanishes for δ approaching one, so that for small shares of online consumers (i.e., $\alpha \leq \alpha''_S$) a ban on online sales decreases welfare if the salience bias is weak. For any $\alpha''_S < \alpha < \alpha_R$, however, the ban on online sales strictly increases social welfare. Absent a ban, only online consumers are served in equilibrium. If, in contrast, online sales are banned, all consumers are served via their local brick-and-mortar stores. Hence, for any $\alpha''_S < \alpha < \alpha_R$, the participation distortion due to salience effects can be avoided through the ban. To see that in this case a direct ban on online sales indeed increases social welfare, note first that—within the respective range of α—the retailers earn zero profit irrespective of whether online sales are banned or not. Second, consumer surplus is also zero in either case, as the retail price is equal to $v(q)$ irrespective of whether a ban is imposed or not. Hence, for any $\alpha''_S < \alpha < \alpha_R$, social welfare coincides with the manufacturer's profit, so that Proposition 2 yields our claim. Figure 2 summarizes these results.

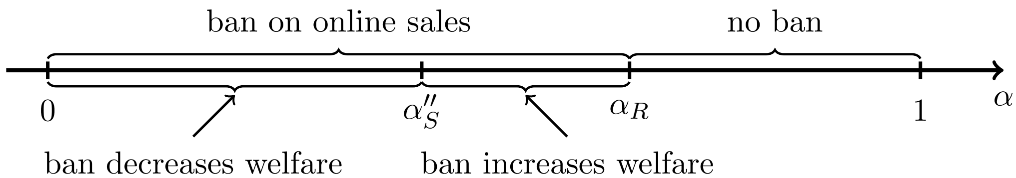

Figure 2: *Let $\delta > \tilde{\delta}$. For any $\alpha < \alpha_R$, the manufacturer prohibits online sales. While this ban strictly decreases welfare for any $\alpha \leq \alpha_S''$, it strictly increases welfare for any $\alpha_S'' < \alpha < \alpha_R$.*

To sum up, a ban on online sales is to be prohibited from a social welfare perspective if and only if prior to the implementation of the ban the product was sold both on- *and* offline. Thus, due to its ambiguous welfare effects, the assessment of a ban requires a case-based analysis with a focus on the market structure that would emerge absent a ban.

Notably, if the manufacturer operates an own online store, allowing bans on online sales is always beneficial from a social welfare perspective (see Section 5.3 for an extension of our baseline model along these lines).

4.2 Resale Price Maintenance

Under resale price maintenance (RPM) the manufacturer determines the prices charged by the retailers in either channel. Absent salience effects, a manufacturer has no incentive to control retail prices in our model (see Appendix A for a more formal argument). If consumers are susceptible to salience, controlling retail prices becomes attractive as RPM allows the adverse salience effects of online sales to be ruled out.

Proposition 4. *Suppose the manufacturer can determine retail prices. Then, if $\alpha \in (0, \alpha_R)$, the manufacturer fixes retail prices to $p_{i,k} = v(q)$ for any $i \in \{1, \dots, N\}$ and any $k \in \{\text{on}, \text{off}\}$, so that in the unique subgame-perfect equilibrium all consumers are served efficiently, no dimension is salient, the manufacturer sets the efficient quality level $q = q^*$, and retailers earn strictly positive profits. For any $\alpha \in [\alpha_R, 1)$, the manufacturer does not impose a restraint on retail prices and the equilibrium is the same as described in Proposition 1.*

Aligning on- and offline prices via RPM allows adverse salience effects to be ruled out without preventing efficient online sales. Thus, RPM is desirable not only for the manufacturer, but also from a social welfare point of view.

Proposition 5. *The manufacturer imposes a restraint on retail prices if and only if this restriction strictly increases social welfare, that is, if and only if $\alpha < \alpha_R$.*

4.3 Dual Pricing

Dual pricing allows the manufacturer to charge different wholesale prices for units to be resold online and for units to be resold offline. This gives the manufacturer control over the channels in which his product is sold as well as over the prices the retailers can charge in each channel. On the one hand, dual pricing allows the manufacturer to extract the online consumers' willingness-to-pay for online sales via a high wholesale price for units to be resold online. On the other hand, it allows lower wholesale prices to be charged for units that are resold offline, so that the retailers can cover the offline retail costs. Besides, dual pricing prevents a price-salient environment and therefore both types of salience distortions. As a consequence, for any $\alpha \in (0, 1)$, the manufacturer strictly prefers to implement a dual pricing scheme.

Proposition 6. *Suppose the manufacturer is allowed to condition his wholesale price on the distribution channel. Then, for any $\alpha \in (0, 1)$, the manufacturer charges a higher wholesale price for units to be resold online than for units to be resold offline, so that in the unique subgame-perfect equilibrium all consumers are served efficiently, no dimension is salient, the manufacturer chooses the efficient quality $q = q^*$, and retailers earn zero profit.*

Already absent salience effects dual pricing strictly increases social welfare for any $\alpha > \alpha_R$. In the presence of salience effects, the use of dual pricing schemes also preempts both the quality and the participation distortion, so that not only the manufacturer's profit but also social welfare is always strictly enhanced.

Proposition 7. *For any $\alpha \in (0, 1)$, a dual pricing regime strictly increases social welfare.*

5 Robustness of our Findings

Our qualitative findings are robust to several extensions of the baseline model. On the one hand, we extend the contract space by allowing the manufacturer to charge a uniform two-part tariff (Section 5.1) or retailer-specific contracts (Section 5.2). On the other hand, we vary the market structure by assuming that the manufacturer runs an own online store (Section 5.3) or that retailers are heterogeneous with respect to their fixed costs of selling offline, so that in equilibrium some retailers only sell online (Section 5.4).

5.1 Uniform Two-Part Tariff

Suppose the manufacturer can offer a uniform two-part tariff. The formal analysis of this extension is relegated to Appendix D.1.

Equilibrium without Vertical Restraints. The equilibrium outcome is the same as before with the exception that for very small shares of online consumers, the manufacturer can enforce equal prices across channels through the linear component of the tariff and extract all profits through the fixed part. In this case, there is no need to distort the product's quality upward and the manufacturer offers the efficient product specification. Besides, the equilibrium outcome does not change qualitatively as the only instrument to control retail prices is the tariff's linear component. More specifically, for larger values of α, the manufacturer can either enforce equal prices across distribution channels by providing an excessive quality or he is not able to induce retailers to charge the same prices on- and offline.

Equilibrium with Vertical Restraints. In contrast to our baseline model, for very small values of α, the manufacturer does not impose a vertical restraint, as the two-part tariff already allows the manufacturer to maximize and extract industry profits.[17] Interestingly, resale price maintenance combined with a two-part tariff allows the manufacturer to extract for any $\alpha \in (0, 1)$ the maximum industry profit, so that under RPM also social welfare is maximized. Altogether, the welfare implications of allowing the manufacturer to impose a certain vertical restraint are qualitatively the same as under linear contracting.

5.2 Retailer-Specific Contracts

Suppose the manufacturer can offer retailer-specific contracts. In addition, let transportation costs be large enough so that the manufacturer does not want to rely on a single retailer to serve offline consumers. Then, the equilibrium structure and our welfare implications do not hinge on the assumption of uniform tariffs (for a formal analysis, see Appendix D.2).

[17] With two-part tariffs we refer to dual pricing as conditioning the linear component on the retail channel.

Equilibrium without Vertical Restraints. If the manufacturer wants to induce equal prices across channels, he may now want to exclude some retailers from the market. On the one hand, the larger the number of active retailers, the more areas and their respective offline consumers can be served (*demand-expanding effect*). On the other hand, the larger the number of active retailers, the more attractive it is for a certain retailer to capture the entire online market by undercutting the other retailers' online prices. Therefore, the maximal wholesale price that induces a retailer to charge a high online price weakly decreases in the number of active retailers (*margin-reducing effect*). If the manufacturer wants to induce an excessive branding equilibrium, he trades off the demand-expanding and the margin-reducing effects to determine the optimal number of active retailers. For small shares of α, the demand-expanding effect dominates, so that it is optimal to charge a uniform wholesale price and to not exclude any retailer. Notably, the maximum profit that the manufacturer can earn in a price salient or an online equilibrium, respectively, does not change compared to the case of a uniform wholesale price.

Altogether, we conclude that the equilibrium structure is qualitatively the same as under uniform tariffs: if the share of online consumers is sufficiently small, the manufacturer supplies *all* retailers at a uniform wholesale price and an excessive branding equilbrium arises. If the share of online consumers is sufficiently large, however, the manufacturer wants only online consumers to be served and an online equilibrium arises. Only for intermediate shares of online consumers the manufacturer could have a strict incentive to exclude some retailers from the market. Here, either an excessive-branding equilibrium arises in which only a subset of retailers are active or a price-salient equilibrium in which all retailers are active.

Equilibrium with Vertical Restraints. Given that the manufacturer can offer retailer-specific linear wholesale prices, the equilibrium with and without vertical restraints has the same structure as under uniform tariffs. As a straightforward consequence, also the welfare implications derived in Section 4 remain valid.

5.3 Manufacturer-Owned Online Store

Next, we extend our baseline model by assuming that the manufacturer also operates an own online store (the formal analysis is relegated to Appendix D.3).

Equilibrium without Vertical Restraints. The equilibrium outcome delineated in Proposition 1 carries over to the case where the manufacturer runs an own online store with one exception: if both channels are operating, online consumers may now be equally distributed across $N+1$ instead of N online stores. In particular, an excessive branding equilibrium is less likely to occur compared to our baseline model, as now each retailer serves only a lower share of online consumers and therefore has a stronger deviation incentive.

Equilibrium with Vertical Restraints. The only difference compared to our baseline model is that operating an own online store makes a ban on online sales even more attractive to the manufacturer. If the manufacturer prohibits online sales by the retailers, he can serve all online consumers via his own online store. By matching the offline price, he can further prevent a price-salient environment. Then, charging a wholesale price that enables retailers to break even on offline sales ensures that all consumers are served efficiently and maximizes not only the manufacturer's profit but also social welfare.

5.4 Online Retailer

Finally, we extend our model by an additional *online retailer* that has no brick-and-mortar store,[18] such as *Amazon* or *Zalando*. We argue that the equilibrium structure does not change qualitatively under retailer-specific contracts. Importantly, the welfare implications of imposing a certain vertical restraint remain the same also under uniform tariffs.

Equilibrium without Vertical Restraints. If the manufacturer can charge retailer-specific wholesale prices, the equilibrium outcome is the same as in the case of a manufacturer-owned online store. The manufacturer can simply adjust the wholesale price charged to the online retailer in a way that rules out price variation. If the manufacturer charges a uniform wholesale price, however, an excessive branding equilibrium no longer exists. At any wholesale price that induces the remaining retailers to charge equal prices across channels, the online retailer has a strict incentive to charge a lower price in order to attract all online consumers. Here, either a price salient equilibrium (for $\alpha < \alpha''_S$) or an online equilibrium (for $\alpha \geq \alpha''_S$) arises.

[18] For instance, this retailer faces high fixed costs of operating a brick-and-mortar store and therefore prefers to only sell the product online, irrespective of the wholesale price and the market structure.

Equilibrium with Vertical Restraints. Under retailer-specific wholesale prices, the welfare effect of imposing a certain vertical restraint does not change qualitatively due to the presence of retailers that exclusively sell online. If the manufacturer charges a uniform wholesale price, the equilibrium without vertical restraints has a different structure compared to our baseline model (i.e., for a small α a price salient instead of an excessive branding equilibrium arises). Importantly, this change in the equilibrium structure absent vertical restraints does not alter the qualitative policy implications derived in Section 4.

6 Related Literature

In this section, we discuss how our paper relates to the existing literature. First, we address questions previously analyzed in the classic literature on vertical restraints. Second, we build on the growing literature that models salience effects. Thereby, our paper relates to other applications of the salience approach to industrial organization.

6.1 Vertical Restraints on Online Sales

This paper relates to the economic literature that is concerned with vertical restraints on online sales. In general, antitrust authorities view vertical restraints skeptically as they alleviate intra-brand competition (OECD, 2013; Bundeskartellamt, 2013).

In a classical model of intra-brand competition the manufacturer has an incentive to apply vertical restraints in order to overcome the opportunism problem, which in turn softens intra-brand competition (Hart and Tirole, 1990). Absent vertical restraints fiercer downstream competition leads to a lower equilibrium price, which could attract—if consumers' were heterogeneous in their valuation of quality—low-value consumers. As a consequence, a manufacturer might provide a lower quality if he cannot impose vertical restraints. In this sense, a classical model with heterogeneous consumers can account for an equilibrium structure that is similar to our price salient equilibrium. An excessive branding equilibrium, however, cannot be the outcome of a classical approach to this issue. More importantly, a classical approach in the spirit of Hart and Tirole (1990) cannot account for the externality that is at the core of our analysis: price discounts in one channel affect the willingness-to-pay of consumers served in another channel.

In order to justify vertical restraints on online sales, manufacturers have put forward that the provision of services suffers from free-riding incentives among online retailers, which may harm social welfare.[19] Telser (1960) and Mathewson and Winter (1984) showed that vertical restraints can align the manufacturer's and the retailers' incentives if free-riding on service externalities (such as retailers' sales effort) is a serious issue in a market.[20] In the presence of free-riding incentives price disparities across channels may exert a negative effect on service provision, as retailers providing services vanish or services are reduced as a response to low online prices. The observation that in such a setup aligning retail prices across channels (e.g., via RPM) yields the first-best solution (as this allows the manufacturer to restore the integrated monopoly outcome) hinges on the assumption that demand characteristics are identical for different retailers and channels. Otherwise, the manufacturer also benefits if the retailers condition their retail prices on demand and channel characteristics. The contrast effect, however, can explain why manufacturers want to stick to flat retail prices even in the presence of demand asymmetries.

In the spirit of Telser (1960) and Mathewson and Winter (1984), online discounts can have a negative effect on brand image, but only an indirect one that results from a reduction in the number of retailers or the quality of services in the long run. In contrast, our salience approach predicts that price disparities have a direct negative effect on both components of brand image: the consumers' perceived and the actual quality. Thus, these two explanations—salience and free-riding—can be empirically disentangled. Anyway, we regard our novel argument in favor of restraints on online sales as complementary to the service-based justification for such restraints.

In other occurrences, vertical restraints have been justified by the need to protect brand image, but only if the product's quality is (at least partially) unobservable ex ante and the product's price therefore serves as a signal of its quality (Inderst and Pfeil, 2016).[21] Unobservable

[19] In particular with respect to hygiene or pharmaceutical products, manufacturers have banned online sales on the grounds that some services (such as personal expert guidance or specific sale methods) could not be replicated over the internet. In the prominent case of *Pierre Fabre* this was regarded as an infringement by object of Article 101(1) TFEU by the European Court of Justice (see Haucap and Stühmeier, 2016).

[20] Hunold and Muthers (2017) challenge the service argument in favor of RPM in a classical model with two manufacturers that share common retailers. Here, minimum RPM does not only increase retail prices, but can also result in lower service quality. Moreover, if manufacturers differ in their market power, RPM distorts service provision in favor of the high-priced product.

[21] Relatedly, Marvel and McCafferty (1984) have investigated a model where the reputation of the retailer

quality, however, plays a role only for specific goods such as credence or experience goods, and also for these goods it is at least questionable whether the product's price serves as an important signal of quality. Nowadays, consumers can typically obtain much information on a product's quality from comprehensive reviews that are easily accessible. In addition, the marketing literature suggests that, especially for brand products, the manufacturer's reputation (as a high-quality producer) rather than the product's price signals the product's quality (Aaker, 2014, Chapter 5). Importantly, our salience approach makes distinct, testable predictions so that, in principle, we can empirically disentangle the salience and the signaling explanation. More specifically, if price serves as a signal of quality, then a price disparity across channels should not affect a consumer's willingness-to-pay in repeat purchases. The contrast effect, however, predicts that price disparities also matter in repeat purchases.

The classical literature has delineated various further explanations for price restraints. Rey and Tirole (1986) show that a manufacturer may want to impose RPM if the retailers have private information about demand or retail costs. Jullien and Rey (2007) reveal that RPM may facilitate collusion among manufacturers. In a model where consumers are heterogeneous with respect to their ability to switch retailers and retailers can engage in third-degree price discrimination, Chen (1999) demonstrates that manufacturers may impose RPM to eliminate discrimination based on consumers' abilities to switch retailers.

In the context of online sales, Miklós-Thal and Shaffer (2017) propose a justification for dual pricing that is not related to brand-image concerns. They show that an optimal contract (i.e., a contract maximizing industry profits) between the manufacturer and the retailer necessarily involves restrictions on resale prices or distribution channels. If consumers accord with the classical model and demand differs across distribution channels, a contract that depends only on the total quantity sold to a retailer is never optimal from the manufacturer's perspective. Absent such restrictions, even if a retailer orders the total quantity that would maximize industry profits, she would sell too little in the less competitive channel, as she charges a too low price in the more competitive channel. In line with our findings, Miklós-Thal and Shaffer suggest that vertical restraints on online sales can positively impact overall welfare. More specifically, Miklós-Thal and Shaffer show that restrictions on online sales can result both in

signals the product's quality to the consumers. Here, the manufacturer may rely on RPM in order to induce reputable retailers to sell his product.

a positive allocation effect across the different channels and a positive effect on the total output. Dertwinkel-Kalt *et al.* (2016) investigate a model where efficient online retailers compete with less efficient offline retailers. Conditioning wholesale prices on the retail channel allows a manufacturer to compensate an offline retailer for higher retail costs, thereby keeping her in the market. If dual pricing was infeasible, a large online retailer could strategically abuse a strong bargaining position in order to enforce poor procurement conditions for *all* retailers. These conditions harm less efficient rivals overproportionally, which may soften competition due to market exit. Thus, Dertwinkel-Kalt *et al.* derive a positive effect of dual pricing in a classical model, which is unrelated to brand-image concerns. Hunold and Muthers (2014) contrast price restraints and channel restraints in a model where service quality plays an important role. They argue that price restraints such as dual pricing or RPM enable the manufacturer to incentivize high service quality by retailers without preventing efficient online sales. In contrast to our study, none of these studies analyzes how channel miscoordination affects the product design.

To conclude, models with rational consumers can justify a *direct* harm to the brand image in the context of e-commerce only for markets in which quality is partially unobservable to consumers. We provide a novel justification of vertical restraints in order to protect brand image that does not hinge on such an auxiliary assumption. We suggest that lower online prices shift a consumer's focus to prices, so that the valuation for high-quality products is deteriorated, which in turn harms the respective brand's image.

