Sustainability and Strategic Differentiation in Unregulated Consumer Goods Markets*

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Abstract

This paper sheds light on the unique role of sustainability in unregulated consumer packaged goods (CPG) markets: it is neither a pure public good, which firms lack incentive to provide without regulation, nor a significant private benefit to consumers largely produced by dominant market players. Instead, sustainability occupies a middle ground, offering strategic differentiation opportunities across brands. In the health and beauty care categories from 2013 to 2019, we find growth in sustainable products only among fringe – not historically dominant – brands and a limited impact of sustainability features on product pricing, both of which suggest firms' growing but modest incentives to invest in sustainability. Consistent with these patterns, our model estimates indicate that sustainability has a marginal impact on consumer purchase decisions: while preference for sustainability is increasing, the average consumer still prioritizes non-sustainable attributes and favors sustainability features that are more easily offered by smaller brands. These preferences rationalize the observed strategic differentiation, where dominant brands face limited incentives to offer sustainable products while smaller brands use sustainable offerings to differentiate. Implications for brands and policymakers are discussed.

Keywords: Sustainability, Pricing, Public Policy, Branding, Product Launch

*Researcher(s)' own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the NielsenIQ data are those of the researcher(s) and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein. The authors would like to thank Andrea Andreeva, Ivan Li, and Lucy Chen for the research assistance. We thank our discussant, Daisy Dai, and colleagues at Rochester and Stanford for the many helpful comments. We also thank conference participants at Berkeley IOFest, Choice Symposium, Marketing for Environmental Sustainability, Marketing Science, UT Dallas BASS, Virtual Quantitative Marketing Seminar, Yale InsightsOn, as well as seminar participants at Cornell, George Mason University, and INSEAD. This research was supported by the BGS Research Fund from Stanford Graduate School of Business.

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1 Introduction

Academic literature and industry reports offer mixed predictions about the impact of rising interest in sustainability among consumers on firms' strategic decisions. On the one hand, sustainable products may face challenges commonly associated with public goods: despite the broad stated consensus that sustainability is a valuable objective,[1] consumers largely do not internalize the positive environmental and social externalities of their sustainable consumption (Bennett and Williams 2011, Luchs et al. 2010, Boston Consulting Group 2023). This may limit firms' ability to capture value from incorporating sustainable features into their products, leading to widespread underprovision of sustainability in the absence of regulations (Samuelson 1954). On the other hand, recent research suggests increasing consumer demand for sustainable consumer products and higher returns from these offerings (Kronthal-Sacco et al. 2020, BusinessWire 2021, Meier et al. 2023, McKinsey & Company and Nielsen IQ 2023). These patterns are less consistent with sustainability as a pure public good and instead indicate that consumers are placing greater emphasis on sustainability in their purchasing decisions, effectively treating it more like a private benefit.[2] In this case, firms may have incentives to invest in sustainability even without regulatory pressure. The extent to which sustainability influences consumer purchases will determine both the market share growth of sustainable products and which firms provide them in equilibrium. If consumers prioritize sustainability in their purchase decisions, we may expect a significant growth in its market provision, likely led by dominant brands that can leverage their resources and economies of scale (Cohen and Klepper 1996). If consumers place some but not large emphasis on sustainability in their purchases, brands may choose to provide sustainability strategically as a point of differentiation.

In this paper, we examine consumer demand for sustainability and brand-level heterogeneity in sustainability provision without regulatory influence to shed light on the position

[1] A large majority of Americans recognize the importance of addressing negative effects of climate change (Tyson and Kennedy 2020). 494 out of S&P 500 firms reported ESG information in 2023 (BusinessWire 2021).

[2] This paper is agnostic about whether this change reflects an increased internalization of the social benefits associated with sustainable consumption or direct private benefits such as status-signaling (Griskevicius et al. 2010) and "warm glow" (Andreoni 1990).

of sustainability between a public good and substantial private benefit to consumers. We evaluate the importance of sustainability in consumer purchase decisions and assess how this emphasis leads to diverse incentives for brands to offer and price sustainable products, ultimately shaping the resulting market equilibrium. Existing literature explores aspects of consumer demand for sustainability, such as loyalty to sustainable products (Zhu et al. 2023) and firms' decisions on the geographic distribution of sustainable offerings based on local profit potential (Bollinger et al. 2023); however, it lacks direct empirical evidence on whether sustainability behaves more like a public or private good and how evolving consumer preferences influence the incentives of diverse brands to introduce and price sustainable products.

Understanding the nature of sustainability in unregulated markets helps policymakers and managers design more effective regulations and marketing strategies. If sustainability is closer to a public good, regulations that assume minimal private incentives for consumers or firms may be more effective in promoting sustainable markets (Cornes and Sandler 1996), and marketing campaigns that prioritize sustainability may underperform compared to those that highlight other features. Conversely, if sustainability acts as a significant private benefit to consumers, regulators can prioritize improving information transparency regarding sustainability, while marketers can focus on directly promoting product sustainability. If sustainability lies somewhere between these two extremes, regulators should consider strategies that elevate its importance in consumer purchasing decisions while leveraging frameworks related to public goods and information disclosure. At the same time, marketers should assess the degree to which sustainability is valued privately by consumers and identify when it is most relevant to emphasize.

We document the unique nature of sustainability, which lies between a public good and a private benefit to consumers, and the opportunities it creates for strategic differentiation across brands. We analyze consumer purchases and firm strategies – including product launches and pricing – for products with sustainability features in the health and beauty care categories from 2013 to 2019. First, we find that the increasing prevalence and market share of products with sustainability features are primarily driven by smaller and emerging brands ("fringe brands") rather than by historically dominant ones ("large

brands"), with sustainability features playing only a secondary role in product pricing, contrary to widespread perception. This implies growing but modest private incentives for firms to invest in sustainable production. Next, we show using our model estimates that sustainability carries positive but small weight in consumer purchase decisions. Although overall consumer preference for sustainability is increasing, non-sustainable product attributes play a significantly more important role in consumer product preferences than sustainable features. Among sustainability features, consumers tend to favor those that smaller brands can provide more readily compared to large brands. These consumer preferences offer a coherent explanation for the observed market equilibrium: dominant brands face limited incentives to offer sustainable products, resulting in a market in which they offer less preferred, lower-cost, and lower-priced sustainable alternatives, whereas smaller brands offer more preferred, higher-cost, and higher-priced options. These findings have important implications for marketers and policy-makers.

We define sustainability features as characteristics highlighted on a product's packaging that indicate the responsible use and protection of resources, ensuring they are not permanently harmed and are managed accountably. Resources include human resources, environmental resources, and other nonhuman resources (e.g., animal resources used for production). These features intend to enhance the well-being of entities beyond the direct consumers, and may or may not directly improve the product's consumption experience. This definition includes a wider range of resources than the single dimensions typically emphasized in the literature (e.g., Gillingham and Bollinger 2021, Bronnenberg et al. 2024, Korganbekova et al. 2024 [CO_2 emissions]; Brecko and Hartmann 2023 [Water use]; Kotschedoff et al. 2024 [Animal welfare]) and reflects the expansive nature of sustainability discussions among both practitioners and policymakers under the ESG pillars and UN's 17 sustainable development goals (described by Devevey et al. 2020, EPA 2023, United Nations 2024; also studied in the literature by Bollinger et al. 2023, Zhu et al. 2023). Given the multi-faceted nature of sustainability and the absence of a unified framework for assessing the relative impacts of different sustainability features (Klemeš 2015), we use sustainability features as an indicator of a product's positive sustainability impact.

We use three main data sources for our empirical analysis. First, we obtain weekly-

store level sales and prices of individual UPCs from the NielsenIQ Retail Scanner (RMS) data set provided by the Kilts Center for Marketing at the University of Chicago. In addition to product characteristics (e.g., price, product size, category, brand), the RMS data also provide store characteristics, including the geographical market and retail chain information. Second, we use the data provided by NielsenIQ Label Insight for detailed information on sustainability features of each product. For the analyses, we select 20 Health & Beauty Care product categories, as they show rich variation in the sales and prevalence of products with sustainability features. Finally, in our model estimation, we incorporate data on individual household purchases and demographics available in the NielsenIQ Homescan Consumer Panel (HMS).

Descriptive analysis in Section 3 reveals a growing prevalence of products with sustainability features, a modest influence of these features on pricing, and distinct differences across brands in both the prevalence and pricing of sustainability features. First, the number of product varieties with sustainability features and their market shares have drastically increased among smaller and entrant brands ("fringe brands"), while both measures have remained largely constant over time among larger, historically dominant brands ("large brands").[3] Second, a sustainability price premium emerges *only* after accounting for a comprehensive set of non-sustainable product characteristics (e.g., package size, parent brand), and this conditional premium is primarily driven by fringe brands. Contrary to widespread consumer perception (Kantar 2022), in a given store, products with sustainability features are generally lower-priced compared to their non-sustainable counterparts when other product characteristics are not taken into account. These patterns indicate that sustainability features are not the primary factor influencing product prices and are often bundled with low-price attributes.

To understand the drivers of the observed asymmetry in sustainable product offerings and pricing across brands, we estimate heterogeneous product-level demand and marginal costs in Section 4. In a field setting, sustainability features are often intertwined with various product- and brand-level attributes due to product design constraints and brands' strategic decisions, making it difficult to isolate preferences for sustainability features from

[3]We define large and fringe brands using parent brand-level sales in 2012, as detailed in Section 2.3.

other confounding factors. To address this challenge in a tractable way, we first estimate product-level preferences and marginal costs in a flexible way and examine the relationship between the recovered parameters and a large set of observed product characteristics (including both sustainability and non-sustainability features) as a second step in the post-estimation analysis stage. Although our model does not explicitly account for brands' entry decisions, it enables us to flexibly recover the structural parameters underlying observed purchase and pricing decisions, providing insights into the forces shaping these equilibrium outcomes.

Consistent with the descriptive evidence in Section 3, estimation results in Section 5 reveal that brands differentiate themselves in unregulated markets by offering varying types and qualities of sustainable products. Dominant brands tend to offer lower-cost products with sustainability features that are less preferred than their non-sustainable counterparts, whereas fringe brands provide higher-cost, more preferred sustainable options. Specifically, for large brands, products with sustainability features are associated with lower consumer preferences, more price elastic demand, and lower marginal costs on average compared to non-sustainable alternatives. In contrast, for fringe brands, these patterns are reversed.

Section 6 shows that, although consumers assign a positive value to sustainability features, the importance they place on such features is modest. This gives weak economic incentives for large brands to invest in sustainability and yields differentiation opportunities for fringe brands. First, we find that the average consumer puts significantly less weight on sustainability features than on other product attributes, such as brand or product size, in their purchase decisions. The presence of sustainability features has minimal power in predicting consumers' overall product-level preferences, with consumers showing a preference for these features only when products are comparable on non-sustainable attributes. Second, all else equal, consumers have stronger preferences for specific types of sustainability features that fringe brands find relatively less costly to provide. In our empirical context, preferences for products with sustainability features are stronger when these features focus on no animal testing (rather than environmental packaging), are third-party certified, and are offered by parent brands committed to providing such features across their entire product lines (rather than only in some of their products). Given that 1) dominant

brands' extensive product lines make a brand-level commitment to sustainability more costly and 2) their established animal-tested formulations may require significant modifications to achieve no-animal-testing production, our results indicate that large brands may face higher barriers to incorporating sustainability features that consumers most prefer. Additionally, we find that the preference and price elasticity for products with sustainability features show a persistent gap between large and fringe brands, even after accounting for a comprehensive set of sustainable and non-sustainable product characteristics. This suggests that consumers may simply prefer sustainability features more when they are offered by fringe brands rather than by historically dominant brands, possibly due to the perception that smaller brands are more authentic (Woolley et al. 2023).

These insights into consumer demand help explain the diverging decisions between large and fringe brands. On the one hand, they highlight the lack of economic incentives for large brands with high brand equity to offer products with sustainability features. On the other hand, they imply opportunities for fringe brands to use sustainability features as a cost-effective point of differentiation and to attract niche, price-inelastic demand that large brands do not capture. In line with this explanation, we observe in our data that multi-brand manufacturers often launch products with sustainability features through their smaller, fringe brands rather than their well-established large brands. Furthermore, we find that product categories with higher market concentration tend to see more fringe brands introducing products with sustainability features.

Section 7 discusses how our results support the potential effectiveness of regulations with nuanced implications for regulatory design. First, we provide large-scale empirical evidence that, even with the rising preference for sustainability, consumers alone do not drive all suppliers to voluntarily invest in sustainable production, as they do not prioritize sustainability features in their purchase decisions relative to other product attributes. Unlike settings where dominant players lead the introduction and growth of new product features (e.g., Tide introducing laundry detergent pods (Leverette, 2022)), we do not see large brands driving introduction of sustainability features, likely due to the relatively low emphasis consumers place on them. As many sustainability-related regulations are based on the premise that consumers prefer sustainable products (European Commission 2024)

and aim to "empower consumers to contribute actively to the green transition" (European Commission 2023), our empirical results raise caution about this assumption and invite additional efforts to promote awareness among consumers about the importance of sustainability in everyday purchase decisions (White et al. 2019). The results also speak to the potential effectiveness of supply-side policies, such as sustainable production mandates or sustainability certification standards. Finally, our results highlight the need for regulations to consider the varying incentives and costs of sustainability features between dominant and fringe brands. Our findings indicate that large brands may incur higher relative costs to incorporating consumer-preferred sustainability features. Effective regulations promoting sustainable production should provide adequate incentives for these major brands to adopt sustainable practices.

