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Attention to Online Sales: The Role of Brand Image Concerns*

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April 2020

Abstract

We provide a novel intuition for why manufacturers restrict their retailers' ability to resell brand products online. Our approach builds on models of limited attention 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. We show that, by ruling out both distortions, vertical restraints can be socially desirable, but can also hurt consumers through higher retail prices. Thereby, we identify a novel trade-off between efficiency and consumer surplus.

JEL-Classification: D21, K21, L42.

Keywords: Limited Attention; Online Sales; Antitrust; Vertical Restraints.

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1 Introduction

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 enlarge the potential customer base. Although the internet facilitates price comparisons for consumers, online sales might therefore have a positive impact not only on social welfare, but also on a manufacturer's profit.

Nevertheless, manufacturers have gone to great lengths to restrain internet sales by their retailers, 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 resale price maintenance (RPM) in order to prevent cheap online sales.[6] Also

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

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

[5]`http://www.bundeskartellamt.de/SharedDocs/Meldung/EN/Pressemitteilungen/2013/23_12_2013_Bosch-Siemens-Haushaltsgerte.html?nn=3591568` (downloaded on Sept. 12, 2017).

[6]See `http://www.bundeskartellamt.de/SharedDocs/Meldung/EN/Pressemitteilungen/2014/22_08_2014_`

Nike, *Sanrio*, and *Universal Studios* have imposed various restrictions on retailers selling their licensed merchandising products online (such as merchandise for the well-known brands of Football Club Barcelona, Hello Kitty, and Minions, respectively).[7] While these examples relate to the EU, similar restraints have been undertaken by manufacturers (e.g., *Nike*) across the globe.[8] According to the German cartel office, a key open question in competition law is how to assess the use of vertical restraints to protect a brand's image (Bundeskartellamt, 2013, p. 27).

While our basic insights hold more generally, we microfound the claim that online discounts can harm a brand's image through a well-documented psychological phenomenon (e.g., Schkade and Kahneman, 1998; Dunn *et al.*, 2003; Schumacher *et al.*, 2017): the *contrast effect*. By the contrast effect, consumers focus their attention on that choice dimension (e.g., quality or price) along which available offers differ the most. To model the contrast effect, we build on recent salience models by Kőszegi and Szeidl (2013) and Bordalo *et al.* (2013), which predict that, in the presence of price disparities across distribution channels, consumers tend to focus on a brand product's price and are therefore less willing to pay for a given quality. We thereby highlight a novel externality that discounts in one distribution channel can have on consumers in another channel, namely a consumer's willingness-to-pay in the offline channel can be reduced by lower online prices. The relevance of the contrast effect for similar purchase decisions has been documented both in the lab (e.g., Dertwinkel-Kalt *et al.*, 2017b) and in the field (e.g., Hastings and Shapiro, 2013).

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."[9] 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. The contrast effect predicts that a consumer's perceived quality decreases due to price disparities across channels and, as a consequence, manufacturers also have lower incentives to provide actual quality. Thus, when stating that cheap online sales harm brand image, we mean that both components—the objective and the perceived quality of the brand—decrease likewise.

`Matratzen.html` (downloaded on Sept. 12, 2017).

[7]See, for instance, `europa.eu/rapid/press-release_IP-17-1646_en.pdf` (downloaded on Apr. 5, 2018).

[8]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).

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

The contrast effect allows us to rationalize restraints on online sales in a way that resonates well with the brand image concerns put forward by the manufacturers. We show that in our model unrestricted online sales can harm the brand's image by distorting both the objective and the perceived quality, which in turn provides incentives to a manufacturer to restrict online sales by its retailers. Absent any restraints on online sales, our model can further account for the lack of price discrimination between the on- and the offline channel (see, e.g., Cavallo and Rigobon, 2016). Altogether, our model captures the manufacturers' line of reasoning that online sales can be detrimental to their brand image, a claim, which is hard to reconcile with classical approaches to vertical contracting (see the discussion in Section 7).

In our baseline model a monopolistic manufacturer sells a single product at a linear wholesale price to a number of retailers that serve final consumers via two channels: the online and the offline channel. While we suppose that competition in the online channel is perfect, retailers 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*).[10]

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, in equilibrium, retail prices vary across distribution channels and therefore attract much attention. In such a *price salient equilibrium* the consumer's valuation for high-quality goods is deteriorated and, in response, the manufacturer provides an inefficiently low quality. On the other hand, the manufacturer may distort the product's quality upward 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. 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

[10] Our results rely on the assumption that offline consumers are aware of the online prices, which is motivated by recent survey evidence suggesting 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). This assumption seems particularly plausible, since online information is quickly and easily accessible. In contrast, the results derived in this paper will not depend on whether or not online consumers are aware of the prices charged offline.

of online consumers is large, the manufacturer offers a contract that does not allow the retailers to profitably serve offline consumers, so that in equilibrium only online stores are operated and prices are non-salient (i.e., an *online equilibrium*). As the contrast effect reduces 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, a participation distortion can arise, as *too* few consumers might be served in equilibrium.

By preventing price variation across distribution channels, vertical restraints on internet sales circumvent the adverse salience effects arising from cheap online sales. In a first step, we study the effects of different vertical restraints in isolation: a *direct ban* on online sales, *resale price maintenance*, and *dual pricing*. 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 a ban on online sales ensure the supply of the efficient product specification and can enhance not only the manufacturer's profit but also social welfare. Thus, aligning retail prices across channels through vertical restraints increases efficiency, but it can also harm consumers through higher retail prices. In a second step, we analyze the manufacturer's choice between all three vertical restraints and discuss what kind of forces outside of our model can affect which vertical restraint is optimal for the manufacturer.

Our analysis adds to the current debate in European competition law on whether the aforementioned vertical restraints on internet sales should be prohibited. In general, the European Commission treats all these practices as hardcore restrictions of intra-brand competition, 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, in Germany firms like *adidas* and *Samsonite* were immediately obliged to revert their bans on online sales, and *Bosch*, *Gardena*, and *Lego* were obliged to abandon their dual pricing regimes. Similarly, in the UK the *National Lighting Company* was fined for engaging in online resale price maintenance.[11] In contrast, since the United States Supreme Court established a rule-of-reason approach in *Leegin Creative Leather Products, Inc. v. PSKS, Inc., 551 U.S. 877 (2007)*, antitrust authorities in the United States decide upon restrictions on distribution channels on a case-by-case basis (see OECD, 2013, and Haucap and

[11] See, for instance, `http://www.bundeskartellamt.de/SharedDocs/Meldung/EN/Pressemitteilungen/2016/18_07_2016_Lego.html?nn=3591568`, and `https://www.gov.uk/government/news/lighting-company-fined-27-million-for-restricting-online-prices` (all downloaded on Apr. 5, 2018).

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), and in the recent landmark ruling on the case *Coty Germany GmbH* vs. *Parfümerie Akzente GmbH*, the ECJ decided that prohibiting retailers to sell via online platforms can be legal.[12] Our analysis points to a trade-off between efficiency, which can be enhanced through vertical restraints, and consumer surplus, which suffers from the corresponding price increases.

In a series of robustness checks we show that the qualitative insights derived from our baseline model still hold in more general setups. First, we argue that our findings generalize to a broader contract space (e.g., retailer-specific two-part tariffs). Second, we show that changing the market structure by allowing for a manufacturer-owned online store or for retailers that sell exclusively online does not affect our qualitative results. Third, we argue that context effects other than the contrast effect (such as the design of a brick-and-mortar store) can result in a *quality salient equilibrium*, but do not change our main findings. It is exactly in this sense that our qualitative insights on the role of brand image concerns are much broader than the specific mirco-foundation based on the contrast effect that we focus on. In the Conclusion, we finally discuss two additional extensions, one with horizontally differentiated manufacturers and one with asymmetric offline markets, both of which preserve the equilibrium structure of our baseline model.

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 discuss what is the optimal vertical restraint from the perspective of a manufacturer. In Section 7, we provide a literature review. Finally, Section 8 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 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 some area i, and/or

[12] See `http://curia.europa.eu/juris/document/document.jsf?text=&docid=197487&pageIndex=0&doclang=en&mode=lst&dir=&occ=first&part=1&cid=559738` (downloaded on Oct. 15, 2018).

an online store, and can charge different prices in each of these stores. 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 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 transportation costs arise. If a consumer shops in a brick-and-mortar store located in a different area, transportation costs of $t > 0$ accrue.[13] The market structure is illustrated in Figure 1.

All consumers value a product of quality q at $v(q)$, where $v(\underline{q}) > r$, $v'(\cdot) > 0$ and $v''(\cdot) \leq 0$. But 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 fixed 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 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.

We assume that consumers are *salient thinkers* who maximize not their consumption utility, but their *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, and that they discount the choice dimension—quality or price—that is less salient within this consideration set by some parameter $\delta \in (0, 1)$.[14] Following Kőszegi and Szeidl (2013), we assume

[13] 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 $t_{ij} > 0$ when buying at retailer i's brick-and-mortar store. Thereby, our model in principle 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).

[14] Bordalo *et al.* (2012, 2013) have proposed this *rank-based* 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 C, we show that our qualitative results replicate if salience weights are not rank-based but continuous, as long as the salience weight is sufficiently steep in zero (i.e., the consumer is sufficiently sensitive already to a

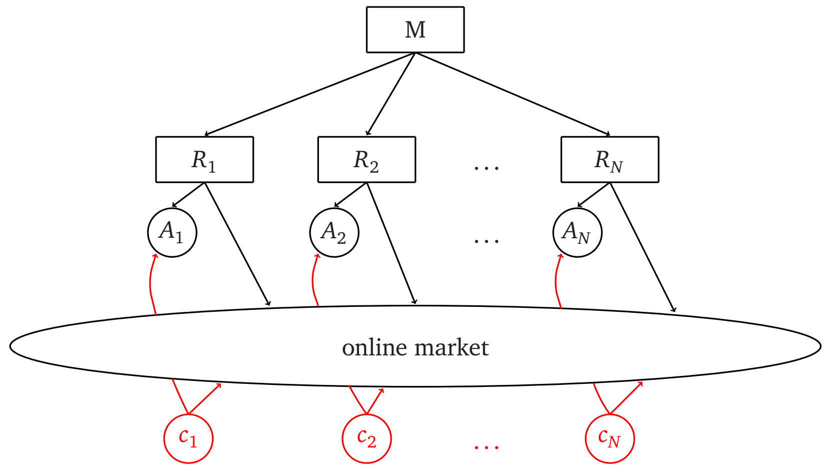

Figure 1: *The manufacturer M sells his product to N retailers, where retailer R_i is located in area A_i. Consumers located in area A_i (i.e., the group c_i) can buy in each on- and offline store. Red arrows indicate purchase opportunities for which no transportation costs arise.*

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, then this dimension is salient. This assumption captures the psychologically founded *contrast effect* according to which a stark contrast among options along a particular dimension attracts attention.

Since we consider a market with one manufacturer and a single 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 at least two different prices are set in the different stores. 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 some price $p \geq 0$ and quality $q \in [\underline{q}, \overline{q}]$.*

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

small level of price dispersion). In particular, all parts of our baseline equilibrium—i.e., the excessive branding equilibrium, the price salient equilibrium, and the online equilibrium—exist also with continuous salience weights.

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

The first part of this assumption ensures that the manufacturer cannot prevent a price-salient environment by simply charging a sufficiently high wholesale price. The second part implies that, even if price is salient, retailers can profitably operate their brick-and-mortar stores at a wholesale price of zero.

The timing of the game played between manufacturer and retailers is as follows:

1. STAGE: The manufacturer sets a quality level $q \in [\underline{q}, \overline{q}]$ and a linear wholesale price $w \geq 0$.
2. STAGE: Given a quality level q and a wholesale price 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 $p_{i,k} \geq 0$.

Since we analyze a game of complete information, we solve for the set of subgame-perfect equilibria. For expositional simplicity, we impose the tie-breaking assumption that all retailers who set the same online price serve the same number of consumers at their online stores. In the following, we denote an equilibrium in the second-stage continuation game as a *retail equilibrium*. Notably, for certain wholesale prices, there exist multiple retail equilibria. We therefore adopt the equilibrium selection criterion of payoff-dominance: if there are multiple retail equilibria, the retailers select the retail equilibrium with the highest retailer profits (for a recent application, see Johnen, 2018). Our results, however, do not rely on the choice of payoff-dominance as the selection criterion: all our results are robust to assuming a selection criterion in the spirit of risk-dominance (Harsanyi and Selten, 1988).[15]

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.[16] Accordingly, denote $q^* := \arg\max_q [v(q) - c(q)]$ the *efficient* quality level, which is implicitly given by $v'(q^*) = c'(q^*)$.

[15]While Harsanyi and Selten (1988) define their concept of risk-dominance only for two-player games with a binary action space, we adopt their intuition that the retail equilibrium in which retailers lose most in case of a (optimal) deviation are particularly stable. It turns out that in all relevant subgames the payoff-dominant retail equilibrium is also the one in which retailers have most to lose, so that both criteria select the same equilibrium.

[16]Our qualitative welfare results do not rely on this assumption. Indeed, all results are robust to assuming that consumer surplus is given by a convex combination of consumption and salience-weighted utility, which would be in the spirit of Bernheim and Rangel (2007).

2.2 Discussion of Modeling Assumptions

Next, we discuss the essential assumptions of our model, namely: the consumer types, the offline retail costs, the upstream and downstream market structures, 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 at least two groups of consumers, one of which strongly prefers to buy offline while the other group 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. In particular, since shelf space is limited offline but not online, brick-and-mortar stores face higher (opportunity) costs for offering additional units of a product. Indeed, our qualitative results do not rely on the assumption that online retail costs are zero, but hold as long as offline retail costs are sufficiently larger.

Upstream Monopolist and Downstream Competition. 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. In the Conclusion, we also sketch an extension of our baseline model with two manufacturers producing horizontally differentiated products of the same quality and argue that our main results still hold.

We further assume that retailers have some market power offline, but stand in perfect competition online. While the former assumption is necessary for parts of our results to hold, the latter is not. Instead, our results hold true as long as competition is tougher online than offline.

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 attentional focusing by Kőszegi and Szeidl (2013) and Bordalo *et al.* (2013), 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. Similarly, Tversky (1972) suggests that options are iteratively eliminated, based on the choice dimension in which available alternatives differ most. The contrast effect is also in line with numerous 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). Most importantly, the up to now only direct experimental test of Bordalo *et al.*'s salience theory in the context of consumption behavior finds strong support for the mechanism that we employ in this paper (Dertwinkel-Kalt *et al.*, 2017b): consumers who have seen lower prices for certain products before tend to be more price-sensitive than consumers who are used to the given price level.[17]

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 natural in our context but seem to be plausible even in more general setups.