6.2 Stimulus-Driven Attention and Economic Choice

Our model of consumer choice builds on the growing behavioral literature on stimulus-driven attention (Bordalo *et al.*, 2013b; Kőszegi and Szeidl, 2013) according to which a decision maker's attention is guided toward certain choice attributes that are salient in the given choice context. Hereby, a certain attribute of an option is the more salient the more it contrasts with the value that alternative options in the choice context offer along this choice dimension. An option's price, for instance, is the more salient the more it differs from the alternative options' prices. Attributes in which the available options offer rather similar values are not attention-grabbing and tend to be neglected.[22] In particular the salience model (Bordalo *et al.*, 2012, 2013b) allows a wide

[22]While both the salience model (Bordalo *et al.*, 2013b) and the focusing model (Kőszegi and Szeidl, 2013) build on the contrast effect, the salience approach is enriched by the additional assumption of diminishing sensitivity.

number of decision biases to be explained in a coherent framework such as the Allais paradox and preference reversals (Bordalo *et al.*, 2012), decoy and compromise effects (Bordalo *et al.*, 2013b; Apffelstaedt and Mechtenberg, 2017; Herweg *et al.*, 2017), skewness preferences (Bordalo *et al.*, 2013a; Dertwinkel-Kalt and Köster, 2017), the newsvendor problem (Dertwinkel-Kalt and Köster, 2017) and violations of money fungibility (Hastings and Shapiro, 2013). Consequently, models that build on the assumption of stimulus-driven attention are promising candidates for improving our understanding of individual decision making.

6.3 Salience and Industrial Organization

Several papers apply the salience approach to open questions in industrial organization. Bordalo *et al.* (2016) investigate how the cost of producing a good of a certain quality strategically determines whether a market exhibits a "commoditized" price salient equilibrium or a "de-commoditized" quality salient equilibrium. Their results are driven by diminishing sensitivity: as the overall price level increases in cost, quality is more likely to be salient in a high- than in a low-cost environment. Apffelstaedt and Mechtenberg (2017) analyze a two-stage game where firms compete à la Bertrand in the first stage, but exploit context-sensitivity as predicted by the salience model as soon as the consumer has entered the store and is "locked-in." Herweg *et al.* (2017) derive the optimal decoy that induces a consumer to focus on the target's quality, thereby maximizing her willingness-to-pay for the target product. Inderst and Obradovits (2016b) show that in the presence of salience effects firms compete excessively for headline prices and provide qualities that are inefficiently low. Building on the model by Varian (1980), Inderst and Obradovits (2016a) investigate the implications of salient thinking for pricing, promotions, and product choice. While in the classical model each firm offers the product that is absolutely stronger, salient thinkers may be attracted by a product that is only relatively stronger (i.e., a product with a higher quality-to-price ratio). Thus, in a model with salient thinking product variety may be larger than in the classical model.

There are two papers building on the salience model that are closely related to our approach, namely Inderst and Obradovits (2017) and Helfrich and Herweg (2017). Importantly, the salience model incorporates two main assumptions: the contrast effect and diminishing sensitivity. While

In our present paper, diminishing sensitivity does not play a role so that our approach is in line with both models.

our model builds on the contrast effect, the findings in Inderst and Obradovits (2017) and Helfrich and Herweg (2017) rely on diminishing sensitivity to a given contrast. Notably, the contrast effect is much harder to reconcile with the classical model and also less explored than diminishing sensitivity, which is already an integral assumption of *prospect theory* (Kahneman and Tversky, 1979). Thus, the central mechanisms in Inderst and Obradovits (2017) and Helfrich and Herweg (2017) are fundamentally different from ours.

Inderst and Obradovits (2017) delineate a model of one-stop shopping, where consumers require several goods, but compare the retailers only with respect to their offers for one prominent good. Beside choosing prices, retailers decide whether to offer a low- or a high-quality of the prominent good. In equilibrium, the prominent product might become a *loss leader*, as retailers offer it at particularly low prices to attract consumers. Absent salience effects, it is an equilibrium for all retailers to stock the high- and for all retailers to stock the low-quality product. If salience effects are taken into account, however, this might not hold true anymore. Due to diminishing sensitivity, a retailer's incentive to deviate from a low-quality equilibrium by offering the high-quality product is weaker than her incentive to deviate from a high-quality equilibrium by offering the low-quality product in order to make the price salient. Hence, if consumers are salient thinkers, the retailers might offer the low- instead of the high-quality product as a loss leader. Thus, also Inderst and Obradovits show that taking salience effects into account can induce a lower provision of quality. In their model the quality reduction is driven by the retailers, while in our model the manufacturer may reduce quality provision if vertical restraints are infeasible.

Helfrich and Herweg (2017) consider a market in which retailers can sell a high-quality product of a strategic manufacturer (procured at a linear wholesale price) and a low-quality substitute produced by a competitive fringe. As in our model, retailers can sell both on- and offline. In contrast to our model, however, they assume that all consumers strictly benefit from offline purchases and that retail costs in both channels are zero. According to diminishing sensitivity, the mark-up that the manufacturer can charge for its higher quality increases in the price level. As online sales lower the overall price level, they also lower the mark-up the manufacturer can charge for its higher quality, so that the manufacturer has an incentive to ban online sales. Notably, this effect also occurs in a model without salience where consumer disutility from paying money is concave. Then, the mark-up that can be charged for the quality-upgrade is higher at high than at low price levels so that online sales are unattractive to a manufacturer as they lower the overall price level.

Helfrich and Herweg assume that the salience of the products' prices depends only on prices charged in the same channel. Thus, in their model a consumer's consideration set when visiting some store includes one imperfect substitute—the fringe product—but not the closer substitute, that is, the same product offered through a different channel. Not including the online offers in the consideration set at the brick-and-mortar store gives also rise to a conceptual problem: if on- and offline offers are not included in the same consideration set, it is not clear how on- and offline products can be compared. In line with the empirical (Hastings and Shapiro, 2013) and experimental (Dertwinkel-Kalt *et al.*, 2017b) evidence and in the spirit of the salience approach our model admits that the salience of a product's current price depends on prices the consumer has previously seen for the same good.

Both the model by Helfrich and Herweg and ours can explain why a manufacturer might want to ban online sales. The welfare implications are different, however, as we allow for explicit advantages of online sales (such as lower retail costs). Moreover, we do not only discuss bans (but also RPM and dual pricing) and we endogenize the quality level (whereas Helfrich and Herweg assume fixed quality levels).

7 Concluding Remarks

Vertical restraints are frequently applied by manufacturers in order to solve coordination problems in vertically related markets. The vertical and horizontal external effects of such restraints can alleviate issues of double marginalization or free-riding on services. In the context of e-commerce, manufacturers have put forward the argument that a restriction of online sales is necessary in order to protect their brand image. Based on the classical model, this argument applies only in rare cases: for instance, if a product's quality is unobservable ex ante and therefore signaled by its price. The widespread use of these restraints is thus somewhat puzzling, and the German cartel office regards it as a key open question whether the use of vertical restraints on online sales can be justified based on brand image concerns.

Our paper contributes to the small, but growing literature on behavioral antitrust by analyzing the welfare implications of vertical restraints in the presence of salience effects. In fact, we provide a novel theoretical foundation for the manufacturers' claim that online sales can harm brand image, and therefore also consumers in the long run. By drawing consumer attention toward prices, low online prices decrease the willingness-to-pay for high-quality products. The manufacturer's product design will respond to the consumers' excessive focus on prices, which results in an inefficiently low provided quality. This quality distortion lowers not only the manufacturer's profit, but also social welfare, so that the implementation of vertical restraints might be both individually and socially desirable. We show that in our model resale price maintenance and dual pricing are never problematic from a social welfare perspective. Moreover, a direct ban on online sales should be allowed if the manufacturer runs an own online store, but should be prohibited if this is not the case and if the product was also sold offline prior to the implementation of the ban (which is very likely to be the case). In this sense, the assessment of such a direct ban on online sales requires a case-based analysis with a focus on the market structure that would emerge absent a ban.

Altogether, the aforementioned restraints (a direct ban, RPM, and dual pricing) should not be regarded as hardcore restrictions of competition as is the case under European competition law. Instead, direct bans on online sales should be judged on a case-by-case basis—due to their ambiguous welfare effects—as in the United States, while resale price maintenance and dual pricing schemes should be considered legal. Thereby, our analysis is complementary to recent papers that study vertical restraints on online sales building on classical economic agents (e.g., Dertwinkel-Kalt *et al.*, 2016; Miklós-Thal and Shaffer, 2017), which have in common that they single out the positive effect of dual pricing schemes on social welfare.

Notably, in our baseline model the manufacturer strictly prefers to condition his wholesale price on the distribution channel over resale price maintenance and a complete ban of online sales. This is due to the fact that given the restriction to linear wholesale prices dual pricing yields the manufacturer a more flexible instrument to extract profits than the other two restraints. Once we extend our model toward more general contracts (i.e., two-part tariffs) or allow for a manufacturer-owned online store, resale price maintenance and a direct ban become equally attractive restraints. In practice, conditioning the wholesale price on the distribution channel requires the manufacturer to track sales separately for each channel, which may be impossible. It is much easier for the manufacturer to implement a ban on online sales or to engage in resale price maintenance. Thus, in practice, the manufacturer may prefer either of these constraints depending on the exact market constellation.

While we have assumed that all consumers are aware of all offers, our results do not rely on this specific assumption. First, as we have delineated in Section 2, we could alternatively assume that online consumers are not aware of the offline offers or that offline consumers only consider the online offers and their local offline offer. Adopting these alternative assumptions does not affect our results. Second, we could also allow for an additional group of consumers that are only aware of the offline offers. If we add such a group of consumers, the online equilibrium would be *less* likely to occur and the excessive branding equilibrium would be *more* likely to occur (in the sense of set inclusion), but the equilibrium structure would not change. Likewise, we could allow for a minority group of rational consumers that are not susceptible to the contrast effect. As our results are driven by the negative externality of cheap online sales on the offline consumers' willingness-to-pay we just need that the share of offline consumers that are aware of online offers is sufficiently large.

Our beneficial view on vertical restraints is also robust with respect to a different definition of consumer welfare. In order to obtain our welfare results, we have assumed that consumption and not salience-weighted utility is the relevant measure of consumer surplus. This assumption is in line with the bulk of behavioral economics literature (see, for instance, the discussion in Kőszegi and Szeidl, 2013). Accordingly, price salience ensures consumers a positive rent in equilibrium, as consumption utility exceeds the consumers' willingness-to-pay due to their focus on prices. Bernheim and Rangel (2007), in contrast, have taken the view that decision utility—in our case, salience-weighted utility—at least partially determines consumer surplus. As opposed to our approach, consumers do not obtain a rent under price salience then. Importantly, our finding that vertical restraints are desirable from a social welfare point of view holds all the more if the approach by Bernheim and Rangel (2007) is adopted. To sum up, our welfare implications are unambiguous in the sense that they do not hinge on the specific concept of consumer surplus.

While our model builds on consumers that are homogeneous in their valuation for quality and buy at most one unit, its economic logic also holds in the case of downward sloping aggregated demand. As price salience lowers the retail prices, one might be concerned that price salience mitigates the double marginalization problem, which in turn implies that price salience could be attractive from the manufacturer's perspective. As we show in Appendix F, however, price salience does not mitigate, but exacerbates the welfare loss due to double marginalization. Hence, the manufacturer has a similar incentive to prevent a price-salient environment as in our baseline model without downward sloping demand. Here, in particular RPM can eliminate double marginalization and the salience distortions simultaneously. In this sense also our positive view on vertical restraints carries over to the case where aggregated demand is downward sloping.

Our model relies on consumer behavior that is experimentally testable. We suggest that a brand manufacturer's potential consumers are affected in their willingness-to-pay by prices of the same product seen before, but not by the prices of substitute products that are not bought. Using a brand product and upfront information emails that contain price information (either regarding the brand or the substitute product), this assumption can be tested in a framework that is similar to the one adopted by Dertwinkel-Kalt *et al.* (2017b). In particular, this gives a test of the fundamental externality that our analysis builds on, that is, the effect a discount in one channel (or, in general, a discount seen somewhere) has on the willingness-to-pay of consumers that buy in a different channel.

Our model also makes novel predictions that are empirically testable. Suppose that direct bans on online sales, RPM, and dual pricing are legally ruled out. We then predict that a manufacturer's incentive to provide a high quality is reduced in the long run if the product is sold online at low prices. If, in contrast, a product is sold online at a price similar to its offline price, we would suggest that a manufacturer will not have an incentive to lower the provided quality. Anecdotal evidence supports this prediction. In a survey on the empirical literature on vertical restraints, Lafontaine and Slade (2008) state: "[...] it appears that when manufacturers choose to impose such restraints, not only do they make themselves better off, but they also typically allow consumers to benefit from higher quality products [...]." Another phenomenon that is in line with our predictions has been detected by Cavallo and Rigobon (2016), who have found that for most products on- and offline prices are identical. Unlike standard theory, our salience-based approach can account for this lack of price dispersion. In order to avoid a price-salient environment, it can be optimal to charge equal prices in different channels, even if cost and demand characteristics vary between these channels. A rigorous test of our empirical predictions is left for future research.

The contrast effect also allows us to understand why the interest in minimum advertised price (MAP) policies has "skyrocketed" (Amarante and Banks, 2013) in recent years. According to Amarante and Banks (2013), "MAP policies impose restrictions on the price at which a product or service may be advertised, without restricting the actual sales price." In light of the contrast effect, these practices can be well-understood. In an extension of our model that distinguishes between advertised and actual prices, it seems intuitive to assume that offline (online) consumers are aware only of advertised instead of actual online (offline) prices. On the one hand, minimum advertised prices can eliminate the negative externality that (advertised) online discounts impose on the offline consumers' willingness-to-pay, while on the other hand they allow for optimal discriminatory pricing. Thereby, we add to the understanding of why "US manufacturers use MAP to protect brand image."[23] In this sense, the contrast effect might further help us to understand widespread price regulations beyond those discussed in the present paper.

We can further add to the recent debate on geoblocking in the EU.[24] For the sake of argument, consider an extension of our baseline model with two countries that have the same mass of consumers and the same share of online consumers. Under geoblocking, consumers can only buy the product from retailers located in the same country. If geoblocking is prohibited, however, consumers can also buy online from retailers in a different country. Thus, a ban on geoblocking increases the size of the online market from a single retailer's perspective, and increases her incentive to charge a low online price. As a consequence, an excessive branding equilibrium is *less* likely to occur. Since the actual size of the online market does not change, the online equilibrium remains equally attractive from the manufacturer's perspective, so that a price salient equilibrium is *more* likely to occur. This yields further testable predictions: a ban on geoblocking reduces retail prices, increases price dispersion, and lowers quality provision.

Finally, our mechanism applies not only to pricing decisions across different distribution channels, but can also explain price rigidity in other setups. For instance, state tax rates in many European countries differ for the same food product bought at the same place, depending on whether it is eaten inside or outside the store or restaurant. Nevertheless, consumer prices are often the same. The contrast effect can rationalize such pricing schemes as it suggests that a price disparity would guide the attention to prices, thereby lowering the overall willingness-to-pay for both options. In light of the contrast effect, variance along dimensions that are undesirable for consumers guides attention away from favorable product features, which explains why manufacturers may well be interested in rigid prices.

[23] `https://econsultancy.com/blog/64520-map-abuse-are-you-protecting-your-brand/` (downloaded on Sept. 12, 2017).

[24] See, e.g., `http://europa.eu/rapid/press-release_IP-17-4781_en.htm` (downloaded on Dec. 5, 2017).

Appendix A: Rational Benchmark with Vertical Restraints

Suppose consumers maximize consumption utility. In this section, we formally analyze whether the manufacturer has an incentive to impose a certain vertical restraint.

Proposition 8. *Fix some $\alpha \in (0,1)$. Then, the following holds:*

i) Even if feasible, the manufacturer does not impose a ban on online sales.

ii) Even if feasible, the manufacturer does not restrain retail prices

iii) If feasible, the manufacturer charges a higher wholesale price for units to be resold online than for those to be resold offline. In the unique subgame-perfect equilibrium all consumers are served efficiently, the manufacturer chooses the efficient quality $q = q^*$, and retailers earn zero profit.

Proof. We prove parts i), ii) and iii) successively.

PART i). For the sake of a contradiction suppose online sales are banned. In this case, the manufacturer maximizes his profit by setting $w(q) = v(q) - r$ and $q = q^*$, so that all consumers are served offline and the manufacturer earns $v(q^*) - r - c(q^*)$. Absent a ban the manufacturer could earn $\max\{v(q^*)-r-c(q^*), \alpha\cdot[v(q^*)-c(q^*)]\}$. Hence, the manufacturer can never increase his profit by imposing a ban on online sales; a contradiction.

PART ii). Note that by fixing retail prices, the manufacturer cannot increase the overall demand. Thus, fixing retail prices cannot increase the manufacturer's profit. By fixing retail prices to $v(q)$, the manufacturer can earn $\max\{v(q^*) - r - c(q^*), \alpha \cdot [v(q^*) - c(q^*)]\}$, that is, the profit level absent a restraint on retail prices. Fixing a different retail price cannot increase the manufacturer's profit either, so that the manufacturer has no incentive to restrain retail prices.

PART iii). Suppose the wholesale price for units to be resold offline is $w_{\text{off}}(q) = v(q) - r$ and the wholesale price for units to be resold online is $w_{\text{on}}(q) = v(q)$. As a consequence, the retailers are able to serve all consumers efficiently, so that the manufacturer earns a profit of $(1-\alpha)w_{\text{off}}(q) + \alpha w_{\text{on}}(q) - c(q) = v(q) - (1-\alpha)r - c(q)$, which strictly exceeds his profit absent dual pricing, that is, $\max\{v(q) - r - c(q), \alpha \cdot [v(q) - c(q)]\}$, for any $\alpha \in (0,1)$ and any $q \in [\underline{q}, \overline{q}]$. Obviously, the manufacturer provides the efficient quality level, $q = q^*$, as this allows him to maximize both the profit to be earned from on- and offline consumers. □

Appendix B: Proofs Omitted in the Main Text

Appendix B.0: Preliminaries

In this subsection, we derive some general properties of the retail equilibria in a given subgame. For that, we have to introduce some notation. Fix some wholesale price $w \geq 0$ and some quality $q \in [\underline{q}, \overline{q}]$. Then, we denote as $\rho_{i,k} = \rho_{i,k}(w, q) \in [0, 1]$ the probability that retailer i operates distribution channel $k \in \{\text{on}, \text{off}\}$ and, given $\rho_{i,k} > 0$, as $\sigma_{i,k} = \sigma_{i,k}(w, q \mid \rho_{i,k} > 0) \in \Delta(\mathbb{R}_+)$ the corresponding pricing strategy of retailer i in this channel. In the following, we denote the strategy of retailer i in a given subgame as $\Sigma_i := (\rho_{i,\text{on}}, \rho_{i,\text{off}}, \sigma_{i,\text{on}}, \sigma_{i,\text{off}})$. Finally, we denote for a given strategy profile $(\Sigma_1, \ldots, \Sigma_N)$ the expected demand of retailer i in channel $k \in \{\text{on}, \text{off}\}$ as $d_{i,k} = d_{i,k}(\Sigma_1, \ldots, \Sigma_N)$ and her expected profit in this channel as $\pi_{i,k} = \pi_{i,k}(\Sigma_1, \ldots, \Sigma_N)$.