The results offer key marketing implications for brands promoting sustainable products. First, given that most consumers prioritize other product features over sustainability, brands should be aware of the trade-offs they face when emphasizing sustainability in their marketing messages. Second, brands should take into account cause-specific preferences in their product design and marketing. In our setting, we document a stronger demand for animal cruelty-free production than environmental packaging. To our knowledge, this is the first large-scale empirical study documenting consumers' systematic preferences for different types of sustainability in a real purchase setting. Third, as consumers discount sustainability features when those features are found in only some (not all) of a brand's products, launching a new, fully sustainable brand can capture demand more effectively than adding sustainable products to an existing brand. Finally, in the current market environment, certification can enhance consumer preferences for products with sustainability features.

This paper contributes to the growing empirical literature studying the demand for and supply of sustainable products. The most relevant to our work are three large-scale studies that use field data and consider supply and demand for sustainability features in a range of categories of consumer goods. Bollinger et al. (2023) study variation in geographic availability of sustainable products due to varying profit potential. Zhu et al. (2023) explore the role of consumer loyalty in the demand for sustainability features. Bronnenberg et al.

(2024) use field data to examine over-time trends in the environmental impact of household food consumption. Our paper addresses the unique nature of sustainability, which blends characteristics of a public good and a private benefit, and shows that although preferences for sustainability are rising, sustainability features are of low importance in consumer decisions, which explains the observed divergence in brand-level strategies regarding products with these features. We also explore factors that influence consumer preferences for sustainability features when other attributes are held constant, including various causes supported by these features and the brand's commitment to providing them.

Our work relates to lab studies and theoretical research that explores firm incentives to invest in sustainable offerings. In the consumer behavior literature, Luchs et al. (2010) demonstrate through lab experiments that consumers may associate sustainability features with lower vertical quality in certain contexts, suggesting this implicit trade-off as a potential barrier to sustainable consumption and firms' investment in sustainable production. Using theoretical models, Harbaugh et al. (2011) and Amaldoss and Prusty (2023) examine the implications of uncertain sustainability standards and consumers' heterogeneous preferences for sustainability on firms' strategic decisions to market sustainable products. Our study contributes to this literature by providing empirical insights into how consumer preferences estimated from field data shape firms' sustainability pricing and product decisions across various consumer packaged goods markets.

Our finding that small and entrant brands may have stronger incentives to provide sustainability features in equilibrium contributes to the growing literature on niche consumption and rising product varieties. Neiman and Vavra (2023) document the rise in niche consumption, attributing it to increasing product variety and a better alignment of products with heterogeneous consumer preferences. Brand (2021) shows the growth of product varieties consistently explains a simultaneous decrease in consumers' price sensitivity. Bronnenberg et al. (2022) emphasize the role of consumer preference formation in the growth of small (craft) brands in the beer industry. Eizenberg and Salvo (2015) document the rise of fringe brands in Brazil's soft drink market along with the growth of the middle class and large brands' responses to it. Our paper adds to this body of work by highlighting that emerging consumer trends can create opportunities for niche brand

entry, particularly in markets where large brands face greater constraints in adapting to these shifts.

Finally, this paper is related to the literature on voluntary product labeling and relevant pricing decisions. Rao and Ursu (2023) examines the impact of voluntary nutrition labels on consumer decisions, and Moshary et al. (2023) investigates the pricing of products with voluntary gender labels on consumer packaged goods. Our paper documents the voluntary provision and pricing of products with sustainability features.

2 Data

We use three main data sources for our empirical analysis: 1) weekly store-level sales and prices of individual products (universal product codes or UPCs) from NielsenIQ Retail Measurement Services (RMS) data, 2) data from NielsenIQ Label Insight that hold detailed information on the sustainability features of each unique UPC, and 3) purchase and household demographics data from the NielsenIQ Homescan Consumer Panel (HMS). RMS and HMS are provided by the Kilts Center for Marketing at the University of Chicago.

2.1 Health & Beauty Care Product Categories

We focus our analysis on the top 20 revenue-generating product categories ("modules") in Health & Beauty Care, which include a variety of sustainability features like eco-friendly packaging and cruelty-free ingredients. These categories have been central to recent sustainability policy discussions. They also vary significantly in market size, product characteristics, prices, and sustainability prevalence, allowing us to draw broader conclusions about the factors influencing sustainable markets.

NielsenIQ utilizes a group hierarchy in which each UPC is assigned to a Product Module (the narrowest product grouping; e.g., Shampoo-Aerosol/Liquid/Lotion/Powder), a Product Group (the second narrowest grouping; e.g., Hair Care), and a Product Department (the broadest grouping; e.g., Health & Beauty Care). Unless stated otherwise, all our empirical analyses are at the product category ("Product Module") level. For simplicity,

Table 1: Overview of Health and Beauty Care products and sustainability feature data

Product group	# Product categories	#UPCs with feature info	% of all RMS UPCs	
			by quantity	by revenue
Cosmetics	6	11,221	55%	58%
Deodorant	1	1,534	84%	87%
Hair Care	6	9,649	80%	77%
Oral Hygiene	2	1,268	56%	61%
Skin Care	5	7,282	61%	63%

Table 2: Sustainability feature prevalence by type

Feature Type (Supported causes)	% UPC with features (by unique product counts)	Market share of UPCs with features (by revenue)	Feature Examples
Any Sustainability Feature	34.9%	25.8%	
Animal Welfare	28.6%	14.7%	Animal Welfare Approved, Humane
Sustainable Packaging	13.7%	16.3%	Recycled Packaging Content, Recyclable, Less Packaging
Environmental Sustainability	2.8%	2.7%	Less Emissions, Reduced Greenhouse Gases
Social Responsibility	2.8%	1.3%	B Corporation, Ethical, Fair Trade
Sustainable Forestry	2.5%	2.2%	Forest Stewardship Council, Rainforest Alliance Certified
Sustainable Resource Management	0.7%	1.4%	Carbon Neutral, Reduce Water Waste, Renewable Energy

we also report some summary statistics at the more aggregate product group ("Product Group") level.

Our data, summarized in Table 1 by product group, comprise weekly sales of 30,954 UPCs from 1,389 brands in the United States from 2012 to 2019.

2.2 Product Sustainability Features

The data on the sustainability features of a given UPC are provided by NielsenIQ Label Insight. Label Insight extracts information about a product's sustainability features from the text on product packaging, classifies each feature into one of pre-defined feature types, and returns a cross-sectional, UPC-level data set on both the quantity and type of

sustainability features (including "no sustainability feature").[4] We match the sustainability feature data with the weekly sales data using product UPC as a key. Table 1 shows that although sustainability feature information is available for a subset of UPCs in the RMS data, the matched UPCs account for the majority of quantity and revenue share in the RMS data in all focal product groups.[5]

Consistent with the broad definition of sustainability that considers the environmental, social, ethical, and other impacts of a product or production practices (EPA 2023, United Nations 2024), NielsenIQ Label Insight captures a large array of sustainability features. Table 2 shows that 34.8% of the unique UPCs available between 2012 and 2019 in the Health & Beauty care product categories have at least one sustainability feature. The table also highlights the most prevalent features in each of the 6 pre-defined sustainability feature types.[6]

The main focus of our study is whether and to what extent sustainability matters for consumers and firms in this field data context. As such, in the main analyses of Sections 3 and 4, we characterize a product by whether or not it incorporates *any sustainability features*. We consider the role of distinct feature types in determining consumers' sustainability preferences and firm feature provision in Section 6 and include detailed by-feature type analysis in Web Appendix B.

2.3 Non-Sustainable Product Attributes

In order to understand the relative importance of sustainability in consumer and firm decisions compared to other product features, we also incorporate in our analyses a rich

[4]NielsenIQ stores only the most recent product information for any given UPC; i.e., when a product changes the packaging, keeping its code the same, the new product information overwrites the old one. This can create an upward bias in the availability of sustainability features in earlier years if firms have added features to existing products over time. Still, in Section 3, we see an upward trend in sustainability feature prevalence, which can be viewed as conservative evidence of the rate of increase.

[5]NielsenIQ Label Insight adds UPCs to the data set annually, which creates a discrete jump in the number of unique UPCs with sustainability feature data every January. As long as newly added UPCs are chosen randomly and are not correlated with their sustainability status, these annual updates will not systematically bias our results. Since NielsenIQ Label Insight stores rich information on newly added UPCs in addition to sustainability features (e.g., nutrition, package size, etc.), it is reasonable to assume that the addition of new UPCs is not solely selected on sustainability features.

[6]Sustainable Seafood and Sustainable Farming features are also available in the NielsenIQ Label Insight data, but are not present in the Health & Beauty Care categories we study.

set of product attributes obtained from NielsenIQ and NielsenIQ Label Insight.

Product Brand, Parent Brand, and Brand Size To build on past research on the importance and persistence of brand preferences (Bronnenberg et al. 2012, Bronnenberg et al. 2015) and to evaluate diverging predictions about different brands' incentives to provide sustainability, we use three variables – a product's brand, parent brand, and brand size – to characterize brands.

The first variable is the product's narrow brand (b), as defined by the NielsenIQ brand name. Under this definition, "DOVE MEN + CARE", "DOVE MEN + CARE ELEMENTS", "DOVE MEN + CARE SPORT CARE" are all defined as separate brands.

We then define a product's parent brand (pb) by truncating the strings of the NielsenIQ narrow brand name (b) and grouping all brand descriptors into a single parent brand if they share the same first word.[7] Table 3 reports both the number of unique brands (the second column) provided by NielsenIQ and the number of unique parent brands defined by us (the third column) within each product group.

Table 3: Products, Brands and Prices, by Product Group

	Products			Prices	
Product Group	#Brands (NielsenIQ)	#Parent Brands	Av.#UPC in Brand-Category	Average Shelf Price	Average Price per Unit Measure
Cosmetics	1172	284	4.96	\$6.20	\$66.69
Deodorant	203	126	4.83	\$4.73	\$1.79
Hair Care	1146	506	3.05	\$6.45	\$3.20
Oral Hygiene	204	85	3.84	\$4.58	\$0.76
Skin Care	1354	792	2.59	\$10.08	\$5.57

Finally, to empirically evaluate the heterogeneity in sustainability provision – whether it is driven by dominant or niche market players – we define a parent brand size variable. Using the sales data in 2012, for each product category, we classify the parent brands as either large incumbent parent brands ("Large") or fringe incumbent parent brands ("Fringe"). The former is comprised of all parent brands that were large incumbents in 2012, whereas the latter includes all small incumbent brands in 2012 and entrant brands since 2012. We

[7] If a NielsenIQ-provided brand name starts with "THE," we take the first two words to extract the parent brand name.

classify a parent brand as "Large" if one of two conditions is satisfied: the parent brand is within the set of parent brands that (1) take the top 70% of revenue share in 2012 in the product category or (2) take the top 90% of the revenue share in 2012 and contribute at least 0.04 incremental revenue share over the second next highest revenue parent brand. This classification approach allows average incremental and cumulative shares of large parent brands to vary across categories. The average in-sample product category has 6.45 large parent brands in 2012, which take 84% cumulative market share and 15% incremental share on average. The average in-sample product category has 37.6 fringe parent brands in 2012, which take up 0.6% incremental share on average. We show these summary statistics for each in-sample product category in Table 7.

Product Manufacturer We supplement the NielsenIQ product brand information with manually collected data on brand manufacturers in order to control for additional variation in supply and demand, validate our marginal cost estimates, and confirm our predictions regarding the mechanism driving divergent strategies across brands. We expect differences between large multi-brand manufacturers and small single-brand manufacturers in marginal costs of producing sustainability features (due to economies of scale) as well as in demand-side advantages (due to, for example, greater advertising resources or better retailer relationships). Therefore, we employ manufacturer identities as control variables in the post-estimation phase and in the robustness checks of our estimated results. We also examine the differences in sustainability-feature-related decisions between large and fringe brands owned by the same manufacturer to understand the incentives behind these strategic decisions.

We collect brand manufacturer information at the brand-year level, accounting for over-time changes in brand ownership. In the post-estimation analysis, we distinguish between brands owned by the largest 2 brand manufacturers (by frequency of brand occurrence in the geographic markets), the largest 10 brand manufacturers, and the rest.[8]

[8]Table 9 summarizes the number of brands, parent brands, and brand manufacturers in the product categories used in estimation as well as the average market share of the largest 2 and 10 brand manufacturers.

Product Package Size In addition to brand information, NielsenIQ data include UPC-level package size dimensions, which we incorporate as additional non-sustainable product attribute controls and use to construct the price measure for our descriptive and structural analyses. We define a product's package size as a categorical variable that combines the size, the size unit (e.g., OZ, counts), and the number of units in the multi-pack (if any). In select analyses, we also consider the continuous measure of a product's package size in ounces. Unless otherwise stated, such analyses are based on only those products with ounces as the unit of measure.[9]

Product Ingredients and Formulations The NielsenIQ Label Insight data includes information about a product's ingredients, which we utilize in two ways. First, for UPC-level analysis (i.e., sustainability feature pricing analysis), we control for product formulation by using the first three ingredients in their listed order as the UPC's ingredient profile (Moshary et al., 2023). Second, for product-level analysis – where products are defined at the brand-sustainability feature level rather than the UPC level, making unique formulation controls infeasible (i.e., post-estimation analysis of demand and supply parameters) – we account for the presence of 100 most common ingredients in the product category using indicator variables. These top 100 ingredients comprise the majority cumulative share in each of the in-sample product categories[10].