We assume that consumers are aware of a good's on- and offline prices. But, as our results are driven by the negative externality of cheap online sales on the offline consumers' willingness-to-pay, we do not need the online consumers to be 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

[17] While not directly testing our theory, further experimental papers support our central mechanism. Bodur *et al.* (2015) show that prices seen before on internet price comparison sites affect a consumer's willingness-to-pay in offline stores, whereby a lower degree of price dispersion on the comparison sites inceases the consumer's willingness-to-pay in the offline environment. And people dislike varying prices even if variance is purely driven by demand fluctuations and does not increase the expected price (Courty and Pagliero, 2008). There are also other explanations, such as fairness reasons (Rotemberg, 2011), for why people dislike price variation across channels.

offline offer, but not of the offers in foreign brick-and-mortar stores.[18] To be precise, we only need that the share of offline consumers that are aware of online offers is sufficiently large.

Alternative products, on the other hand, are assumed to be not included in the consumer's consideration set.[19] This assumption is canonical in our model, as it builds on a monopolist manufacturer producing only a single product. In practice, it is particularly plausible with respect to licensed products such as merchandise of certain sports teams. For instance, a fan of FC Barcelona probably does not consider buying jerseys of other sports clubs as a viable alternative. As we argue in the following, however, the main salience-implication of having only one quality level in the consideration set—namely, that quality cannot be salient—is not implausible, also in a more general context.

By restricting the consideration set to a single quality level, we rule out quality salience in terms of the model. Even though quality salience cannot occur in our model, we still 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. An attention-grabbing 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 to a brand product and therefore it is often unlikely to be considered at all. Thus, in the context of high-quality brand products, we regard it as a plausible assumption of our model that the contrast effect does not render quality salient.[20]

[18] 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).

[19] Following the literature that studies the role of salience in the context of industrial organization (e.g., Bordalo *et al.*, 2016; Inderst and Obradovits, 2016; Apffelstaedt and Mechtenberg, 2018; Canidio and Karle, 2018), we further assume that the outside option of not buying is not included in the consideration set and therefore does not affect the salience of prices. 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 fictitious 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.

[20] There are indeed hypothetical studies suggesting that *decoys* could render the quality of a "product" salient (see the experiment and the meta-analysis in Heath and Chatterjee, 1995). These studies, however, do not vary the real quality of products, but use options that are represented by a price and some hypothetical numerical quality dimension. In incentivized decoy studies such as Lichters *et al.* (2017) decoys only extend the price dimension.

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 also sell low-quality substitutes, these are often 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 in practice apparently restrain a consumer's consideration set to products of similar quality.[21] Rather than extending the contrast in offered qualities, retailers manipulate the arrangement of products or the store environment (e.g., background music, scents, or colors) in a way that highlights quality. This type of salience is not included in the baseline model, but in Section 5 we study an extension along these lines and show that—although quality might become salient—our qualitative results remain to hold.

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 (i.e., let $\delta = 1$). In this case, the manufacturer faces a basic trade-off between charging a high wholesale price and serving only online consumers or charging a low wholesale price and serving all consumers. As a straightforward consequence, the subgame-perfect equilibrium of this game is determined by the share of online consumers, α.

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 since offline consumers obtain a disutility of $l > r$ from online purchases, the manufacturer cannot charge a wholesale price that exceeds $v(q) - r$. If the

[21] There are also shops that present products of very different qualities next to each other. These shops, however, often directly indicate the different target groups that should consider the respective product. Sportswear seller *Decathlon*, for instance, clearly indicates whether a running shoe is suitable for an amateur or a professional runner. This could be interpreted as a method to prevent professionals from actively considering the purchase of the cheap, amateur shoe, and vice versa. We thank an anonymous referee for suggesting this example.

manufacturer sets a wholesale price $w = v(q) - r$, retailers are able to break even on offline sales by charging a retail price of $v(q)$. In addition, a standard Bertrand argument implies that competition drives down online prices to cost 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 $w = v(q)$, 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 a critical share of online consumers,

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

below which all consumers are served. The following lemma characterizes the equilibrium.

Lemma 1. *Let $\delta = 1$. In any subgame-perfect equilibrium, the manufacturer sets the efficient quality $q = q^*$, and depending on the share of online consumers, α, the following holds:*

i) Suppose that $\alpha < \alpha_R$. Then, the manufacturer sets a wholesale price $w = v(q^*) - r$ and all consumers are served efficiently. Moreover, on the path of play, each retailer i operates her offline store at a retail price $p_{i,\text{off}} = v(q^*)$, and at least two retailers offer the product also online at a retail price equal to cost w. Retailers earn zero profits.

ii) Suppose that $\alpha \geq \alpha_R$. Then, the manufacturer sets a wholesale price $w = v(q^*)$ and only online consumers are served. Moreover, on the path of play, at least one retailer offers the product online at a retail price equal to cost w, and retailers who operate their offline store charge a strictly higher price, not making any offline sales. Retailers earn zero profits.

Equilibrium under Salience. Also when taking salience effects into account, the manufacturer wants all consumers to be served in equilibrium if and only if the share of online consumers is sufficiently small. But in contrast to the rational benchmark, he cannot induce such an equilibrium while charging a wholesale price $w = v(q) - r$. Recall that at this wholesale price, retailers need to charge a retail price of $v(q)$ to break even on offline sales. First, suppose that at least two retailers offer the product also online at cost 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 implies that, given $w = v(q) - r$, retailers cannot serve offline consumers and break even at the same time. If retailers instead charge a price of $v(q)$ in both channels, price is not salient, all consumers are willing to buy, and retailers break even on offline sales. In this case, however, retailers earn a considerable margin on online sales, and, 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 prices 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 retailers would prefer to drop offline sales. The equilibrium is characterized in the following proposition.

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 $q = q^S_{\text{ex}}(\alpha, \delta) > q^*$ and a wholesale price

$$w = w^S_{\text{ex}}(\alpha, \delta) := \left(\frac{1 - \alpha\delta N}{1 - \alpha N}\right) v\big(q^S_{\text{ex}}(\alpha, \delta)\big) - \left(\frac{1 - \alpha}{1 - \alpha N}\right) r.$$

Moreover, on the path of play, each retailer i operates both distribution channels at retail prices $p_{i,k} = v\big(q^S_{\text{ex}}(\alpha, \delta)\big)$, $k \in \{\text{on}, \text{off}\}$, and earns 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 any 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 a wholesale price $w = w^S_{\text{ps}}(\alpha, \delta) := \delta v\big(q^S_{\text{ps}}(\delta)\big) - r$. Moreover, on the path of play, each retailer i operates her offline store at a retail price $p_{i,\text{off}} = \delta v\big(q^S_{\text{ps}}(\delta)\big)$, and at least two retailers offer the product also online at a retail price equal to cost $w^S_{\text{ps}}(\alpha, \delta)$. Retailers earn zero profits.

iii) Suppose the share of online consumers is large (i.e., $\alpha \geq \alpha''_S$). Then, in any subgame-perfect equilibrium only online consumers are served, no dimension is salient, the manufacturer sets the efficient quality $q = q^*$ and a wholesale price $w = w^S_{\text{on}} := v(q^*)$. Moreover, on the path of play, at least one retailer offers the product online at a retail price equal to cost w^S_{on}, but no retailer offers the product in her offline store. Retailers earn zero profits.

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, as the decrease in a consumer's willingness-to-pay due to price salience, $(1-\delta)v(q)$, increases in provided quality q, the manufacturer makes online price cuts even less attractive by increasing the product's quality beyond the efficient level. Hence, we say that in the case of few online consumers—that is, for any $\alpha \in (0, \alpha_S')$—an *excessive branding equilibrium* arises.

For intermediate shares 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 symmetric online retail price equals $p_{i,\text{on}} = \delta v(q) - r$, while the symmetric offline retail price is given by $p_{i,\text{off}} = \delta v(q)$, 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.* Given that price would become salient, it may not be profitable to lower the wholesale price and enable retailers to sell the product online, so that 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, but may also reduce consumer welfare, as low retail prices in a price salient equilibrium are ruled out.

4 The Effects of Vertical Restraints in the Baseline Model

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, and we contrast our results with the implications of the classical model. Throughout the analysis we adopt the convention that the manufacturer imposes a vertical restraint if and only if it *strictly* increases his profit. In the light of these results, we finally discuss under which circumstances which vertical restraint is adopted (Section 6).

4.1 A Direct Ban on Online Sales

If the manufacturer wants all consumers to be served in equilibrium, he can strictly increase his profits by prohibiting online sales. In this way he preempts both types of salience distortions.

Proposition 2. *Suppose the manufacturer is allowed to impose a ban on online sales. Then, for any $\alpha \in (0, \alpha_R)$, the manufacturer imposes a ban on 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 a wholesale price $w = v(q^*) - r$. Moreover, on the path of play, each retailer i operates her offline store at a retail price $p_{i,\text{off}} = v(q^*)$, and earns zero profits. 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.*

The manufacturer admits online sales if and only if the share of online consumers is large enough, so that in the classical model without vertical restraints, he would induce retailers to serve *only* online consumers. If the manufacturer bans online sales, he can charge a wholesale price $w = v(q) - r$ and earn the same profit from serving all consumers as in the classical model without vertical restraints. Since, by Proposition 1, the manufacturer's profit from serving only online consumers is not affected by salience, the claim follows from Lemma 1. Notably, if consumers are not susceptible to the salience bias, the manufacturer would never impose a ban on online sales, as his profit would not suffer from price variation across distribution channels.

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 loss in efficiency due to the quality distortion arising from salience effects.

Proposition 3. *For $\delta = 1$, the manufacturer will never ban online sales. If $\delta < 1$, allowing the manufacturer to ban online sales affects social welfare as follows:*

i) Let $\alpha \in (0, \alpha''_S)$. Then, the manufacturer's ban on online sales weakly decreases social welfare if and only if $\Delta_q(\alpha, \delta) \leq \alpha r$. In addition, there exists some $\overline{\delta} < 1$ such that for any $\delta > \overline{\delta}$ the manufacturer's ban strictly decreases social welfare.

ii) Let $\alpha \in [\alpha''_S, 1)$. Then, the manufacturer imposes a ban on online sales if and only if a ban strictly increases social welfare, that is, if and only if $\alpha''_S < \alpha < \alpha_R$ holds.

In addition, allowing the manufacturer to impose a ban on online sales, weakly decreases consumer welfare, whereby consumers are strictly worse off if and only if $\alpha \in [\alpha'_S, \alpha''_S)$.

On the one hand, a ban on online sales prevents price salience in equilibrium and it ensures that the manufacturer produces the efficient quality, q^*. In this sense, we provide a rationale for the claim that a ban on online sales indeed allows the protection of a brand's image, without any inefficient quality adjustments, as would be the case in an excessive branding equilibrium. Moreover, for any $\alpha \in [\alpha''_S, \alpha_R)$, a ban on online sales also prevents the participation distortion arising from salience effects. On the other hand, as online consumers are forced to buy via their local brick-and-mortar store, retail costs are inefficiently high under a ban on online sales. The welfare implication of a ban depends on which of these effects prevails.

Since the quality distortion vanishes as δ approaches one, a weak salience bias implies that a ban on online sales decreases social welfare for small shares of online consumers (i.e., $\alpha < \alpha''_S$). In addition, for any $\alpha \in [\alpha'_S, \alpha''_S)$, a ban on online sales prevents low retail prices in an otherwise price salient equilibrium, thereby strictly decreasing consumer welfare. For any $\alpha \in [\alpha''_S, \alpha_R)$, however, the ban on online sales strictly increases social welfare. Notice that, for these shares of online consumers, retailer profits and consumer surplus are equal to zero, both with and without the ban, so that the manufacturer is the residual claimant to social welfare. Figure 2 summarizes the welfare implications of a direct ban on online sales.

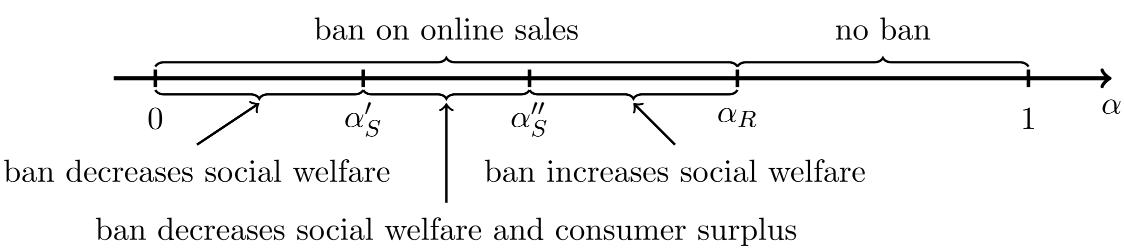

Figure 2: *Let $\delta > \max\{\underline{\delta}, \overline{\delta}\}$. For any $\alpha < \alpha_R$, the manufacturer prohibits online sales. While this ban on online sales strictly decreases social welfare without affecting consumer surplus for any $\alpha < \alpha'_S$, it decreases both social and consumer welfare for any $\alpha \in [\alpha'_S, \alpha''_S)$. Finally, for any $\alpha \in [\alpha''_S, \alpha_R)$, the manufacturer's ban on online sales strictly increases social welfare without affecting consumer surplus.*

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. But, 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 is allowed to determine retail prices. 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 a wholesale price $w = v(q^*) - r$. Moreover, on the path of play, each retailer i operates both distribution channels at retail prices $p_{i,k} = v(q^*)$, $k \in \{\text{on}, \text{off}\}$, and earns 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.*

As aligning on- and offline prices via RPM rules out adverse salience effects without preventing efficient online sales, it is desirable not only for the manufacturer, but also from a social welfare point of view. Similar as in the case of a ban on online sales, however, RPM prevents low retail prices in an otherwise price salient equilibrium, thereby reducing consumer welfare.

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 $\alpha \in (0, \alpha_R)$. For any $\alpha \in [\alpha'_S, \alpha''_S)$, the manufacturer's restraint strictly decreases consumer welfare.*

4.3 Dual Pricing

Under a dual pricing regime the manufacturer can charge a different wholesale price for units to be resold online than 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 him to charge a lower wholesale price for units that are resold offline, so that the retailers can cover the offline retail cost and serve offline consumers. Besides, dual pricing prevents a price-salient environment and thus both types of salience distortions. Consequently, 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 $\alpha \in (0, 1)$, in any subgame-perfect equilibrium all consumers are served efficiently, no dimension is salient, the manufacturer chooses the efficient quality $q = q^*$ and wholesale prices $w_{\text{off}} = v(q^*) - r$ and $w_{\text{on}} = v(q^*)$. Moreover, on the path of play, each retailer i operates her offline store at a retail price $p_{i,\text{off}} = v(q^*)$, and at least one retailer offers the product also online at a retail price equal to cost w_{on}. Retailers earn zero profits.*

Already absent salience effects dual pricing strictly increases social welfare for any $\alpha \geq \alpha_R$. 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. Again, since also dual pricing prevents a price salient equilibrium and therefore low retail prices, consumers can be strictly worse off.