Definition 1. *A strategy profile $(\Sigma_1, \ldots, \Sigma_N)$ is* pure on the active path *if for any retailer i and any channel k: $d_{i,k} > 0 \Rightarrow$ (i) $\rho_{i,k} = 1$ and (ii) $\sigma_{i,k}$ assigns probability one to a single price.*

In a first step, we verify that any equilibrium strategy profile is pure on the active path.

Lemma 1. *A strategy profile $(\Sigma_1, \ldots, \Sigma_N)$ constitutes a retail equilibrium only if it is pure on the active path, irrespective of whether consumers are rational or susceptible to salience.*

Proof. In a first step, we show that *if in equilibrium $d_{i,k} > 0$, then $\rho_{i,k} = 1$.* For the sake of a contradiction, suppose the opposite; that is, we have $d_{i,k} > 0$ and $\rho_{i,k} < 1$ in equilibrium. If $\pi_{i,k} \geq 0$, retailer i can strictly increase her expected demand while making a weakly higher expected profit by setting $\rho_{i,k} = 1$ and by our tie-breaking assumption she always has an incentive to do so; a contradiction. If $\pi_{i,k} < 0$, retailer i can strictly increase her expected profit by setting $\rho_{i,k} = 0$, which in turn implies $d_{i,k} = 0$; a contradiction.

In a second step, we show that *if in equilibrium $d_{i,k} > 0$, then retailer i charges a deterministic price $p_{i,k}$.* For the sake of a contradiction, suppose the opposite; that is, in equilbrium we have $d_{i,k} > 0$ and retailer i mixes over different prices. This implies that retailer i is indifferent between charging each of the prices in the support of her mixed strategy with probability one, as otherwise she would have an incentive to deviate to the deterministic price that yields the highest expected profit. As $d_{i,k} > 0$, the indifference condition further implies that the other retailers' strategies must be such that retailer i has a strictly higher demand if the lowest price in the support of her mixed strategy is realized compared to any other feasible price realization. But then, retailer i can strictly increase her expected demand (without changing her expected profit) by charging the lowest price in the support of her pricing strategy with probability one and by our tie-breaking assumption she has always an incentive to do so; a contradiction. $\square$

In a second step, we introduce a notion of symmetry (Definition 2). Then, we verify in Lemma 2 that our tie-breaking assumptions imply that any retail equilibrium is symmetric in the sense of Definition 2, irrespective of whether consumers are rational or susceptible to salience.

Definition 2. *We say that a retail equilibrium is* symmetric *if and only if the following holds: if in equilibrium a strictly positive share of consumers buy the product via distribution channel* $k \in \{\text{on}, \text{off}\}$*, then each retailer* i *operates channel* k *and charges the same retail price,* $p_{i,k} = p_k$*.*

Lemma 2. *Any retail equilibrium is symmetric, irrespective of whether consumers are rational or susceptible to salience.*

Proof. In a first step, we show that *if in equilibrium some consumers buy via distribution channel* $k \in \{\text{on}, \text{off}\}$*, then* $d_{i,k} > 0$ *for any retailer* i*.* For the sake of a contradiction, suppose the opposite; that is, $\sum_{i \neq j} d_{i,k} > 0$ and $d_{j,k} = 0$ for at least some retailer j. By Lemma 1, any retailer i with $d_{i,k} > 0$ operates channel k with probability one at a deterministic price $p_{i,k}$. Moreover, we have $\pi_{i,k} \geq 0$, as otherwise retailer i would strictly prefer to not operate distribution channel k. Thus, by operating channel k at a price $p_{j,k} = p_{i,k}$ retailer j can strictly increase her expected demand (and maybe also her expected profit) and by our tie-breaking assumption she has always an incentive to do so; a contradiction.

In a second step, we show that *if in equilibrium some consumers buy via distribution channel* $k \in \{\text{on}, \text{off}\}$*, then each retailer* i *charges* $p_{i,k} = p_k$*.* By Lemma 1 and the first step, we know that any retailer i operates channel k with probability one at a deterministic price $p_{i,k}$ and has a strictly positive expected demand, that is, $d_{i,k} > 0$ for any i. For the sake of a contradiction, suppose that in equilibrium $p_{i,k} \neq p_{j,k}$ for some retailers i and j. This implies that $\underline{p}_k := \min_i p_{i,k} < \max_i p_{i,k} =: \overline{p}_k$. We now distinguish between the two distribution channels. If $k = \text{on}$, then $d_{i,\text{on}} = 0$ for any retailer i with $p_{i,k} > \underline{p}_k$; a contradiction. If $k = \text{off}$ and $\overline{p}_k - \underline{p}_k \leq t$, then $d_{i,\text{off}} = d_{j,\text{off}}$ for any two retailers i and j, so that those retailers charging $\underline{p}_k$ can strictly increase their profits by charging $\overline{p}_k$ instead; a contradiction. If $k = \text{off}$ and $\overline{p}_k - \underline{p}_k > t$, then $d_{i,k} = 0$ for those retailers charging $\overline{p}_k$; a contradiction. $\square$

In a third step, we characterize the equilibrium behavior of consumers (Lemma 3) and use these insights to derive necessary properties of the retailers' best response (Lemmata 4 and 5).

Lemma 3. *In any retail equilibrium a consumer buys via distribution channel $k \in \{\text{on}, \text{off}\}$ either with probability one or zero, irrespective of whether he is rational or susceptible to salience.*

Proof. Fix some equilibrium strategy profile $(\Sigma_1, \dots, \Sigma_N)$ and denote as $\beta_{t,k} \in [0,1]$ the probability that a consumer of a given type $t \in \{\text{on}, \text{off}\}$ buys via channel $k \in \{\text{on}, \text{off}\}$.

In a first step, we show that *if $\beta_{t,k} \in (0,1)$, then $\beta_{t,\text{on}} + \beta_{t,\text{off}} = 1$.* For the sake of a contradiction, suppose the opposite; that is, $\beta_{t,k} \in (0,1)$ and the probability of not purchasing is strictly positive. Since $\beta_{t,k} > 0$, we conclude by Lemmata 1 and 2 that each retailer i operates channel k with probability one at a deterministic price $p_{i,k} = p_k$. In addition, as $\beta_{t,\text{on}} + \beta_{t,\text{off}} < 1$ and the price in channel k is deterministic, with probability one the consumer is indifferent between buying via channel k and not buying the product. Then, our tie-breaking assumptions imply that the consumer buys with probability one; a contradiction.

In a second step, we show that $\beta_{t,k} \in \{0,1\}$. For the sake of a contradiction, suppose the opposite; that is, $\beta_{t,k} \in (0,1)$. By the first step, this implies that the consumer buys the product with probability one, which in turn implies that the consumer is indifferent between buying via either channel. Then, by analoguous arguments as above, the retailers charge deterministic prices in either channel, so that the consumer has to be indifferent between both channels with probability one. As, by our tie-breaking assumptions, online consumers buy online and offline consumers buy offline in case of indifference, we obtain $\beta_{t,t} = 1$; a contradiction. □

Lemma 4. *In any retail equilibrium offline consumers either buy the product offline or do not buy the product at all, irrespective of whether consumers are rational or susceptible to salience.*

Proof. We prove the statement only for the case that consumers are susceptible to salience. The proof in case of rational consumers is straightforward and available on request.

For the sake of a contradiction, suppose the opposite; that is, in equilibrium offline consumers buy the product online with positive probability. Then, by Lemma 3, we have that offline consumers buy online with probability one. This immediately implies that also online consumers buy the product online with probability one, as they have a strictly higher valuation for online purchases than offline consumers. Therefore, Lemmata 1 and 2 imply that $d_{i,\text{off}} = 0$, $d_{i,\text{on}} > 0$ and $p_{i,\text{on}} = p_{\text{on}}$ for any retailer $i \in \{1, \dots, N\}$.

Since offline consumers incur disutility l when buying online, the retail price p_{on} cannot exceed $v(q) - l$. Hence, without loss of generality, we consider the subgames with $w \leq v(q) - l$. By Assumption 1, we conclude that $p_{\text{on}} < \delta v(q)$ holds. Note that for retail prices below $\delta v(q)$ consumers buy irrespective of whether price is salient or not. As a consequence, the standard Bertrand logic applies and the unique retail equilibrium candidate price is given by $p_{\text{on}} = w$. This further implies that for any retailer i with $\rho_{i,\text{off}} > 0$ we have $p_{i,\text{off}} > w + l$ with probability one. Otherwise, offline consumers buy offline with positive probability which contradicts the fact that offline consumers buy online with probability one.

Now suppose that each retailer i charges $p_{i,\text{on}} = w$ (i.e., the last remaining retail equilibrium candidate), in which case she earns zero profit. Then, retailer i could profitably deviate by offering the product offline with probability one at a deterministic price $p_{i,\text{off}} = \min\{\delta v(q), w+l\}$, which ensures that offline consumers buy offline with probability one, although price becomes salient. Indeed price could have been salient anyhow, as we stay agnostic on the retailers' strategies on the *inactive* path. Notably, this does not change the argument. By Assumption 1, we have $\min\{\delta v(q), w + l\} - r - w > 0$ for any $w \leq v(q) - l$, so that retailer i could earn strictly positive profits in case of a deviation; a contradiction. □

Lemma 5. *Suppose online sales are feasible. In any retail equilibrium with sales online consumers buy online, irrespective of whether consumers are rational or susceptible to salience.*

Proof. We prove the statement only for the case that consumers are susceptible to salience. The proof in case of rational consumers is straightforward and available on request.

For the sake of a contradiction, suppose the opposite; that is, by Lemma 3, in equilibrium either (i) only offline consumers buy or (ii) online consumers buy offline with probability one. Consider the first case. Then, as online consumers have a weakly higher valuation for the product than offline consumers (i.e., the same valuation for offline purchases but a strictly higher valuation for online purchases), we conclude that online consumers buy whenever offline consumers buy; a contradiction. Thus, online consumers buy in any equilibrium with sales. Hence, it remains to show that online consumers never buy offline in equilibrium.

For the sake of a contradiction, suppose that in equilibrium online consumers buy offline with probability one. Then, also offline consumers buy offline with probability one, as both consumer types have the same valuation for offline purchases. By Lemmata 1 and 2, each retailer i

operates her brick-and-mortar store at a deterministic price $p_{i,\text{off}} = p_{\text{off}}$, where $p_{\text{off}} \leq v(q)$ if price is non-salient and $p_{\text{off}} \leq \delta v(q)$ if price is salient. In addition, we must have $p_{i,\text{on}} > p_{\text{off}}$ with probability one for any $i \in \{1, \ldots, N\}$ with $\rho_{i,\text{on}} > 0$. Otherwise, online consumers would buy online with positive probability. Then, each retailer i serves a share $1/N$ of consumers via her brick-and-mortar store. Now, retailer i could increase her profit by offering the product online at price $p_{i,\text{on}} = p_{\text{off}}$, as our tie-breaking assumptions imply that all online consumers then buy via retailer i's online store, so that retailer i can increase her demand by $\alpha \cdot \left(\frac{N-1}{N}\right)$ and further saves retail costs on those online consumers who had otherwise bought via her brick-and-mortar store. Thus, retailer i has an incentive to deviate; a contradiction. $\square$

In order to summarize our results we introduce the notion of *equivalent* retail equilibria.

Definition 3. *The strategy profiles* $(\Sigma_1, \ldots, \Sigma_N)$ *and* $(\Sigma'_1, \ldots, \Sigma'_N)$ *are* identical on the active path *if and only if (i)* $d_{i,k} = d'_{i,k}$ *for any* $i \in \{1, \ldots, N\}$ *and* $k \in \{\text{on}, \text{off}\}$ *and (ii)* $\rho_{i,k} = \rho'_{i,k}$ *as well as* $\sigma_{i,k} = \sigma'_{i,k}$ *for any* $i \in \{1, \ldots, N\}$ *and* $k \in \{\text{on}, \text{off}\}$ *with* $d_{i,k} > 0$*. We say that two retail equilibria are* equivalent *if the corresponding strategy profiles are identical on the active path.*

After pooling equivalent equilibria, we can identify four types of feasible retail equilibria:

(1) *Online Retail Equilibrium.* In this type of retail equilibrium only online consumers are served (via the online channel). In the following, we distinguish two cases depending on whether in equilibrium prices are salient with positive probability or not.

First, suppose that prices are non-salient with probability one. This immediately implies that retailers do not operate their brick-and-mortar stores (i.e., $\rho_{i,\text{off}} = 0$ for any retailer i). For the sake of a contradiction, suppose the opposite; that is, in equilibrium we have $\rho_{j,\text{off}} > 0$ for some retailer j, only online consumers are served, and price is non-salient. By Lemma 2, each retailer i operates the online channel at a deterministic price $p_{i,\text{on}} = p_{\text{on}}$. For price to be non-salient, retailer j has to charge a deterministic price $p_{j,\text{off}} = p_{\text{on}}$ at her brick-and-mortar store. But if online consumers buy at price p_{on} via the online channel, then also the offline consumers located in area j buy at price $p_{j,\text{off}} = p_{\text{on}}$ via retailer j's brick-and-mortar store; a contradiction. Hence, in an online retail equilibrium with non-salient prices, given it exists, we have $\rho_{i,\text{off}} = 0$, $\rho_{i,\text{on}} = 1$ and $p_{i,\text{on}} = p_{\text{on}}$ for any i.

Second, suppose that prices are salient with positive probability. By Lemma 2, this implies that at least some retailers operate their brick-and-mortar stores with positive probability (i.e., $\rho_{i,\text{off}} > 0$ for at least some retailer i). Now, we can see that the corresponding offline prices must differ from the symmetric online price, p_{on}, with probability one, as otherwise offline consumers would buy with positive probability. Similarly, we have $p_{i,\text{off}} > \delta v(q)$ with probability one, as otherwise offline consumers would buy with positive probability. Moreover, the symmetric online price satisfies $p_{\text{on}} \leq \delta v(q)$, as otherwise online consumers would not buy in equilibrium. Note that any retail equilibrium that satisfies these criteria is equivalent to one in which all retailers who operate their brick-and-mortar store do so with probability one and further charge the same deterministic offline price. Hence, without loss of generality, in an online retail equilibrium with salient prices, given it exists, we have $\rho_{i,\text{on}} = 1$ and $p_{i,\text{on}} = p_{\text{on}} \leq \delta v(q)$ for any retailer i as well as $\rho_{j,\text{off}} = 1$ and $p_{j,\text{off}} = p_{\text{off}} > p_{\text{on}}$ for at least some retailer j.

(2) *Price Salient Retail Equilibrium.* In this type of retail equilibrium all consumers are served efficiently (i.e., online consumers buy online and offline consumers buy at their local brick-and-mortar store) and prices are salient. Then, by Lemma 2, we have $\rho_{i,k} = 1$ and $p_{i,k} = p_k$ for any retailer i and any channel k, where $p_{\text{off}} \neq p_{\text{on}}$, as otherwise prices are not salient.

(3) *Distortion-Free Retail Equilibrium.* In this type of retail equilibrium all consumers are served efficiently and prices are non-salient. Therefore, Lemma 2 implies that we must have $\rho_{i,k} = 1$ and $p_{i,k} = p_k$ for any retailer i and any channel k, where $p_{\text{off}} = p_{\text{on}}$, as otherwise prices are salient.

(4) *No Sales Retail Equilibrium.* In this type of retail equilibrium no consumer is served (i.e., $d_{i,k} = 0$ for any retailer i and any channel k). Here, we *either* have $p_{i,k} \neq p_{j,l}$ for at least some $(i,k),(j,l) \in \{1,\ldots,N\} \times \{\text{on},\text{off}\}$ and $p_{i,k} > \delta v(q)$ for any i and k *or* $p_{i,k} = p_{j,l} > v(q)$ for any retailers i,j and channels k,l (that are operating), as otherwise $d_{i,k} > 0$ for at least some i and k. Moreover, by definition any two retail equilibria with $d_{i,k} = 0$ for any i and k are equivalent. Note that, if the set of no sales equilibria is non-empty, then it includes the strategy profile with $\rho_{i,\text{on}} = 1$ and $p_{i,\text{on}} = p_{\text{on}} > v(q)$ for any retailer i. Hence, without loss of generality, we consider the strategy profile with $\rho_{i,\text{on}} = 1$ and $p_{i,\text{on}} = p_{\text{on}} > v(q)$ when we analyze this type of retail equilibrium in the following.

B.1: Equilibrium Analysis

Proof of Proposition 1. We solve the game backwards.

STAGE 3: Fix some quality level $q \in [\underline{q}, \overline{q}]$ and some wholesale price $w \geq 0$.

By our preliminary considerations, it is sufficient to consider symmetric retail equilibria in which either (1) only online consumers are served (i.e., an *online retail equilibrium* or short *on*), or (2) all consumers are served efficiently and price is salient (i.e., a *price salient retail equilibrium* or short *ps*), or (3) all consumers are served efficiently and neither price nor quality is salient (i.e., a *distortion-free retail equilibrium* or short *df*). In addition, retail equilibria without any sales (i.e., a *no sales retail equilibrium*) can exist, but as we discuss below, these do not affect the subgame-perfect equilibria of our game. For each type of retail equilibrium $k \in \{\text{on}, \text{ps}, \text{df}\}$, we determine the *maximal wholesale price* w_k^S, that is defined as the highest wholesale price under which retail equilibrium k can be sustained. This price pins down the maximum profit the manufacturer can earn given each of these retail equilibria and suffices to determine the subgame-perfect equilibria of our game. Finally, we apply our equilibrium selection criterion.

(1) *Online Retail Equilibrium.*

We derive necessary and sufficient conditions for an online retail equilibrium to exist. Without loss of generality, we only consider subgames with $w \leq v(q)$. By Lemma 2 any retail equilibrium is symmetric (in the sense of Definition 2), so that in an online retail equilibrium two cases can emerge: either (i) $C_i = \{\text{on}\}$ and $p_{i,\text{on}} = p_{\text{on}}$ for any i, or (ii) on $\in C_i$ and $p_{i,\text{on}} = p_{\text{on}} \leq \delta v(q)$ for any i as well as off $\in C_j$ and $p_{j,\text{off}} = p_{\text{off}} > p_{\text{on}}$ for some j. We analyze these cases successively. Note that for $w < v(q)$ there can exist online retail equilibria where retailers earn strictly positive profits (i.e., the standard Bertrand logic does not apply).

CASE (i): $C_i = \{\text{on}\}$ and $p_{i,\text{on}} = p_{\text{on}}$ for any retailer $i \in \{1, \dots, N\}$.