2.4 Prices

From the NielsenIQ RMS data, we obtain UPC-store-week level prices[11]. We deflate prices using the monthly Consumer Price Index (U.S. Bureau of Labor Statistics, 2024) to January 2012 real dollar levels. Table 3 shows for each product group the average product's shelf price (i.e., price of a given unit of product, regardless of package size) and

[9]Most of the revenue in our in-sample categories comes from products with ounces as unit of measure. A notable exception is the Hair Coloring - Women's category, in which 93% of sales revenue is from products measured in counts.

[10]Of the product categories used in estimation, lowest (0.61) and highest (0.85) cumulative shares are in the Hair Preparations and Oral Rinse categories, respectively.

[11]UPC-store-week prices are observed conditional on purchase. We impute store-UPC unit prices on weeks with 0 unit sales by computing the median price for the store-UPC in that year across all weeks when at least 1 unit was observed to be purchased.

the average product's price per unit measure (i.e., the price per ounce or count of the product), revealing substantial differences in average prices across the product groups and motivating our use of percentage differences when evaluating sustainability price premia.

2.5 Household Demographics and Purchase Data

Finally, we supplement the weekly-store-level sales data with individual household demographics and purchase data from the Nielsen IQ Homescan Consumer Panel (HMS). We use household income and age as observable characterizations of the households. To compute a numeric value for household income, we use the mid-point of the income bin tracked by Nielsen IQ. To compute a numeric value for the household age, we take the maximum of the ages of the two heads of household. Finally, using the purchase data, we track whether a household purchases a product with sustainability features in a given market in a given year and whether the average price they pay in a given category is below the average price paid in that category by all in-sample households. We then use these data to form "micro moments" in our structural estimation exercise in Section 5.

3 Provision and Pricing of Sustainability Features

We examine key data patterns related to the provision of sustainability features across brands, focusing on their product launch and pricing decisions. First, we show that fringe brands contribute significantly more to the growth in both the availability and market share of sustainable products compared to large brands. Second, the presence of sustainability features is not the primary determinant of prices. These indicate that the average brand has positive but only modest incentives to provide sustainability without regulations.

3.1 Sustainability Feature Provision

We start by investigating the availability and market share of products with sustainability features and their variation across brand sizes. To do so, we define two aggregate share measures, separately for large and fringe brands: (1) market share of products with

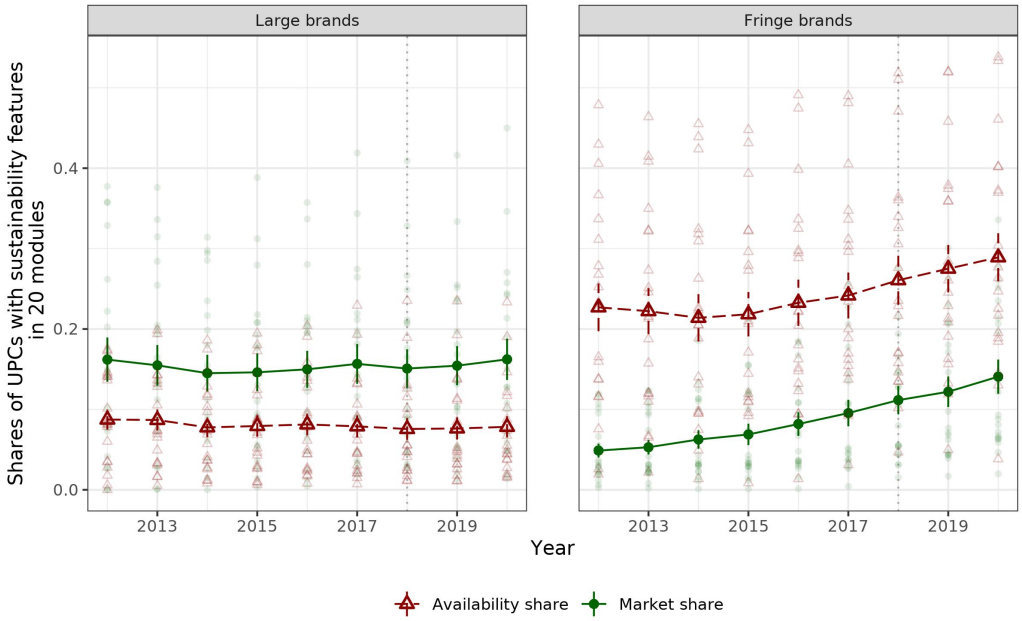


Figure 1: Availability and market shares of products with sustainability features by brand size

sustainability features based on quantity sold ("market share") $= \frac{\sum_j q_j \mathbb{1}\{\text{sustainability feature}_j\}}{\sum_j q_j}$ where $\mathbb{1}\{\text{sustainability feature}_j\}$ is a binary variable indicating whether product j has any sustainability features and q_j is the quantity sold of product j, and (2) availability share of products with sustainability features ("availability share") $= \frac{\sum_j \mathbb{1}\{\text{sustainability feature}_j\}}{N}$ where N is the number of unique products (UPCs).

Figure 1 summarizes the market shares, availability shares, and their over-time changes, highlighting an asymmetric growth in sustainability feature provision between large and fringe brands. Each green circle (red triangle) represents a market share (an availability share) of products with sustainability features in a given category-year, and the green (red) line traces the average market (availability) share across the 20 product categories. The number of product varieties with sustainability features and their market shares have drastically increased for fringe brands, while both measures remain largely constant over time for large brands.[12] Fringe brands represent an increasing majority of available products with sustainability features in most categories and enjoy a steep growth in market share between 2012 to 2020, approaching the average market share of large brands with

[12]Importantly, the increase in market shares pre-dates (and thus is unlikely driven by) the first state-level ban on animal testing in cosmetics (The California Cruelty-Free Act), which was proposed on February 16, 2018, passed on September 28, 2018, and became effective on January 1, 2020 (Galgiani, 2018).

sustainability features by 2020.[13] Although both availability and market shares vary significantly across categories (with aggregate market shares ranging from 2% to 58%), they do not appear to be closely related to the category revenue size (Figure A.1).

3.2 Sustainability Feature Pricing

We next consider the pricing of products with sustainability features, using an approach similar to Moshary et al. (2023). For each UPC j and store s, we compute the average per unit (per ounce or per count) shelf price in a given year $y(t)$.[14][15] We estimate the sustainability price premium by regressing the price of UPC j in store s in year $y(t)$ on an indicator of whether the given product j contains any sustainability feature $\mathbb{1}\{\text{sustainability feature}_j\}$. Our baseline specification (Specification 1) is as follows:

$$\text{Specification 1:} \quad p_{jsy(t)} = \beta \mathbb{1}\{\text{sustainability feature}_j\} + \gamma_s + \varepsilon_{jst} \tag{1}$$

where γ_s is a store fixed effect and β represents the average within-store price difference between UPCs with and without sustainability features across all brands.

We consider two additional specifications that control for other non-sustainable product attributes: Specification 1a with package size fixed effects (γ_v) that help account for varying sustainability feature prevalence in different package sizes (Table A.1) and Specification 1b with parent brand fixed effects (γ_{pb}) and formulation (top 3 ingredients) fixed effects (γ_{ing}) to enable like-for-like comparison (Moshary et al. 2023).

Among the three specifications, Specification 1b accounts for the widest range of non-sustainability attributes, thereby most effectively isolating the price effect of the presence of sustainability features in a given product. However, it returns a price premium estimate for a selected set of parent brands as only a subset of products remains after more granular

[13] In Web Appendix B, we also show that fringe brands increasingly sort into offering animal welfare-related sustainability features. We additionally revisit this specialization as a possible explanation for the differences in demand for large and fringe brands' products with sustainability features in Section 6.

[14] Following Hitsch et al., 2021, we also exclude UPCs for which prices are imputed in more than 80% of the weeks and stores in which prices are imputed for more than 80% of store-weeks.

[15] In Table B.2, we show that price differences are similar with two alternative price definitions: (1) a logged measure of price and (2) an absolute shelf price measure (that does not account for package size).

fixed effects are included.[16]

Given the distinct patterns of sustainability feature prevalence among large and fringe brands, we also use a modified version of Specification 1b to estimate price premia by brand size. The modified regression specification for sustainability price premia by brand size (with shortened notation for sustainability feature$_j$) is the following:

Specification 2:

$$p_{jsy(t)} = \beta \mathbb{1}\{\text{sust}_j\} + \beta^{F0}\mathbb{1}\{\text{fringe}_j\} + \beta^{F1}\mathbb{1}\{\text{sust}_j\}\mathbb{1}\{\text{fringe}_j\} + \gamma_s + \gamma_v + \gamma_{ing} + \varepsilon_{jst} \quad (2)$$

We perform the analysis separately for each product category (c) and for each year $y(t)$ between 2013 and 2019 to estimate category-year-specific price differences and to measure their over-time changes. After obtaining the category-year-specific estimates $\hat{\beta}_{cy(t)}$, we compute % *price difference* as $100\% \times \frac{\hat{\beta}_{cy(t)}}{\overline{p}^{ns}_{cy(t)}}$, where $\overline{p}^{ns}_{cy(t)}$ is the average price of UPCs with no sustainability features in that category and year, in order to allow for cross-category comparability.[17]

Table 4 reports the average price differences obtained from Specifications 1, 1a, and 1b, summarized by product group and three select years to show the over-time changes in pricing.[18] First, negative estimates from Specification 1 in Table 4a show that, within a store, products with sustainability features are typically *lower-priced* compared to products without such features. Second, a comparison of estimates from Specification 1 and other specifications reveals that a large part of this price difference can be explained by correlated variation in non-sustainable product attributes. When accounting for other product characteristics, such as package size, ingredient formulations, and parent brands,

[16]The majority of product sizes (size-unit combinations) carry both products with and without sustainability features (∼64% in 2019). By contrast, a minority of brands (∼32% in 2019) and an even smaller share of unique formulations (∼19% in 2019) are associated with both products with and without sustainability features.

[17]For Specification 2, we first obtain obtaining category and year specific estimates $\hat{\beta}_{cy(t)}$ and $\hat{\beta}^{F1}_{cy(t)}$ from Equation (2) and compute % price premia for *large* (*fringe*) brands as $100\% \times \frac{\hat{\beta}_{cy(t)}}{\overline{p}^{Lns}_{cy(t)}}$ ($100\% \times \frac{\hat{\beta}_{cy(t)}+\hat{\beta}^{F1}_{cy(t)}}{\overline{p}^{Lns}_{cy(t)}}$). Here, $\overline{p}^{Lns}_{cy(t)}$ is the average price of UPCs of *large brands* with no sustainability features in that category and year.

[18]All tables summarizing differences in prices between products with and without sustainability features are based on 18 of the 20 categories for which price differences can be estimated at the year level across all years (from 2013 to 2019) using each of the specifications. In two of the categories - Acne Remedies and Cosmetics-Remaining - the full set of fixed effects (Specification 3) is too granular for at least some years.

Table 4: Average Price Difference (as % of Mean Non-Sustainable Product Price from Large Brands)

(a) Select Years, Varying Store and Product Characteristics Controls

	Avg. % Price Difference (baseline: Avg. price of products without sustainability features)								
	Specification (1)			Specification (1a)			Specification (1b)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	2013	2017	2019	2013	2017	2019	2013	2017	2019
Average	-20.32	-18.04	-14.83	-5.51	-3.71	-6.41	5.03	10.04	5.34
Cosmetics	-44.07	-23.27	-17.80	-25.74	-8.83	-19.02	1.76	8.56	9.15
Deodorant	-1.67	-5.13	7.21	18.46	18.85	21.87	4.40	6.61	4.42
Hair Care	-3.67	-18.72	-25.80	8.57	-0.51	1.50	4.64	16.51	2.01
Oral Hygiene	-31.76	-16.17	-14.87	3.04	5.88	9.81	-4.96	-1.09	0.94
Skin Care	-14.55	-14.62	-0.13	-11.63	-12.56	-17.68	14.88	8.61	8.01
Regression FE	*Store*			*Store + Size*			*Store + Size + Ing + Parent*		

(b) Select Years and Package Size Controls, By Brand Type

	Avg. % Price Difference (baseline: Avg. price of large brands' products without sustainability features)					
	Specification (2)					
	Large			Fringe		
	(1)	(2)	(3)	(4)	(5)	(6)
	2013	2017	2019	2013	2017	2019
None				-0.09	6.97	8.78
Sustainable	-5.46	-8.31	-6.37	-30.70	12.91	11.33
Regression FE	*Store + Size +Ing*					

the average price difference between products with and without sustainability features narrows (from -14.83% to -6.41%, first row of Specification 1a) and even becomes positive (Specification 1b). This suggests that the lower average prices of products with sustainability features obtained from Specification 1 are due to the co-occurrence of sustainability features with certain lower-priced packaging sizes, ingredient formulations, and parent brands. Finally, Table 4b (Specification 2) and Figure A.2 in the Web Appendix highlight the distinction between large and fringe brands: large brands contribute to the lower average prices of products with sustainability features, whereas fringe brands command price premia for those features. When controlling for package size and ingredients, we find that fringe brands' products with sustainability features are consistently priced

higher than both their non-sustainable products and large brands' sustainable products from 2015 and onwards.[19]

The results highlight several key findings. First, when other non-sustainable features are not taken into account, products with sustainability features have lower average prices than those products without such features, challenging the common perception that products with sustainability features are more expensive (Kantar 2022). Second, while generally available at accessible prices, products with sustainability features command a price premium after accounting for non-sustainable product attributes such as package size and parent brand identities. This suggests that sustainability features tend to be bundled with low-price non-sustainable attributes and are not the primary determinants of product prices. Finally, the results uncover distinct pricing patterns between large and fringe brands. Large brands generally provide sustainability price discounts and consistently exhibit lower sustainability price premia compared to fringe brands, suggesting that the nature of pricing incentives varies systematically with brand size.