Proposition 7. *For any $\alpha \in (0,1)$, a dual pricing scheme strictly increases social welfare. For any $\alpha \in [\alpha'_S, \alpha''_S)$, dual pricing strictly decreases consumer welfare.*

5 Robustness of our Findings

Our qualitative findings are robust to several extensions, for instance, regarding contract space and market structure. We provide a detailed analysis of these extensions in Appendix B.

Uniform Two-Part Tariff. Consider the exact same game as before, with the one exception that the manufacturer can offer a uniform two-part tariff. The equilibrium outcome without vertical restraints is the same as before with two exceptions: 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. For large shares of online consumers, the manufacturer sets a fixed fee that allows only a single retailer to break even, so that instead of an online equilibrium, we obtain an equilibrium where one retailer serves all online consumers and, depending on the strength of offline competition, some or all offline consumers. The only difference in the equilibrium with vertical restraints is that resale price maintenance combined with a two-part tariff enables the manufacturer to extract for any $\alpha \in (0,1)$ the maximum industry profit, so that under RPM also social welfare is maximized.

Retailer-Specific Contracts. Keeping everything else constant, suppose that the manufacturer can offer observable 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. The equilibrium without vertical restraints has the same structure as before with the one exception that for intermediate shares of online consumers the manufacturer could have a strict incentive to exclude some retailers from the market. In this case, either an excessive branding equilibrium arises in which only a subset of retailers are active in the market or a price salient equilibrium in which all retailers are active. The effects of vertical restraints remain basically the same, unless the manufacturer can selectively ban online sales of specific retailers. A selective ban on online sales—where only one retailer is allowed to sell online—does not only have the potential to increase the manufacturer's profit, but also social welfare.

Manufacturer-Owned Online Store. The baseline equilibrium outcome without vertical restraints, as delineated in Proposition 1, carries over to the case where the manufacturer runs an own online store, with the one exception that the manufacturer directly serves some of the online consumers. 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 and avoid price salience by matching the price that the retailers charge at their brick-and-mortar stores. Here, a ban on online sales maximizes not only the manufacturer's profit but also social welfare.

Online Retailer. If we allow for an online retailer that has no brick-and-mortar store, the equilibrium absent vertical restraints changes only in one regard: an excessive branding equilibrium does no longer exist. 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 to attract all online consumers, as she does not internalize the negative externality of a price cut on offline profits. In this sense, the manufacturers' claim that online sales harm their brand image by creating a price-salient environment is particularly plausible in the presence of online retailers. Although the equilibrium structure absent vertical restraints changes slightly, the implications of vertical restraints, derived in Section 4, remain qualitatively the same.

Other Context Effects and Quality Salient Equilibria. Beside the contrast effect, there are other ways in which the choice context could affect the perception of quality (e.g., highlighting quality via expensive interior, background music, scents, or colors). Absent vertical restraints, such context effects imply two changes compared to our baseline model: If the share of online consumers is very small, a *quality salient equilibrium* arises, where the weight that a consumer attaches to the product's quality is larger than the weight she attaches to its price. Second, also if in equilibrium prices vary across channels, retailers inflate the perceived quality in their offline stores, so that the product's price is not necessarily salient for all consumers; that is, in equilibrium, offline consumers might attach a higher weight to quality, while online consumers always attach a higher weight to price. Despites these two changes, the manufacturer's incentives to impose a vertical restraint remain basically the same. Also the qualitative welfare implications of imposing different vertical restraints do not change compared to our baseline model.

6 Optimal Vertical Restraint

In our baseline model, the manufacturer strictly prefers a dual pricing regime over a direct ban on online sales and resale price maintenance. This changes, however, once we relax our assumptions on contract space and market structure. On the one hand, if the manufacturer can offer a two-part tariff, he is indifferent between dual pricing and RPM, but would never impose a ban on online sales. On the other hand, if the manufacturer operates an own online store, he is indifferent between dual pricing and a direct ban on online sales, but would not engage in RPM. Thus, depending on the market environment, we can expect to observe different types of vertical restraints, and at least the examples discussed in the Introduction are consistent with our model: while *adidas* and *Samsonite*, both of which operate an own online store, tried to directly ban online sales by their retailers, *Recticel Schlafkomfort*—that does not have an own online store—has instead enaged in RPM to prevent cheap online sales.

In addition, it is important to highlight that our model abstracts from monitoring issues, which are probably highly relevant from a practical perspective: for instance, it might be easier to enforce a direct ban on online sales or RPM compared to a dual pricing regime, as the latter requires the manufacturer to track the retailers' sales separately for each distribution channel. Incorporating such heterogeneous monitoring costs (already an ϵ-difference is sufficient) into our model would, for certain market structures, yield a strict preference for a direct ban or RPM.

7 Related Literature

7.1 Vertical Restraints on Online Sales in the Classical Model

The economic literature has put forward several justifications for vertical restraints such as mitigating opportunism (e.g., Hart and Tirole, 1990), ensuring high service quality (e.g., Telser, 1960), signaling issues (e.g. Marvel and McCafferty, 1984; Inderst and Pfeil, 2016), or simply responding to channel characteristics (e.g., Miklós-Thal and Shaffer, 2018; Dertwinkel-Kalt *et al.*, 2016). In the following, we discuss the classical approaches that are most relevant in the context of brand-image concerns, namely: models on service externalities and signaling issues.[22]

[22] 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

Service Externalities. 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 a retailer's sales effort) is a serious issue in a market.[23][24] In the presence of free-riding incentives price disparities across channels may exert a negative externality on service provision, as retailers providing services vanish or as services are reduced in response to low online prices. The observation that in such a setup aligning retail prices across channels (e.g., via RPM) allows the manufacturer to restore the integrated monopoly outcome, thereby also improving service quality, hinges on the assumption that demand characteristics are identical for different retailers and channels. Otherwise, the manufacturer benefits if the retailers condition their retail prices on demand and channel characteristics. Notably, Telser (1960) and Mathewson and Winter (1984) can explain why online discounts—by reducing the number of service-providing retailers—might have a negative effect on brand image in the long run. Our approach, in contrast, predicts a more direct negative effect of price disparities on a brand's image. We therefore regard these two arguments in favor of restraints on online sales as complementary.

Signaling. In other occurrences, vertical restraints have been justified by a more direct need to protect brand image, but only if the product's quality is (at least partially) unobservable ex ante and the product's price thus serves as a signal of its quality (Inderst and Pfeil, 2016).[25] Unobservable quality, however, plays a role only for specific 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 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 its quality (Aaker, 2014, Chapter 5). Importantly, even if price serves as

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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.

[23]In particular with respect to hygiene or pharmaceutical products, manufacturers banned online sales on the grounds that some services (e.g., personal expert guidance or specific sale methods) cannot be replicated over the internet. In the prominent case of *Pierre Fabre*, the ECJ regarded this ban as an infringement by object of Article 101(1) TFEU, as the court did not agree on the importance of these services (Haucap and Stühmeier, 2016).

[24]Hunold and Muthers (2017) challenge the service argument in favor of RPM in a classical model with two manufacturers that share common retailers as it can actually result in lower service quality.

[25]Relatedly, Marvel and McCafferty (1984) have shown that a manufacturer can benefit from RPM, as this way retailers with a high reputation (that signals quality to consumers) can be incentivized to sell his product.

a signal of quality, price disparities 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. In this sense, the two stories are empirically distinguishable.

With respect to status goods, high prices—as maintained by vertical restraints such as RPM—can even promote sales. Unlike high wholesale prices, RPM can further prevent the use of status goods as loss leaders which in turn protects brand image (for an extensive discussion of vertical restraints in the context of status goods see Orbach, 2008). Arguments in favor of vertical restraints along these lines are not specific to online sales, but apply irrespective of the distribution channel. Notably, in the landmark case of *Pierre Fabre*, the European Commission rejected such defense arguments for restraints on online sales regarding status goods stating that "maintaining a prestigious image is not a legitimate aim for restricting competition."[26]

7.2 Salience and Industrial Organization

Our model of consumer demand builds on the growing behavioral literature on salience (Bordalo *et al.*, 2013) and focusing (Kőszegi and Szeidl, 2013). These models can explain a wide number of decision biases in one framework, thereby providing us with a better understanding of consumer demand and eventually the functioning of markets. According to these models, a decision maker's attention is guided toward choice attributes that are particularly salient within the choice context. Hereby, a certain feature of an option is the more salient the more it contrasts with the value that alternative options offer along this choice dimension.[27] While both the salience and the focusing model build on the contrast effect, the salience approach is enriched by the additional assumption of diminishing sensitivity. According to diminishing sensitivity, a given contrast in, say, prices is the less salient the higher is the price level. In our present paper, diminishing sensitivity, which can be understood as a qualifier to the contrast effect, does not play a role so that our results are consistent with both models.[28]

We contribute to the growing literature on the effects of consumer (in)attention in industrial

[26]See `eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:62009CJ0439&from=EN` (downloaded on Apr. 5, 2018).

[27]As our results build on the contrast effect, the model of relative thinking by Bushong *et al.* (2017), which builds on the setup by Kőszegi and Szeidl (2013), but assumes reverse contrast effects (i.e., attention assigned to an attribute decreases in the range of values offered along this dimension), does not share our predictions.

[28]Notably, the contrast effect is much harder to reconcile with the classical model and also less explored than diminishing sensitivity (see, e.g., Lanzani, 2019), which is already an integral assumption of *prospect theory* (Kahneman and Tversky, 1979).

organization (for an overview see, e.g., Grubb, 2015, or Heidhues and Kőszegi, 2018, and for a recent application see, e.g., Heidhues *et al.*, 2018), and in particular to the literature that applies the salience approach to open questions in industrial organization (e.g., Bordalo *et al.*, 2016; Inderst and Obradovits, 2016, 2019; Apffelstaedt and Mechtenberg, 2018).[29]

8 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. The German cartel office, however, regards it as a key open question whether the use of vertical restraints on online sales can be justified based on brand image concerns.

Main Contribution of the Paper. Our paper contributes to the small, but growing literature on behavioral antitrust by analyzing the welfare implications of vertical restraints on online sales in the presence of salience effects. We provide a novel theoretical foundation for the manufacturers' claim that online sales can harm brand image. By drawing consumers' 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 socially desirable. Altogether, vertical restraints typically increase efficiency in our model. In this regard, our analysis is complementary to classical efficiency defenses of vertical restraints on online sales (e.g., Telser, 1960; Inderst and Pfeil, 2016; Miklós-Thal and Shaffer, 2018).

While vertical restraints enhance efficiency in our model, they also (weakly) decrease consumer surplus. Even though a price salient equilibrium is inefficient as consumers do not appropriately value the provided quality, its low retail prices benefit consumers. Using vertical

[29] Helfrich and Herweg (2019) apply context-dependent preferences that are fundamentally different from those predicted by salience theory to answer a similar question as we do. Their model is not built on the contrast effect and therefore makes predictions opposite to ours.

restraints to align retail prices across channels (and to prevent such a price-salient environment) leads to higher consumer prices and lower consumer welfare. Price salience here works similar to a commitment device: consumers only purchase if prices are, to a sufficient degree, below their true willingness-to-pay. Our results thus point to a trade-off between efficiency and consumer surplus that has in general received much attention in the antitrust literature (for a discussion of different objectives see, e.g., Crane, 2013; Blair and Sokol, 2012). In particular, we provide a rationale for the current practice of the European Commission—that follows a consumer-surplus standard—whereby vertical restraints on online sales are typically prohibited, but we also question this practice in the light of an efficiency standard.

Addressing Shortcomings of the Model. While we assume that consumers are homogeneous in their valuation for quality and buy at most one unit of the product, the economic logic underlying our results still applies when aggregate demand in each channel is downward sloping. 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 D, 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, our finding that vertical restraints tend to improve efficiency in the presence of salience effects also holds for elastic demand.

So far, by assuming a monopolist manufacturer, we have completely abstracted from interbrand competition. Our results are robust, however, to assuming that two manufacturers—say, A and B—produce horizontally differentiated products of the same quality at the same costs. Suppose that half of the online and half of the offline consumers in each region prefer the product of Manufacturer A, while the other half prefer the product of Manufacturer B. For the sake of the argument, we assume that consumers incur a disutility $b \geq l$ from buying their less preferred brand, which implies that brand preferences are weakly stronger than preferences over distribution channels. In addition, suppose both products enter the consumers' consideration set. Given these additional product characteristics, it seems plausible to assume that products are defined along *three* dimensions: quality, price, and additional brand features (as captured by b). Finally, we assume that retailers can stock a second product at no additional costs, and that retail costs are the same across products (i.e., zero for online and $r > 0$ for offline sales).

We verify in Appendix E that, for sufficiently strong brand preferences, all parts of the equilibrium characterized in Proposition 1 survive also in a model with two manufactures. More precisely, we show that (i) for any $\alpha < \alpha'_S$ an excessive branding equilibrium exists, (ii) for any $\alpha'_S \leq \alpha < \alpha''_S$ a price salient equilibrium exists, and (iii) for any $\alpha \geq \alpha''_S$ an online equilibrium exists. Intuitively, since equilibrium retail prices will not differ by more than offline retail costs, our assumption that brand preferences are stronger than channel preferences (which gives $b > r$) implies that the brand dimension always attracts more attention—and therefore is assigned a larger decision-weight—than the price dimension. But this implies that, for her preferred brand, a consumer's willingness-to-pay and therefore the basic trade-off that manufacturers and retailers face is the same as before: *either* quality and price are equally salient—namely, if on- and offline prices are the same—and consumers are willing to pay at most $v(q)$, *or* price is more salient than quality—namely, if on- and offline prices differ—and consumers pay at most $\delta v(q)$ for their preferred brand. Although we do not prove uniqueness of the subgame-perfect equilibrium outcome, our analysis suggests that the incentives to impose a vertical restraint are basically the same as in our baseline model with a single manufacturer.

Testable Predictions. Our model makes novel predictions on *firm behavior* that are testable. Cavallo and Rigobon (2016) 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, although demand and/or cost characteristics differ across channels. Indeed, as we verify in Appendix F, this result does not rely on the symmetry in demand that our model imposes, but still holds if demand characteristics vary between the online and the offline channel. A rigorous test of our empirical predictions is left for future research.

Additional Applications. 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 feels natural 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. In this sense, the contrast effect can add to the understanding of why "US manufacturers use MAP to protect brand image."[30]

We can further contribute to the recent debate on geoblocking in the EU.[31] 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 a consumer's attention to prices, thereby lowering her overall willingness-to-pay for both options. According to the contrast effect, variance along dimensions that are undesirable for consumers guides attention away from favorable product features, which explains why firms may well be interested in rigid prices.