First, suppose $w = v(q)$. In this case, the unique retail equilibrium candidate is $p_{\text{on}} = w$. Obviously, retailer i cannot profitably deviate by charging a higher or a lower online price. In addition, retailer i cannot profitably deviate by serving consumers via her brick-and-mortar store since $w > v(q) - r$. Hence, for a given wholesale price $w = v(q)$, there is a retail equilibrium with $C_i = \{\text{on}\}$ and $p_{i,\text{on}} = w$ for any $i \in \{1, \dots, N\}$.

Second, suppose $\delta v(q) < w < v(q)$. In this case, any $p_{\text{on}} \in [w, v(q)]$ constitutes an equilibrium price. To see why, suppose that all retailers charge $p_{i,\text{on}} = p_{\text{on}} \in [w, v(q)]$ and serve an equal share of online consumers. Obviously, charging a higher online price is not a profitable deviation as demand drops to zero. In addition, charging a lower online price renders prices salient so that the consumers' willingness-to-pay falls below the wholesale price. Finally, retailer i cannot profitably deviate by serving consumers via her brick-and-mortar store since $w > \delta v(q) - r$. Hence, for a given wholesale price $\delta v(q) < w < v(q)$, there is a retail equilibrium with $C_i = \{\text{on}\}$ and $p_{i,\text{on}} = p_{\text{on}} \in [w, v(q)]$ for any $i \in \{1, \dots, N\}$.

Third, suppose $v(q)\left(\frac{\delta N-1}{N-1}\right) \leq w \leq \delta v(q)$. For these wholesale prices, any symmetric retail price $p_{\text{on}} \in [N \cdot (\delta v(q) - w) + w, v(q)] \cup \{w\}$ constitutes an equilibrium price. To see why, we have to distinguish two cases: (i) $p_{\text{on}} \in (w, v(q)]$, and (ii) $p_{\text{on}} = w$. In the first case, since $p_{\text{on}} > w$ and $v(q)\left(\frac{\delta N-1}{N-1}\right) > v(q) - r$ (by Assumption 1), the only feasible deviation is charging a lower online price, and serving all online consumers. Obviously, retailer i has an incentive to deviate from any symmetric price $p_{\text{on}} \in (w, \delta v(q)]$ since an arbitrarily small price decrease allows her to serve all online consumers. Hence, consider only prices $p_{\text{on}} \in (\delta v(q), v(q)]$. For these symmetric online prices, retailer i has no incentive to deviate to a lower online price if and only if

$$\frac{\alpha}{N} \cdot \Big[p_{\text{on}} - w\Big] \geq \alpha \cdot \Big[\delta v(q) - w\Big],$$

or, equivalently,

$$p_{\text{on}} \geq N \cdot (\delta v(q) - w) + w,$$

which was to be proven. We observe that the interval $[N \cdot (\delta v(q) - w) + w, v(q)]$ is non-empty if and only if the wholesale price satisfies $w \geq v(q)\left(\frac{\delta N-1}{N-1}\right)$. Finally, it is straightforward to see that in the second case where $p_{\text{on}} = w$, no profitable deviation exists. Hence, for any wholesale price $v(q)\left(\frac{\delta N-1}{N-1}\right) \leq w \leq \delta v(q)$, there exists a retail equilibrium with $C_i = \{\text{on}\}$ and retail price $p_{i,\text{on}} = p_{\text{on}} \in [N \cdot (\delta v(q) - w) + w, v(q)] \cup \{w\}$ for any $i \in \{1, \dots, N\}$.

Fourth, suppose $\delta v(q) - r < w < v(q)\left(\frac{\delta N-1}{N-1}\right)$, which is a non-empty set of wholesale prices as $r \geq v(q)\left(\frac{N(1-\delta)}{N-1}\right)$ by Assumption 1. In this case, the unique online retail equilibrium price is $p_{\text{on}} = w$. By the previous step, we know that for any $w < v(q)\left(\frac{\delta N-1}{N-1}\right)$ no online retail equilibrium with $p_{i,\text{on}} > w$ exists. In addition, since $w > \delta v(q) - r$, no profitable deviation from a symmetric price $p_{\text{on}} = w$ exists. Hence, for wholesale prices $\delta v(q) - r < w < v(q)\left(\frac{\delta N-1}{N-1}\right)$, there is a retail equilibrium with $C_i = \{\text{on}\}$ and $p_{i,\text{on}} = w$ for any $i \in \{1, \dots, N\}$.

Fifth, suppose $0 \leq w \leq \delta v(q) - r$. Again using the same arguments as in the fourth step, we conclude that the unique online retail equilibrium candidate is $p_{\text{on}} = w$. If this was a retail equilibrium, each retailer would serve a share α/N of consumers. By offering the product also offline at price $p_{i,\text{off}} = \delta v(q)$, retailer i could increase her demand (and for $w < \delta v(q) - r$ also her profits), as her local offline consumers would buy. Our fifth tie-breaking assumption implies that retailer i actually has an incentive to do so. Hence, for a given wholesale price $0 \leq w \leq \delta v(q) - r$, no retail equilibrium with $C_i = \{\text{on}\}$ for any $i \in \{1, \dots, N\}$ exists.

CASE (ii): on $\in C_i$ and $p_{i,\text{on}} = p_{\text{on}}$ for any i and off $\in C_j$ and $p_{j,\text{off}} = p_{\text{off}} > p_{\text{on}}$ for some j.

First, note that here price is salient with probability one, so that the unique online retail equilibrium candidate price is $p_{i,\text{on}} = w$. Second, we already know from the analysis of the first case that we can have an online retail equilibrium with $p_{i,\text{on}} = w$ only if $w > \delta v(q) - r$. Third, since price is salient in equilibrium, we must have $p_{i,\text{on}} \leq \delta v(q)$, so that for any wholesale price $w > \delta v(q)$ retailers cannot break even on online sales. Using this fact and analogous arguments as in first case, we conclude that on $\in C_i$ and $p_{i,\text{on}} = w$ for any retailer i as well as off $\in C_j$ and $p_{j,\text{off}} = p_{\text{off}} > p_{\text{on}}$ for some retailer j is indeed a retail equilibrium for any $w \in (\delta v(q) - r, \delta v(q)]$.

Altogether, we conclude that a retail equilibrium in which only online consumers are served (via the online channel) exists if and only if $w \in (\delta v(q) - r, v(q)]$. Thus, the maximal wholesale price for this type of retail equilibrium is $w^S_{\text{on}} := v(q)$.

(2) *Distortion-Free Retail Equilibrium.*

Without loss of generality, we consider only the subgames with $w \leq v(q) - r$. By Lemma 2 any retail equilibrium has to be symmetric, so that in a distortion-free retail equilibrium, given it exists, we have $C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} = p^* = p_{i,\text{on}}$ for any retailer $i \in \{1, \dots, N\}$.

First, we show that *in any distortion-free retail equilibrium we must have* $p^* > \delta v(q)$. This follows from the fact that for any symmetric retail price $p^* \leq \delta v(q)$ retailer i could increase her profits by offering the product online at a price $p_{i,\text{on}} = p^* - \epsilon$ for some $\epsilon > 0$ sufficiently small. In this case, all online consumers would buy via retailer i's online store although price is salient, so that retailer i discretely increases her demand, as she now serves all online consumers instead of only a share $1/N$ of them. Hence, if $p^* \leq \delta v(q)$, then the standard Bertrand logic implies $p^* = w$, but at this price retailers would make a loss when selling the product via their brick-and-mortar stores; a contradiction to off $\in C_i$.

The remaining proof of this part proceeds in two steps: in STEP 1, we show that *there exists some* $\tilde{\alpha} > 0$ *such that for any* $\alpha \leq \tilde{\alpha}$ *there exists some* $\tilde{w}(\alpha) \in [\delta v(q) - r, v(q) - r)$ *such that* *a retail equilibrium with* $C_i = \{\text{on}, \text{off}\}$ *and* $p_{i,\text{off}} = v(q) = p_{i,\text{on}}$ *for any* $i \in \{1, \ldots, N\}$ *exists if and only if* $\delta v(q) - r \leq w \leq \tilde{w}(\alpha)$. Here, the restriction to the retail equilibrium with the highest *feasible* retail price is without loss of generality, as: (i) whenever a distortion-free retail equilibrium exists, then also $p^* = v(q)$ constitutes an equilibrium price, and (ii) the manufacturer is indifferent between consumers or retailers getting the surplus he cannot extract. In STEP 2, we show that *for any* $\alpha > \tilde{\alpha}$ *a retail equilibrium with* $C_i = \{\text{on}, \text{off}\}$ *and* $p_{i,\text{off}} = p^* = p_{i,\text{on}}$, $i \in \{1, \ldots, N\}$, *does not exist.* Note that, for $\alpha < \tilde{\alpha}$ also at wholesale prices $w < \delta v(q) - r$ there may exist retail equilibria in which all consumers are served efficiently and prices are non-salient. As we solve for a subgame-perfect equilibrium, however, we are only interested in the distortion-free retail equilibrium with the highest wholesale price, so that—given our previous considerations—we can restrict attention to wholesale prices $w \geq \delta v(q) - r$.

STEP 1: Let $\delta v(q) - r \leq w \leq v(q) - r$, which implies that the only deviation that could be optimal for retailer i is setting $C_i = \{\text{on}\}$ and $p_{i,\text{on}} = \delta v(q)$. Thereby, retailer i attracts all online consumers. Thus, given a wholesale price $\delta v(q) - r \leq w \leq v(q) - r$, serving all consumers efficiently at a symmetric retail price $p^* = v(q)$ is a retail equilibrium if and only if

$$\frac{1-\alpha}{N} \cdot \Big[v(q) - r - w\Big] + \frac{\alpha}{N} \cdot \Big[v(q) - w\Big] \geq \alpha \cdot \Big[\delta v(q) - w\Big], \tag{1}$$

or, equivalently,

$$(1 - \alpha N) \cdot w \leq (1 - \alpha\delta N) \cdot v(q) - (1 - \alpha) \cdot r. \tag{2}$$

We have to distinguish three cases: (i) $\alpha > \frac{1}{N}$, (ii) $\alpha = \frac{1}{N}$, and (iii) $\alpha < \frac{1}{N}$. First, note that the right-hand side of Inequality (2) is strictly negative for any $\alpha > \frac{v(q)-r}{v(q)\delta N - r}$, where the denominator, $v(q)\delta N - r$, is strictly positive by Assumption 1. Second, note that

$$\frac{1}{N} > \frac{v(q) - r}{v(q)\delta N - r} \quad \Longleftrightarrow \quad \delta > 1 - \frac{N-1}{N} \cdot \frac{r}{v(q)},$$

which holds for any $q \in [\underline{q}, \overline{q}]$ by Assumption 1.

First, consider $\alpha > \frac{1}{N}$. Then, Inequality (2) holds if and only if

$$w \geq \frac{(1-\alpha) \cdot r - (1 - \alpha\delta N) \cdot v(q)}{\alpha N - 1}.$$

Since $w \leq v(q) - r$ by assumption and

$$\frac{(1-\alpha) \cdot r - (1 - \alpha\delta N) \cdot v(q)}{\alpha N - 1} > v(q) - r \quad \Longleftrightarrow \quad \delta > 1 - \frac{N-1}{N} \cdot \frac{r}{v(q)},$$

which holds for any $q \in [\underline{q}, \overline{q}]$ by Assumption 1, we arrive at a contradiction and conclude that Inequality (2) is violated for any $\alpha > \frac{1}{N}$, so that retailer i has an incentive to deviate. Hence, if $\alpha > \frac{1}{N}$, there is no equilibrium with $C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} = v(q) = p_{i,\text{on}}$, $i \in \{1, \ldots, N\}$.

Second, consider $\alpha = \frac{1}{N}$. Since the left-hand side of (2) is zero and the right-hand side of (2) is strictly negative, retailer i has an incentive to deviate. Hence, if $\alpha = \frac{1}{N}$, there is no equilibrium with $C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} = v(q) = p_{i,\text{on}}$, $i \in \{1, \ldots, N\}$.

Finally, consider $\alpha < \frac{1}{N}$. Then, Inequality (2) is equivalent to

$$w \leq \frac{(1 - \alpha\delta N)v(q) - (1 - \alpha)r}{1 - \alpha N} =: w^S_{\text{df}}(q; \alpha, \delta). \tag{3}$$

To complete the first step, we have to verify that $w^S_{\text{ex}}(q; \alpha, \delta) \in [\delta v(q) - r, v(q) - r]$. Here, the upper bound is slack due to $\delta > 1 - \frac{N-1}{N}\frac{r}{v(q)}$ (Assumption 1). In contrast, the lower bound is met if and only if

$$\alpha \leq \frac{(1 - \delta)v(q)}{(N - 1)r} =: \tilde{\alpha}(q). \tag{4}$$

As a consequence, for any wholesale price $\delta v(q) - r \leq w \leq w^S_{\text{ex}}(q; \alpha, \delta)$, there exists a retail equilibrium with $C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} = v(q) = p_{i,\text{on}}$ for any $i \in \{1, \ldots, N\}$ if and only if $\alpha \leq \tilde{\alpha}$, while for any $w > w^S_{\text{ex}}(q; \alpha, \delta)$ no such equilibrium exists.

STEP 2: Suppose the share of online consumers satisfies $\alpha > \tilde{\alpha}$. It follows immediately from the first step that for any wholesale price $w \geq \delta v(q) - r$ there is no retail equilibrium with $C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} = p^* = p_{i,\text{on}}$, $i \in \{1, \ldots, N\}$. Hence, it remains to show that *also for wholesale prices $w < \delta v(q) - r$ no such equilibrium exists if $\alpha > \tilde{\alpha}$*. In the following, we consider the deviation strategy of operating both channels at a uniformly lower price, namely $p_d := \min\{\delta v(q), p^* - \epsilon\} = \delta v(q)$ for some ϵ larger but sufficiently close to zero. Here, the equality follows from the fact that $p^* > \delta v(q)$. As a consequence, the deviation profit equals

$$\begin{cases} \frac{1}{N}(1 - \alpha)\big[\delta v(q) - r - w\big] + \alpha\big[\delta v(q) - w\big] & \text{if } t \geq p^* - \delta v(q), \\ (1 - \alpha)\big[\delta v(q) - r - w\big] + \alpha\big[\delta v(q) - w\big] & \text{otherwise.} \end{cases}$$

Since $p^* \leq v(q)$, retailer i actually has an incentive to deviate if

$$\frac{1 - \alpha}{N} \cdot \Big[\delta v(q) - r - w\Big] + \alpha \cdot \Big[\delta v(q) - w\Big] > \frac{1 - \alpha}{N} \cdot \Big[v(q) - r - w\Big] + \frac{\alpha}{N} \cdot \Big[v(q) - w\Big],$$

which is equivalent to

$$w < \frac{v(q)[\alpha\delta(N - 1) - (1 - \delta)]}{\alpha(N - 1)}.$$

It is straightforward to see that for any $\alpha > \tilde{\alpha}$, we obtain

$$\frac{v(q)[\alpha\delta(N-1)-(1-\delta)]}{\alpha(N-1)} \geq \delta v(q) - r.$$

Therefore, if $\alpha > \tilde{\alpha}$, retailer i has an incentive to deviate at any wholesale price $w < \delta v(q) - r$. Hence, we have proven that for $\alpha > \tilde{\alpha}$ there does not exist a retail equilibrium with $C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} = p^* = p_{i,\text{on}}$, $i \in \{1, \ldots, N\}$, which completes the proof of the second step.

Altogether, a distortion-free retail equilibrium exists if and only if $\alpha \leq \tilde{\alpha}$ and $w \leq w^S_{\text{df}}(q; \alpha, \delta)$, where the maximal wholesale price, $w^S_{\text{df}}(q; \alpha, \delta)$, is defined in (3).

(3) *Price Salient Retail Equilibrium.*

As in equilibrium—given it exists—the product's price is salient, the wholesale price cannot exceed $\delta v(q) - r$; otherwise, the retailers could not profitably serve consumers via their brick-and-mortar stores. By Lemma 2 any retail equilibrium is symmetric, so that in a price salient retail equilibrium we have $C_i = \{\text{on}, \text{off}\}$, $p_{i,\text{off}} = p_{\text{off}}$ and $p_{i,\text{on}} = p_{\text{on}}$ for any retailer $i \in \{1, \ldots, N\}$. As the product's price is salient irrespective of whether retailer i deviates or not, standard arguments yield the unique price salient retail equilibrium candidate prices

$$p_{\text{on}} = w \quad \text{and} \quad p_{\text{off}} = \min\left\{\delta v(q), w + r + t \cdot \left(\frac{N}{N-1}\right), w + l\right\}.$$

For these candidate prices, it is straightforward to see that neither charging a higher or lower online price nor a higher or lower offline price would increase retailer i's profit given that the other retailers charge p_{on} and p_{off} as delineated above. Hence, for a given wholesale price $w \leq \delta v(q) - r$, there exists a retail equilibrium with $C_i = \{\text{on}, \text{off}\}$ and

$$p_{i,\text{off}} = \min\left\{\delta v(q), w + r + t \cdot \left(\frac{N}{N-1}\right), w + l\right\} > w = p_{i,\text{on}} \text{ for any } i \in \{1, \ldots, N\}. \tag{5}$$

As a consequence, a price salient equilibrium exists if and only if $w \leq \delta v(q) - r$ and the maximal wholesale price for this type of equilibrium is $w^S_{\text{ps}} := \delta v(q) - r$.

(4) *No Sales Retail Equilibrium.*

By our preliminary considerations, we can restrict attention to the case in which all retailers operate only the online channel—that is, $C_i = \{\text{on}\}$ for any retailer i—and charge a deterministic and symmetric retail price in this channel that exceeds the consumers' maximum willigness-to-pay—that is, $p_{i,\text{on}} = p_{\text{on}} > 0$ for any retailer i.

First, suppose $\delta v(q) < w \leq v(q)$. If $C_i = \{\text{on}\}$ and $p_{i,\text{on}} = p_{\text{on}} > v(q)$, any deviation renders prices salient so that the consumers willigness-to-pay drops below the wholesale price. Hence, no retailer can profitably deviate and we have indeed a retail equilibrium without any sales.

Second, suppose $0 \leq w \leq \delta v(q)$. In addition, suppose that $C_i = \{\text{on}\}$ and $p_{i,\text{on}} = p_{\text{on}} > v(q)$ for any i, so that all retailers earn zero profit and have zero demand. Then, retailer j can strictly increase her demand while making at least a non-negative profit by charging a deterministic online price $p_{j,\text{on}} = \delta v(q)$. Hence, by our tie-breaking assumptions, each retailer j has an incentive to deviate in the delineated way, so that for any wholesale price $0 \leq w \leq \delta v(q)$, we cannot have a retail equilibrium without any sales.

Altogether, a no sales retail equilibrium exists if and only if $\delta v(q) < w \leq v(q)$.