3.3 Summary and Discussion

Descriptive analysis shows heterogeneous sustainability strategies across brands, which are inconsistent with predictions for pure public goods and for substantial private benefits to consumers. The growth in the prevalence and market share of products with sustainability features is driven by fringe – not historically dominant – brands. Moreover, sustainability pricing strategies differ notably across large and fringe brands: large brands tend offer a sustainability discount on average, whereas fringe brands charge a sustainability price premium. These empirical patterns show that, without regulations, only fringe brands have economic incentives to offer sustainability features and charge sustainability premia, highlighting sustainability as a dimension of differentiation for smaller brands.

[19]Table A.2 shows that although there is some variation across the five product groups, in most product groups, fringe brands' products with sustainability features are consistently priced higher than large brands' products with such features.

4 Model

While the empirical patterns in Section 3 indicate positive but modest incentives for firms to provide sustainability, they do not give direct evidence of whether the observed variations in sustainability strategies stem from consumers' low prioritization of sustainability in their purchase decisions or from cost differences between large and fringe brands. To determine whether the differences in sustainability provision between dominant and smaller brands are driven by demand-side (preferences) or supply-side (marginal costs) factors, we estimate a model of heterogeneous consumer demand and product pricing under differentiated-products Bertrand competition.

The focal components of the demand model are (1) consumer preferences for each "product" in a given year (characterized as a distinct brand and sustainability feature combination), (2) a general consumer preference for sustainability features that vary by observed household demographics, and (3) consumers' heterogeneous price sensitivity. We use fixed effects controls to account for any time-varying differences in consumer demand across markets (geographic region-retailer chain).[20]. The focal components of the supply-side pricing model are product-year-specific marginal costs, which are recovered from the demand-side estimates, the observed market shares and prices, cost shifters, and the structure of the model. Similarly to the demand-side model, we use fixed effects controls to account for time-varying differences in marginal costs across markets.

4.1 Demand Model

We define a product j as a combination of brand b and mutually exclusive sustainability feature l and aggregate its weekly sales on a quarterly basis. By defining products based on distinct types of sustainability features, we group UPC-level observations using a finer filter than brands, which allows us to flexibly estimate heterogeneous preferences for sustainability features while maintaining a manageable number of products for the estimation exercise. The mutually exclusive sustainability features are defined based on the observed

[20]For insights related to differences in geographic availability of products with sustainability features see Bollinger et al., 2023.

frequencies in our data (Table 8). These sustainability features are: (1) Animal Welfare features only ("Animal"), (2) Sustainable Packaging features only ("Packaging"), (3) Animal Welfare and Sustainable Packaging features with or without other types of sustainability features ("Animal + Packaging"), (4) all other sustainability features or combinations of features ("Other"), and (5) no sustainability features ("None"). Under this definition, examples of a product $j = (b, l)$ include (DOVE MEN + CARE, None), (DOVE MEN + CARE, Packaging), and (DOVE MEN + CARE, Animal + Packaging). We define a market m as a combination of retail chain r and designated market area (DMA) z,[21], and time t as year-quarter.

Consumer i's utility from choosing a product j (b, l) in quarter t in market m (r,z) is as follows:

$$u_{ijmt} = \tilde{\beta}_{ijmt} - \tilde{\alpha}_i p_{jmt} + \gamma_{mt} + \xi_{jmt} + \epsilon_{ijmt} = \delta_{ijmt} + \epsilon_{ijmt} \tag{3}$$

where $\tilde{\beta}_{ijmt}$ captures product preferences (which include sustainability feature preferences), $\tilde{\alpha}_i$ captures sensitivity to price, and γ_{mt} are retail chain×DMA×year-quarter fixed effects, capturing baseline differences in demand across markets. Utility from the outside good u_{i0mt} is normalized to have mean 0, and the error term ϵ_{ijmt} follows Type 1 Extreme Value distribution.

We further parameterize product preferences $\tilde{\beta}_{ijmt}$ as follows:

$$\tilde{\beta}_{ijmt} = \beta_{jry(t)} + \beta_{il} = \tilde{\beta}_{jmt} + \varepsilon_{ijmt} \tag{4}$$

where $\beta_{jry(t)}$ represents the preference in year $y(t)$ for product j in retailer chain r and β_{il} represents consumers' heterogeneous preferences for products with and without sustainability features.[22] We parametrize consumer-specific coefficients β_{il} and α_i as functions of

[21] A designated market area is a geographical designation of NielsenIQ and is typically comprised of a group of counties.

[22] We allow the product preferences to differ by retail chain, following literature on uniformity in pricing and assortment within (but not across) retailers (e.g., DellaVigna and Gentzkow 2019, Hitsch et al. 2021). Moreover, because the retailer footprint is geographically regional, our specification allows us to in part capture geographic variation in product provision considered in Bollinger et al. (2023).

observed demographics and unobserved consumer heterogeneity:

$$\beta_{il} = \beta_I \mathrm{D}_{it} + \beta_I^{\tilde{l}} \mathbb{1}\{\text{sustainability}_j\}\mathrm{D}_{it} \tag{5}$$

$$\tilde{\alpha}_i = \alpha + \sigma\nu_i \tag{6}$$

where D_{it} contains the observed demographics, $\nu_i \sim N(0,1)$ and $\mathbb{1}\{\text{sustainability}_j\}$ is an indicator for the presence of any sustainability features within product j. That is, $\beta_I^{\tilde{l}}$ captures the variation in preferences for products with sustainability features by household demographics. We focus on two observed demographics: household income (measured as the mid-point of the household income bin provided by NielsenIQ) and age (measured as the age of the oldest householder), as income may affect substitution patterns across products with and without sustainability features when such alternatives are differently priced, and age may affect the propensity to purchase new alternatives with sustainability features (Bronnenberg et al. 2022).

Market share of product j in market m in time t can be expressed as

$$s_{jmt} = \int_i \frac{\exp(\delta_{ijmt})}{1 + \sum_{k \in \mathcal{J}} \exp(\delta_{ikmt})} dF_i \tag{7}$$

We follow Döpper et al. (2022)'s approach in defining a market size that is proportional to the geographic market population and the number of retail stores operated by the chain within each market.[23]

4.2 Pricing Model

Each parent brand *pb* sets prices for all UPCs in its product line to maximize the brand-level profit within market m in time t.[24] We assume no substitution across geographical markets, which implies that within-market profit maximization leads to total profit maximization. We assume that brands face constant marginal costs in output, take competitors' prices

[23] See Appendix B.1 of Döpper et al. (2022) for the detailed description, which we follow closely.

[24] In focusing on own-brand profit maximization, we follow recent literature that finds that standard own-firm (vs. common owner) profit maximization to be more consistent with the data patterns in another consumer packaged goods category with significant common ownership (ready-to-eat cereal, Backus et al. 2021).

as given, and take the retail markup as part of their marginal costs (Döpper et al. 2022). The first order condition for pricing is:

$$s_{jmt} + \sum_{k \in J_t^{bm}} (p_{jmt} - c_{jmt}) \frac{\partial s_{jmt}}{\partial p_{kmt}} = 0 \tag{8}$$

where $\mathcal{J}_t^{bm}$ is the set of products that parent brand pb sells in market m at time t. We assume that the marginal cost c_{jmt} has the following components:

$$c_{jmt} = c_{jry(t)} + c_{my(t)} + c_t + \omega_{jmt} \tag{9}$$

where $c_{jry(t)}$ is the marginal cost of selling a product $j = (b, l)$ in retailer r in year $y(t)$. $c_{my(t)}$ and c_t are retail chain $\times$ DMA $\times$ year fixed effect and quarter fixed effect, respectively.

5 Estimation and Results

5.1 Estimation

Estimation Approach We estimate the model using the generalized method of moments, implemented with the `pyblp` package (Conlon and Gortmaker, 2020, Conlon and Gortmaker, 2023).

The GMM estimator for $\theta = (\beta_I, \beta_I^{\tilde{I}}, \alpha, \sigma)$ is

$$\hat{\theta} = \arg\min_{\theta} g(\theta)' W g(\theta), \qquad g(\theta) = \begin{bmatrix} g^D(\theta) \\ g^S(\theta) \\ g^M(\theta) \end{bmatrix} \tag{10}$$

where W is the weighting matrix and $g(\theta)$ collects the set of demand-side moments $g^D(\theta)$, supply-side moments $g^S(\theta)$ and "micro" moments $g^M(\theta)$. We formulate the demand and supply side moments $g^D(\theta) = \mathbb{E}[\xi_{jmt} Z_{jmt}^D]$ and $g^S(\theta) = \mathbb{E}[\omega_{jmt} Z_{jmt}^S]$, using demand and supply side instruments Z_{jmt}^D and Z_{jmt}^S described in detail below.

We supplement the aggregate demand- and supply-side moments with micro moments, which allow us to estimate heterogeneity in consumer demand for sustainability features. We use the demographics (income and age) of households that (1) purchase products with sustainability features and (2) pay a below mean price in the given market (retailer×DMA×year-quarter) as our micro moments for a given product category. Web Appendix C.1 describes in detail the construction of these moments.

Instruments We instrument for price using the price of the same product $j(b,l)$ averaged across all other markets (DMA-retailer chain) in the same year (a commonly used "Hausman" instrument as in Huang et al. (2022)). This instrument captures cost shifts that are common to all markets and should not reflect demand shocks that are specific to the focal market conditional on the included fixed effects[25]

We also use differentiation instrumental variables, as proposed by Gandhi and Houde, 2019, to help with the identification of the random coefficient on price. These instruments reflect how "differentiated" a given product j is in terms of the particular characteristic x_j. We use two product attributes to construct these instruments: (1) predicted prices calculated based on the Hausman instrument described above and (2) whether or not the product has a sustainability feature. To help with the identification of the observed heterogeneity parameters, we also construct another set of instruments by interacting the price and sustainability feature differentiation IVs described above with the mean demographics of a given market.

Finally, we incorporate supply-side cost shifters, which reflect the quarterly changes in production and packaging costs for the in-sample health and beauty product categories. To measure these changes in input costs, we use producer price indexes obtained from the Federal Reserve Economic Database maintained by the St. Louis Fed (see Web Appendix C.2).

[25]Hitsch et al., 2021 find that a substantial portion of price variation is explained by retail chain-market (ZIP3) factors, suggesting that demand shocks in a given retailer in other DMAs should not be related to pricing at this retailer in the focal DMA.

Estimation Sample In our estimation, we restrict our attention to the 32 DMAs with at least 500 NielsenIQ household panel members in each of the sample years in order to (1) avoid over-generalizing from markets with too few panelists and (2) retain a manageable estimation sample size.

We estimate the model separately by category and restrict our attention to the six categories for which the estimation is successful at recovering price elasticities within the reasonable range (mean price elasticity at or below -1): Deodorant, Shampoo, Conditioner, Hair Preparations, Hair Spray, and Oral Rinse. Figure A.1 shows that this set of product categories has a higher average revenue than the average top 20 Health & Beauty Care category and, importantly, covers the full range of baseline levels of sustainable product market shares and their over-time growth rates. Table 11 further shows that the six selected product categories cover the full range of sustainability price premia and discounts discussed in Section 3. We take this as evidence that our sample is not biased towards any specific sustainability feature patterns and retains a representative set of Health & Beauty Care product categories.[26]

The resulting estimation sample has 1,744 unique products, 8,062 unique product-year pairs, 133,004 unique product-retail chain-year combinations, and 1,417,046 unique product-market (retail chain-DMA)-year-quarters across the six product categories.

5.2 Estimation Results

Estimates for Products with and without Sustainability Features After confirming that the category-specific own price elasticities align with those reported in the literature (see Web Appendix D.1), we focus our discussion on the differences in the estimated parameters between products with and without sustainability features, and how these differences vary by brand size. To ensure comparability across categories, we standardize each set of the estimated parameters (preferences $\widehat{\widetilde{\beta}}_{jmt}$ and marginal costs $\widehat{c}_{jmt}$) to mean 0 and variance 1 in a given product category. Next, we calculate the average parameter estimates based on the presence of sustainability features at the category-year

[26]Most of the top 20 Health & Beauty Care categories would similarly be excluded based on selection criteria used in other large-scale, multi-category estimation studies (Döpper et al. 2022, Brand 2021).

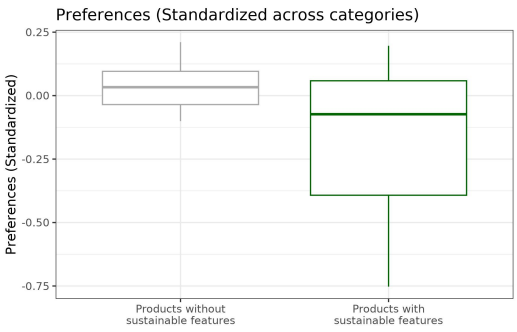
level (and for some summary plots, by brand size), and plot the distribution of those category-year averages. This approach assigns equal weight to estimates from each product category, rather than giving more weight to categories with a larger number of unique products.