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

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

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Appendix A: Proofs

A.1: Equilibrium Analysis

Proof of Proposition 1. We solve the game backwards.

STAGE 2: Fix some quality level $q \in [\underline{q}, \overline{q}]$ and some wholesale price $w \geq 0$.

Roadmap for the second stage: In a first step, we analyze pure-strategy retail equilibria that are *symmetric* in the following sense: *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,* $p_{i,k} = p_k$. Given this restriction, three types of retail equilibria with sales can exist; that are, retail equilibria in which (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 price is non-salient (i.e., a *distortion-free retail equilibrium* or short df).

As online consumers have a weakly higher valuation for the product than offline consumers—namely, the same valuation for offline purchases and a strictly higher valuation for online purchases—, we cannot have a symmetric retail equilibrium in which only offline consumers buy. Moreover, as online retail cost are lower than offline retail cost, there cannot exist a symmetric retail equilibrium in which all consumers are served offline. This holds both with and without salience effects, as in the case that no consumer buys online while some consumers buy offline, retailer i could simply match the offline price in her online store, thereby making online consumers buy online without creating any (additional) price dispersion that could aversely affect profits from offline consumers. Note, however, that (4) symmetric retail equilibria without any sales (i.e., a *no-sales retail equilibrium*) can exist. But, as we discuss below, these no-sales retail equilibria do not affect the subgame-perfect equilibrium of our game.

We proceed as follows: For each type of symmetric retail equilibrium $l \in \{\text{on}, \text{ps}, \text{df}\}$, we determine the *maximal wholesale price* w_l^S, which is defined as the highest wholesale price under which retail equilibrium l can be sustained. Moreover, we determine the subgames in which a no-sales retail equilibrium exists. Notice that a full characterization of retail equilibria requires a large number of tedious case distinctions (in particular, regarding online retail equilibria). For the sake of brevity, we focus on the relevant subgames, but a full proof is available upon request.

In a second step, we apply our equilibrium selection criterion to make sure that for any wholesale price w_l^S—or at least in an ϵ-neighborhood below w_l^S—a unique symmetric retail equilibrium in pure strategies exists. Afterwards, we argue that any selected retail equilibrium yields the payoffs as one of the symmetric pure-strategy retail equilibria. Given this fact, the wholesale price w_l^S pins down the maximum profit the manufacturer can earn given retail equilibrium l and suffices to determine the subgame-perfect equilibrium of our game. Notably, when solving for the subgame-perfect equilibrium, we do not characterize retail equilibria in irrelevant subgames; that is, we neglect subgames which do not affect the incentives on the path of play.[32]

(1) *Online Retail Equilibrium.*

Without loss of generality, we only consider subgames with $w \leq v(q)$. We further assume that retailers do not operate their offline stores, which implies that price is non-salient in any symmetric online retail equilibrium. While in certain subgames there exist also online retail equilibria in which price is salient, these retail equilibria do not affect the subgame-perfect equilibrium of our game and are therefore omitted in the following analysis.

First, suppose $\delta v(q) < w \leq v(q)$. In this case, any $p_{\text{on}} \in [w, v(q)]$ constitutes a symmteric retail equilibrium price. To see why, assume 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 in this case demand drops to zero. As charging a lower online price renders prices salient, any deviation implies that the consumers' willingness-to-pay falls below the wholesale price. Finally, retailer i cannot profitably deviate by serving consumers via her offline store since $w > v(q) - r$ (by the first part of Assumption 1). Hence, for any $w \in (\delta v(q), v(q)]$, there is a symmetric retail equilibrium with $C_i = \{\text{on}\}$ and $p_{i,\text{on}} = p_{\text{on}} \in [w, v(q)]$.

Second, suppose $v(q)(\delta N - 1)/(N - 1) \leq w \leq \delta v(q)$. In this case, any symmetric retail price $p_{\text{on}} \in [N \cdot (\delta v(q) - w) + w, v(q)] \cup \{w\}$ is an equilibrium price. Since $v(q)(\delta N - 1)/(N - 1) > v(q) - r$ (by the first part of Assumption 1), the only potentially profitable deviation is charging a lower online price, and serving all online consumers (indeed, for $p_{\text{on}} = w$, even this is not profitable). 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 cut 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

[32] For a formal definition of irrelevant subgames see Blume and Heidhues (2006).

deviate to a lower online price if and only if $\frac{\alpha}{N} \cdot (p_{\text{on}} - w) \geq \alpha \cdot (\delta v(q) - w)$, or, equivalently, $p_{\text{on}} \geq N \cdot (\delta v(q) - w) + w$. Hence, for any $w \in [v(q)(\delta N - 1)/(N-1), \delta v(q)]$, there is a symmetric retail equilibrium with $C_i = \{\text{on}\}$ and $p_{i,\text{on}} = p_{\text{on}} \in [N \cdot (\delta v(q) - w) + w, v(q)] \cup \{w\}$.

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

Fourth, suppose $0 < w < \delta v(q) - r$. Again, using the same arguments as in the third step, we conclude that the unique equilibrium candidate price is $p_{\text{on}} = w$. Here, each retailer could profitably deviate by offering the product also offline (at a retail price of $\min\{\delta v(q), w + l\}$), so that no symmetric retail equilibrium with $C_i = \{\text{on}\}$ exists.

In conclusion, an online retail equilibrium 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 given by $w^S_{\text{on}}(q) := v(q)$.

(2) *Distortion-Free Retail Equilibrium.*

Without loss of generality, we consider only subgames with $w \leq v(q) - r$. By definition, 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. As retail costs are lower online than offline, this immediately implies that retailers earn positive profits. Thus, as retailers equally share the online market, a necessary condition for such a retail equilibrium to exist is $p^* > \delta v(q)$, as otherwise already a marginal price cut yields a discrete increase in demand, so that each retailer could profitably deviate.

The remaining proof of this part proceeds in two steps: in STEP 1, we consider only sufficiently small values of α and derive a necessary and sufficient condition for the existence of a retail equilibrium in which $C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} = v(q) = p_{i,\text{on}}$ for any $i \in \{1, \ldots, N\}$. Precisely, we show that *for any $\alpha \leq \tilde{\alpha}(q) := \frac{(1-\delta)v(q)}{(N-1)r}$ there exists a critical wholesale price $\tilde{w}(\alpha) \in [\delta v(q) - r, v(q) - r)$ such that this type of retail equilibrium exists if $\delta v(q) - r \leq w \leq \tilde{w}(\alpha)$. Moreover, we show that for any $\alpha \leq \tilde{\alpha}(q)$ and any $w > \tilde{w}(\alpha)$ such a retail equilibrium does not exist.* In STEP 2, we argue that *for any $\alpha > \tilde{\alpha}(q)$ a retail equilibrium in which $C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} = p^* = p_{i,\text{on}}$, $i \in \{1, \ldots, N\}$, does not exist.*

1. STEP: 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,

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

It is easy to see that, due to Assumption 1, Inequality (2) is violated for any $\alpha \geq \frac{1}{N}$. Hence, from now on, let $\alpha < \frac{1}{N}$. Then, Inequality (2) is equivalent to

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

It remains to be verified that $w^S_{\text{df}}(q; \alpha, \delta) \in [\delta v(q) - r, v(q) - r)$. Here, the upper bound is slack due to the first part of Assumption 1. In contrast, the lower bound is met if and only if

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

Hence, for any $w \in [\delta v(q) - r, w^S_{\text{df}}(q; \alpha, \delta)]$, there exists a symmetric retail equilibrium with $C_i = \{\text{on}, \text{off}\}$ and $p_{i,k} = v(q)$ if and only if $\alpha \leq \tilde{\alpha}(q)$, while for any $w > w^S_{\text{df}}(q; \alpha, \delta)$ no such retail equilibrium exists, which was to be proven.

2. STEP: Suppose that the share of online consumers satisfies $\alpha > \tilde{\alpha}(q)$. It immediately follows from STEP 1 that for wholesale prices $w > w^S_{\text{df}}(q; \alpha, \delta)$ no distortion-free retail equilibrium exists. As $\alpha > \tilde{\alpha}(q)$ gives $w^S_{\text{df}}(q; \alpha, \delta) < \delta v(q) - r$, it is sufficient to show that *for any $\alpha > \tilde{\alpha}(q)$ and any wholesale price $w < \delta v(q) - r$ no distortion-free retail equilibrium exists.*

Consider a candidate equilbrium in which $C_i = \{\text{on}, \text{off}\}$ and $p_{i,k} = p^* > \delta v(q)$ for any retailer $i \in \{1, \ldots, N\}$ and any channel $k \in \{\text{on}, \text{off}\}$. In the following, we consider the deviation of operating both channels at a uniformly lower price of $\delta v(q)$.

Since $p^* \leq v(q)$ and $w < \delta v(q) - r$, retailer i actually has an incentive to deviate if

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

which holds if and only if the wholesale price satisfies

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

It is straightforward to check that for any $\alpha > \tilde{\alpha}(q)$, the right-hand side of the preceding inequality exceeds $\delta v(q) - r$. Thus, if $\alpha > \tilde{\alpha}(q)$, retailer i has an incentive to deviate at any wholesale price $w < \delta v(q) - r$. Hence, for $\alpha > \tilde{\alpha}(q)$ there does not exist a symmetric retail equilibrium with $C_i = \{\text{on}, \text{off}\}$ and $p_{i,k} = p^*$, 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. As the product's price is salient irrespective of whether retailer i deviates or not, standard arguments yield the unique symmetric equilibrium candidate prices

$$p_{\text{on}} = w \quad \text{and} \quad p_{\text{off}} = \min\left\{\delta v(q), w + r + t \cdot \left(\frac{N}{N-1}\right), w + l\right\}. \tag{5}$$

If the product's price is salient anyhow and if the symmetric online price lies above cost, retailer i could marginally decrease both her online price and her offline price by the same amount, which discretely increase her demand, as now all online consumers buy via her online store, and at the same time ensures that the offline consumers located in area i still buy offline. Hence, whenever price is salient and $p_{\text{on}} > w$, a profitable deviation exists. In equilibrium, the symmetric offline price is chosen such that offline consumers buy in their local store—yielding retailers positive profits whenever $w < \delta v(q) - r$— given that competition drives down the online price to cost.

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 any other retailer j charges $p_{j,\text{on}} = p_{\text{on}}$ and $p_{j,\text{off}} = p_{\text{off}}$ as delineated in (5). As a consequence, a price salient retail equilibrium exists if and only if $w \leq \delta v(q) - r$ and the maximal wholesale price for this type of retail equilibrium is given by $w_{\text{ps}}^S := \delta v(q) - r$.

(4) *No-Sales Retail Equilibrium.*

Without loss of generality, suppose that retailers operate only their online stores and charge a symmetric, deterministic online price that exceeds the consumers' maximum willingness-to-pay (i.e., $p_{i,\text{on}} = p_{\text{on}} > v(q)$). It is easy to check that retailers have no incentive to deviate if and only if $\delta v(q) \leq w \leq v(q)$. Hence, for any $w \in [\delta v(q), v(q)]$, a no-sales retail equilibrium exists.

Selection Among Symmetric Pure-Strategy Retail Equilibria.

We have derived the set of maximal wholesale prices $\{w_{\text{ps}}^S, w_{\text{df}}^S, w_{\text{on}}^S\}$. Now, we want to verify that our selection criterion yields a unique symmetric retail equilibrium in pure strategies for a wholesale price of $w = w_{\text{df}}^S$ as well as for any wholesale price that lies either in an ϵ-environment below w_{on}^S or in an ϵ-environment below w_{ps}^S. 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.

First, we observe that for any wholesale price below w_{ps}^S—that is, also for a wholesale price of $w = w_{\text{df}}^S$ if $\alpha > \tilde{\alpha}(q)$—only a price salient retail equilibrium exists, so that we already have a unique symmetric retail equilibrium.

Second, we can show that *there exists some $\epsilon > 0$ such that for any $w \in (w_{\text{on}}^S - \epsilon, w_{\text{on}}^S)$ the unique retail equilibrium under selection is the online retail equilibrium with a retail price of $v(q)$.* We have seen above that there exists some $\epsilon' > 0$ such that for any $w \in (w_{\text{on}}^S - \epsilon', w_{\text{on}}^S)$ both an online and a no-sales retail equilibrium exist. Moreover, we know that there exists some $\epsilon'' > 0$ such that for any $w \in (w_{\text{on}}^S - \epsilon'', w_{\text{on}}^S)$ 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 any no-sales retail equilibrium. Finally, observe that for any $w \in (w_{\text{on}}^S - \epsilon'', w_{\text{on}}^S)$ and any retail equilibrium the highest deviation profit is always zero, which implies that retailers have most to lose in the payoff-dominant retail equilibrium. Consequently, using risk- instead of payoff-dominance would not change the selected retail equilibrium.

Third, we will show that *for any $\alpha \leq \tilde{\alpha}$ and $w = w_{\text{df}}^S$ the unique retail equilibrium under selection is a distortion-free retail equilibrium.* Note that, at a wholesale price of $w = w_{\text{df}}^S$, 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. As retailers earn positive profits in a distortion-free equilibrium, our selection criterion implies that for any $\alpha \leq \tilde{\alpha}$ and $w = w^S_{\text{df}}$ retailers select the distortion-free retail equilibrium with the highest feasible retail price of $v(q)$. Finally, observe that the highest deviation profit given an online retail equilibrium is zero, while the highest deviation profit given a distortion-free retail equilibrium does not depend on the retail price. Hence, retailers have most to lose in the payoff-dominant retail equilibrium, so that using risk- instead of payoff-dominance would not change the selected retail equilibrium.

Irrelevance of Mixed-Strategy and Asymmetric Pure-Strategy Retail Equilibria.

As an illustration, we consider the subgame following a wholesale price of $w = w^S_{\text{df}}$, where among the symmetric retail equilibria the distortion-free retail equilibrium with a retail price of $v(q)$ is selected. We observe that in this subgame the retailers' equilibrium profits are necessarily maximized in this distortion-free retail equilibrium, as mixed strategies or asymmetric pure strategies—even if they can be supported as equilibrium strategies—imply price salience (at least) with positive probability, and, in addition, *either* assign probability one to (weakly) lower prices without increasing demand *or* assign positive probability to prices that exceed $v(q)$, thereby inducing zero demand. Altogether, we conclude that neither a mixed-strategy retail equilibrium nor an asymmetric pure-strategy retail equilibrium can increase the retailers' profits relative to the distortion-free retail equilibrium with a retail price of $v(q)$. It is also easy to check that retailers still have most to lose in the payoff-dominant retail equilibrium, so that applying risk- instead of payoff-dominance would not change the selected retail equilibrium.