(5) *Equilibrium Selection.*

We have derived the set of maximal wholesale prices $\{w^S_{\text{ps}}, w^S_{\text{df}}, w^S_{\text{on}}\}$. Now, we want to verify that our selection criterion yields a unique retail equilibrium for each $w \in \{w^S_{\text{ps}}, w^S_{\text{df}}\}$ as well as for any wholesale price that lies in an ϵ-environment below w^S_{on}. Remember that our selection criterion says that retailers choose the retail equilibrium that yields the highest retailer profits; in particular, for a given type of retail equilibrium the one with the highest feasible retail price.

For any $\alpha > \tilde{\alpha}$ and $w \in \{w^S_{\text{ps}}, w^S_{\text{ex}}\}$ our selection criterion gives a unique retail equilibrium, as in these cases only a single type of retail equilibrium exists (i.e., a price salient retail equilibrium). In addition, we can show that *there exists some $\epsilon > 0$ such that for any $w \in (w^S_{\text{on}} - \epsilon, w^S_{\text{on}})$ the unique retail equilibrium under selection is an online retail equilibrium.* First, note that there is some $\epsilon' > 0$ such that for any $w \in (w^S_{\text{on}} - \epsilon', w^S_{\text{on}})$ both an online and a no sales retail equilibrium exist. Second, we observe that there is some $\epsilon'' > 0$ such that for any $w \in (w^S_{\text{on}} - \epsilon'', w^S_{\text{on}})$ there is an online retail equilibrium in which retailers earn strictly positive profits. Combining these observations yields the claim, as retailers earn zero profits in a no sales retail equilibrium. Next, we will show that *for any $\alpha \leq \tilde{\alpha}$ and $w \in \{w^S_{\text{ps}}, w^S_{\text{df}}\}$ the unique retail equilibrium under selection is a distortion-free retail equilibrium.* First, note that at a wholesale price $w = w^S_{\text{df}}$, there exist both a distortion-free and an online retail equilibrium. As for any $\alpha \leq \tilde{\alpha}$ we have $w^S_{\text{df}} < v(q) - r$, it follows immediately from our characterization of online retail equilibria that retailers earn zero profit in this type of retail equilibrium. In addition, we have

$$\frac{1-\alpha}{N} \cdot \left[v(q) - r - w^S_{\text{df}}\right] + \frac{\alpha}{N} \cdot \left[v(q) - w^S_{\text{df}}\right] > 0,$$

so that our selection criterion implies that for $\alpha \leq \tilde{\alpha}$ and $w = w^S_{\text{df}}$ the retailers select the distortion-free retail equilibrium. Second, note that at a wholesale price $w = w^S_{\text{ps}}$, there exist both a distortion-free and a price salient retail equilibrium. By analogous arguments as above, the retailers select the distortion-free retail equilibrium. Table 2 summarizes the unique retail equilibrium in the relevant subgames.

	$0 < \alpha \leq \tilde{\alpha}$	$\tilde{\alpha} < \alpha < 1$
$w = w^S_{\text{ps}}$	$C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} = p_{i,\text{on}}$	$C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} > p_{i,\text{on}}$
$w = w^S_{\text{ex}}$	$C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} = p_{i,\text{on}}$	$C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} > p_{i,\text{on}}$
$w \in (w^S_{\text{on}} - \epsilon, w^S_{\text{on}})$	$C_i = \{\text{on}\}$ and $p_{i,\text{on}} = v(q)$	$C_i = \{\text{on}\}$ and $p_{i,\text{on}} = v(q)$

Table 2: *Unique retail equilibrium under selection.*

STAGE 2: Fix some quality level $q = [\underline{q}, \overline{q}]$. We show that *the manufacturer charges $w = w^S_k$ whenever he wants to induce retail equilibrium $k \in \{\text{on}, \text{df}, \text{ps}\}$*. In a first step, we prove the statement for $k \in \{\text{df}, \text{ps}\}$. In a second step, we prove the statement for $k = \text{on}$.

1. STEP: Note that the manufacturer wants to induce a price salient retail equilibrium only if $\alpha > \tilde{\alpha}$, as in a distortion-free retail equilibrium he serves the same number of consumers but does so at weakly higher wholesale price $w^S_{\text{df}} \geq w^S_{\text{ps}}$. Moreover, as delineated in Table 2, the manufacturer can always induce a price salient retail equilibrium by charging $w = w^S_{\text{ps}}$ if he cannot induce a distortion-free retail equilibrium, that is, if $\alpha > \tilde{\alpha}$ holds. Now, for the sake of a contradiction, suppose that the manufacturer wants to induce retail equilibrium k—that is, $w^S_k - c(q) > \max\{\alpha \cdot [w^S_{\text{on}} - c(q)], w^S_j - c(q)\}$ for $j \neq k, \text{on}$—and charges a wholesale price $w < w^S_k$. Then, the manufacturer can increase his profit by charging a wholesale price $w = w^S_k$, since for $w = w^S_k$ he serves the same demand at a higher price; a contradiction.

2. STEP: For the sake of a contradiction, suppose that the manufacturer wants to induce an online equilibrium—that is, $\alpha \cdot [w^S_{\text{on}} - c(q)] > \max\{w^S_{\text{ps}} - c(q), w^S_{\text{df}} - c(q)\}$—and charges a wholesale price $w < w^S_{\text{on}}$. Then, as delineated in Table 2, there exists some $\epsilon > 0$ such that the manufacturer can induce the retailers to sell the product only online by charging a wholesale price $w \in (w^S_{\text{on}} - \epsilon, w^S_{\text{on}})$. Hence, the manufacturer can earn a profit arbitrarily close to $\alpha \cdot [w^S_{\text{on}} - c(q)]$, so that our assumption toward a contradiction implies that a profitbale deviation exists; a contradiction.

STAGE 1: In a first step, we determine *the manufacturer's optimal quality choice for any potential retail equilibrium* $k \in \{\text{on}, \text{df}, \text{ps}\}$. The optimal quality level in case of inducing either a price salient retail equilibrium or an online retail equilibrium is given by

$$q_k^S := \underset{q \in [\underline{q}, \overline{q}]}{\arg\max} \left[w_k^S(q) - c(q) \right] \quad \text{for} \quad k \in \{\text{on}, \text{ps}\}, \tag{6}$$

while in case of inducing a distortion-free retail equilibrium the optimal quality level is given by the solution to the following constrained maximization problem

$$q_{\text{df}}^S := \underset{q \in [\underline{q}, \overline{q}] \text{ s.t. } \tilde{\alpha}(q) \geq \alpha}{\arg\max} \left[w_{\text{df}}^S(q) - c(q) \right]. \tag{7}$$

Here, we make three immediate observations: first, *if the manufacturer induces a retail equilibrium in which all consumers are served and prices are non-salient, he produces an excessive quality (i.e., a quality above q^*).* Since $\tilde{\alpha}'(q) > 0$, any solution to problem (7) has to satisfy

$$\frac{\partial}{\partial q} w_{\text{df}}^S(q; \alpha, \delta) \leq c'(q) \quad \text{and} \quad \tilde{\alpha}(q) \geq \alpha \quad \text{and} \quad \left(\frac{\partial}{\partial q} w_{\text{df}}^S(q; \alpha, \delta) - c'(q) \right) \cdot \big(\alpha - \tilde{\alpha}(q) \big) = 0.$$

Again since $\tilde{\alpha}'(q) > 0$, the Inada conditions ensure a unique solution also to the constrained problem in (7). Now, as the cost function is convex, it is sufficient to verify

$$\frac{\partial}{\partial q} w_{\text{df}}^S(q; \alpha, \delta) = \left(\frac{1 - \alpha \delta N}{1 - \alpha N} \right) \cdot v'(q) > v'(q),$$

which holds for any $\delta \in (0, 1)$. Interestingly, the manufacturer optimally distorts the product's quality upwards if he induces a distortion-free retail equilibrium. Therefore, we denote this an *excessive branding (subgame-perfect) equilibrium* and relabel the provided quality as $q_{\text{ex}}^S := q_{\text{df}}^S$ and the corresponding wholesale price as $w_{\text{ex}}^S := w_{\text{df}}^S$.

Second, *if the manufacturer induces a retail equilibrium in which all consumers are served and prices are salient, he produces an insufficient quality (i.e., a quality below q^*).* Again, since the cost function is convex, it is sufficient to verify

$$\frac{\partial}{\partial q} w_{\text{ps}}^S(q; \delta) = \delta \cdot v'(q) < v'(q),$$

which holds for any $\delta \in (0, 1)$.

Third, *if the manufacturer induces a retail equilibrium in which only online consumers are served, he produces the efficient quality level.* This follows immediately from $\frac{\partial}{\partial q} w_{\text{on}}^S(q) = v'(q)$.

In a second step, we show that *there exists some* $\alpha'_S \in (0, \tilde{\alpha}]$ *such that for any* $\alpha < \alpha'_S$ *the manufacturer induces the retailers to serve all consumers efficiently while keeping prices non-salient.* By definition, for any $\alpha \leq \tilde{\alpha}$, the manufacturer definitely wants to avoid a price-salient environment in case that all consumers are served in equilibrium, as $w^S_{\text{df}}(q; \alpha, \delta) \geq w^S_{\text{ps}}(q; \delta)$ for any $q \in [\underline{q}, \overline{q}]$. Anyway, given such a share of online consumers, the manufacturer could not even induce a price-salient equilibrium at a wholesale price $w = w^S_{\text{ps}}(q; \delta)$ due to our selection criterion (see Table 2). Thus, for $\alpha \leq \tilde{\alpha}$, the manufacturer induces a retail equilibrium in which all consumers are served efficiently and prices are non-salient if and only if

$$w^S_{\text{ex}}(q^S_{\text{ex}}(\alpha, \delta); \alpha, \delta) - c(q^S_{\text{ex}}(\alpha, \delta)) > \alpha \cdot \big[v(q^*) - c(q^*)\big]. \tag{8}$$

The left-hand side of the preceding inequality monotonically decreases in α as

$$\begin{aligned}
\frac{\partial}{\partial \alpha}\left(w^S_{\text{ex}}(q^S_{\text{ex}}(\alpha, \delta); \alpha, \delta) - c(q^S_{\text{ex}}(\alpha, \delta))\right) &= \frac{\partial}{\partial \alpha}\left(w^S_{\text{ex}}(q; \alpha, \delta) - c(q)\right)\Bigg|_{q = q^S_{\text{ex}}(\alpha, \delta)} \\
&= \frac{\partial}{\partial \alpha} w^S_{\text{ex}}(q; \alpha, \delta)\bigg|_{q = q^S_{\text{ex}}(\alpha, \delta)} \\
&= \frac{(1-\delta)v(q) - r}{(1 - \alpha N)^2}\bigg|_{q = q^S_{\text{ex}}(\alpha, \delta)} \\
&< 0,
\end{aligned}$$

where the first equality follows by the Envelope Theorem, and the inequality by Assumption 1. In addition, we observe that the right-hand side of Inequality (8) monotonically increases in α and approaches zero for $\alpha \to 0$, so our claim follows from the fact that

$$\lim_{\alpha \to 0}\left[w^S_{\text{ex}}(q^S_{\text{ex}}(\alpha, \delta); \alpha, \delta) - c(q^S_{\text{ex}}(\alpha, \delta))\right] = v(q^*) - c(q^*) > 0.$$

In a third step, we show that *there exists some* $\alpha''_S \in [\alpha'_S, 1)$ *such that for any* $\alpha \geq \alpha''_S$ *the manufacturer induces the retailers to serve only the online consumers (via the online channel).* Since for α sufficiently large there does not exist a retail equilibrium in which all consumers are served efficiently and price is non-salient, the claim follows from the observation that

$$\lim_{\alpha \to 1} \alpha \cdot \left[v(q^*) - c(q^*)\right] = v(q^*) - c(q^*) \geq \delta v(q^S_{\text{ps}}) - r - c(q^S_{\text{ps}}).$$

This completes the proof. $\square$

Proof of Corollary 1. By Proposition 1, a retail equilibrium in which all consumers are served efficiently, but price is non-salient exists only if $\alpha \leq \tilde{\alpha}$, where the threshold value $\tilde{\alpha}$—as defined in Equation (4)—depends on the strength of the salience bias, δ. Specifically, $\tilde{\alpha}$ approaches zero for $\delta \to 1$. In addition, it is straightforward to see that $\lim_{\delta \to 1} w^S_{\text{ps}}(q; \delta) = v(q) - r$, so that

$$\lim_{\delta \to 1} \left[w^S_{\text{ps}}(q^S_{\text{ps}}; \delta) - c(q^S_{\text{ps}}) \right] = v(q^*) - r - c(q^*) > \alpha \cdot \left[v(q^*) - c(q^*) \right]$$

holds if and only if

$$\alpha < \frac{v(q^*) - r - c(q^*)}{v(q^*) - c(q^*)} = \alpha_R.$$

As the threshold value α_R is bounded away from zero, we obtain

$$\lim_{\delta \to 1} \alpha''_S = \alpha_R > 0 = \lim_{\delta \to 1} \alpha'_S,$$

which was to be proven. □

B.2: A Direct Ban on Online Sales

Proof of Proposition 2. In a first step, we derive the equilibrium under a ban on online sales. In a second step, we show that the manufacturer prohibits online sales if and only if $\alpha < \alpha_R$.

First, we show that, although salience might induce multiple retail equilibria in certain subgames, *the subgame-perfect equilibrium under a ban on online sales is the same irrespective of whether consumers are rational or susceptible to salience.* Suppose that online sales are banned and note that, if the manufacturer charges the highest wholesale price that allows retailers to profitably serve consumers via their brick-and-mortar stores, $w = v(q) - r$, there is a unique retail equilibrium with $p_{i,\text{off}} = v(q)$ for any $i \in \{1, \ldots, N\}$. Thus, it is straightforward to see that *the manufacturer bans online sales if he wants all consumers to be served.*

By our considerations above, the manufacturer can earn $v(q^*) - r - c(q^*)$ if he bans online sales. If the manufacturer allows for online sales and induces the retailers to serve only online consumers, he earns $\alpha \cdot \left[v(q^*) - c(q^*) \right]$. Thus, the manufacturer bans online sales if and only if $v(q^*) - r - c(q^*) > \alpha \cdot \left[v(q^*) - c(q^*) \right]$ or, equivalently, $\alpha < \alpha_R$. □

Proof of Proposition 3. Under a ban on online sales all consumers are served offline and quality provision is efficient, so that social welfare is equal to $SW_{ban} = v(q^*) - r - c(q^*)$. The remainder of this proof proceeds in two steps, that is, we subsequently consider the following two cases: (i) $\alpha \in (0, \alpha''_S]$, and (ii) $\alpha \in (\alpha''_S, 1)$.

1. STEP: Suppose $\alpha \in (0, \alpha''_S]$. Absent a ban, by Proposition 1, all consumers are served an inefficient quality $q^S \neq q^*$ via their efficient distribution channel, so that equilibrium welfare is $SW_S = v(q^S) - (1-\alpha)r - c(q^S)$. Remember that $\Delta_q = [v(q^*) - c(q^*)] - [v(q^S) - c(q^S)]$ gives the loss in welfare due to the quality distortion arising from salience effects. Then, we obtain $SW_{ban} \geq SW_S$ if and only if $\Delta_q(\alpha, \delta) \geq \alpha \cdot r$.

Now it remains to show that *there exists some* $\tilde{\tilde{\delta}} < 1$ *such that for any* $\delta > \tilde{\tilde{\delta}}$ *a ban on online sales strictly decreases welfare; that is, we have to verify* $\Delta_q(\alpha, \delta) < \alpha \cdot r$ *for any* $\delta > \tilde{\tilde{\delta}}$. Here, we proceed in three steps: first, we show that *for any* $\alpha \in (0, \alpha''_S]$ *there exists some* $\check{\delta}(\alpha) \in (0, 1)$ *such that for any* $\delta > \check{\delta}(\alpha)$ *a ban on online sales strictly decreases welfare.* Second, we argue that *there exists some* $\underline{\alpha} > 0$ *such that for any* $\alpha < \underline{\alpha}$ *and any* δ *a ban on online sales strictly decreases welfare.* Third, we conclude from the previous steps that *there exists some* $\tilde{\tilde{\delta}} < 1$ *such that for any* $\delta > \tilde{\tilde{\delta}}$ *a ban on online sales strictly decreases welfare.*

Fix some $\alpha \in (0, \alpha''_S]$. By the proof of Proposition 1, it follows that $\frac{\partial}{\partial \delta}|q^* - q^S(\alpha, \delta)| < 0$. Then, since $q^S(\alpha, \delta)$ approaches q^* for $\delta \to 1$ and $\alpha \cdot r > 0$, there exists some $\check{\delta}(\alpha) \in (0, 1)$ such that for any $\delta > \check{\delta}(\alpha)$ we have $\Delta_q(\alpha, \delta) < \alpha \cdot r$. This completes the first step.

Next, we show that *there exists some* $\underline{\alpha} > 0$ *such that for any* $\alpha < \underline{\alpha}$ *and for any* δ *we have* $\Delta_q < \alpha \cdot r$. Denote $F(\alpha) := \Delta_q(\alpha, \delta) - \alpha \cdot r$. First, we observe that $\lim_{\alpha \to 0} F(\alpha) = 0$. Now, by continuity, it is sufficient to verify that $\lim_{\alpha \to 0} F'(\alpha) = \lim_{\alpha \to 0}[\frac{\partial}{\partial \alpha}\Delta_q(\alpha, \delta) - r] < 0$ holds. By Proposition 1, we know that for α sufficiently close to zero the manufacturer offers an excessive quality $q = q^S_{\text{ex}}(\alpha, \delta) > q^*$, which is implicitly given by

$$\left(\frac{1 - \alpha\delta N}{1 - \alpha N}\right) \cdot v'(q^S_{\text{ex}}) = c'(q^S_{\text{ex}}), \tag{9}$$

as $\tilde{\alpha}(q) > 0$ implies that for sufficiently small shares of online consumers, α, the constraint in (7) is slack. Hence, for α sufficiently close to zero, we obtain

$$\frac{\partial}{\partial \alpha}\Delta_q(\alpha, \delta) = -\left(\frac{\partial}{\partial \alpha} q^S_{\text{ex}}(\alpha, \delta)\right)[v'(q^S_{\text{ex}}) - c'(q^S_{\text{ex}})].$$

Using Equation (9), we conclude that $q^S_{\text{ex}}(\alpha, \delta)$ approaches q^* for $\alpha \to 0$, again as $\tilde{\alpha}(q) > 0$ implies that for small α the constraint in (7) is slack. By definition, we have $v'(q^*) - c'(q^*) = 0$.

In addition, by applying the Implicit Function Theorem to (9), we obtain

$$\lim_{\alpha \to 0} \frac{\partial}{\partial \alpha} q^S_{\text{ex}}(\alpha, \delta) = N(1-\delta) \left(\frac{v'(q^*)}{v''(q^*) - c''(q^*)} \right) < \infty.$$

Combining the two considerations above, we conclude that $\lim_{\alpha \to 0} \frac{\partial}{\partial \alpha} \Delta_q(\alpha, \delta) = 0$ holds, so that $\lim_{\alpha \to 0} F'(\alpha) = \lim_{\alpha \to 0} [\frac{\partial}{\partial \alpha} \Delta_q(\alpha, \delta) - r] < 0$. This completes the second step.