Figure 2a shows that preferences ($\widehat{\widehat{\beta}}_{jmt}$ from Equation 4) for products with sustainability features are consistently lower than preferences for products without. Figure 2b suggests that this difference stems from the gap in preferences for large brands' products: preferences are the highest for large brands' products without sustainability features, while their products with sustainability features exhibit niche appeal similar to fringe brands' offerings. In contrast, we find no substantial difference in preferences between fringe brands' products with and without sustainability features (Figure 2b, right panel).

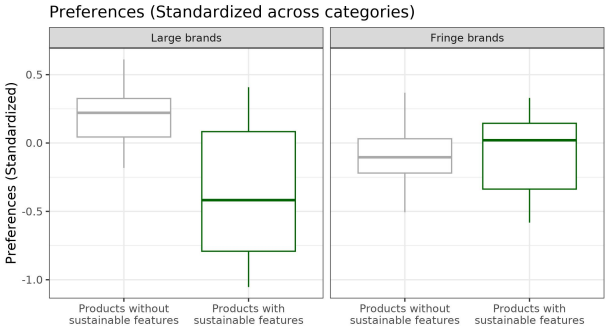
Figure 3 reveals that, in our empirical context, products with sustainability features are not always associated with less price elastic demand. In the case of fringe brands, products with sustainability features have *less* elastic demand than those without (Figure 3b, right), which aligns with existing literature (Zhu et al. 2023, Bollinger et al. 2023). However, the pattern reverses for large brands: products with sustainability features face *more* price elastic demand than their non-sustainable counterparts (Figure 3b, left).

Figure 4 shows that the recovered marginal costs also demonstrate diverging patterns by brand size: large brands' products with sustainability features cluster at the lower end of the cost distribution, while fringe brands' products occupy the higher end (Figure 4b). Notably, similarly to the price elasticity patterns, large brands' products with sustainability features have a lower median marginal cost than their non-sustainable counterparts, whereas sustainability features are associated with higher costs for fringe brands.

We interpret the recovered marginal costs as indicative of the producers' efficiencies of scale as well as their choices of product quality. We view the lower marginal costs of large brands' products with sustainability features – and the higher costs of fringe brands – as reflecting the brands' decision to set the overall product quality for items with sustainability features. To further assess whether the variation in the recovered marginal costs supports this interpretation, we conduct a set of validation checks in Web Appendix D.2, using additional product and market characteristics not used in estimation. This

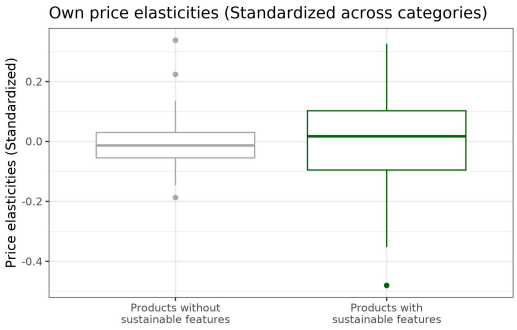


(a) All brands

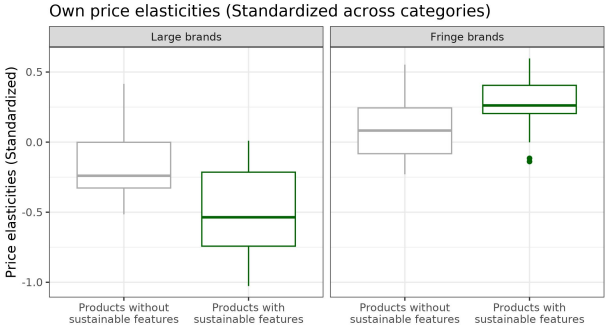


(b) By brand type

Figure 2: Preferences for products with and without sustainability features

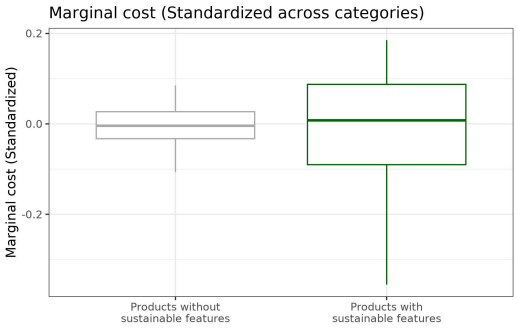


(a) All brands

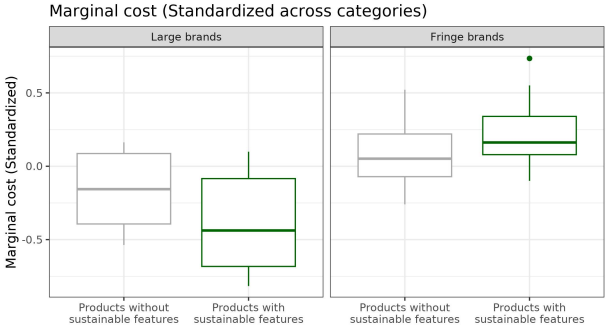


(b) By brand type

Figure 3: Price elasticities by brand type and sustainability feature



(a) All brands



(b) By brand type

Figure 4: Marginal costs of products with and without sustainability features

supplementary analysis provides supporting evidence that the marginal cost estimates capture meaningful differences across brands and products rather than being mechanical artifacts of the model.

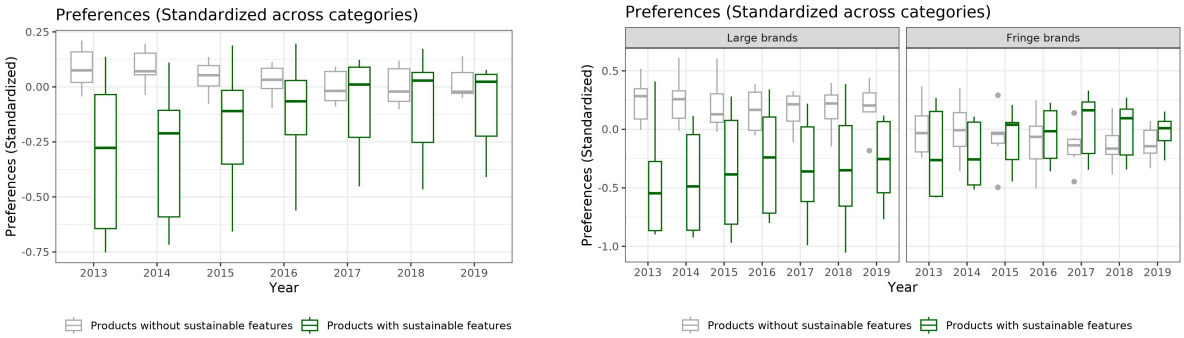
Over-Time Trends Next, we investigate changes in preferences, price elasticities, and marginal costs over time, applying the same averaging approach as in Figures 2-4 for each year.

We find a substantial increase in preference for products with sustainability features (Figure 5a), seen in large and fringe brands (Figure 5b). By 2019, consumers prefer the median product with sustainability features from fringe brands over those without. However, despite this upward trend, large brands face much lower preferences for their products with sustainability features compared to their products without, which maintain consistently high preferences over time. Marginal costs of products with sustainability features have also slightly increased (Figure 7a), but price elasticities show rather stable patterns without distinct over-time trends (Figure 6a). These over-time trends align with the growing sustainability price premium we document in Section 3.2 (Table 4a). Importantly, the disparity between large and fringe brands in terms of preferences, marginal costs, and price elasticity for sustainable products persists regardless of the time trends (Figure 5b, 6b, and 7b).[27]

Summary and Discussion Our estimation results reveal the overall growth in consumer preferences for sustainability features but with significant differences in preferences, price elasticities, and marginal costs across brands. For large brands, on average, products with sustainability features are associated with lower preferences, more elastic demand, and lower marginal costs than products without sustainability features. For fringe brands, products with sustainability features are associated with higher preferences, less elastic demand, and higher marginal costs than products without sustainability features.

Consistent with the descriptive analysis results in Section 3, without regulations, the market exhibits a sorting equilibrium in which large brands offer lower-preference, lower-cost products with sustainability features that face more elastic demand, while fringe brands offer higher-preference, higher-cost products with sustainability features that face less elastic demand. Although products with sustainability features experience an overall

[27]Web Appendix F further shows that this gap extends to markups associated with sustainability features (with only fringe brands charging higher markups on products with such features), reinforcing the consistent differences between large and fringe brands.



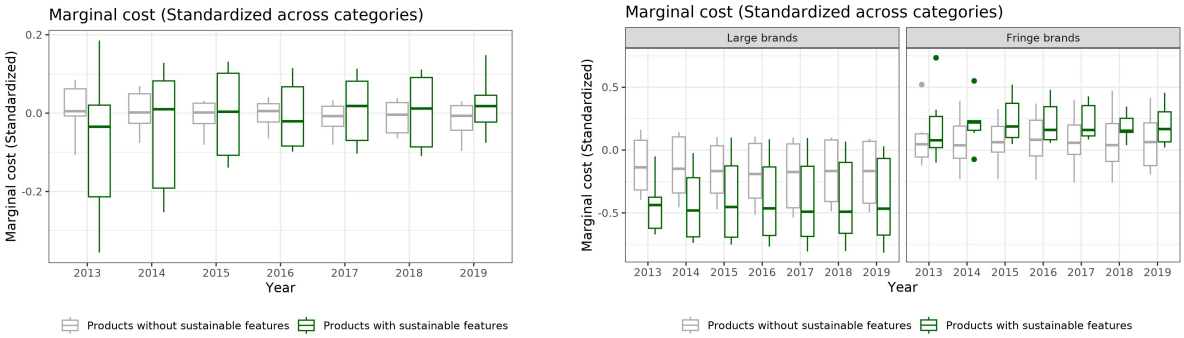
(a) All brands (b) By brand type

Figure 5: Preferences of products with and without sustainability features by year



(a) All brands (b) By brand type

Figure 6: Price elasticities of products with and without sustainability features by year



(a) All brands (b) By brand type

Figure 7: Marginal costs of products with and without sustainability features by year

increase in preferences over time, the gap between large and fringe brands still persists.

The results provide additional insights into potential drivers of this equilibrium that the descriptive findings alone do not reveal. The estimates indicate that products with sustainability features from large brands have significantly lower marginal costs than those

from fringe brands, ruling out cost differences as a reason for the brands' different sustainability strategies. The lower consumer preference for large brands' products with sustainability features compared to those without suggests that the weaker provision of sustainable features by large brands is driven by demand-side factors.

6 What Explains Sustainability in Equilibrium?

In this section, we explore possible explanations for the equilibrium outcome, in which large and fringe brands provide different types of sustainable products at different prices. This analysis helps us to better understand 1) how much sustainability influences consumer purchase decisions, revealing the extent to which consumers treat it as a private benefit, and 2) the incentives and disincentives that large and fringe brands face in offering and pricing products with sustainability features, providing insights into both managerial and policy implications.

We first examine the relative importance of sustainability features compared to other product attributes in driving consumer demand. We then explore whether consumer demand is stronger for particular sustainability feature arrangements. Finally, we discuss how the recovered importance of sustainability features and sustainability feature arrangement explains firms' incentives to provide sustainability in equilibrium.

6.1 Importance of Sustainability in Consumer Demand

To assess the weight consumers place on sustainability features in their purchase decisions, we analyze the contribution of sustainability features, compared to other non-sustainable product attributes, to the estimated preference and price elasticity parameters. We regress the standardized category(k)-product-market-year demand parameters ($\widehat{\theta}_{kjmt}$) on an incrementally expanding set of sustainable and non-sustainable product attributes (X_{kj}), controlling for category-market-year fixed effects ($\Phi_{kmy(t)}$):

$$\widehat{\theta}_{kjmt} = \phi X_{kj} + \Phi_{kmy(t)} + \nu_{kjrmt} \quad \text{for } \widehat{\theta}_{kjmt} \in \{\widehat{\widehat{\beta}}_{kjmt}, \widehat{\eta}_{kjmt}\} \tag{11}$$

Table 5: Product Features Predicting Preferences for Products: Regression Results

Dependent Variable:	Estimated preferences (standardized)								Elasticities (standardized)
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fringe brands	-0.038***	-0.163***	-0.051***	0.011***	-0.033***	-0.142***			
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)			
Sustainable	-0.021***								
	(0.002)								
Sustainable × Large		-0.270***	-0.006	-0.198***	-0.029***	0.022***	-0.235***	-0.025***	-0.099***
		(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.005)	(0.0022)
Sustainable × Fringe		0.096***	0.227***	0.038***	0.154***	0.149***	-0.008**	0.120***	0.060***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.0018)
Top 2 manufacturers						0.178***	0.217***	0.178***	0.038***
						(0.004)	(0.012)	(0.012)	(0.005)
Top 10 manufacturers						0.263***	0.050***	0.091***	-0.001
						(0.004)	(0.010)	(0.011)	(0.005)
Marginal cost						0.502***	0.484***	0.540***	0.732***
						(0.004)	(0.005)	(0.006)	(0.006)
Fixed effects:									
Category									
×Market×Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
×Product Size			Yes		Yes	Yes		Yes	Yes
×Ingredients				Yes	Yes	Yes		Yes	Yes
×Parent brand							Yes	Yes	Yes
Observations	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223
R^2	0.003	0.009	0.379	0.387	0.494	0.557	0.426	0.633	0.850
Adjusted R^2	-0.002	0.004	0.376	0.384	0.491	0.555	0.423	0.630	0.849

Clustered (Market-level) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

where $\widehat{\widehat{\beta}}_{jmt}$ (defined in Equation 4) and $\widehat{\eta}_{jmt}$ are the estimated product-market-quarter level preference and price elasticity, respectively.