The arguments for the other symmetric retail equilibria to be selected in the respective subgames go along the same lines, with one (irrelevant) exception: in these other subgames, it might be the case that an asymmetric retail equilibrium, in which all players earn the exact same payoffs as in the corresponding symmetric retail equilibrium (e.g., only a subset of retailers offer the product online at cost), is selected. Since this fact does not change the manufacturer's incentives to induce a certain type of retail equilibrium, it is without loss of generality to assume for the remaining analysis that also in these subgames the symmetric retail equilibrium is selected.

Summary of the Second Stage.

Table 2 summarizes the selected retail equilibria in the relevant subgames.

	$0 < \alpha \leq \tilde{\alpha}$	$\tilde{\alpha} < \alpha < 1$
$w \in (w^S_{\text{ps}} - \epsilon, w^S_{\text{ps}})$	$C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} > p_{i,\text{on}}$	$C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} > p_{i,\text{on}}$
$w = w^S_{\text{df}}$	$C_i = \{\text{on}, \text{off}\}$ and $p_{i,\text{off}} = p_{i,\text{on}} = v(q)$	$C_i = \{\text{on}, \text{off}\}$ 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: *Essentially unique retail equilibrium under selection.*

STAGE 1: First, we fix some quality level $q = [\underline{q}, \overline{q}]$, and we show that *the manufacturer charges $w = w^S_l$ if he wants to induce the retail equilibrium $l \in \{\text{on}, \text{df}, \text{ps}\}$*. Obviously, if the manufacturer wants to induce a distortion-free retail equilibrium, he charges a wholesale price $w = w^S_{\text{df}}$. Now consider the optimal way to induce an online retail equilibrium. For the sake of a contradiction, suppose that the manufacturer wants to induce such a retail equilibrium—i.e., $\alpha \cdot [w^S_{\text{on}} - c(q)] > \max\{w^S_{\text{ps}} - c(q), w^S_{\text{df}} - c(q)\}$—and sets a wholesale price $w < w^S_{\text{on}}$. Then, as delineated in Table 2, there exists some $\epsilon > 0$ so that he 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 profits arbitrarily close to $\alpha \cdot [w^S_{\text{on}} - c(q)]$, so that our assumption toward a contradiction yields a profitable deviation; a contradiction. The argument for optimally inducing a price salient retail equilibrium goes along the same lines. Finally, note that, by similar arguments as above, (i) consumers, who are indifferent between buying or not, indeed purchase the product in equilibrium, and (ii) offline (online) consumers, who are indifferent between buying in either channel, buy offline (online) in equilibrium.

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

$$q^S_l := \arg\max_{q \in [\underline{q}, \overline{q}]} \left[w^S_l(q) - c(q)\right] \quad \text{for} \quad l \in \{\text{on}, \text{ps}\}, \tag{6}$$

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 on the cost function 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 $\delta \in (0,1)$. As the manufacturer optimally distorts the product's quality upwards whenever he induces a distortion-free retail equilibrium, we denote this an *excessive branding (subgame-perfect) equilibrium*, and we 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, the claim follows as $\frac{\partial}{\partial q} w_{\text{ps}}^S(q;\delta) = \delta v'(q) < v'(q)$ holds for $\delta \in (0,1)$.

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 $\frac{\partial}{\partial q} w_{\text{on}}^S(q) = v'(q)$.

Next, given the characterization of optimal quality, 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 $w_{\text{ex}}^S(q;\alpha,\delta) \geq w_{\text{ps}}^S(q;\delta)$ 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 $w = w_{\text{ps}}^S(q;\delta)$ 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

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

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

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

Finally, 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. □

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 $\delta \to 1$, which in turn implies that also α'_S approaches zero for $\delta \to 1$. In addition, since

$\lim_{\delta\to 1} w_{\text{ps}}^S(q;\delta) = v(q) - r$, we conclude that

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

holds if and only if

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

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

$$\lim_{\delta\to 1}\alpha_S''(\delta) = \alpha_R > 0 = \lim_{\delta\to 1}\alpha_S'(\delta),$$

which was to be proven. □

A.2: A Direct Ban on Online Sales

Proof of Proposition 2. If the manufacturer bans online sales and charges a wholesale price in an ϵ-environment below the highest wholesale price that allows retailers to profitably serve consumers via their brick-and-mortar stores (i.e., $w = v(q) - r$), there is a unique retail equilibrium with $p_{i,\text{off}} = v(q)$ for any retailer $i \in \{1,\ldots,N\}$. Thus, by the same arguments as in the proof of Proposition 1, banning online sales and charging a wholesale price of $w = v(q) - r$, induces retailers to serve all consumers offline. Then, using the fact that the manufacturer's profits in an online equilibrium are not affected by salience, the claim follows from Lemma 1. □

Proof of Proposition 3. As the effect on consumer surplus is obvious, we only derive the effect on social welfare. Given a ban on online sales social welfare is equal to $SW_{ban} = v(q^*) - r - c(q^*)$. The remainder of the proof subsequently considers two cases: (i) $\alpha \in (0, \alpha_S'')$, and (ii) $\alpha \in [\alpha_S'', 1)$.

1. CASE: Let $\alpha \in (0, \alpha_S'')$. Absent a ban, by Proposition 1, all consumers are served an inefficient quality $q^S = q^S(\alpha,\delta) \neq q^*$ via their efficient distribution channel, so that equilibrium welfare is given by $SW_S = v(q^S) - (1-\alpha)r - c(q^S)$. Recall that $\Delta_q(\alpha,\delta) = [v(q^*) - c(q^*)] - [v(q^S) - c(q^S)]$. Then, we obtain $SW_{ban} \geq SW_S$ if and only if $\Delta_q(\alpha,\delta) \geq \alpha\cdot r$.

We have to show that *there is some $\overline{\delta} < 1$ such that for any $\delta > \overline{\delta}$ a ban on online sales strictly decreases welfare; i.e., we have to verify $\Delta_q(\alpha,\delta) < \alpha r$ for any $\delta > \overline{\delta}$.* We proceed in three steps: first, we show that *for any $\alpha \in (0, \alpha_S'')$ there is $\check{\delta}(\alpha) \in (0,1)$ so that for any $\delta > \check{\delta}(\alpha)$*

a ban on online sales strictly decreases welfare. Second, we argue that *there is some $\underline{\alpha} > 0$ such that for any $\alpha < \underline{\alpha}$ and any δ a ban on online sales strictly decreases welfare.* Third, we show that $\sup_{\alpha \in [\underline{\alpha}, \alpha''_S)} \check{\delta}(\alpha) = \max_{\alpha \in [\underline{\alpha}, \alpha''_S)} \check{\delta}(\alpha)$. Defining $\overline{\delta} := \max_{\alpha \in [\underline{\alpha}, \alpha''_S)} \check{\delta}(\alpha)$ completes the proof.

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* $\Delta_q(\alpha, \delta) < \alpha \cdot r$. First, we observe that $\lim_{\alpha \to 0} \Delta_q(\alpha, \delta) - \alpha \cdot r = 0$. Now, by continuity, it is sufficient to verify that $\lim_{\alpha \to 0} [\frac{\partial}{\partial \alpha} \Delta_q(\alpha, \delta) - r] < 0$ holds. By Proposition 1, for α sufficiently close to zero, the manufacturer offers an excessive quality, $q^S_{\text{ex}}(\alpha, \delta)$, implicitly given by

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

This identity follows from the fact that for sufficiently small 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 $\alpha \to 0$. By definition, we have $v'(q^*) - c'(q^*) = 0$, and applying the Implicit Function Theorem to (9) yields

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

This implies that $\lim_{\alpha \to 0} [\frac{\partial}{\partial \alpha} \Delta_q(\alpha, \delta) - r] < 0$, which was to be proven.

It remains to be shown that $\sup_{\alpha \in [\underline{\alpha}, \alpha''_S)} \check{\delta}(\alpha) = \max_{\alpha \in [\underline{\alpha}, \alpha''_S)} \check{\delta}(\alpha)$. But this equality follows from the fact that for δ sufficiently large and α sufficiently close to α''_S we have $q^S(\alpha, \delta) = q^S_{\text{ps}}(\delta)$.

2. CASE: Let $\alpha \in [\alpha''_S, 1)$. Indeed, it is sufficient to verify that $\alpha''_S < \alpha_R$. Recall that, by Proposition 1, the manufacturer earns the same profit as in the case of rational consumers if only online consumers are served in equilibrium. 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. Hence, 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), so that, by Proposition 1, social welfare coincides with the manufacturer's profits. But then the claim follows immediately from Proposition 2. □

A.3: Resale Price Maintenance

Proof of Proposition 4. The proof is straightforward and therefore omitted. □

Proof of Proposition 5. The proof is straightforward and therefore omitted. □

A.4: Dual Pricing

Proof of Proposition 6. The proof is straightforward and therefore omitted. □

Proof of Proposition 7. The proof is straightforward and therefore omitted. □

Appendix B: Robustness

B.1: Uniform Two-Part Tariff

Let the manufacturer offer a two-part tariff, with linear component w and 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 8. *There exist threshold values* $0 < \hat{\alpha}'_S < \hat{\alpha}''_S \leq \hat{\alpha}'''_S < 1$ *so that the following holds:*

i) Suppose the share of online consumers is very small (i.e., $\alpha \leq \hat{\alpha}'_S$*). In any subgame-perfect equilibrium all consumers are served efficiently, no dimension is salient, and the manufacturer chooses the efficient quality* $q = q^*$*. Moreover, on the path of play, each retailer* i *operates both channels at prices* $p_{i,k} = v(q^*)$*,* $k \in \{\text{on}, \text{off}\}$*, and earns zero profit.*

ii) Suppose the share of online consumers is small (i.e., $\hat{\alpha}'_S < \alpha < \hat{\alpha}''_S$*). In any subgame-perfect equilibrium all consumers are served efficiently, no dimension is salient, and the manufacturer sets an inefficiently high quality* $q = q^{TP}_{\text{ex}}(\alpha, \delta) \geq q^S_{\text{ex}}(\alpha, \delta) > q^*$*. Moreover, on the path of play, each retailer* i *operates both distribution channels at retail prices* $p_{i,k} = v\big(q^{TP}_{\text{ex}}(\alpha, \delta)\big)$*,* $k \in \{\text{on}, \text{off}\}$*, and earns 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 any 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 a linear tariff with* $w = w^S_{\text{ps}}(\alpha, \delta)$*. Moreover, on the path of play, each retailer* i *operates her brick-and-mortar store at a retail price* $p_{i,\text{off}} = \delta v\big(q^S_{\text{ps}}(\delta)\big)$*, and at least two retailers offer the product also online at a retail price equal to cost* $w^S_{\text{ps}}(\alpha, \delta)$*. Retailers earn zero profit.*

iv) Suppose the share of online consumers is large (i.e., $\alpha \geq \hat{\alpha}'''_S$*). In any subgame-perfect equilibrium only a single retailer* i *sells the product, all online consumers are served via the online channel and either all offline consumers or only those located in area* i *are served offline, no dimension is salient, and the manufacturer chooses the efficient quality* $q = q^*$*. Moreover, on the path of play, retailer* i *either charges retail prices* $p_{i,k} = v(q^*) - t$*,* $k \in \{\text{on}, \text{off}\}$*, or retail prices* $p_{i,k} = v(q^*)$*,* $k \in \{\text{on}, \text{off}\}$*, and earns zero profit.*

Proof. In the following, we build on the insights derived in Proposition 1.

PRELIMINARIES: First, given that at least two retailers sell the product, 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 any $\alpha \leq \tilde{\alpha}(q)$, 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—that is, the mapping $\tilde{\alpha} : [\underline{q}, \overline{q}] \to \tilde{\alpha}([\underline{q}, \overline{q}])$—is a one-to-one correspondence. Fourth, by the first part of 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 all consumers are served efficiently and price is salient (Proposition 1). Hence, if the manufacturer wants to induce a price salient retail equilibrium, a linear tariff is sufficient to extract retailer profits. Sixth, if α is sufficiently large and the manufacturer offers a tariff

$$(w, F) = \left(0, \max \left\{ \frac{1-\alpha}{N} \big(v(q) - r \big) + \alpha v(q),\ v(q) - t - (1-\alpha)r \right\} \right), \tag{11}$$

then only a single retailer can break even in equilibrium and the manufacturer earns a profit of $\pi(q) := \max \left\{ \frac{1+\alpha(N-1)}{N} [v(q) - c(q)] - \frac{1-\alpha}{N} r,\ v(q) - c(q) - t - (1-\alpha)r \right\}$.

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

$$v(\tilde{q}(\alpha)) - (1-\alpha)r - c(\tilde{q}(\alpha)) > \max\left\{\delta v(q^S_{\text{ps}}) - r - c(q^S_{\text{ps}}),\ \pi(q^*)\right\}. \tag{12}$$

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

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

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 (12) 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 a single retailer sells the product. We have seen in the proof of Proposition 1 that a linear wholesale price is sufficient to induce the former retail equilibria while extracting retailer profits. Applying our insights from Proposition 1 and our preliminary considerations, we conclude that the manufacturer prefers a retail equilibrium in which all consumers are served efficiently and price is salient if and only if $\delta v(q^S_{\text{ps}}) - r - c(q^S_{\text{ps}}) > \pi(q^*)$, or, equivalently, $\alpha < \overline{\alpha}(\delta)$, whereby this threshold value is defined as follows:

$$\overline{\alpha}(\delta) := \min\left\{\frac{1}{(N-1)[v(q^*)-c(q^*)]+r}\left(N[\delta v(q^S_{\text{ps}}) - r - c(q^S_{\text{ps}})] - [v(q^*)-c(q^*)] - r(N-1)\right),\right.$$
$$\left.\frac{1}{r}\left([\delta v(q^S_{\text{ps}}) - c(q^S_{\text{ps}})] - [v(q^*)-c(q^*)] + t\right)\right\}.$$

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 and very large 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. If the share of online consumers is very large, the manufacturer now offers a two-part tariff that enables only a single retailer to break even. Instead of an online equilibrium, we obtain an equilibrium in which a single retailer serves all online consumers (via her online store) and, depending on the strength of offline competition, some or all offline consumers.

Importantly, given that at least two retailers are active, the manufacturer can incentivize them 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 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. Hence, a two-part tariff does not fully solve the manufacturer's channel coordination problem arising from salience effects, and an excessive branding equilibrium still exists.

Again, a price salient equilibrium exists as long as the salience bias is sufficiently weak.

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

Proof. The proof is straightforward and therefore omitted. □

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, a simple two-part tariff already enables the manufacturer to maximize and extract industry profits. Nevertheless, the welfare implications of allowing the manufacturer to impose a vertical restraint remain qualitatively the same.