Define $\tilde{\delta} := \max_{\alpha \in [\underline{\alpha}, \alpha''_S]} \check{\delta}(\alpha)$ and note that $\tilde{\delta} < 1$. This completes the third step.

2. STEP: Suppose $\alpha \in (\alpha''_S, 1)$. We immediately conclude that $\alpha''_S < \alpha_R$. To see why, suppose that online sales are feasible. Then, if only online consumers are served in equilibrium, the manufacturer earns the same profit as in the case of rational consumers. If instead all consumers are served in equilibrium, the manufacturer earns strictly less than in the rational benchmark. Thus, it is straightforward to see that $\alpha''_S < \alpha_R$ has to hold. Note that for any $\alpha \in (\alpha''_S, 1)$ either all consumers are served offline (which is the case if online sales are banned), or only online consumers are served (which is the case if online sales are feasible). In either case consumer surplus as well as retailer profits are equal to zero, so that social welfare coincides with the manufacturer's profits.

First, let $\alpha''_S < \alpha < \alpha_R$. By Proposition 2, the manufacturer's profit is strictly higher under a ban on online sales. Hence, for any $\alpha \in (\alpha''_S, \alpha_R)$, the manufacturer bans online sales and this ban strictly increases social welfare. Second, let $\alpha \geq \alpha_R$. By Proposition 2, the manufacturer's profit is weakly higher if he allows online sales. Hence, for any $\alpha \in [\alpha_R, 1]$, the manufacturer allows online sales, which weakly increases social welfare compared to a ban on online sales. $\square$

B.3: Resale Price Maintenance

Proof of Proposition 4. Suppose the manufacturer is allowed to determine the retail prices, but can only charge a uniform, linear wholesale price, w. First, we observe that, if the manufacturer fixes on- and offline prices to be same for any retailer, salience does not play a role in equilibrium. Thus, the equilibrium under resale price maintenance is the same irrespective of whether consumers are rational or susceptible to salience. Second, since the manufacturer can only charge a uniform, linear wholesale price, he still faces the same trade-off as in the classical model: the manufacturer must decide whether to charge a high wholesale price that only allows to serve online consumers or to charge a low wholesale price in order to serve all consumers.

By our tie-breaking assumption, the manufacturer indeed fixes retail prices to $p_{i,k} = v(q)$, $k \in \{\text{on}, \text{off}\}$, if and only if he wants all consumers to be served in equilibrium; that is, if and only if $\alpha < \alpha_R$. To understand why this is the case, note that under resale price maintenance the manufacturer can earn a profit of $v(q^*) - r - c(q^*)$ from serving all consumers by fixing retail prices to $p_{i,k} = v(q)$, charging a wholesale price of $w(q) = v(q) - r$, and choosing the efficient quality level $q = q^*$. If the manufacturer instead charges a wholesale price of $w(q) = v(q)$ and chooses the efficient quality $q = q^*$, he can earn a profit of $\alpha \cdot [v(q^*) - c(q^*)]$ also without restraining retail prices (see the proof of Proposition 1). Thus, the manufacturer imposes a restraint on retail prices if and only if

$$v(q^*) - r - c(q^*) > \alpha[v(q^*) - c(q^*)],$$

or, equivalently, $\alpha < \alpha_R$. This completes the proof. □

Proof of Proposition 5. If the manufacturer can impose RPM, by Proposition 4 social welfare is the same as in the classical model. Specifically, the manufacturer imposes RPM if and only if $\alpha < \alpha_R$. For any $\alpha < \alpha_R$, the manufacturer imposes RPM and all consumers are served the efficient quality via their efficient distribution channel, so that equilibrium welfare equals $SW_{RPM} = v(q^*) - (1-\alpha)r - c(q^*)$. This strictly exceeds the social welfare in a market without RPM, as without such a restraint for any $\alpha < \alpha''_S$ the manufacturer chooses an inefficient quality, while for any $\alpha''_S \leq \alpha < \alpha_R$ only online consumers are served. If instead $\alpha \geq \alpha_R$, the manufacturer does not impose RPM. Notably, for $\alpha \geq \alpha_R$, RPM would not change the equilibrium outcome. □

B.4: Dual Pricing

Proof of Proposition 6. In a first step, we use our insights derived in the proof of Proposition 8 in order to argue that the manufacturer can prevent a price-salient environment by conditioning the wholesale price on the distribution channel. In a second step, we show that the manufacturer actually prefers to condition his wholesale price on the distribution channel for any $\alpha \in (0, 1)$. Suppose from now on that the manufacturer charges $w_{\text{off}} \geq 0$ for units to be resold offline and $w_{\text{on}} \geq 0$ for units to be resold online.

STAGE 3: Without loss of generality, consider the subgame in which $w_{\text{off}} = v(q) - r$ and $w_{\text{on}} = v(q)$. At a wholesale price $w_{\text{off}} = v(q) - r$, retailer i can profitably serve offline consumers (for $t > 0$ only those offline consumers located in area i) if and only if $p_{i,\text{off}} = v(q)$. In addition, the retailers can serve online consumers via the online channel if and only if $p_{i,\text{on}} = v(q)$. Hence, for wholesale prices $w_{\text{off}} = v(q) - r$ and $w_{\text{on}} = v(q)$ price salience is ruled out and in the unique retail equilibrium all consumers are served efficiently.

STAGE 2: The manufacturer *neither* faces a trade-off between charging a high wholesale price and serving only online consumers or charging a low wholesale price and serving all consumers *nor* a trade-off between inducing a distortion-free retail equilibrium or a price salient retail equilibrium. As in the case of rational consumers, the manufacturer optimally charges wholesale prices $w_{\text{off}} = v(q) - r$ and $w_{\text{on}} = v(q)$, so that he earns a profit of $v(q) - (1 - \alpha)r - c(q)$.

STAGE 1: The manufacturer chooses a quality level $q \in [\underline{q}, \overline{q}]$ as to maximize

$$v(q) - (1 - \alpha) \cdot r - c(q),$$

and thus chooses the efficient quality $q = q^*$, irrespective of the share of online consumers, α.

As we have seen in Proposition 1, charging the same wholesale price for on- and offline sales, $w_{\text{off}} = w = w_{\text{on}}$, yields the manufacturer a profit of

$$\max\left\{v(q^*) - r - c(q^*), \alpha \cdot \big[v(q^*) - c(q^*)\big]\right\},$$

which is strictly less than $v(q^*) - (1 - \alpha) \cdot r - c(q^*)$ for any $\alpha \in (0, 1)$. Hence, for any $\alpha \in (0, 1)$, the manufacturer charges channel-specific wholesale prices $w_{\text{on}} > w_{\text{off}}$. $\square$

Proof of Proposition 7. First, since under dual pricing all consumers are served efficiently and the manufacturer offers the efficient quality $q = q^*$, social welfare is maximized. Precisely, under a dual pricing regime, the equilibrium welfare is equal to the manufacturer's profit, that is, social welfare is given by $SW_{DP} = v(q^*) - (1 - \alpha)r - c(q^*)$.

Second, if the manufacturer cannot condition his wholesale price on the distribution channel, social welfare is strictly lower. For any $\alpha \leq \alpha''_S$, all consumers are served efficiently, but the provided quality is either excessive or insufficient, so that we have $SW_S < SW_{DP}$. If we have $\alpha > \alpha''_S$ instead, only online consumers are served in equilibrium. Thus, also in this case we conclude that $SW_S < SW_{DP}$. $\square$

Appendix D: Robustness

D.1: Uniform Two-Part Tariff

Consider the same game as before with the one exception that the manufacturer can now offer a uniform two-part tariff, consisting of a linear component w and a fixed component F.

Equilibrium without Vertical Restraints. The following proposition characterizes the equilibrium outcome without vertical restraints depending on the share of online consumers.

Proposition 9. *Suppose the manufacturer can offer a uniform two-part tariff, but cannot impose a vertical restraint. Then, there exist* $0 < \hat{\alpha}'_S < \hat{\alpha}''_S \leq \hat{\alpha}'''_S < 1$ *so that the following holds:*

i) Suppose the share of online consumers is very small (i.e., $\alpha \leq \hat{\alpha}'_S$*). In the essentially unique subgame-perfect equilibrium all consumers are served efficiently, no dimension is salient, the manufacturer chooses the efficient quality* $q = q^*$*, and retailers earn zero profit.*

ii) Suppose the share of online consumers is small (i.e., $\hat{\alpha}'_S < \alpha < \hat{\alpha}''_S$*). In the essentially unique subgame-perfect equilibrium all consumers are served efficiently, no dimension is salient, the manufacturer sets an inefficiently high quality* $q = q^{TP}_{\text{ex}}(\alpha, \delta) \geq q^S_{\text{ex}}(\alpha, \delta) > q^*$*, and retailers earn zero profit.*

iii) Suppose the share of online consumers is at an intermediate level (i.e., $\hat{\alpha}''_S \leq \alpha < \hat{\alpha}'''_S$*). In the essentially unique subgame-perfect equilibrium all consumers are served efficiently, price is salient, the manufacturer chooses an inefficiently low quality* $q = q^S_{\text{ps}}(\delta) < q^*$*, and retailers earn zero profit.*

iv) Suppose the share of online consumers is large (i.e., $\alpha \geq \hat{\alpha}'''_S$*). In the essentially unique subgame-perfect equilibrium only online consumers are served, no dimension is salient, the manufacturer chooses the efficient quality* $q = q^*$*, and retailers earn zero profit.*

Proof. We prove parts i), ii), iii), and iv) successively. We build on the insights derived in Proposition 1 in order to determine the manufacturer's optimal uniform two-part tariff.

PRELIMINARIES: First, note that the manufacturer can incentivize the retailers to avoid a price-salient environment only via the linear part of the tariff, but not via the fixed part. Thus, according to Proposition 1, the manufacturer can induce the retailers to serve all consumers efficiently while prices are non-salient if and only if $\alpha \leq \tilde{\alpha}(q)$, where the threshold $\tilde{\alpha}(q)$ is defined in Equation (4). Second, for $\alpha \leq \tilde{\alpha}(q)$, the manufacturer can design a two-part tariff that does not only induce a distortion-free retail equilibrium but also extracts all retailer profits. Precisely, if the manufacturer offers

$$(w, F) = \left(w^S_{\text{df}}(q; \alpha, \delta), \alpha \cdot \left(\frac{(1-\alpha)r - (1-\delta)v(q)}{1 - \alpha N} \right) \right), \tag{10}$$

where $w^S_{\text{df}}(q; \alpha, \delta)$ is defined in Equation (3), then the retailers indeed charge the same prices on- and offline (as shown in Proposition 1) and the manufacturer earns a profit of

$$N \cdot \left(\frac{w}{N} + F \right) - c(q) = v(q) - (1-\alpha)r - c(q).$$

Third, we observe that the critical share of online consumers, $\tilde{\alpha}(q)$, is continuous and strictly increasing in q on the interval $[\underline{q}, \overline{q}]$, which implies that the restriction of $\tilde{\alpha}(q)$ to its image—i.e., $\tilde{\alpha} : [\underline{q}, \overline{q}] \to \tilde{\alpha}([\underline{q}, \overline{q}])$—is a one-to-one correspondence. Fourth, by Assumption 1, we have $\tilde{\alpha}(\overline{q}) < \frac{1}{N}$. Fifth, if the manufacturer charges a uniform linear wholesale price, then retailers earn zero profit in any equilibrium in which either all consumers are served and price is salient or only online consumers are served (see Proposition 1). Hence, if the manufacturer wants to induce either a price salient retail equilibrium or a retail equilibrium in which only online consumers are served, a linear tariff is sufficient to extract retailer profits.

PART i): Suppose $0 < \alpha \leq \tilde{\alpha}(q^*)$. In this case, by Proposition 1, the manufacturer can induce the retailers to charge the same prices on- and offline, while offering the efficient quality $q = q^*$. It is straightforward that for any $\alpha \leq \tilde{\alpha}(q^*)$ the manufacturer charges the two-part tariff defined in (10)—or an essentially equivalent one, i.e., one that yields the same outcome—and all consumers are served efficiently. Denoting $\hat{\alpha}'_S := \tilde{\alpha}(q^*)$ completes the proof of Part i).

PART ii): Suppose $\tilde{\alpha}(q^*) < \alpha \leq \tilde{\alpha}(\overline{q})$. Then, the manufacturer can induce the retailers to charge the same prices on- and offline by choosing an inefficiently high quality level

$$\tilde{q}(\alpha) := v^{-1} \left(\frac{\alpha N r}{1 - \delta} \right) \in (q^*, \overline{q}].$$

If the manufacturer now offers the two-part tariff defined in Equation (10), he earns a profit of $v(\tilde{q}(\alpha)) - (1-\alpha)r - c(\tilde{q}(\alpha))$. Hence, the manufacturer induces the retailers to charge the same prices on- and offline if and only if

$$v(\tilde{q}(\alpha)) - (1-\alpha)r - c(\tilde{q}(\alpha)) > \max \left\{ \delta v(q^S_{\text{ps}}) - r - c(q^S_{\text{ps}}), \alpha \cdot [v(q^*) - c(q^*)] \right\}. \tag{11}$$

First, note that $v(\tilde{q}(\alpha)) - (1-\alpha)r - c(\tilde{q}(\alpha))$ is continuous in α on the interval $(\tilde{\alpha}(q^*), \tilde{\alpha}(\overline{q})]$ and approaches $v(q^*) - (1-\alpha)r - c(q^*)$ for $\alpha \to \tilde{\alpha}(q^*)$. Second, we already know that

$$v(q^*) - (1-\alpha)r - c(q^*) > \max\left\{\delta v(q^S_{\text{ps}}) - r - c(q^S_{\text{ps}}), \alpha \cdot [v(q^*) - c(q^*)]\right\}.$$

Hence, there exists some $\hat{\alpha}''_S \in (\tilde{\alpha}(q^*), \tilde{\alpha}(\overline{q})]$ such that for any $\alpha \in (\tilde{\alpha}(q^*), \hat{\alpha}''_S)$ Inequality (11) holds. Finally, denote $q^{TP}_{\text{ex}}(\alpha, \delta) := \tilde{q}(\alpha, \delta)$, which completes the proof of Part ii).

PARTS iii) and iv): Suppose $\hat{\alpha}''_S \leq \alpha < 1$. In this case, the manufacturer does not induce the retailers to charge the same prices on- and offline. Hence, the manufacturer either induces a retail equilibrium in which all consumers are served efficiently and price is salient or a retail equilibrium in which only the online consumers are served (via the online channel). We have seen in the proof of Proposition 1 that a linear wholesale price is sufficient to induce each of both retail equilibria while extracting retailer profits. Applying our insights from Proposition 1, we conclude that the manufacturer prefers a retail equilibrium in which all consumers are served efficiently and price is salient if and only if

$$\delta v(q^S_{\text{ps}}) - r - c(q^S_{\text{ps}}) > \alpha \cdot [v(q^*) - c(q^*)] \quad \iff \quad \alpha < \frac{\delta v(q^S_{\text{ps}}) - r - c(q^S_{\text{ps}})}{v(q^*) - c(q^*)} =: \overline{\alpha}(\delta). \tag{12}$$

Denote $\hat{\alpha}'''_S := \max\{\overline{\alpha}(\delta), \hat{\alpha}''_S\}$, which is—by our previous considerations—strictly smaller than one. This completes the proof of Parts iii) and iv). □

Except for very small shares of online consumers the equilibrium has the same structure as under a linear tariff. If the share of online consumers is very small, however, the manufacturer is able to incentivize the retailers to charge the same retail price on- and offline (via the linear part of the tariff as in Proposition 1) while extracting retailer profits (via the fixed part of the tariff). Hence, at least for very small values of α, the possibility to charge a two-part tariff enables the manufacturer to eliminate the salience threat and to maximize and extract industry profits. In this case, there is no need to distort the product's quality upward, and the manufacturer offers the efficient quality level. Here, social welfare is maximized in equilibrium.

Importantly, the manufacturer can incentivize retailers to abstain from charging a lower online price only via the linear part of the tariff. As we have seen in the proof of Proposition 1, such an incentive-compatible linear wholesale price exists only for sufficiently small values of α, so that a two-part tariff does not fully solve the manufacturer's channel coordination problem arising from salience effects. Precisely, the manufacturer can induce retailers to charge the same price on- and offline if and only if $\alpha \leq \tilde{\alpha}(q)$, where the upper bound $\tilde{\alpha}(q)$, as defined in Equation (4), strictly increases in q. Thus, for small values of α, the manufacturer offers an excessive quality as only this allows him to induce a retail equilibrium in which all consumers are served efficiently and price is non-salient.

If in equilibrium either all consumers are served efficiently and price is salient or only online consumers are served, already a linear wholesale price suffices to extract retailer profits. Hence, whenever the manufacturer wants to induce either of these retail equilibria, he offers a simple linear tariff, so that the equilibrium outcome is exactly the same as described in Proposition 1. Similar to the case of linear contracting, only online consumers are served in equilibrium if and only if the share of online consumers, α, is sufficiently large.

As before, if the salience bias is only weak (i.e., δ is sufficiently close to one), then for a certain range of α a price salient equilibrium arises.

Corollary 2. *There exists some $\overline{\delta} < 1$ such that for any $\delta > \overline{\delta}$ a price salient equilibrium exists.*

Proof. We have to show that there exists some $\overline{\delta} < 1$ such that for any $\delta > \overline{\delta}$ we have $\hat{\alpha}_S''' > \hat{\alpha}_S''$. Remember that $\tilde{\alpha}(q) \to 0$ for $\delta \to 1$, so that also $\hat{\alpha}_S'' \to 0$ for $\delta \to 1$. Thus, the statement simply follows from the fact that $\lim_{\delta \to 1} \hat{\alpha}_S''' = \lim_{\delta \to 1} \overline{\alpha}(\delta) = \alpha_R > 0$, where the threshold value $\overline{\alpha}(\delta)$ is defined in Equation (12). $\square$

Equilibrium with Vertical Restraints. In contrast to our baseline model, for any $\alpha \leq \hat{\alpha}_S'$, the manufacturer does not have an incentive to impose a vertical restraint on online sales. If the share of online consumers is sufficiently small, then a two-part tariff enables the manufacturer to maximize and extract industry profits even without imposing a restraint on online sales (see Part i) of Proposition 9). Nevertheless, the welfare implications of allowing the manufacturer to impose a vertical restraint remain qualitatively the same; if anything, the manufacturer's and society's incentives are aligned more often.