We then examine how the correlation between sustainability features and preference parameters changes as we control for this expanding set of non-sustainable attributes (including package size, formulation ingredients, marginal cost, manufacturer, and parent brand). If demand for products with sustainability features is fully explained by these co-occurring attributes rather than by the sustainability features themselves, the regression coefficient for sustainability features should diminish and become statistically insignificant as more non-sustainable characteristics are controlled for. Additionally, the largest increases in R^2 values would result from adding non-sustainable product attributes.

Table 5 shows that sustainability features alone have limited explanatory power for consumer preferences, with non-sustainable product attributes accounting for a much larger portion of the variation in preferences. The R^2 measures are low when only sustainability feature variables are included in the regression (Columns (1) and (2)) but increase substantially when other non-sustainable product attributes, such as product size, ingredients, or parent brand are added.[28] Additionally, the correlation between sustainability features

[28]Supplementary analysis in Web Appendix E further confirms this finding using analysis of individual at-

and preferences (the coefficients on Sustainable× Large and Sustainable× Fringe) changes in magnitude and even in its sign as we include more non-sustainable attributes. The negative and statistically significant coefficient of sustainability features from large brands (Sustainable × Large) in Column (2) becomes statistically insignificant and small with the inclusion of product package size controls in Column (3), decreasing even further when ingredients and marginal cost are added (Column (6)). These results indicate that the negative preference for large brands' products with sustainability features can be largely explained by less popular package sizes, lower marginal cost products, and less preferred ingredients that co-occur with sustainability features. In the case of fringe brands, the correlation (Sustainable × Fringe) stays statistically significant and positive across nearly all specifications, which increases the most with product size fixed effects (Column (3)) and drops the most with parent brand fixed effects (Column (7)). These results suggest that among fringe brands, sustainability features are often bundled with less popular sizes and more popular brands. We find similar changes in the correlation between sustainability features and price elasticities with the inclusion of non-sustainable attributes (Table 12).

In summary, we find that sustainability features are not a primary factor in consumer choices. Much of the variation in demand for products with sustainability features can be attributed to co-occurring non-sustainable attributes, and average consumers show marginal but statistically significant disutility from sustainability features of large brands. These patterns imply that sustainability features offer minimal private benefits to consumers.

Collectively, these results provide large-scale empirical evidence that sustainability influences consumer demand as a blend of both a public and private good, but remains only a marginal driver of consumer purchases. Nevertheless, sustainability features of fringe brands exhibit a more pronounced and statistically significant positive correlation with consumer preferences, suggesting that sustainability can act more like a significant private benefit to consumers when aligned with specific characteristics. We further explore this heterogeneity in the following subsection.

tribute contribution to the R^2 measures and a variance decomposition analysis.

6.2 Determinants of Demand for Sustainability

Although sustainability features play a relatively minor role in consumer demand, differences in the estimated preferences for sustainability features between large and fringe brands persist even after controlling for the full set of non-sustainable product attributes (Table 5, Column (8)). Motivated by this observation, we explore whether certain sustainability feature arrangements (e.g., certification status, specific sustainability causes supported by the feature, a parent brand's sustainability provision) help explain the variation in preferences for sustainability features across brands.

We consider three different dimensions of sustainability feature arrangements: 1) the specific cause supported by sustainability features (product level), such as no animal cruelty or reduced plastic usage; 2) the third-party certification status (Third-party-certified $\in$ [0,1]) of the sustainability features (product level), capturing the share of UPCs with certified features within a product (e.g., B-corporation, Terracycle, Forest Stewardship Council); and 3) the overall commitment to sustainability (parent brand level) reflected in its product portfolio (%Sustainability-featured products $\in [0, 1]$), ranging from exclusively sustainable products to a mix of products with and without sustainability features. These dimensions may reflect different consumer preferences (e.g., some may prioritize animal welfare over reduced plastic usage) or influence perceptions of the authenticity of sustainability efforts (e.g., consumers may view certified products and brands with a stronger commitment to sustainable product lines as more authentic). We include a detailed discussion of the construction of these measures and their prevalence among large and fringe brands in Web Appendix G.

Table 6 shows the regression results. Columns (1) and (2) replicate the differences in sustainability feature preferences by brand size in Columns (2) and (8) in Table 5. The remaining columns highlight sustainability feature arrangements that help explain the differences. Two patterns are noticeable. First, when all other non-sustainable attributes are controlled for, the animal welfare-related sustainability feature has the largest positive coefficient and the packaging-related feature has the smallest coefficient (Column (4)). This implies that consumer preferences for sustainability features vary depending on the cause

Table 6: Factors Predicting Preferences for Sustainability Features: Regression Results

Dependent Variable:	Estimated preferences (standardized)								
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Brand Size									
Sustainable									
× Large brands	-0.270***	-0.025***	-0.321***	-0.073***	-0.357***	-0.028***	-0.281***	-0.052***	-0.089***
	(0.003)	(0.005)	(0.005)	(0.006)	(0.003)	(0.005)	(0.003)	(0.005)	(0.007)
× Fringe brands	0.096***	0.120***	0.074***	0.050***	0.077***	0.120***	0.080***	0.083***	0.029***
	(0.003)	(0.004)	(0.004)	(0.005)	(0.003)	(0.004)	(0.004)	(0.005)	(0.006)
Sustainability Type									
Animal welfare			-0.011***	0.095***					0.087***
			(0.004)	(0.005)					(0.005)
Sustainable packaging			-0.018***	0.033***					0.027***
			(0.004)	(0.005)					(0.005)
Other			0.274***	0.043***					0.043***
			(0.004)	(0.006)					(0.006)
By Certification Status									
Sustainable									
× Third-party-certified					0.406***	0.028**			-0.005
					(0.004)	(0.011)			(0.012)
Brand-level Commitment									
Sustainable									
× %Sustainability-featured							0.021***	0.098***	0.072***
							(0.005)	(0.011)	(0.011)
Other control variables									
Fringe brands	-0.163***		-0.162***		-0.160***		-0.163***		
	(0.003)		(0.003)		(0.003)		(0.003)		
Top 2 manufacturers		0.178***		0.178***		0.177***		0.178***	0.178***
		(0.012)		(0.012)		(0.012)		(0.012)	(0.012)
Top 10 manufacturers		0.091***		0.092***		0.090***		0.091***	0.092***
		(0.011)		(0.011)		(0.011)		(0.011)	(0.011)
Marginal cost		0.540***		0.541***		0.540***		0.541***	0.541***
		(0.008)		(0.008)		(0.008)		(0.008)	(0.008)
Fixed effects:									
Category									
×Market×Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
×Product Size		Yes		Yes		Yes		Yes	Yes
×Ingredients		Yes		Yes		Yes		Yes	Yes
×Parent Brand		Yes		Yes		Yes		Yes	Yes
Observations	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223
R^2	0.00921	0.63261	0.01320	0.63273	0.01392	0.63261	0.00923	0.63265	0.63275
Adjusted R^2	0.00446	0.63038	0.00846	0.63049	0.00919	0.63038	0.00448	0.63041	0.63051

Clustered (Market-level) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

these features support. Second, preferences for sustainability features are significantly higher when the product has certified sustainability features ((Column (5)) and the parent brands show a higher level of commitment to sustainability feature provision (Column (7)).

Table 6 also reveals that fundamental differences may exist in consumer perceptions of large and fringe brands' products with sustainability features that are not explained by observed product characteristics. Although the gap in preference between large brands' sustainability features (Sustainable × Large) and fringe brands' sustainability features (Sustainable × Fringe) narrows when additional variables on sustainability feature arrangements are included, it remains statistically significant across all specifications, including the most comprehensive model with the full set of observed sustainable and non-sustainable product characteristics (Column (9)). A similar gap is found in price elasticities (Table 12). This persistent difference suggests that consumer perception of sustainability features

may differ depending on whether they are offered by fringe brands or historically dominant brands, possibly due to the beliefs that smaller brands are more authentic (Woolley et al. 2023).

In summary, we find that sustainability provides greater utility to consumers when specific types of sustainability features are aligned with particular brand characteristics. In particular, preferences for sustainability features are strongly and positively correlated with the types of sustainability causes that these features support, the presence of certification, and the commitment of the parent brand to providing only products with sustainability features. These correlations largely persist and sometimes are strengthened after accounting for other co-occurring non-sustainable product attributes. Even after controlling for these specific dimensions of sustainability features and a rich set of other non-sustainable product characteristics, consumer preferences for sustainability features remain stronger for fringe brands than for large brands. This suggests potential differences in consumer perception of sustainability features that are inherent to brand sizes.

6.3 Implications for Supply of Sustainability in Equilibrium

Our estimation results provide a consistent explanation for the heterogeneous supply of products with sustainability features documented in Section 3.1 and Section 5.2. On the one hand, consumers' relatively low emphasis on sustainability features in their purchase decisions implies that, similar to the public goods case, large brands with high brand equity have little incentive to widely incorporate these features into their product lines in the absence of regulations. If at all, a small subset of lower-cost sustainable products (Figure 1, Figure 4b, Table F.1) may enable large brands to satisfy demands for sustainability from stakeholders other than consumers. On the other hand, this lack of incentive for large brands offers an opportunity for entry for fringe brands; fringe brands can use sustainability features as points of differentiation and attract niche, price-inelastic demand, which results in high prevalence of products with sustainability features among fringe brands (Figure 1, Figure 3(b), Table 12). Supporting this interpretation, we find that fringe brands are more likely to launch products with sustainability features in more concentrated product

categories (Table 13).

Our results also highlight cases in which sustainability offers more substantial private benefits to consumers. Consumers' stronger preferences for specific arrangements of sustainability features – arrangements that fringe brands are likely to find relatively less costly to provide – suggest that sustainability provides larger private benefits to consumers in these cases and helps explain the observed differences in the sustainability offerings between large and fringe brands. In our empirical context, estimated preferences for products with sustainability features are higher when the features concern animal welfare (rather than environmental packaging), are third-party certified, and come from parent brands committed to providing such features across their entire product lines. Given that 1) large brands' extensive product lines make a brand-level commitment to sustainability more challenging and 2) their established formulations may require significant changes to ensure animal cruelty-free production,[29] our results indicate that large brands may face higher barriers to incorporating sustainability features most preferred by consumers. Finally, the persistent gap in consumer preferences for large versus fringe brands with sustainability features, even after accounting for differences in those features, suggests that the dominant brand identity itself may affect consumer perception of sustainability features and deter consumers from purchasing sustainable alternatives of large brands. Consistent with the presence of such predicted frictions, we find that multi-brand manufacturers choose to provide sustainability features not through their established large brands but through their fringe brands, particularly when it comes to animal welfare features (Figure 9).

7 Marketing and Policy Implications

In this section, we discuss policy and marketing implications based on our findings. While evaluating the social optimality of sustainability-related policies is beyond the scope of this paper, our findings offer a new perspective on the hybrid nature of sustainability, which exhibits characteristics of both public and private goods, highlighting the potential

[29]Figure 8 reveals that – across both large and fringe brands – products with animal welfare features have the most distinct ingredients, compared to large brands' products without sustainability features. This suggests that incorporating animal welfare features may require firms to adjust their product formulations.

effectiveness of regulations with nuanced implications for regulatory design.

Policy Implications We provide large-scale empirical evidence that consumer demand alone does not sufficiently drive suppliers to voluntarily invest in sustainable production as consumers do not prioritize sustainability features in their purchase decisions. A recent survey report by Kantar shows that, despite heightened interest in sustainability, 82% of consumers in Europe prioritize their finances and day-to-day needs over making sustainable purchases, and 61% believe that sustainability is the responsibility of businesses, not consumers (Kantar, 2022). Consistent with these stated preferences, we find that consumers' product choices are minimally influenced by the presence of sustainability features, indicating that consumer demand alone is not a sufficiently strong force to achieve high levels of sustainability in the consumer packaged goods (CPG) market without enforced policy intervention.

These results suggest that policies should approach sustainability more like a public good, which both consumers and firms have weak incentives to promote. As many sustainability-related regulations are based on the premise that consumers prefer sustainable products (European Commission 2024) and aim to "empower consumers to contribute actively to the green transition" (European Commission 2023), our empirical results raise caution about this assumption and invite additional efforts to promote the importance of sustainability in consumers' everyday purchase decisions. Instead of relying on the assumed interest among consumers, policies should consider how to increase the importance consumers place on sustainability features in their purchase decisions to foster the growth of sustainable markets.

Our results offer relevant information to two types of policies targeting consumer choices: information interventions (e.g., clear labeling standards) and pricing interventions (e.g., tax on non-sustainable products). First, establishing clear labeling standards for sustainability features could boost demand by making these features more prominent in consumer decisions. Past literature shows mixed evidence on the effectiveness of consumer-facing information interventions in encouraging sustainable consumption, which varies with the types of information provided, the way it is delivered, and other psycholog-

ical factors that are context-specific (Allcott and Rogers 2014, Berkouwer and Dean 2022, Brecko and Hartmann 2023, White et al. 2019). We demonstrate that, in our case, third-party certification increases both consumer preferences for sustainability features and their influence on purchase decisions (Table 6, Column (5)), indicating the potential effectiveness of this particular information intervention. Second, pricing interventions like taxes on non-sustainable goods should be approached with caution. In our context, higher-income households show stronger preferences for sustainability features (Table 10), suggesting that tax and subsidy policies may have unintended distributional consequences.