If the salience bias is not too strong, the manufacturer imposes a ban on online sales if and only if $\alpha \in (\hat{\alpha}''_S, \alpha_{ban})$—for smaller values of δ the manufacturer may also impose a ban for $\alpha \in (\hat{\alpha}'_S, \hat{\alpha}''_S]$—, where the upper bound on the share of online consumers is given by

$$\alpha_{ban} := \min\left\{\frac{v(q^*) - r - c(q^*)}{v(q^*) - c(q^*) + \frac{r}{N-1}}, \frac{t}{r}\right\} < \alpha_R.$$

Thereby, for any $\alpha \in (\hat{\alpha}''_S, \hat{\alpha}'''_S]$, the manufacturer's ban strictly decreases social as well as consumer welfare (i.e., in case of a quality distortion), while his ban strictly increases social welfare for $\alpha \in (\hat{\alpha}'''_S, \alpha_{ban})$ (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.

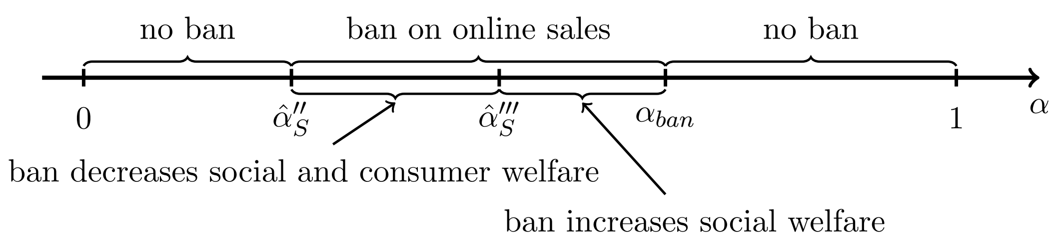

Figure 3: *Suppose the salience bias is not too strong. For any $\alpha \in (\hat{\alpha}''_S, \alpha_{ban})$, the manufacturer prohibits online sales. While this ban strictly decreases social and consumer welfare for any $\alpha \in (\hat{\alpha}''_S, \hat{\alpha}'''_S]$, a ban on online sales strictly increases social welfare for any $\alpha \in (\hat{\alpha}'''_S, \alpha_{ban})$.*

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 $\alpha \in (0, 1)$. 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 $\alpha \in (\hat{\alpha}'_S, 1)$. Both practices do not only maximize the manufacturer's profit, but also social welfare. As before, these restraints prevent low retail prices in an otherwise price salient equilibrium, thereby hurting consumers.

B.2: Retailer-Specific Contracts

In this subsection, we show that the equilibrium structure and the qualitative welfare implications of vertical restraints 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.[33]

Equilibrium without Vertical Restraints. Suppose the manufacturer offers an observable 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 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 retailer i's share of online consumers decreases in k, she is less likely to deviate if k is

[33] 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 $t > (1-\delta)v(q)$, then an excessive branding equilibrium and/or a price salient equilibrium exist.

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 $\delta v(q) - r \leq w \leq \hat{w}(q,k;\alpha,\delta)$.

Lemma 2. *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) At any k, we have $\lim_{\alpha\to 0} \frac{\partial}{\partial k}\hat{w}(q,k;\alpha,\delta) = 0$.

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

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

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

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

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

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

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

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

As $r > (1-\delta)v(q)$ by the first part of 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 2). In addition, by Lemma 2, 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 equilibria with and without vertical restraints have 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 not only his profits, but also social welfare.

B.3: Manufacturer-Owned Online Store

Suppose the manufacturer also operates an own online store.[34]

Equilibrium without Vertical Restraints. We characterize the equilibrium outcome in the absence of vertical restraints depending on the share of online consumers. The equilibrium

[34] 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.

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 incentive to deviate to a lower online price.

Proposition 9. *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., $\alpha < \breve{\alpha}'_S$). 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 a wholesale price

$$w = w^{OS}_{\text{ex}}(\alpha,\delta) := \left(\frac{N+1-\alpha(1+\delta N+\delta N^2)}{N+1-\alpha(1+N+N^2)}\right) v\big(q^{OS}_{\text{ex}}(\alpha,\delta)\big) - \left(\frac{(1-\alpha)(N+1)}{N+1-\alpha(1+N+N^2)}\right) r.$$

Moreover, on the path of play, each retailer i operates both distribution channels at retail prices $p_{i,k} = v\big(q^{OS}_{\text{ex}}(\alpha,\delta)\big)$, $k \in \{\text{on}, \text{off}\}$, and also the manufacturer offers the product online at the same retail price. Retailers earn strictly positive profits.

ii) Suppose the share of online consumers is at an intermediate level (i.e., $\breve{\alpha}'_S \leq \alpha < \breve{\alpha}''_S$). In any 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 a wholesale price $w = w^S_{\text{ps}}(\alpha,\delta) := \delta v\big(q^S_{\text{ps}}(\delta)\big) - r$. Moreover, on the path of play, each retailer i operates her offline store at a retail price $p_{i,\text{off}} = \delta v\big(q^S_{\text{ps}}(\delta)\big)$, and at least two retailers offer the product also online at a retail price equal to cost $w^S_{\text{ps}}(\alpha,\delta)$. Retailers earn zero profits.

iii) Suppose the share of online consumers is large (i.e., $\alpha \geq \breve{\alpha}''_S$). In any subgame-perfect equilibrium only online consumers are served, no dimension is salient, the manufacturer sets the efficient quality $q = q^*$ and a wholesale price $w = w^S_{\text{on}} := v(q^*)$. Moreover, on the path of play, at least one retailer offers the product online at a retail price equal to cost w^S_{on}, but no retailer offers the product in her offline store. Retailers earn zero profits.

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

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, without the need to distort quality. 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.

B.4: Online Retailer

Without loss, suppose that there are $N-1$ "regular" retailers (and also $N-1$ areas) operating both an offline and an online store, and one "online" retailer that has only an online store.[35]

Equilibrium without Vertical Restraints. It is easy to check that in the presence of an online retailer an excessive branding equilibrium no longer exists.[36] 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, as she does not internalize the negative externality of a price cut on offline profits. As a consequence, there exists some $\alpha_o \in (0,1)$, such that for any $\alpha < \alpha_o$ a price salient equilibrium arises, while for any $\alpha \geq \alpha_o$ an online equilibrium arises. In this sense, the manufacturers' claim that online sales harm their brand image seems to be particularly plausible in the presence of online retailers. The following proposition characterizes the equilibrium outcome in the absence of vertical restraints.

Proposition 10. *There exists some threshold value $0 < \alpha_o < 1$ so that the following holds:*

i) Suppose the share of online consumers is small (i.e., $\alpha < \alpha_o$). In any 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 wholesale price $w = w^S_{\text{ps}}(\alpha, \delta) := \delta v\big(q^S_{\text{ps}}(\delta)\big) - r$. Moreover, on the path of play, each "regular" retailer i operates her offline store at a retail

[35] 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.

[36] This relies on the assumption of a uniform wholesale price. If the manufacturer charges retailer-specific wholesale prices, the equilibrium is similar to 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. Notably, the European Commission's 2010 guidelines on vertical restraints enforce that on- and offline retailers are delivered at the same conditions (see for instance the discussion in Dertwinkel-Kalt *et al.*, 2016).

price $p_{i,\text{off}} = \delta v\big(q_{\text{ps}}^S(\delta)\big)$, and at least two retailers offer the product also online at a retail price equal to cost $w_{\text{ps}}^S(\alpha,\delta)$. Retailers earn zero profits.

ii) Suppose the share of online consumers is large (i.e., $\alpha \geq \alpha_o$). In any subgame-perfect equilibrium only online consumers are served, no dimension is salient, the manufacturer sets the efficient quality $q = q^*$ and a wholesale price $w = w_{\text{on}}^S := v(q^*)$. Moreover, on the path of play, at least one retailer offers the product online at a retail price equal to cost w_{on}^S, but no retailer offers the product in her offline store. Retailers earn zero profits.

Proof. It suffices to verify that the online retailer has an incentive to deviate from any candidate distortion-free retail equilibrium. By the proof of Proposition 1, we only have to show that for any $\alpha \leq \tilde{\alpha}(q)$, where this threshold is defined in Equation (4), and any $w \in [\delta v(q) - r, w_{\text{df}}^S(q;\alpha,\delta)]$, where the upper bound is defined in Equation (3), the online retailer has an incentive deviate from a symmetric retail price $v(q)$. In fact, the online retailer wants to deviate if and only if

$$\alpha\big[\delta v(q) - w\big] > \frac{\alpha}{N}\big[v(q) - w\big],$$

or, equivalently, $w < \left(\frac{\delta N-1}{N-1}\right) v(q)$. By the first part of Assumption 1, $\left(\frac{\delta N-1}{N-1}\right) v(q) > w_{\text{df}}^S(q;\alpha,\delta)$, which was to be proven. The remainder of the proof is analogous to that of Proposition 1. $\square$

Equilibrium with Vertical Restraints. Although the equilibrium structure absent vertical restraints changes, salience effects still imply a quality distortion for small shares of online consumers (i.e., always an insufficient quality) and a participation distortion for larger shares of online consumers. Therefore, also the implications of vertical restraints for social welfare, derived in Section 4, remain qualitatively the same. Notably, since a price salient equilibrium, with low retail prices, is more likely to occur—in the sense of set inclusion—compared to our baseline model, vertical restraints are also more likely to decrease consumer welfare.

B.5: Other Context Effects and Quality Salient Equilibria

Offline retailers could, for instance, highlight the quality of certain products via the design of their brick-and-mortar stores (e.g., expensive interior, background music, scents, or colors). Since the aspects of the store environment are orthogonal to the characteristics of a product, these context effects are not captured by the contrast effect.

Let us assume that retailers can inflate the perceived quality in their brick-and-mortar stores, but not in their online stores, by a multiplicative weight $\gamma > 1$ at some fixed costs $\kappa > 0$; that is, the perceived quality in the brick-and-mortar store can be increased to $\gamma\delta v(q)$ if prices vary or to $\gamma v(q)$ otherwise. This entails the implicit assumption that a nice store environment increases the perceived quality in the offline store, but does not distort a consumer's attention towards the contrast in the perceived quality on- and offline. In what follows, we will say that quality is salient if consumers attach a higher weight to quality than to price. Notice that in equilibrium quality might be salient for offline consumers while price might be salient for online consumers.

As before, we assume that context effects are bounded by specific thresholds; namely, $\gamma \in \left(1 + \frac{\kappa}{v(\underline{q})}, \frac{1}{\delta} + \frac{\kappa}{\delta v(\overline{q})}\right)$ and $\delta \in \left(\frac{\kappa}{r+\kappa}, \frac{1+\frac{\kappa}{v(\overline{q})}}{1+\frac{\kappa}{v(\underline{q})}}\right)$, which necessarily implies $\frac{r}{\kappa} > \frac{v(\overline{q})}{v(\underline{q})}$. We also still impose Assumption 1.

Equilibrium without Vertical Restraints. The equilibrium absent vertical restraints is then characterized as follows.

Proposition 11. *There exist threshold values $0 < \alpha'_{ce} \leq \alpha''_{ce} \leq \alpha'''_{ce} < 1$ such that it holds:*

i) Suppose the share of online consumers is very small (i.e., $\alpha < \alpha'_{ce}$). In the unique subgame-perfect equilibrium all consumers are served offline, quality is salient, the manufacturer sets an inefficiently high quality $q = q^S_{\text{qs}}(\alpha, \delta, \gamma) > q^S_{\text{ex}}(\alpha, \delta)$ and a wholesale price

$$w = w^S_{\text{qs}}(\alpha, \gamma) := \left(\frac{\gamma - \alpha\delta N}{1 - \alpha N}\right) v\big(q^S_{\text{qs}}(\alpha, \delta, \gamma)\big) - \frac{r + \kappa}{1 - \alpha N}.$$

Moreover, on the path of play, each retailer i operates only her brick-and-mortar store at a retail price $p_{i,\text{off}} = \gamma v\big(q^S_{\text{qs}}(\alpha, \delta, \gamma)\big)$ and inflates the perceived quality by γ. Retailers earn strictly positive profits.

ii) Suppose the share of online consumers is small (i.e., $\alpha'_{ce} < \alpha \leq \alpha''_{ce}$). In the unique subgame-perfect equilibrium all consumers are served efficiently, no dimension is salient, the manufacturer sets an inefficiently high quality $q = q^S_{\text{ex}}(\alpha, \delta) > q^*$ and a wholesale price

$$w = w^S_{\text{ex}}(\alpha, \delta) := \left(\frac{1 - \alpha\delta N}{1 - \alpha N}\right) v\big(q^S_{\text{ex}}(\alpha, \delta)\big) - \left(\frac{1 - \alpha}{1 - \alpha N}\right) r.$$

Moreover, on the path of play, each retailer i operates both distribution channels at retail *prices* $p_{i,k} = v\big(q_{\text{ex}}^{S}(\alpha,\delta)\big)$*,* $k \in \{\text{on}, \text{off}\}$*, and does not inflate the perceived quality in her brick-and-mortar store. Retailers earn strictly positive profits.*

iii) Suppose the share of online consumers is at an intermediate level (i.e., $\alpha''_{ce} \leq \alpha < \alpha'''_{ce}$*). Then, in any subgame-perfect equilibrium all consumers are served efficiently, price is salient for all consumers if and only if either* $\gamma\delta < 1$ *or* $\kappa \geq (\gamma-1)\delta v(q)$*, the manufacturer sets a quality* $q = q_{\text{ps}}^{CE}(\delta,\gamma)$*, which is inefficiently low if and only if price is salient for all consumers, and a wholesale price*

$$w = w_{\text{ps}}^{CE}(\alpha,\delta,\gamma) := \max\big\{\gamma\delta v\big(q_{\text{ps}}^{CE}(\delta,\gamma)\big) - r - \kappa, \delta v\big(q_{\text{ps}}^{CE}(\delta,\gamma)\big) - r\big\}.$$

Moreover, if $\kappa < (\gamma-1)\delta v(q)$*, then, on the path of play, each retailer* i *operates her offline store at a retail price* $p_{i,\text{off}} = \gamma\delta v\big(q_{\text{ps}}^{CE}(\delta,\gamma)\big)$*, and inflates the perceived quality by* γ*. Otherwise, on the path of play, each retailer* i *sets an offline price* $p_{i,\text{off}} = \delta v\big(q_{\text{ps}}^{CE}(\delta,\gamma)\big)$*, and does not inflate the perceived quality by* γ*. In addition, at least two retailers offer the product also online at a price equal to cost* $w_{\text{ps}}^{CE}(\alpha,\delta,\gamma)$*. Retailers earn zero profits.*

iv) Suppose the share of online consumers is large (i.e., $\alpha \geq \alpha'''_{ce}$*). In any subgame-perfect equilibrium only online consumers are served, no dimension is salient, the manufacturer sets the efficient quality* $q = q^*$ *and a wholesale price* $w = w_{\text{on}}^{S} := v(q^*)$*. Moreover, on the path of play, at least one retailer offers the product online at a retail price equal to cost* w_{on}^{S}*, but no retailer offers the product in her offline store. Retailers earn zero profits.*

Proof. The proof is similar to that of Proposition 1, so we only sketch the differences here.