If the salience bias is not too strong, the manufacturer imposes a ban on online sales if and only if $\hat{\alpha}_S'' < \alpha < \alpha_R$ (for smaller values of δ the manufacturer may also impose a ban for $\hat{\alpha}_S' < \alpha \leq \hat{\alpha}_S''$). The manufacturer's ban strictly decreases social welfare for $\hat{\alpha}_S'' < \alpha \leq \hat{\alpha}_S'''$ (i.e., in case of a quality distortion), while his ban strictly increases social welfare for $\hat{\alpha}_S''' < \alpha < \alpha_R$

(i.e., in case of a participation distortion). Thus, as depicted in Figure 3, the equilibrium under a ban on online sales has a similar structure as in our baseline model with a linear wholesale price—except for the new part that arises for small shares of online consumers.

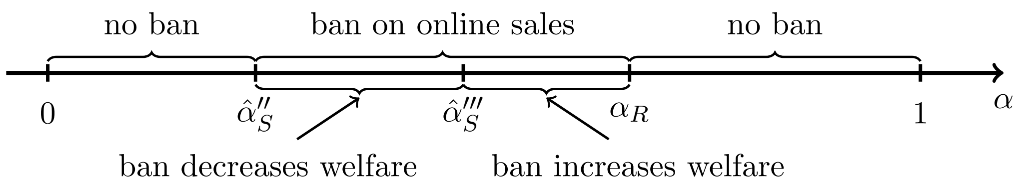

Figure 3: *For illustrative reasons, suppose the salience bias is not too strong. For* $\hat{\alpha}''_S < \alpha < \alpha_R$*, the manufacturer prohibits online sales. While this ban strictly decreases social welfare for any* $\hat{\alpha}''_S < \alpha \leq \hat{\alpha}'''_S$*, a ban on online sales strictly increases social welfare for any* $\hat{\alpha}'''_S < \alpha < \alpha_R$*.*

Notably, under a uniform two-part tariff the manufacturer is indifferent between RPM and dual pricing. In contrast to our baseline model, resale price maintenance in combination with a uniform two-part tariff enables the manufacturer to extract the maximum industry profit for any $0 < \alpha < 1$. As a consequence, the manufacturer either determines the retail prices—i.e., he fixes on- and offline prices to be the same—or engages in dual pricing—i.e., he charges a higher linear wholesale price for units intended to be sold online—if and only if $\hat{\alpha}'_S < \alpha < 1$. Both practices do not only maximize the manufacturer's profit, but also social welfare.

D.2: Retailer-Specific Contracts

In this subsection, we show that the equilibrium structure and our qualitative welfare implications do not hinge on the assumption of uniform tariffs as long as transportation costs are sufficiently large so that the manufacturer does not want to rely on a single retailer to serve all offline consumers.[25]

Equilibrium without Vertical Restraints. Suppose the manufacturer charges a retailer-specific, linear wholesale price, w_i (the argument for retailer-specific two-part tariffs goes along the same lines). For the sake of the argument, let the transportation costs, t, be sufficiently

[25] If transportation costs are close to zero and the manufacturer wants all consumers to be served in equilibrium, he may want to supply only one retailer in order to avoid a quality distortion. But if a single retailer *cannot* profitably serve all offline consumers at a wholesale price $w = \delta v(q) - r$, an excessive branding equilibrium exists.

high, so that a consumer will never buy in a foreign brick-and-mortar store. In contrast to our baseline model, the manufacturer may now have an incentive to exclude some retailers from the market by charging them a prohibitively high wholesale price. Even though excluding some retailers reduces the overall demand, it might be profitable since it relaxes the salience threat.

We make two immediate observations: first, if in equilibrium only online consumers are served, the manufacturer earns a profit of $\alpha \cdot [v(q^*) - c(q^*)]$, which is independent of the number of active retailers, $k = k(w_1, \ldots, w_N)$, provided at least one retailer is active. Second, as it is efficient to serve offline consumers via their local brick-and-mortar store and the optimal quality under price salience does not depend on the number of active retailers, the manufacturer's profit in a price salient equilibrium strictly increases in k. Hence, if the manufacturer induces a price salient equilibrium, then he supplies all retailers (i.e., $k = N$) and earns $\delta v(q^S_{\text{ps}}) - r - c(q^S_{\text{ps}})$.

If the manufacturer wants to induce the retailers to charge the same price on- and offline, he can make online price cuts less attractive by excluding some retailers from the market. To see why, suppose the manufacturer offers a wholesale price $w_i = w \in [\delta v(q) - r, v(q) - r]$ to a subset of $k \leq N$ retailers, while he charges the remaining retailers a prohibitively high wholesale price, $w_j > v(q)$. Then, retailer i has no incentive to deviate to a lower online price if and only if

$$\frac{1-\alpha}{N} \cdot \Big[v(q) - r - w\Big] + \frac{\alpha}{k} \cdot \Big[v(q) - w\Big] \geq \alpha \cdot \Big[\delta v(q) - w\Big]. \tag{13}$$

Since each retailer i obtains a larger share of online consumers when only few retailers are active in the market, she is less likely to deviate if k is small. By similar arguments as in the proof of Proposition 1, there exists some $\hat{\alpha}(q,k) > 0$ such that Inequality (13) holds for some $w \in [\delta v(q) - r, v(q) - r]$ if and only if $\alpha \leq \hat{\alpha}(q,k)$. In fact, for any $\alpha \leq \hat{\alpha}(q,k)$, there exists a maximal wholesale price $\hat{w}(q,k;\alpha,\delta) \in [\delta v(q) - r, v(q) - r]$ such that (13) holds if and only if the wholesale price satisfies $\delta v(q) - r \leq w \leq \hat{w}$.

Lemma 6. *For any quality level $q \in [\underline{q}, \overline{q}]$, the following statements hold:*

i) The threshold value $\hat{\alpha}(q,k)$ strictly decreases in k.

ii) For any $\alpha \leq \hat{\alpha}(q,k)$, the maximal wholesale price $\hat{w}(q,k;\alpha,\delta)$ weakly decreases in k.

iii) $\lim_{\alpha \to 0} \frac{\partial}{\partial k} \hat{w}(q,k;\alpha,\delta) = 0$.

Proof. For any $k \leq N$ and $\alpha \leq \hat{\alpha}(q,k)$, Inequality (13) holds if and only if

$$w \leq \hat{w}(q,k;\alpha,\delta) := \min\left\{\frac{v(q)\cdot\big[(1-\alpha)k+\alpha N-\alpha\delta kN\big]-r(1-\alpha)k}{(1-\alpha)k+\alpha N-\alpha kN}, v(q)-r\right\}, \tag{14}$$

where the upper bound on the share of online consumers equals

$$\hat{\alpha}(q,k) := \frac{k(1-\delta)v(q)}{r(k-1)N-(N-k)(1-\delta)v(q)}.$$

PART i): Straightforward computations yield

$$\frac{\partial}{\partial k}\hat{\alpha}(q,k) = -\frac{(1-\delta)Nv(q)\big(r+(1-\delta)v(q)\big)}{\big(r(k-1)N-(N-k)(1-\delta)v(q)\big)^2} < 0.$$

PART ii): For any $\alpha \leq \hat{\alpha}(q,k)$, we obtain

$$\frac{\partial}{\partial k}\hat{w}(q,k;\alpha,\delta) = \begin{cases} -\alpha N\left(\frac{r(1-\alpha)-\alpha Nv(q)(1-\delta)}{\big(\alpha(k-1)N-(1-\alpha)k\big)^2}\right) & \text{if } \frac{r}{r-(1-\delta)v(q)} \leq k \leq N, \\ 0 & \text{if } 1 \leq k < \frac{r}{r-(1-\delta)v(q)}. \end{cases} \tag{15}$$

Note that $\frac{\partial}{\partial k}\hat{w}(q,k;\alpha,\delta) < 0$ holds for any $k \geq \frac{r}{r-(1-\delta)v(q)}$ if and only if

$$r(1-\alpha)-\alpha Nv(q)(1-\delta) > 0.$$

Since the left-hand side of the preceding inequality strictly decreases in α, a sufficient condition for this inequality to hold is given by

$$r(1-\hat{\alpha}(q,k))-\hat{\alpha}(q,k)Nv(q)(1-\delta) > 0.$$

Re-arranging this inequality yields

$$k > \frac{r(1-\delta)v(q)}{r^2-(1-\delta)^2v(q)^2}.$$

As $r > (1-\delta)v(q)$ by Assumption 1, the right-hand side of this inequality is less than $\frac{r}{r-(1-\delta)v(q)}$, so that we indeed obtain $\frac{\partial}{\partial k}\hat{w}(q,k;\alpha,\delta) < 0$ for any $k \geq \frac{r}{r-(1-\delta)v(q)}$.

PART iii): Follows immediately from (15). □

Hence, if the number of active retailers decreases, a distortion-free retail equilibrium becomes more likely in the sense of set inclusion. Intuitively, if only few retailers are active in the market, each active retailer i serves a larger share of online consumers at a high price, so that she has less incentives to deviate to a lower online price in order to capture the entire online market.

Thus, for a given number of active retailers k, the manufacturer can earn

$$\Pi(k) := \left[\alpha + (1-\alpha)\frac{k}{N}\right] \cdot \left[\hat{w}(\hat{q}(k), k; \alpha, \delta) - c(\hat{q}(k))\right], \tag{16}$$

where the optimal quality choice is given by

$$\hat{q}(k) := \underset{q \in [\underline{q}, \overline{q}] \text{ s.t. } \hat{\alpha}(q,k) \geq \alpha}{\arg\max} \left[\hat{w}(q, k; \alpha, \delta) - c(q)\right].$$

For $\alpha \leq \hat{\alpha}(\underline{q}, N)$, applying the Envelope Theorem to Equation (16) gives

$$\Pi'(k) = \underbrace{\frac{1-\alpha}{N} \cdot \left[\hat{w}(\hat{q}(k), k; \alpha, \delta) - c(\hat{q}(k))\right]}_{\text{demand expanding effect}} + \underbrace{\left[\alpha + (1-\alpha)\frac{k}{N}\right] \cdot \frac{\partial}{\partial k}\hat{w}(q, k; \alpha, \delta)\bigg|_{q=\hat{q}(k)}}_{\text{margin reducing effect}}.$$

While increasing the number of active retailers increases the overall demand for the product, the maximal wholesale price that induces a retailer to charge a high online price weakly decreases in k (Lemma 6). In addition, by Lemma 6, the reduction in the maximal wholesale price due to an increase in the number of active retailers k disappears for α approaching zero. Hence, for α sufficiently small, we have $\Pi'(k) > 0$ for any $k \leq N$, so that the manufacturer has no incentive to exclude retailers from the market.

Altogether, we conclude that for small values of α the manufacturer does not exclude any retailer from the market, so that we obtain an excessive branding equilibrium as described in Proposition 1 i). In addition, for large values of α, it is still optimal for the manufacturer to induce an equilibrium in which only online consumers are served. Hence, if the share of online consumers is sufficiently large, the equilibrium is the same as described in Proposition 1 iii). Finally, for intermediate values of α, we either obtain a price salient equilibrium as described in Proposition 1 ii) or an excessive branding equilibrium in which only a subset of retailers is active in the market and some offline consumers will not be served.

Equilibrium with Vertical Restraints. Given that the manufacturer can offer retailer-specific linear wholesale prices, the equilibrium with and without vertical restraints has the same structure as under a uniform linear wholesale price, so that the welfare implications derived in Section 4 remain valid. Also with retailer-specific, linear wholesale prices the manufacturer imposes a ban on online sales if and only if $\alpha < \alpha_R$. In addition, if the salience bias is weak (i.e., δ is close to one), a ban on online sales decreases welfare for a sufficiently small share of online consumers, but increases welfare for intermediate values of α. As in the case of a uniform wholesale price, the manufacturer imposes a restraint on retail prices if and only if this restriction strictly increases social welfare (i.e., if and only if $\alpha < \alpha_R$). Finally, for any $\alpha \in (0,1)$, the manufacturer strictly prefers to condition his wholesale price on the distribution channel, thereby maximizing social welfare.

D.3: Manufacturer-Owned Online Store

Suppose the manufacturer also operates an own online store.[26] We characterize the equilibrium outcome in the absence of vertical restraints depending on the share of online consumers.

Proposition 10. *Suppose the manufacturer charges a uniform linear wholesale price and cannot impose any vertical restraint, but operates an own online store. Then, there exist some threshold values* $0 < \breve{\alpha}'_S \leq \breve{\alpha}''_S < 1$ *so that the following holds:*

i) Suppose the share of online consumers is small (i.e., $\alpha \leq \breve{\alpha}'_S$*). In the unique subgame-perfect equilibrium all consumers are served efficiently, no dimension is salient, the manufacturer sets an inefficiently high quality* $q = q^{OS}_{\text{ex}}(\alpha, \delta) > q^*$*, and retailers earn strictly positive profits.*

ii) Suppose the share of online consumers is at an intermediate level (i.e., $\breve{\alpha}'_S < \alpha \leq \breve{\alpha}''_S$*). In the essentially unique subgame-perfect equilibrium all consumers are served efficiently, price is salient, the manufacturer sets an inefficiently low quality* $q = q^S_{\text{ps}}(\delta) < q^*$*, and retailers earn zero profit.*

iii) Suppose the share of online consumers is large (i.e., $\alpha > \breve{\alpha}''_S$*). In the essentially unique subgame-perfect equilibrium only online consumers are served, no dimension is salient, the manufacturer sets the efficient quality* $q = q^*$*, and retailers earn zero profit.*

Proof. We omit the proof, as it goes along the same lines as the proof of Proposition 1. □

[26] Our fourth tie-breaking assumption then reads as follows: if all online stores (including the manufacturer-owned store) offer the product at the same price, they all serve the same number of consumers. If we assume instead that in case of indifference a slightly higher or lower share of consumers buy at the manufacturer's online store, our qualitative findings stay the same.

Appendix E: Continuous Salience Distortions

In the main text, we have adopted a *discrete* salience approach in the spirit of Bordalo *et al.* (2012, 2013b), according to which in our setup already a marginal price difference across stores results in a discrete drop of a consumer's willingness-to-pay. Bordalo *et al.* (2012) argue that this simplified discrete model is best thought of as an approximation to a more realistic, but also more complex, *continuous* salience model where salience weights are continuous functions of the respective dimension's salience. Also Kőszegi and Szeidl (2013) assume that the weight assigned to a certain choice dimension is a continuous function of the difference in values available along this particular dimension. In the following, we argue that our qualitative results are robust to the assumption that the relative weight on a product's price is proportional to the stimulus, that is, the contrast in retail prices across the different stores.

Continuous Model. For the sake of comparability, we adjust the model of Kőszegi and Szeidl (2013) as follows. Denote the range of retail prices as $D := \max_{(i,k)\in\mathcal{C}} p_{i,k} - \min_{(i,k)\in\mathcal{C}} p_{i,k}$ where $\mathcal{C} := \{(i,k)|1 \leq i \leq N \text{ and } k \in C_i\}$ gives the set of active retailer-channel combinations. We then assume that a consumer's perceived value derived from a product of quality $q \in [\underline{q}, \overline{q}]$ is given by $\frac{v(q)}{g(D)}$, where $g(\cdot)$ is a twice continuously differentiable, strictly increasing and concave function with $g(0) = 1$, $g(r)r < v(\underline{q})$ (remember that r gives the retail costs), and $g'(0) > \frac{1}{v(\underline{q})}$.

Preliminaries. In order to verify that our qualitative results still hold under continuous salience distortions, we first derive some preliminary results.

Lemma 7. *For any quality $q \in [\underline{q}, \overline{q}]$ there exists a unique retail price $\hat{p}(q) \in (0, v(q))$ such that*

$$\hat{p}(q) = \frac{v(q)}{g(v(q) - \hat{p}(q))}. \tag{17}$$

In addition, we have $p > \frac{v(q)}{g(v(q)-p)}$ for any price $p > \hat{p}$ and $p < \frac{v(q)}{g(v(q)-p)}$ for any price $p < \hat{p}$.

Proof. First, since $g'(0) > \frac{1}{v(\underline{q})}$, we obtain

$$\begin{aligned}
\lim_{p\to v(q)} \frac{\partial}{\partial p}\left(\frac{v(q)}{g(v(q)-p)} - p\right) &= \lim_{p\to v(q)}\left(v(q)\cdot\frac{g'(v(q)-p)}{g(v(q)-p)^2} - 1\right)\\
&= v(q)\cdot g'(0) - 1\\
&> 0.
\end{aligned}$$

Second, we have

$$\begin{aligned}\lim_{p\to 0}\left(\frac{v(q)}{g(v(q)-p)}-p\right) &= \frac{v(q)}{g(v(q))}\\ &> \quad 0 \qquad = \lim_{p\to v(q)}\left(\frac{v(q)}{g(v(q)-p)}-p\right).\end{aligned}$$

Third, since $g(\cdot)$ is strictly increasing and concave, we obtain

$$\frac{\partial^2}{\partial p^2}\left(\frac{v(q)}{g(v(q)-p)}-p\right)=v(q)\ \frac{-g''(v(q)-p)g(v(q)-p)^2+2g'(v(q)-p)^2}{g(v(q)-p)^4}>0.$$

Using the first and second observation and applying the Intermediate Value Theorem, we conclude that there exists some retail price $\hat{p}(q)\in(0,v(q))$ such that $\hat{p}(q)=\frac{v(q)}{g(v(q)-\hat{p}(q))}$. The second and third observation ensure uniqueness, as a convex function has at most two roots. Moreover, we immediately obtain $p>\frac{v(q)}{g(v(q)-p)}$ for any price $p>\hat{p}$ and $p<\frac{v(q)}{g(v(q)-p)}$ for any price $p<\hat{p}$. $\square$

Next, we determine how the price $\hat{p}(q)$, defined in (17), depends on the provided quality, q.

Lemma 8. *For any $q\in[\underline{q},\overline{q}]$, we have $\hat{p}'(q)<v'(q)$.*

Proof. Applying the Implicit Function Theorem to Equation (17) yields

$$\hat{p}'(q)=v'(q)\cdot\left(\frac{1-g'(v(q)-\hat{p}(q))\hat{p}(q)}{g(v(q)-\hat{p}(q))-g'(v(q)-\hat{p}(q))\hat{p}(q)}\right).$$

In order to prove the statement, we have to verify that the fraction on the right-hand side is strictly less than one. As $\hat{p}(q)<v(q)$, as $g(0)=1$ and as $g(\cdot)$ is strictly increasing, we immediately conclude that the denominator is strictly larger than the numerator. Hence, it remains to show that the denominator is strictly positive.