Our results also suggest the potential to stimulate sustainable markets through firm-side policies with nuanced implications. We discuss these findings in the context of sustainable production mandates, which have recently gained traction among policymakers. Our findings indicate that such mandates could effectively promote sustainability, given that they resemble a public good more closely than a significant private benefit to consumers. Second, our results suggest that nationwide sustainable production mandates may have varying impacts on consumers. On the one hand, the average consumer's lack of focus on sustainability features will likely drive the majority of suppliers to continue competing on price and other product attributes, while simultaneously incorporating more sustainability features to comply with mandates. This approach may steer the market toward greater sustainability without causing substantial distortions. On the other hand, because sustainability features provide a significant point of differentiation for fringe brands in an unregulated market, these mandates may alter the degree of differentiation, competition, and pricing dynamics.

Importantly, we highlight the need for regulations to consider the varying incentives and costs of sustainability features between large and fringe suppliers. Our findings indicate that, in addition to facing lower average preference for their products with sustainability features, large brands may incur higher relative costs when incorporating consumer-preferred sustainability features. Since large established brands dominate the market share in consumer packaged goods categories, effective regulations promoting sustainable production must provide adequate incentives for these major brands to adopt sustainable practices.

Marketing Implications Our findings offer important marketing implications for brands. First, sustainability is not a priority for the average consumer, which suggests that brands should be mindful of the trade-offs when placing sustainability information at the forefront of their marketing messages. Second, not all sustainability causes are perceived equally by consumers, and brands should be aware of their consumers' cause-specific preferences. In our empirical context, consumers show significantly higher preferences for animal welfare-related features over environmental packaging features. To our knowledge, this is the first large-scale empirical documentation of heterogeneous preferences for different dimensions of sustainability in a real purchase setting, highlighting the need for brand and marketing managers' understanding of such heterogeneity for optimal product design and marketing communications. Third, consumers discount sustainability features if the features are present only within a subset – not all – of a brand's products. This finding aligns with the explanation that consumers place higher value on sustainability features from brands with a greater commitment to sustainable production. Marketing a fully sustainable brand can be more effective at capturing sustainable demand than simply adding sustainability features to some of the products of an existing brand's product line. Consistent with this prediction, our supplementary analysis of manufacturer data shows that large manufacturers with multiple brands are more likely to launch or acquire new, fully sustainable brands than to add products with sustainability features to their existing established brands (Figure 9). Finally, consumers prefer sustainability features with third-party certification. This result suggests that brands can consider certification as an effective tool to increase the demand for their sustainable products.

8 Conclusion

In this paper, we document sustainability's unique position between a public good and a private benefit, as evidenced by consumer preferences for sustainability and the resulting systematic heterogeneity in the supply of sustainable products across large and fringe brands. Despite the rising interest in sustainability, not all brands equally provide sustainable products due to the low importance that sustainability has in consumer purchases: on

average, large brands offer low-cost, low-preference products with sustainability features at lower prices, while fringe brands provide high-cost, high-preference products with such features at higher prices. Consumers' sensitivity to certain sustainability feature arrangements, coupled with their low prioritization of sustainability features during purchases, explains the observed sorting equilibrium. The results offer implications for marketing strategies and public policies promoting sustainability and open further discussion on their effective design.

References

Allcott, H., & Rogers, T. (2014). The short-run and long-run effects of behavioral interventions: Experimental evidence from energy conservation. *American Economic Review*, *104*(10), 3003–3037.

Amaldoss, W., & Prusty, S. (2023). Sustainable consumption: A strategic analysis. *SSRN*. https://doi.org/10.2139/ssrn.4512307

Andreoni, J. (1990). Impure altruism and donations to public goods: A theory of warm-glow giving. *The economic journal*, *100*(401), 464–477.

Backus, M., Conlon, C., & Sinkinson, M. (2021). Common ownership and competition in the ready-to-eat cereal industry. *National Bureau of Economic Research, No. w28350*.

Bennett, G., & Williams, F. (2011). Mainstream green: Moving sustainability from niche to normal. *The Red Papers by Ogilvy & Mather*.

Berkouwer, S. B., & Dean, J. T. (2022). Credit, attention, and externalities in the adoption of energy efficient technologies by low-income households. *American Economic Review*, *112*(10), 3291–3330.

Bollinger, B., Kronthal-Sacco, R., & Zhu, L. (2023). Sustainable product demand and profit potential. *SSRN 4546321*.

Boston Consulting Group. (2023). *Less than 7% of consumers pay a premium for sustainable products and services today, but 40% could be convinced to make sustainable choices*. Retrieved October 2, 2024, from https://www.bcg.com/press/13september2022-consumers-sustainable-choices

Brand, J. (2021). Differences in differentiation: Rising variety and markups in retail food stores. *SSRN 3712513*.

Brecko, K., & Hartmann, W. R. (2023). Marketing and economics of harm reduction: Evidence from conservation field experiments. *SSRN 4143753*.

Bronnenberg, B., Dubé, J.-P., Gentzkow, M., & Shapiro, J. M. (2015). Do pharmacists buy bayer? informed shoppers and the brand premium. *The Quarterly Journal of Economics*, *130*(4), 1669–1726.

Bronnenberg, B., Dubé, J.-P., & Joo, J. (2022). Millennials and the takeoff of craft brands: Preference formation in the us beer industry. *Marketing Science*, *41*(4), 710–732.

Bronnenberg, B., Dubé, J.-P. H., & Gentzkow, M. (2012). The evolution of brand preferences: Evidence from consumer migration. *American Economic Review*, *102*(6), 2472–2508.

Bronnenberg, B., T. H. T. Bui, B. D., Haerkens, L., Knox, G., van Lin, A., Pachali, M. J., Paley, A., Smith, R., & St abler, S. (2024). Tracking the Environmental Costs of Household Grocery Purchases. *SSRN Working paper 4687177*.

BusinessWire. (2021). *Recent study reveals more than a third of global consumers are willing to pay more for sustainability as demand grows for environmentally-friendly alternatives* (tech. rep.) [Accessed on Nov 1, 2023]. https://www.businesswire.com/news/home/20211014005090/en/Recent-Study-Reveals-More-Than-a-Third-of-Global-Consumers-Are-Willing-to-Pay-More-for-Sustainability-as-Demand-Grows-for-Environmentally-Friendly-Alternatives

Cohen, W. M., & Klepper, S. (1996). Firm size and the nature of innovation within industries: The case of process and product r&d. *The review of Economics and Statistics*, *May*(401), 232–243.

Conlon, C., & Gortmaker, J. (2020). Best practices for differentiated products demand estimation with PyBLP. *The RAND Journal of Economics*, *51*(4), 1108–1161. https://doi.org/https://doi.org/10.1111/1756-2171.12352

Conlon, C., & Gortmaker, J. (2023). Incorporating micro data into differentiated products demand estimation with pyblp. *National Bureau of Economic Research, No. w31605*.

Cornes, R., & Sandler, T. (1996). *The theory of externalities, public goods, and club goods*. Cambridge University Press.

DellaVigna, S., & Gentzkow, M. (2019). Uniform pricing in US retail chains. *The Quarterly Journal of Economics*, *134*(4), 2011–2084.

Devevey, F., Ferguson, M., Burks, B., Bendersky, C., Gorce, N. D. L., Wright, H., Wilkins, M., & de Longevialle, B. (2020). *The ESG Risk Atlas: Sector And Regional Rationales And Scores* (tech. rep.). S&P Global Ratings. Retrieved July 31, 2024, from https://www.spglobal.com/_assets/documents/ratings/esg/analytical-approach-esg-17-june-2020.pdf

Döpper, H., MacKay, A., Miller, N., & Stiebale, J. (2022). Rising markups and the role of consumer preferences. *Harvard Business School Strategy Unit Working Paper 22-025*.

Eizenberg, A., & Salvo, A. (2015). The rise of fringe competitors in the wake of an emerging middle class: An empirical analysis. *American Economic Journal: Applied Economics*, *7*(3), 85–122.

EPA. (2023). *Learn about sustainability* (tech. rep.). United States Environmental Protection Agency. Retrieved May 29, 2024, from https://www.epa.gov/sustainability/learn-about-sustainability

European Commission. (2023). Proposal for a directive of the european parliament and of the council on substantiation and communication of explicit environmental claims (green claims directive).

European Commission. (2024). *Circular economy: Commission proposes new consumer rights and a ban on greenwashing*. Retrieved July 30, 2024, from https://ec.europa.eu/commission/presscorner/detail/en/ip_22_2098

Galgiani, S. C. (2018). California Cruelty-Free Cosmetics Act, California Senate Bill No. 1249. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1249

Gandhi, A., & Houde, J.-F. (2019). Measuring substitution patterns in differentiated-products industries. *NBER working paper*, (w26375).

Gillingham, K. T., & Bollinger, B. (2021). Social learning and solar photovoltaic adoption. *Management Science*, *67*(11), 7091–7112.

Griskevicius, V., Tybur, J. M., & den Bergh, B. V. (2010). Going green to be seen: Status, reputation, and conspicuous conservation. *Journal of personality and social psychology*, *98*(3), 392.

Harbaugh, R., Maxwell, J. W., & Roussillon, B. (2011). Label confusion: The groucho effect of uncertain standards. *Management Science*, *57*(9), 1512–1527. https://doi.org/10.1287/mnsc.1110.1412

Hitsch, G. J., Hortacsu, A., & Lin, X. (2021). Prices and promotions in us retail markets. *Quantitative Marketing and Economics*, *19*, 1–80.

Huang, Y., Ellickson, P. B., & Lovett, M. J. (2022). Learning to set prices. *Journal of Marketing Research*, *59*(2), 411–434.

Kantar. (2022). *Sustainability: The european story*. https://www.kantar.com/campaigns/sustainability-the-european-story

Klemeš, J. J. (2015). *Assessing and measuring environmental impact and sustainability*. Butterworth-Heinemann.

Korganbekova, M., Korganbekova, A., Khazaeni, Y., & Zuber, C. (2024). Assessing the environmental impact of fast shipping: Towards sustainable ranking solutions. *Working paper*.

Kotschedoff, M., Pachali, M. J., & Rao, A. (2024). Animal welfare labels and consumer demand. *SSRN Working paper 4887912*.

Kronthal-Sacco, R., Van Holt, T., Atz, U., & Whelan, T. (2020). Sustainable purchasing patterns and consumer responsiveness to sustainability marketing messages. *Journal of Sustainability Research*, *2*(2).

Leverette, M. M. (2022). *The history of tide laundry detergent through the decades*. Retrieved October 9, 2024, from https://www.thespruce.com/tide-laundry-detergent-through-the-decades-2146627

Luchs, M. G., Naylor, R. W., Irwin, J. R., & Raghunathan, R. (2010). The sustainability liability: Potential negative effects of ethicality on product preference. *Journal of Marketing*, *74*(5), 18–31.

McKinsey & Company & Nielsen IQ. (2023). *Consumers care about sustainability – and back it up with their wallets*. Retrieved October 2, 2024, from https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/consumers-care-about-sustainability-and-back-it-up-with-their-wallets#/

Meier, J.-M., Servaes, H., Wei, J., & Xiao, S. C. (2023). Do consumers care about esg? evidence from barcode-level sales data. *Evidence from Barcode-Level Sales Data (July 24, 2023). European Corporate Governance Institute–Finance Working Paper*, (926).

Moshary, S., Tuchman, A., & Vajravelu, N. (2023). Gender-based pricing in consumer packaged goods: A pink tax? *Marketing Science*.

Neiman, B., & Vavra, J. (2023). The rise of niche consumption. *American Economic Journal: Macroeconomics*, *15*(3), 224–264.

Rao, A., & Ursu, R. (2023). The impact of voluntary labeling. *SSRN*. https://doi.org/10.2139/ssrn.4476545

Samuelson, P. A. (1954). The pure theory of public expenditure. *The review of economics and statistics*, 387–389.

Tyson, A., & Kennedy, B. (2020). *Two-thirds of americans think government should do more on climate*. Retrieved October 3, 2024, from https://www.pewresearch.org/science/2020/06/23/two-thirds-of-americans-think-government-should-do-more-on-climate/

United Nations. (2024). *Sustainability*. Retrieved July 29, 2024, from https://www.un.org/en/academic-impact/sustainability

U.S. Bureau of Labor Statistics. (2024). Consumer Price Index for All Urban Consumers: All Items Less Food and Energy in U.S. City Average [CPILFESL]. https://fred.stlouisfed.org/series/CPILFESL,%20January%2017,%202024

White, K., Habib, R., & Hardisty, D. J. (2019). How to shift consumer behaviors to be more sustainable: A literature review and guiding framework. *Journal of Marketing*, *83*(3), 22–49.

Woolley, K., Kupor, D., & Liu, P. J. (2023). Does company size shape product quality inferences? larger companies make better high-tech products, but smaller companies make better low-tech products. *Journal of Marketing Research*, *60*(3), 425–448.

Zhu, L., Bollinger, B., & Kronthal-Sacco, R. (2023). Loyalty in sustainable product choice. *Working paper*.