1. STEP: *In an excessive branding equilibrium (as introduced in Proposition 1), retailers will not inflate the perceived quality in their brick-and-mortar stores.* Since inflating the perceived quality at the offline store is costly, a retailer will do so, only if she can raise the retail price in response. As an immediate consequence, if the retailer charges the same price of $v(q)$ on- and offline—as she does on the equilibrium path in an excessive branding equilibrium—, she will not incur the fixed cost $\kappa > 0$ to render the products's quality salient at her brick-and-mortar store.

2. STEP: *For small values of* α*, the manufacturer can induce retailers to serve all consumers offline and to render the product's quality salient.* Along the lines of the first step in deriving

the distortion-free retail equilibrium in the proof of Proposition 1, the relevant constraint is

$$\frac{1}{N} \cdot \Big[\gamma v(q) - r - \kappa - w\Big] \geq \alpha \cdot \Big[\delta v(q) - w\Big]. \tag{17}$$

Notice that by our assumptions on γ—in particular, by $\gamma > 1 + \frac{\kappa}{v(\underline{q})}$—, a retailer always prefers to inflate the perceived quality in her offline store if price is not salient.

Since, by assumption, $\gamma < \delta + \frac{r+\kappa}{v(\overline{q})}$ and therefore $\gamma v(q) - r - \kappa < \delta v(q)$, Inequality (17) is violated for any $\alpha \geq \frac{1}{N}$. For any $\alpha < \frac{1}{N}$, however, Inequality (17) is equivalent to

$$w \leq \frac{(\gamma - \alpha\delta N)v(q) - r - \kappa}{1 - \alpha N} =: w^S_{\text{qs}}(q; \alpha, \gamma). \tag{18}$$

Thus, by charging a wholesale price $w = w^S_{\text{qs}}(\alpha, \gamma)$, the manufacturer can, for small α, actually induce an equilibrium where retailers sell the product only offline and render quality salient.

3. STEP: *For small values of α, the manufacturer can induce a distortion-free retail equilibrium, as introduced in the proof of Proposition 1.* For that, it is sufficient to show that, for small values of α, we have $w^S_{\text{ex}}(\alpha, \delta) > \gamma\delta v(q) - r - \kappa$, where $w^S_{\text{ex}}(\alpha, \delta)$ is defined in (3). In this case the incentive constraint given in the proof of Proposition 1 does not change, and the proof remains valid. It is easy to see that, in the limit of α approaching zero, $w^S_{\text{ex}}(\alpha, \delta) > \gamma\delta v(q) - r - \kappa$ is equivalent to $\gamma < \frac{1}{\delta} + \frac{\kappa}{\delta v(\overline{q})}$, which holds by our restrictions on the strength of context effects.

4. STEP: *The manufacturer prefers a quality-salient retail equilibrium—as introduced in the second step—over a distortion-free retail equilibrium—as discussed in the third step—if and only if $\alpha > \frac{1}{r}\big[(\gamma - 1)v(q) - \kappa\big]$.* The claim follows immediately from comparing (3) and (18).

5. STEP: *If, in equilibrium, prices vary across distribution channels, a retailer inflates the perceived quality in her brick-and-mortar store if and only if $\kappa < (\gamma - 1)\delta v(q)$.* This follows immediately from the fact that, if there is variation in prices already, then additional price variation does not affect a consumer's willigness-to-pay for a product of a given quality.

Combining these steps in the same fashion as in the proof of Proposition 1 yields the claim. □

Compared to our baseline equilibrium, as characterized in Proposition 1, two slight differences arise: If the share of online consumers is very small, then in equilibrium retailers serve all consumers offline and render the product's quality salient. In such a *quality salient equilibrium*—where the weight that a consumer attaches to the product's quality is larger than the weight she attaches to its price—, the manufacturer offers an even higher quality than in the excessive branding equilibrium of Proposition 1 (which still exists, but only for larger shares of online consumers). Second, also if in equilibrium prices vary across channels, retailers inflate the perceived quality in their offline stores, so that the product's price is not necessarily salient for all consumers; that is, in equilibrium, offline consumers might attach a higher weight to quality, while online consumers always attach a higher weight to price. If indeed quality is salient at the brick-and-mortar stores, then, although there is variation in prices, the manufacturer offers an inefficiently high quality in equilibrium.

Equilibrium with Vertical Restraints. Since the equilibrium without vertical restraints has similar properties as in our baseline model—that is, retailers earn positive profits for small shares of online consumers and price variation distorts the consumers' perception of quality for intermediate shares of online consumers—, the manufacturer's incentives to impose a vertical restraint remain basically the same. Also the qualitative welfare implications of imposing different vertical restraints do not change compared to our baseline model.

Appendix C: Continuous Salience (not intended for publication)

In the main text, we have adopted a *rank-based* salience approach in the spirit of Bordalo *et al.* (2012, 2013), 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 rank-based 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) suggest that the weight assigned to a product's price is a continuous function of the difference in prices across stores.

In the following, we will 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. More precisely, we will show that all parts of our baseline equilibrium—i.e., the excessive branding equilibrium, the price salient equilibrium, and the online equilibrium—exist also with continuous salience weights, as long as the weighting function is sufficiently steep in zero. Consequently, also our welfare implications remain the same. Technically, we will introduce a continuous salience function that allows us to re-formulate the salience parameter δ, which we used in the main text, as a function of provided quality, q.

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 $D(\mathcal{C}) := \max_{(i,k)\in\mathcal{C}} p_{i,k} - \min_{(i,k)\in\mathcal{C}} p_{i,k}$ 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 $g(0) = 1$, $g(r)r < v(\underline{q})$ (recall 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 3. *For any quality $q \in [\underline{q}, \overline{q}]$ there exists a unique retail price $\hat{p}(q) \in (0, v(q))$ such that*

$$\hat{p}(q) = \frac{v(q)}{g\big(v(q) - \hat{p}(q)\big)}. \tag{19}$$

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 we assume $g'(0) > \frac{1}{v(\underline{q})}$, it has to hold that

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

Second, given $g(0) = 1$, it immediately follows that

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

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 $p<\hat{p}$. □

Next, we determine how the price $\hat{p}(q)$, defined in (19), depends on the provided quality, q.

Lemma 4. *For any $q\in[\underline{q},\overline{q}]$, we have $\hat{p}'(q)<v'(q)$.*

Proof. Applying the Implicit Function Theorem to Equation (19) 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 $g(v(q)-\hat{p}(q))\leq g'(v(q)-\hat{p}(q))\hat{p}(q)$. Since $g(\cdot)$ is strictly increasing and concave, we have

$$\frac{\partial}{\partial p}\left(g(v(q)-p)-g'(v(q)-p)p\right)=-2\cdot g'(v(q)-p)+g''(v(q)-p)p<0 \tag{20}$$

for any retail price $p\in(0,v(q))$, such that our assumption toward a contradiction implies that

$g(v(q)-p) < g'(v(q)-p)p$ for any price $p \in (\hat{p}(q), v(q))$. 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 (19), the last equality follows by partial integration and linearity of the integral and the inequality follows from the assumption toward a contradiction and Equation (20); 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 5. *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 4. $\square$

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

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

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

Lemma 6. *Let $p' > p'' > 0$ with $\frac{v(q)}{g(p'-p'')} \geq p'$. Then, there exists some $\epsilon > 0$ such that $\frac{v(q)}{g(p'-p)} \geq p$ for any $p \in [p''-\epsilon, p'']$.*

Finally, by analogous arguments as in the proof of Proposition 1 (for the rank-based salience model), we conclude that, given our selection criterion, also under continuous salience distortions any selected retail equilibrium has to be symmetric (or essentially equivalent to a symmetric equilibrium). Hence, in what follows, we will restrict attention to symmetric retail equilibria.

Equilibrium. Using our preliminary considerations, it is straightforward to see that the economic logic of our rank-based 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. Recall that, by Lemma 3, online consumers would not buy at retail prices above $\hat{p}(q)$ given that the remaining firms charge $v(q)$. 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

$$\frac{1-\alpha}{N} \cdot \Big[v(q) - r - w\Big] + \frac{\alpha}{N} \cdot \Big[v(q) - w\Big] \geq \alpha \cdot \Big[\delta v(q) - w\Big]. \tag{21}$$

By analogous arguments as for the rank-based salience model (see the proof of Proposition 1), Inequality (21) 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 (4) and $\delta = \delta(q)$ is now a function of q. Applying Lemma 5 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 for the rank-based 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 $i \in \{1, \dots, N\}$. 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 6 some $\epsilon > 0$ such that $\frac{v(q)}{g(p_{\text{off}}-p)} \geq p$ for any $p \in [p_{\text{on}} - \epsilon, p_{\text{on}}]$. 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 rank-based salience model, the manufacturer can induce a retail equilibrium in which only the 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 for the rank-based salience model, the manufacturer actually induces an online equilibrium if and only if the share of online consumers is sufficiently large.

Appendix D: Elastic Demand (not intended for publication)

In this section, we extend our model by assuming that aggregate 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 results on the efficiency gains from vertical restraints—in particular, those of RPM—do 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, aggregate 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. We only consider symmetric pure-strategy equilibria, which in turn implies that in a price salient equilibrium both channels are operating (for at least some retailers), although demand in the offline channel can be zero.

Lemma 7. *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 2 (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

$$p^*_{\text{off}}(w,\delta) := \min\left\{\arg\max_{p\geq 0}\ (p - w - r)\cdot D(p;\delta), w + r + t\cdot\left(\frac{N}{N-1}\right), w + l\right\}. \tag{22}$$

Note that, if the constraints in (22) 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

$$1 - \frac{p^*_{\text{off}}}{\delta v(q)} - \frac{p^*_{\text{off}} - w - r}{\delta v(q)} = 0, \tag{23}$$

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 willingness-to-pay under price salience, so that demand in the offline channel is zero and prices are indeed salient.

STAGE 1 (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

$$\begin{cases} 1 - (1-\alpha)\frac{p^*_{\text{off}}(w^*)}{\delta v(q)} - \alpha \frac{w^*}{\delta v(q)} - \frac{w^*}{\delta v(q)} \left[(1-\alpha)\frac{\partial p^*_{\text{off}}}{\partial w} + \alpha \right] = 0 & \text{if } w^* < \delta v(q) - r, \\ 1 - \frac{w^*}{\delta v(q)} - \frac{w^*}{\delta v(q)} = 0 & \text{otherwise,} \end{cases} \tag{24}$$

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 (23). The second and third line refer to the cases in which the product is sold offline but the offline retail price does not solve (23). 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

$$\frac{d}{d\delta}\left((1-\alpha)\left[1-\frac{p^*_{\text{off}}(w^*(\delta),\delta)}{\delta v(q)}\right]+\alpha\left[1-\frac{w^*(\delta)}{\delta v(q)}\right]\right)>0 \tag{25}$$

holds, which is indeed the case if and only if

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

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 (26) 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 (23). In a second step, we consider the case in which the offline retail price is determined by the first-order condition in (23).

STEP 1. Suppose that the offline price is not determined by the first-order condition in (23). We have seen above that in this case there exists some constant $\lambda>0$ such that

$$p^*_{\text{off}}=w^*+\lambda \quad\text{and}\quad w^*=\frac{\delta v(q)}{2}-\frac{(1-\alpha)}{2}\lambda. \tag{27}$$

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 (26) simplifies to

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

Using (27), we conclude that (28) holds if and only if

$$\delta\frac{\partial w^*}{\partial\delta}-w^*-(1-\alpha)\lambda<0. \tag{29}$$

Then, substituting $\frac{\partial w^*}{\partial\delta}=\frac{v(q)}{2}$ and using (27) again, yields the claim.

STEP 2. Suppose the offline retail price is determined by the first-order condition in (23). 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 (26) simplifies to

$$\delta\frac{\partial w^*}{\partial\delta}+\delta\frac{\partial w^*}{\partial\delta}\frac{(1-\alpha)}{2}-(1-\alpha)p^*_{\text{off}}-\alpha w^*<0. \tag{30}$$

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.

Appendix E: Horizontally Differentiated Manufacturers (not intended for publication)

Suppose that there are two manufacturers—say, A and B—producing horizontally differentiated products of the same quality at the same costs. Let half of the online and half of the offline consumers in each region prefer the product of Manufacturer A, while the other half prefer the product of Manufacturer B. We assume that consumers incur a disutility $b \geq l$ from buying their less preferred brand, which implies that brand preferences are weakly stronger than preferences over distribution channels. In addition, let $2b \geq \max\{v(\overline{q}), \delta^2 v(\overline{q}) + \delta r\}$. We assume that products are now characterized by *three* attributes: quality, price, and additional brand features (as captured by b). We also assume that both products enter the consumers' consideration set. If all three attributes differ in salience, then the least salient dimension is discounted by δ^2, the second-most salient dimension is discounted by δ, and the most salient dimension is not discounted. Finally, we assume that retailers can stock a second product at no additional costs, and that retail costs are the same for both products (i.e., zero for online and r for offline sales).

In the following, we will analyze the subgame-perfect equilibria in the absence of vertical restraints and we will show that all parts of the equilibrium characterized in Proposition 1 survive also in a model with two manufactures. More precisely, we will prove that (i) for any $\alpha < \alpha'_S$ an exessive branding equilibrium exists, (ii) for any $\alpha'_S \leq \alpha < \alpha''_S$ a price salient equilibrium exists, and (iii) for any $\alpha \geq \alpha''_S$ an online equilibrium exists. For the sake of the argument, we assume that salience effects are weak enough for a price salient equilibrium to exist. Although we do not prove uniqueness of the subgame-perfect equilibrium outcome, the following analysis suggests that the incentives to impose a vertical restraint are similar as in our baseline model.

Preliminaries. In a first step, we argue that, *given wholesale prices $w_A = w_B$, retailers face the same incentives as in a model with only one manufacturer.* Since both products are equally costly and since consumers have a homogeneous valuation for their preferred brand, retailers will offer both products at the same retail price(s), so that in any retail equilibrium consumers buy their preferred brand. As evident from our baseline analysis, equilibrium on- and offline prices will not differ by more than the offline retail costs, r, so that our assumption on the strength of brand preferences (which gives $b > r$) implies that the brand dimension always attracts more attention—and therefore is assigned a larger decision-weight—than the price dimension. But this implies that, for her preferred brand, a consumer's willinngness-to-pay and therefore the basic trade-off that retailers face is the same as before: *either* quality and price are equally salient—namely, if on- and offline prices are the same—and consumers are willing to pay at most $v(q)$, *or* price is more salient than quality—namely, if on- and offline prices differ—and consumers pay at most $\delta v(q)$ for their preferred brand. Hence, the feasible retail equilibrium outcomes in any given subgame with identical wholesale prices for the two manufacturers are the same as in our baseline model with a single manufacturer.