For the sake of a contradiction, suppose the opposite; that is, let us assume that we have $g(v(q)-\hat{p}(q))\le g'(v(q)-\hat{p}(q))\hat{p}(q)$. Then, since $g(\cdot)$ is strictly increasing and concave, we have

$$\frac{\partial}{\partial p}\left(g(v(q)-p)-g'(v(q)-p)p\right)=-2\cdot g'(v(q)-p)+g''(v(q)-p)p<0 \tag{18}$$

for any $p\in(0,v(q))$, so that $g(v(q)-p)<g'(v(q)-p)p$ for any $p\in(\hat{p}(q),v(q))$. Then, we obtain

$$\begin{aligned}0&=g(v(q)-v(q))v(q)-g(v(q)-\hat{p}(q))\hat{p}(q)\\ &=\int_{\hat{p}(q)}^{v(q)} g(v(q)-p)\ dp-\left(-\big[g(v(q)-p)p\big]_{\hat{p}(q)}^{v(q)}+\int_{\hat{p}(q)}^{v(q)} g(v(q)-p)\ dp\right)\\ &=\int_{\hat{p}(q)}^{v(q)} g(v(q)-p)-g'(v(q)-p)p\ dp\\ &<0,\end{aligned}$$

where the first equality follows from (17), the last equality follows by partial integration and linearity of the integral and the inequality follows from the assumption toward a contradiction and Equation (18); a contradiction. $\square$

Now, for a given quality $q \in [\underline{q}, \overline{q}]$, we set $\delta(q) := \frac{1}{g(v(q)-\hat{p}(q))}$ and conclude:

Lemma 9. *For any $q \in [\underline{q}, \overline{q}]$, we have $\delta'(q) < 0$.*

Proof. Taking the first derivative of $\delta(q)$ yields

$$\delta'(q) = -\delta(q)^2 \cdot g'(v(q) - \hat{p}(q)) \cdot [v'(q) - \hat{p}'(q)],$$

so that the claim follows immediately from Lemma 8. $\square$

Next, we impose an analogue to Assumption 1 for our continuous salience model.

Assumption 2. $\delta(\overline{q}) > \max\left\{1 - \left(\frac{N-1}{N}\right) \cdot \frac{r}{v(\overline{q})},\ 1 - \frac{l-r}{v(\overline{q})},\ \frac{r}{v(\underline{q})}\right\}.$

In addition, continuity of $g(\cdot)$ immediately yields the following lemma.

Lemma 10. *Let $p' > p'' > 0$ with $\frac{v(q)}{g(p'-p'')} \geq p'$. Then, there exists some $\varepsilon > 0$ such that $\frac{v(q)}{g(p'-p)} \geq p$ for any $p \in [p'' - \varepsilon, p'']$.*

Finally, by analogous arguments as in the discrete salience model, we conclude that also under continuous salience distortions any retail equilibrium is symmetric in the sense of Definition 2.

Equilibrium. Using our preliminary considerations, it is straightforward to see that the economic logic of our discrete salience model remains to hold.

Excessive Branding Equilibrium. Fix some quality $q \in [\underline{q}, \overline{q}]$ and some wholesale price $w \geq 0$. Suppose that the retailers charge the same prices on- and offline. Without loss of generality, let $p_{j,k} = v(q)$ for any $j \in \{1, \dots, N\}$ and any $k \in \{\text{on}, \text{off}\}$. In this case, retailer i has to charge an online price $p_{i,\text{on}} \leq \hat{p}(q)$ in order to attract all online consumers. As a consequence, for a given wholesale price $w \in [\delta v(q) - r, v(q) - r]$, there exists a retail equilibrium in which all retailers charge the same prices on- and offline if and only if

$$\frac{1-\alpha}{N} \cdot \Big[v(q) - r - w\Big] + \frac{\alpha}{N} \cdot \Big[v(q) - w\Big] \geq \alpha \cdot \Big[\delta v(q) - w\Big]. \tag{19}$$

By analogous arguments as in the discrete salience model (see the proof of Proposition 1), Inequality (19) holds if and only if

$$w \leq v(q) \cdot \left(\frac{1-\alpha\delta N}{1-\alpha N} \right) - r \cdot \left(\frac{1-\alpha}{1-\alpha N} \right) =: w^C_{\text{df}}(q;\alpha,N) \quad \text{and} \quad \alpha \leq \tilde{\alpha}(q),$$

where $\tilde{\alpha}(q)$ is defined in Equation (4). Applying Lemma 9 gives

$$\begin{aligned} \frac{\partial}{\partial q} w^C_{\text{df}}(q;\alpha,N) &= v'(q) \cdot \left(\frac{1-\alpha\delta N}{1-\alpha N} \right) - v(q) \cdot \left(\frac{\alpha N}{1-\alpha N} \right) \delta'(q) \\ &> v'(q). \end{aligned}$$

Hence, the manufacturer indeed offers an excessive quality if he induces an equilibrium in which retailers charge the same prices on- and offline. Again by the same arguments as in the discrete salience model, the manufacturer induces an excessive branding equilibrium if and only if the share of online consumers is sufficiently small.

Price Salient Equilibrium. Fix some quality $q \in [\underline{q}, \overline{q}]$ and some wholesale price $w \geq 0$. Suppose that all consumers are served efficiently and that retailers charge a higher price offline, that is, $p_{i,\text{off}} = p_{\text{off}} > p_{\text{on}} = p_{i,\text{on}}$ for any retailer $i \in \{1, \ldots, N\}$. We now show that $p_{\text{on}} = w$ *holds in equilibrium.* For the sake of a contradiction, suppose the opposite; that is, $p_{\text{on}} > w$. Since $\frac{v(q)}{g(p_{\text{off}}-p_{\text{on}})} \geq p_{\text{off}}$ (otherwise offline consumers would not buy), there exists by Lemma 10 some $\varepsilon > 0$ such that $\frac{v(q)}{g(p_{\text{off}}-p)} \geq p$ for any $p \in [p_{\text{on}} - \varepsilon, p_{\text{on}}]$. Hence, a marginal reduction in her online price enables retailer i to attract all online consumers. If retailer i earns zero profits on offline sales, this is obviously a profitable deviation. If retailer i instead earns a positive margin on offline sales, she can simultaneously reduce also her offline price (just enough to keep offline consumers buying), which again gives a profitable deviation. Hence, we arrive at a contradiction and conclude that $p_{\text{on}} = w$ in any price salient retail equilibrium. Next, we observe that $p_{\text{off}} - p_{\text{on}} \geq r$. Otherwise, retailers were not able to cover their retail costs from offline sales. Thus, it is straightforward to see that charging a wholesale price of $w^C_{\text{ps}}(q) = \frac{v(q)}{g(r)} - r$, thereby inducing an offline price of $p_{\text{off}} = \frac{v(q)}{g(r)}$ and minimizing the price difference across channels, maximizes the manufacturer's profit. Since $g(r) > 1$, the manufacturer always provides an inefficiently low quality level in a price salient equilibrium. Depending on the strength of salience distortions a price salient equilibrium may exist for intermediate shares of online consumers.

Online Equilibrium. As in the discrete salience model, the manufacturer can induce a retail equilibrium in which only online consumers are served by charging a wholesale price $w = v(q)$.

In this case, the manufacturer provides the efficient quality $q = q^*$. By the same arguments as in the discrete salience model, the manufacturer actually induces an online equilibrium if and only if the share of online consumers is sufficiently large.

Appendix F: Downward Sloping Demand

In this section, we extend our model by assuming that aggregated demand is downward sloping. In contrast to the main text, however, we fix the quality level throughout this section. Given this restriction, we will argue below that relative to the rational benchmark (i) manufacturer profits stricly decrease, and (ii) social welfare (weakly) decreases if prices are salient in equilibrium. Hence, the manufacturer has a similar incentive to prevent a price-salient environment as in our baseline model with unit demand. In addition, we briefly argue that our beneficial view on vertical restraints—in particular the positive welfare effect of RPM—does not hinge on the assumption of unit demand. Altogether, we conclude that the economic logic underlying the results derived in the main text does not change given that demand is downward sloping.

Setup. As in the main text, we assume that there is share α of online consumers and a share $1-\alpha$ of offline consumers. Additionally, suppose that consumers are heterogeneous with respect to their valuation for quality; that is, a consumer values a product of quality $q \in [\underline{q}, \overline{q}]$ at $\theta v(q)$, where θ is uniformly distributed on $[0,1]$, independently of the consumer's shopping preferences (i.e., both for on- and offline consumers). Thus, aggregated demand at some retail price p equals

$$D(p;\delta) := \begin{cases} \max\left\{1 - \frac{p}{\delta v(q)}, 0\right\} & \text{if price is salient,} \\ \max\left\{1 - \frac{p}{v(q)}, 0\right\} & \text{otherwise.} \end{cases}$$

As the quality level is fixed, we can set, without loss of generality, the manufacturer's marginal production cost to zero. In addition, suppose that $\delta v(\underline{q}) > r$ holds, so that retailers can profitably sell the product offline also under price salience as long as the wholesale price is sufficiently low.

Characterization of Equilibria with Salient Prices. Suppose that prices are salient in equilibrium. By the same arguments as in Appendix B, we conclude that any equilibrium has to be symmetric in the sense of Definition 2. This implies that in equilibrium both channels are operating (for at least some retailers), although demand in the offline channel can be zero.

Lemma 11. *If prices are salient in equilibrium, social welfare is weakly lower than in the rational benchmark. If demand is positive in both channels social welfare is even strictly lower. In addition, the manufacturer's profit is always strictly lower than in the rational benchmark.*

Proof. We solve the game backwards under the assumption that prices are salient.

STAGE 3 (Retail Pricing): Fix some wholesale price $w \geq 0$. As prices are salient by assumption, retailers charge a symmetric online retail price of $p^*_{\text{on}}(w) = w$. If the wholesale price is low enough to allow for profitable offline sales (i.e., $w < \delta v(q) - r$), retailer i charges an offline retail price of

$$p^*_{\text{off}}(w, \delta) := \min \left\{ \underset{p \geq 0}{\arg\max} \ (p - w - r) \cdot D(p; \delta), w + r + t \cdot \left(\frac{N}{N-1} \right), w + l \right\}. \tag{20}$$

Note that, if the constraints in (20) do not bind (i.e., t and l are sufficiently large), the optimal offline retail price under price salience, $p^*_{\text{off}} = p^*_{\text{off}}(w, \delta)$, solves

$$1 - \frac{p^*_{\text{off}}}{\delta v(q)} - \frac{p^*_{\text{off}} - w - r}{\delta v(q)} = 0, \tag{21}$$

which in turn implies $p^*_{\text{off}}(w, \delta) = \frac{1}{2}(\delta v(q) + w + r)$. For any wholesale price $w \geq \delta v(q) - r$, however, the retailers prefer to not sell the product offline. More precisely, the retailers charge an offline retail price that (weakly) exceeds the consumers' maximum willigness-to-pay under price salience, so that demand in the offline channel is zero and prices are indeed salient.

STAGE 2 (Wholesale Pricing): Given optimal retail pricing, the manufacturer chooses a wholesale price in order to solve the following problem

$$w \cdot \left((1 - \alpha) \cdot \max \left\{ 1 - \frac{p^*_{\text{off}}(w, \delta)}{\delta v(q)}, 0 \right\} + \alpha \cdot \max \left\{ 1 - \frac{w}{\delta v(q)}, 0 \right\} \right).$$

As $p^*_{\text{off}} \geq w + r$ if the product is sold offline, the optimal wholesale price, $w^* = w^*(\delta)$, solves

$$\begin{cases} 1 - (1 - \alpha) \frac{p^*_{\text{off}}(w^*)}{\delta v(q)} - \alpha \frac{w^*}{\delta v(q)} - \frac{w^*}{\delta v(q)} \left[(1 - \alpha) \frac{\partial p^*_{\text{off}}}{\partial w} + \alpha \right] = 0 & \text{if } w^* < \delta v(q) - r, \\ 1 - \frac{w^*}{\delta v(q)} - \frac{w^*}{\delta v(q)} = 0 & \text{otherwise,} \end{cases} \tag{22}$$

which in turn implies that the optimal wholesale price is given by

$$w^*(\delta) = \begin{cases} \frac{\delta v(q)}{2} - \frac{(1-\alpha)}{2(1+\alpha)} r & \text{if } \delta > \frac{r}{v(q)} \frac{1+3\alpha}{1+\alpha}, \ l \geq \frac{(1+\alpha)\delta v(q) + r(1+3\alpha)}{2(1+\alpha)^2} \ \& \ t \geq \frac{N-1}{N} \frac{(1+\alpha)\delta v(q) - r(1+\alpha+2\alpha^2)}{2(1+\alpha)^2}, \\ \frac{\delta v(q)}{2} - \frac{(1-\alpha)}{2} l & \text{if } \frac{2r - \delta v(q)}{(1-\alpha)} < l < \min\left\{ \frac{(1+\alpha)\delta v(q) + r(1+3\alpha)}{2(1+\alpha)^2}, r + \frac{tN}{N-1} \right\}, \\ \frac{\delta v(q)}{2} - \frac{(1-\alpha)}{2} \left(r + \frac{tN}{N-1} \right) & \text{if } \frac{N-1}{N} \frac{(1+\alpha) r - \delta v(q)}{(1-\alpha)} < t < \min\left\{ \frac{N-1}{N} \frac{(1+\alpha)\delta v(q) - r(1+\alpha+2\alpha^2)}{2(1+\alpha)^2}, \frac{N-1}{N}(l - r) \right\}, \\ \frac{\delta v(q)}{2} & \text{otherwise.} \end{cases}$$

Here, the first line refers to the case in which the retail offline price is determined by the first-order condition in (21). The second and third line refer to the cases in which the product is sold offline but the offline retail price does not solve (21). The fourth line corresponds to the case in which offline demand is zero. Note that $\frac{\partial w^*}{\partial \delta} = \frac{v(q)}{2}$ for any combination of parameter values.

In the following, we distinguish between two cases. First, we prove that both social welfare and the manufacturer's profit are strictly lower than in the rational benchmark if offline demand is strictly positive. Second, we verify that social welfare is weakly lower while the manufacturer's profit is strictly lower than in the rational benchmark if offline demand is zero.

1. CASE: In order to understand the effect of price salience on equilibrium welfare, we determine the change in equilibrium demand due to an increase in the salience-parameter δ. If equilibrium demand increases in δ, then also equilibrium welfare increases in δ, which in turn implies that price salience harms social welfare. As we consider the case in which demand is strictly positive in both channels, we have to verify that

$$\frac{d}{d\delta}\left((1-\alpha)\left[1-\frac{p^*_{\text{off}}(w^*(\delta),\delta)}{\delta v(q)}\right]+\alpha\left[1-\frac{w^*(\delta)}{\delta v(q)}\right]\right)>0 \tag{23}$$

holds, which is indeed the case if and only if

$$(1-\alpha)\left[\delta\left(\frac{\partial p^*_{\text{off}}}{\partial \delta}+\frac{\partial p^*_{\text{off}}}{\partial w}\frac{\partial w^*}{\partial \delta}\right)-p^*_{\text{off}}\right]+\alpha\left[\delta\frac{\partial w^*}{\partial \delta}-w^*\right]<0. \tag{24}$$

As $\frac{\partial w^*}{\partial \delta} > 0$, we further conclude that the manufacturer's profit increases in δ if aggregated demand increases in δ. Hence, to prove our claim, it is sufficient to verify that (24) is satisfied.

The remainder of this first case proceeds in two steps. In a first step, we consider the cases in which either offline competition is sufficiently tough (i.e., t is small) or the offline consumers' preference for offline purchases is sufficiently weak (i.e., l is small) so that the offline retail price is *not* determined by the first-order condition in (21). In a second step, we consider the case in which the offline retail price is determined by the first-order condition in (21).

STEP 1. Suppose that the offline price is not determined by the first-order condition in (21). We have seen above that in this case there exists some constant $\lambda > 0$ such that

$$p^*_{\text{off}} = w^* + \lambda \quad \text{and} \quad w^* = \frac{\delta v(q)}{2} - \frac{(1-\alpha)}{2}\lambda. \tag{25}$$

In addition, we observe that $\frac{\partial p^*_{\text{off}}}{\partial \delta} = 0$ and $\frac{\partial p^*_{\text{off}}}{\partial w} = 1$ hold, so that (24) simplifies to

$$\delta\frac{\partial w^*}{\partial \delta} - (1-\alpha)p^*_{\text{off}} - \alpha w^* < 0. \tag{26}$$

Using (25), we conclude that (26) holds if and only if

$$\delta\frac{\partial w^*}{\partial\delta} - w^* - (1-\alpha)\lambda < 0. \tag{27}$$

Then, substituting $\frac{\partial w^*}{\partial\delta} = \frac{v(q)}{2}$ and using (25) again, yields the claim.

STEP 2. Suppose the offline retail price is determined by the first-order condition in (21). By our analysis above, we know that in this case $\frac{\partial p^*_{\text{off}}}{\partial\delta} = \frac{v(q)}{2} = \frac{\partial w^*}{\partial\delta}$ and $\frac{\partial p^*_{\text{off}}}{\partial\delta} = \frac{1}{2}$ hold. Hence, we conclude that (24) simplifies to

$$\delta\frac{\partial w^*}{\partial\delta} + \delta\frac{\partial w^*}{\partial\delta}\frac{(1-\alpha)}{2} - (1-\alpha)p^*_{\text{off}} - \alpha w^* < 0. \tag{28}$$

As we have $p^*_{\text{off}}(w^*) = \frac{1}{2}(\delta v(q) + w^* + r)$ and $\frac{\partial w^*}{\partial\delta} = \frac{v(q)}{2}$, the above inequality is equivalent to

$$\frac{\delta v(q)}{2} - \frac{(1+\alpha)}{2}w^* + \underbrace{\delta\frac{\partial w^*}{\partial\delta}\frac{(1-\alpha)}{2} - \delta v(q)\frac{(1-\alpha)}{2}}_{=-\delta v(q)\frac{(1-\alpha)}{4}} - r\frac{(1-\alpha)}{2} < 0,$$

which holds if and only if

$$\delta v(q)\frac{(1+\alpha)}{4} - \frac{(1+\alpha)}{2}w^* - r\frac{(1-\alpha)}{2} < 0.$$

Then, substituting $w^* = \frac{\delta v(q)}{2} - \frac{(1-\alpha)}{2(1+\alpha)}r$, yields the claim.

2. CASE: Since the manufacturer charges a (discretely) higher wholesale price if offline demand is zero, aggregated demand is obviously lower than in the first case and therefore also lower than in a model with rational consumers where demand is strictly positive in both channels. If the product is sold only online with and without salience effects, then the aggregated demand is the same as in the rational benchmark. Nevertheless, the manufacturer's profit is strictly smaller than in the rational benchmark also if the product is sold only online, as we have $\frac{\partial w^*}{\partial\delta} > 0$. $\square$

The above analysis implies that price salience does not mitigate, but exacerbates the double marginalization problem. As a consequence, also in case of downward sloping demand the manufacturer has an incentive to prevent a price-salient environment (e.g., via a vertical restraint).

Welfare Effects of Vertical Restraints. It is straightforward to see that resale price maintenance does not only eliminate the negative welfare effects of price salience, but also solves the problem of double marginalization. Thus, allowing the manufacturer to restrict retail prices (weakly) increases social welfare also if demand is downward sloping. The welfare consequences of a direct ban and dual pricing, respectively, are less straightforward, but intuitively dual pricing should work in a similar fashion as RPM.

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