In a second step, we argue that *manufacturers offer the same wholesale price in equilibrium.* It is easy to check that, for any pair of wholesale prices (w_A, w_B) with $|w_A - w_B| \leq b/\delta$, retailers set prices such that all consumers—who buy in equilibrium—purchase their preferred brand, as the necessary reduction in the retail price to convince consumers to buy the less preferred brand (i.e., b/δ) exceeds the cost savings (i.e., $|w_A - w_B|$). It also follows immediately that, if $|w_A - w_B| \leq b/\delta$, retailers charge the same price(s) for both products. If the wholesale prices satisfy $|w_A - w_B| > b/\delta$, however, retailers will only offer the product with the lower wholesale price, so that some consumers might buy their less preferred brand in equilibrium. But this would imply that one manufacturer, say A, earns zero profits. By matching his rival's price, Manufacturer A can induce retailers to sell also his product, thereby making positive profits; a contradiction. Hence, we must have $|w_A - w_B| \leq b/\delta$ in any equilibrium, which in turn implies that retailers offer both products at the same retail price(s). As a consequence, manufacturers charge the same wholesale price in any equilibrium, which was to be proven.

In a third step, we derive some properties of the equilibrium wholesale price. Consider a candidate equilibrium wholesale price w, and denote the corresponding aggregate consumer demand as $D(w)$. Recall that a manufacturer has to undercut his rival's price by at least b/δ to monopolize the market. Since $2b \geq v(q)$ by assumption, we obtain

$$\frac{1}{2}D(w)w \geq D(w)(w - b/\delta),$$

for any $w \leq v(q)$, which implies that monopolizing the market can be an attractive deviation *only if* it increases aggregate consumer demand. In addition, we find that *any equilibrium wholesale price satisfies* $w \geq \delta v(q) - r$. First, it is easy to check that we have $w \geq \min\{b/\delta, \delta v(q) - r\}$ in any equilibrium, as otherwise a manufacturer could increase his wholesale price without losing demand. Now, let $b/\delta < \delta v(q) - r$ and consider a wholesale price $w \in [b/\delta, \delta v(q) - r)$. Since $2b \geq v(q)$ by assumption and since for any wholesale price below $\delta v(q) - r$ there exists only the price salient retail equilibrium, each manufacturer can increase his wholesale price to $\delta v(q) - r$ without losing demand, which was to be proven.

Existence of Excessive Branding Equilibrium. We show that *for any $\alpha < \alpha'_S$ an excessive branding equilibrium with $w = w_{\text{df}}(q; \alpha, \delta)$, as defined in Equation (3), exists.* Recall from the proof of Proposition 1 that for any $\alpha \leq \tilde{\alpha}(q)$, where the threshold value is defined in Equation (4), and for any wholesale price $w \in [\delta v(q) - r, w_{\text{df}}(q; \alpha, \delta)]$ the unique retail equilibrium under selection is a distortion-free retail equilibrium. Thus, for any $w \in [\delta v(q) - r, w_{\text{df}}(q; \alpha, \delta))$, a manufacturer can increase his wholesale price to $\min\{w + b/\delta, w_{\text{df}}(q; \alpha, \delta)\}$ without losing demand, which gives a strict incentive to deviate. We conclude that the only equilibrium candidate is given by $w = w_{\text{df}}(q; \alpha, \delta)$. Now, since aggregate demand is already one, manufacturers have no incentive to deviate to a lower wholesale price to monopolize the market. In addition, as the deviation profit from increasing the wholesale price is bounded from above by the profit in an online equilibrium, it follows from Proposition 1 that manufacturers have no incentive to deviate to a higher wholesale price. Thus, both manufacturers charging a wholesale price of $w = w_{\text{df}}(q; \alpha, \delta)$, thereby inducing a distortion-free retail equilibrium, is indeed a subgame-perfect equilibrium.

Existence of Price Salient Equilibrium. We show that *for any $\alpha'_S \leq \alpha < \alpha''_S$ a price salient equilibrium with $w = \delta v(q) - r$ exists.* Recall from the proof of Proposition 1 that for these shares of online consumers there does not exist a distortion-free retail equilibrium. Hence, when charging a wholesale price of $w = \delta v(q) - r$, a price salient retail equilibrium arises. Now, since aggregate demand is already one, manufacturers have no incentive to deviate to a lower wholesale price in order to monopolize the market. In addition, as the deviation profit from increasing the wholesale price is bounded from above by the profit in an online equilibrium, it follows from Proposition 1 that manufacturers have no incentive to deviate to a higher wholesale price. Thus, both manufacturers charging a wholesale price of $w = \delta v(q) - r$, thereby inducing a price salient retail equilibrium, is indeed a subgame-perfect equilibrium.

Existence of Online Equilibrium. We show that *for any* $\alpha \geq \alpha''_S$ *an online equilibrium with* $w = v(q)$ *exists.* Keep in mind that, by Proposition 1 and our assumption that salience effects are weak enough for a price salient equilibrium to exist, for these shares of online consumers there does not exist a distortion-free retail equilibrium. Moreover, it follows from Proposition 1 and our preliminary considerations that any profitable deviation must result in (i) some consumers start buying their less preferred brand (since $\alpha \geq \alpha''_S$) and (ii) some offline consumers start buying (since aggregate consumer demand has to increase). But this implies that, for any deviation, price is salient in equilibrium, so that consumers would buy their less preferred brand *only if* the retail price was weakly below $\delta v(q) - b/\delta$, which in turn implies that the manufacturer has to deviate to a wholesale price weakly below $\delta v(q) - b/\delta$. This also gives an upper bound on the deviation profit. We conclude that manufacturers have no incentive to deviate as long as

$$\frac{\alpha}{2} v(q) \geq \delta v(q) - b/\delta,$$

or, equivalently, $2b \geq \delta^2 v(q) + \delta r$, which holds by assumption. Thus, both manufacturers charging $w = v(q)$, thereby inducing an online retail equilibrium, is a subgame-perfect equilibrium.

Appendix F: Asymmetric Regions (not intended for publication)

Consider a variant of our baseline model in which the offline consumers in some, but not all regions have a higher valuation for quality than the remaining consumers (i.e., all online consumers, irrespective of their region, and the offline consumers in the other regions). Denote the willingness-to-pay of these *high-value* offline consumers as $\tilde{v}(q) > v(q), \forall q \in [\underline{q}, \overline{q}]$, whereby we assume that the willingness-to-pay for a product of a given quality does not differ too much across consumer types: let $\delta v(q) > \tilde{v}(q) - r$, $v(q) > \delta\tilde{v}(q)$, and $v'(q) > \delta\tilde{v}'(q)$ for any $q \in [\underline{q}, \overline{q}]$.

Preliminaries. First, it is easy to check that we cannot have a retail equilibrium in which only the high-value, but not the low-value offline consumers are served and price is non-salient. Consider the subgames with a wholesale price $w \in (v(q) - r, \tilde{v}(q) - r]$, which would, in principle, allow the retailers to serve the high-value, but not the low-value offline consumers. In this case, retailers in regions with low-value offline consumers cannot profitably sell offline and therefore will fiercely compete for online consumers by charging a low online price. Fierce online competition renders prices salient, however, which was to be proven. Intuitively, retailers that have a brick-and-mortar store in a region with low-value offline consumers do not internalize the negative effect of cheap online sales on the offline consumers' willingness-to-pay, so that a retail equilibrium with non-salient prices does not exist in these subgames.

Second, we observe from the proof of Proposition 1 that, for small values of α and a wholesale price of $w = w_{\mathrm{df}}(q; \alpha, \delta)$, as defined in (3), there exists a distortion-free retail equilibrium in which all retailers operate both channels at retail prices $p_{i,k} = v(q)$, $k \in \{\text{on}, \text{off}\}$. Notice that for any wholesale price $w \in [\delta\tilde{v}(q) - r, v(q) - r]$ the incentive constraint for *all* retailers (i.e., also for those in regions with high-value offline consumers) is exactly the same as in our baseline model, that is, we only have to worry about deviations to a lower online price in order to serve all online consumers. The claim then follows from the fact that $w_{\mathrm{df}}(q; \alpha, \delta)$ monotonically decreases in α with $\lim_{\alpha \to 0} w_{\mathrm{df}}(q; \alpha, \delta) = v(q) - r$. Moreover, by the same arguments as above, in any other retail equilibrium in this subgame *either* price is salient and retailers earn a lower margin *or* only online consumers served at the same margin. Hence, for small α and a wholesale price of $w = w_{\mathrm{df}}(q; \alpha, \delta)$, the distortion-free retail equilibrium is the unique equilibrium under selection.

Third, it follows immediately from Proposition 1 that, at a wholesale price of $w = \delta v(q) - r$, a price salient equilibrium in which all consumers are served efficiently exists. In contrast to our baseline model, however, retail prices differ not only across channels, but also vary across regions, as the retailers in regions with high-value offline consumers charge $\min\{\delta\tilde{v}(q), \delta v(q) + t\} > \delta v(q)$ at their brick-and-mortar stores. As before, in an ϵ-environment below a wholesale price of $w = \delta v(q) - r$, the price salient retail equilibrium is the unique retail equilibrium under selection.

Fourth, at wholesale prices $w \in (\delta v(q) - r, \delta\tilde{v}(q) - r]$, there also exist retail equilibria in which price is salient and only the high-value offline consumers and the online consumers are served efficiently, while low-value offline consumers are excluded from the market. Since we have $\delta\tilde{v}(q) < v(q)$ by assumption, *all* retailers (i.e., also those in regions with high-value offline consumers) earn less than in the distortion-free retail equilibrium discussed above, so that this type of price salient retail equilibrium is selected in a given subgame only if the distortion-free retail equilibrium with a uniform retail price of $v(q)$ does not exist. Notice, however, that even if at a wholesale price of $w = \delta\tilde{v}(q) - r$ no distortion-free retail equilibrium exists, it is not clear that this type of price salient equilibrium is selected, because depending on the magnitude of salience effects there can exist online equilibria in which at least some retailers are better off.

Nevertheless, it is easy to check that this second type of price salient retail equilibrium becomes more attractive from the manufacturer's perspective relative to a price salient retail equilibrium in which *all* consumers are served efficiently if the share of online consumers, α, increases. Denote the number of regions with high-value offline consumers as $k < N$. Then, the manufacturer prefers the second type of price salient equilibrium, given that he can induce it at a wholesale price of $w = \delta\tilde{v}(q) - r$, over the first type of price salient equilibrium if and only if

$$\left[\frac{k}{N}(1-\alpha)+\alpha\right]\cdot\left[\delta\tilde{v}(q)-r\right] > \delta v(q) - r.$$

Obviously, the left-hand side of this inequality strictly increases in α, which proves the claim.

Fifth, it follows immediately from our assumptions on the valuations, namely, $\delta\tilde{v}(q) < v(q)$, that at a wholesale price of $w = v(q)$ there exists an online retail equilibrium, as introduced in Proposition 1, and that for any wholesale price in an ϵ-environment below $w = v(q)$, the online retail equilibrium with a retail price of $v(q)$ is the unique retail equilibrium under selection.

Equilibrium without Vertical Restraints. Combining our preliminary considerations with Proposition 1 is sufficient to characterize the equilibrium outcome absent vertical restraints.

Proposition 12. *There exist threshold values* $0 < \alpha'_{AR} \leq \alpha''_{AR} \leq \alpha'''_{AR} < 1$ *so that:*

i) Suppose the share of online consumers is very small (i.e., $\alpha < \alpha'_{AR}$*). Then, in the unique subgame-perfect equilibrium all consumers are served efficiently, no dimension is salient, the manufacturer sets an inefficiently high quality* $q = q^S_{\text{ex}}(\alpha, \delta) > q^*$ *and a wholesale price*

$$w = w^S_{\text{ex}}(\alpha,\delta) := \left(\frac{1-\alpha\delta N}{1-\alpha N}\right) v\big(q^S_{\text{ex}}(\alpha,\delta)\big) - \left(\frac{1-\alpha}{1-\alpha N}\right) r.$$

Moreover, on the path of play, each retailer i *operates both distribution channels at retail prices* $p_{i,k} = v\big(q^S_{\text{ex}}(\alpha,\delta)\big)$, $k \in \{\text{on}, \text{off}\}$, *and earns strictly positive profits.*

ii) Suppose the share of online consumers is small (i.e., $\alpha'_{AR} \leq \alpha < \alpha''_{AR}$*). Then, in any 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 a wholesale price* $w = w^S_{\text{ps}}(\alpha,\delta) := \delta v\big(q^S_{\text{ps}}(\delta)\big) - r$*. Moreover, on the path of play, each retailer* i *in a region with high-value offline consumers operates her offline store at a retail price*

$p_{i,\text{off}} = \delta\tilde{v}\big(q^S_{\text{ps}}(\delta)\big)$, *each retailer* j *in one of the other regions operates her offline store at a retail price* $p_{j,\text{off}} = \delta v\big(q^S_{\text{ps}}(\delta)\big)$, *and at least two retailers offer the product also online at a retail price equal to cost* $w^S_{\text{ps}}(\alpha, \delta)$. *Retailers in regions with high-value offline consumers earn positive profits, while the remaining retailers earn zero profits.*

iii) Suppose the share of online consumers is large (i.e., $\alpha''_{AR} \leq \alpha < \alpha'''_{AR}$*). Then, in any subgame-perfect equilibrium only high-value offline consumers and online consumers are served efficiently, price is salient, the manufacturer sets an inefficiently low quality* $q = \tilde{q}^S_{\text{ps}}(\delta) < q^*$ *defined by* $\delta\tilde{v}'(q) = c'(q)$ *and a wholesale price* $w = \tilde{w}^S_{\text{ps}}(\alpha, \delta) := \delta\tilde{v}\big(\tilde{q}^S_{\text{ps}}(\delta)\big) - r$. *Moreover, on the path of play, each retailer* i *in a region with high-value offline consumers operates her offline store at a retail price* $p_{i,\text{off}} = \delta\tilde{v}\big(\tilde{q}^S_{\text{ps}}(\delta)\big)$, *and at least two retailers offer the product also online at a retail price equal to cost* $\tilde{w}^S_{\text{ps}}(\alpha, \delta)$. *Retailers earn zero profits.*

iv) Suppose the share of online consumers is very large (i.e., $\alpha \geq \alpha'''_{AR}$*). Then, in any subgame-perfect equilibrium only online consumers are served, no dimension is salient, the manufacturer sets the efficient quality* $q = q^*$ *and a wholesale price* $w = w^S_{\text{on}} := v(q^*)$. *Moreover, on the path of play, at least one retailer offers the product online at a retail price equal to cost* w^S_{on}, *but no retailer offers the product in her offline store. Retailers earn zero profits.*

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