9 Supplementary Tables and Figures

Table 7: Number and Shares of Large and Fringe Brands by Product Category

Product Category	Product Group	Cum Share of Large Brands	# of Large Brands	Avg Share of Large Brands	# of Fringe Brands	Avg Share of Fringe Brands
Eyebrow and Eye Liner	COSMETICS	0.894	8	0.112	12	0.009
Foundation-Liquid	COSMETICS	0.902	5	0.18	9	0.011
Lipsticks	COSMETICS	0.896	7	0.128	14	0.007
Mascara	COSMETICS	0.889	3	0.296	16	0.007
Nail Polish	COSMETICS	0.864	4	0.216	14	0.01
Remaining	COSMETICS	0.855	9	0.095	20	0.007
Deodorants-Personal	DEODORANT	0.768	8	0.096	34	0.007
Creme Rinses and Conditioners	HAIR CARE	0.828	8	0.104	84	0.002
Hair Coloring-Women's	HAIR CARE	0.911	4	0.228	15	0.006
Hair Preparations-Other than Men's	HAIR CARE	0.683	8	0.085	65	0.005
Hair Spray-Women's	HAIR CARE	0.874	7	0.125	25	0.005
Shampoo-Aerosol/Liquid/Lotion/Powder	HAIR CARE	0.696	5	0.139	100	0.003
Wave Setting Products	HAIR CARE	0.815	12	0.068	65	0.003
Oral Rinse and Antiseptic	ORAL HYGIENE	0.91	4	0.227	15	0.006
Tooth Cleaners	ORAL HYGIENE	0.884	4	0.221	23	0.005
Acne Remedies	SKIN CARE	0.906	7	0.129	14	0.007
Face Cleaners and Creams and Lotions	SKIN CARE	0.783	7	0.112	60	0.004
Hand and Body Lotions	SKIN CARE	0.688	7	0.098	97	0.003
Skin Cream-All Purpose	SKIN CARE	0.788	7	0.113	51	0.004
Sunscreens and Sunblocks	SKIN CARE	0.948	5	0.19	19	0.003
Average (Across Categories)		0.839	6.45	0.148	37.6	0.006

This table shows the number of large and fringe brands by product category as well as their average and cumulative sales shares. Brands are defined as "Large" or "Fringe" in Section 2.

Table 8: Mutually Exclusive Claim Types

Features (Mutually Exclusive)	% UPCs with Feature Type		
	(1) All	(2) Large	(3) Fringe
Animal welfare only ("Animal")	17.6%	11.8%	17.9%
Sustainable packaging only ("Packaging")	4.1%	1.6%	4.2%
Animal, packaging, and / or other features ("Animal + Packaging")	8.3%	3.6%	8.6%
All other ("Other")	4.8%	0.7%	5%
No features ("None")	65.2%	82.3%	64.3%

This table shows the prevalence of the mutually exclusive sustainability feature types defined in Section 4. Column 1 shows the percentage of *all* UPCs that carry each of the mutually exclusive feature types. Columns 2 and 3 summarize the same percentages separately for Large and Fringe brands.

Table 9: Brands, Parent Brands and Manufacturers (Estimation Data)

Product Category Name	# Brands	# Parent Brands	# Manufacturers	Manufacturer Type Share (Avg. Market) Top 2	Top 10	Other
Creme Rinses & Conditioners	374	208	169	0.27	0.13	0.05
Deodorants - Personal	144	74	62	0.31	0.12	0.01
Hair Preparations - Other than Men's	325	197	170	0.19	0.15	0.12
Hair Spray - Women's	92	59	46	0.26	0.16	0.05
Oral Rinse and Antiseptic	69	38	30	0.22	0.21	0.01
Shampoo-Aerosol / Liquid / Lotion / Powder	406	223	183	0.29	0.11	0.04

This table shows brand and manufacturer related summary statistics for the estimation data sample described in Section 5. The first three columns show that in each of the estimation product categories there is a much larger number of unique brands than parent brands and product manufacturers. The last three columns show that in each of the estimation categories, the products of the largest manufacturers take the bulk of the market share in the average market.

Table 10: Variation in Sustainable Feature Preferences by Observable Household Characteristics ($\widehat{\beta}_I^{\tilde{l}}$)

Product Category	HH Income Estimate	[Std. Err.]	HH Age Estimate	[Std. Err.]
Creme Rinses & Conditioners	0.065	[0.001]	-0.077	[0.001]
Deodorants - Personal	0.170	[0.002]	-0.066	[0.002]
Hair Preparations - Other than Men's	0.013	[0.001]	-0.029	[0.001]
Hair Spray - Women's	-0.021	[0.002]	0.180	[0.002]
Oral Rinse and Antiseptic	0.068	[0.002]	0.220	[0.002]
Shampoo-Aerosol / Liquid / Lotion / Powder	0.058	[0.001]	-0.040	[0.001]

This table shows product category specific estimates of observable heterogeneity in sustainability feature preferences $\widehat{\beta}_I^{\tilde{l}}$, where $I \in \{\text{household income}, \text{household age}\}$, as defined in Section 4.

Table 11: Price Premia in Estimation Categories (as % of Mean Non-Sustainable Product Price)

	Avg. % Price Prem		
	Specification (2)		
	(1)	(2)	(3)
Product Category Name	2013	2017	2019
Creme Rinses & Conditioners	24.93	-2.71	-1.99
Deodorants - Personal	18.46	18.85	21.87
Hair Preparations - Other than Men's	16.83	10.87	17.65
Hair Spray - Women's	-27.17	-16.16	-7.22
Oral Rinse and Antiseptic	1.76	19.91	14.76
Shampoo-Aerosol / Liquid / Lotion / Powder	12.54	-4.16	-11.82
Regression FE	*Store + Size*		

This table supports the estimation data sample selection discussion in Section 5 by showing that the estimation product categories cover the full range of sustainability price premia and discounts discussed in Section 3.

Table 12: Product Features Predicting Elasticities: Regression results

Dependent Variable:	Estimated price elasticities (standardized)							
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fringe brands	0.546***	0.333***	0.293***	0.354***	0.210***	-0.045***		
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)		
Sustainable	0.024***							
	(0.002)							
Sustainable × Large		-0.399***	-0.069***	-0.238***	-0.159***	-0.095***	-0.173***	-0.099***
		(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
Sustainable × Fringe		0.223***	0.191***	0.009***	0.053***	0.045***	0.072***	0.060***
		(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.002)	(0.002)
By top 2 manufacturers						-0.0540***	0.040***	0.038***
						(0.002)	(0.005)	(0.005)
By top 10 manufacturers						0.018***	-0.011***	-0.001
						(0.002)	(0.004)	(0.005)
Marginal cost						0.787***	0.822***	0.732***
						(0.003)	(0.004)	(0.006)
Fixed effects:								
Category								
×Market×Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
×Product Size			Yes		Yes	Yes		Yes
×Ingredients				Yes	Yes	Yes		Yes
×Parent brand							Yes	Yes
Observations	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223
R^2	0.107	0.127	0.541	0.451	0.649	0.804	0.804	0.850
Adjusted R^2	0.103	0.123	0.539	0.448	0.647	0.803	0.802	0.849

Clustered (Market-level) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 12 reports the regression results from Equation (11) using the estimated elasticities as the outcome variable. Across all specifications, large brands' products with sustainability features are associated with *more* elastic demand, while fringe brands' products with sustainability features face *less* elastic demand.

Table 13: Logit Regression of sustainability feature provision using UPC-level data

Dependent Variable:	$\mathbb{1}$\{Product has any sustainability feature\}	
Model:	(1) All UPCs	(2) Newly launched UPCs only
Fringe brands	1.584***	1.613***
	(0.0450)	(0.1145)
HHI	-3.149***	-0.1525
	(0.5519)	(1.205)
Fringe brands × HHI	4.120***	3.322***
	(0.3283)	(0.8000)
Fixed-effects		
Category	Yes	Yes
Product group-Year	Yes	Yes
Unit of observation	UPC-Year	UPC-Year
Observations	139,569	25,449
Squared Correlation	0.15975	0.16393
Pseudo R^2	0.13937	0.13981
BIC	156,101.3	29,800.6

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 13 displays the correlation between fringe brands' likelihood of providing sustainability-featured products and market concentration (HHI) at the product category level. Using UPC-year-level observations, we regress whether a UPC has sustainability claims on whether the UPC is from fringe brands in highly concentrated product categories, along with other control variables. HHI is calculated annually based on parent brand-level market shares within each product category. The positive and significant coefficient for the interaction term (Fringe brands × HHI) indicates that fringe brands' UPCs are more likely to feature sustainability attributes when they are in more concentrated categories (with higher HHI).

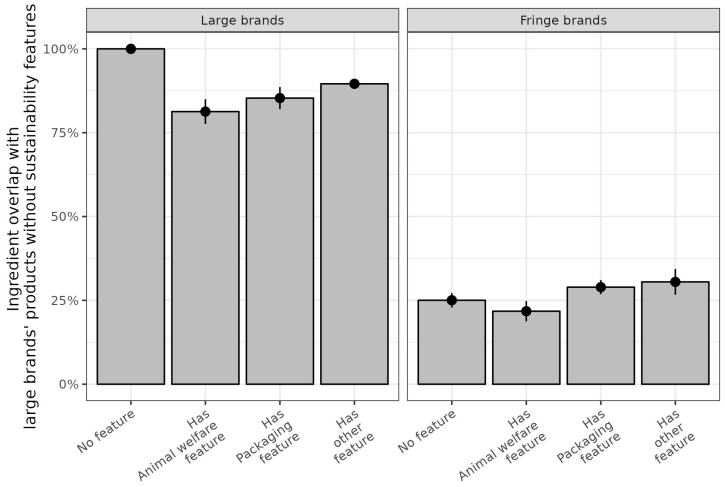


Figure 8: Differences in the ingredients of products with and without sustainability features

Figure 8 summarizes the relative differences in formulations between products with and without sustainability features, using large brands' products without sustainability features as the reference. Each gray bar represents the share of unique ingredients in a product type (e.g., large brands' products with animal welfare features) that are also present in the baseline products (large brands' products without sustainability features). A share of 100% means all ingredients in the product type of interest are also found in the baseline products, indicating the greatest similarity in formulations. A share of 0% means none of the ingredients in the specific product type are found in the baseline products, indicating the greatest difference in formulations. The results show that, for both large and fringe brands, products with animal welfare features have the most distinct formulations compared to large brands' products without sustainability features.

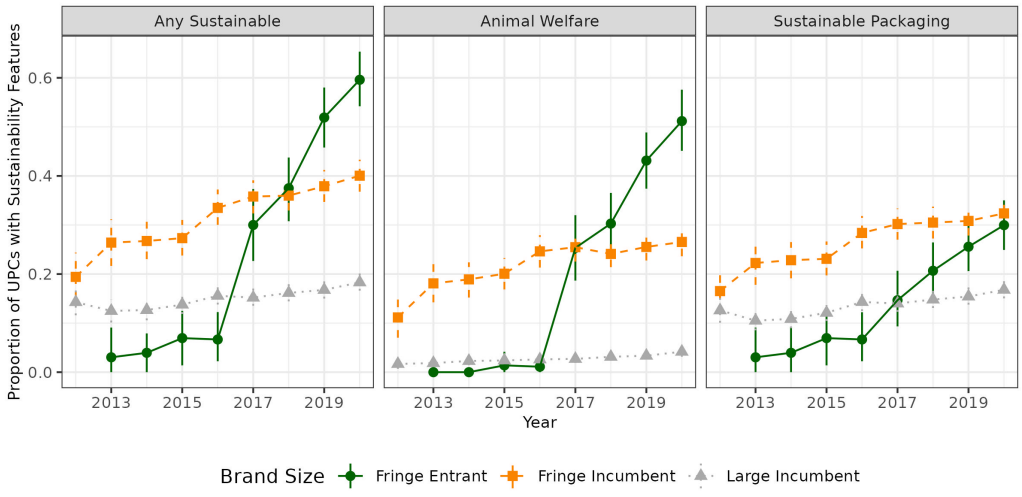


Figure 9: Proportion of UPCs with Sustainability Features by Brand Size (Top 2 Manufacturers)

Figure 9 shows the share of UPCs with sustainability features among large and fringe brands produced by the top 2 manufacturers in each estimation product category and their evolution over time. We summarize proportions across UPCs of all product categories, forming across averages by year and the corresponding 95% confidence intervals. This figure shows that large manufacturers are increasing commitment to sustainability mainly among their niche brands.

Sustainability and Strategic Differentiation in Unregulated Consumer Goods Markets

Kristina Brecko Yewon Kim

November 15, 2024

Web Appendix

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A Supplementary Tables and Figures

Table A.1: Prevalence of Sustainability Features and Product Package Size

Dependent Variables (Indicator)	Sustainable (1)	Animal (2)	Packaging (3)
log(package size)	0.0077	-0.0087	0.0242***
	(0.0109)	(0.0139)	(0.0079)
Fixed-effects			
Category-Size Unit	Yes	Yes	Yes
Year	Yes	Yes	Yes
Fit statistics			
Observations	139,569	139,569	139,569
R^2	0.08910	0.07100	0.07910

Clustered (Category-Size Unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table A.1 shows the results of a regression of an indicator for presence of sustainability feature (Column (1)) and presence of two of the most common sustainability feature types (Columns (2) and (3)) on log(package size), controlling for product category, size unit and year. The table shows that in the average product category, sustainable packaging features are more prevalent among larger product package sizes.

Table A.2: Average Price Premia by Brand Size and Product Group

		Avg. % Price Prem			Avg. % Price Prem		
		Specification (2)					
		Large			Fringe		
		(1)	(2)	(3)	(4)	(5)	(6)
		2013	2017	2019	2013	2017	2019
Cosmetics	None				-14.87	-1.88	-8.92
	Sustainable	-6.91	-1.57	-9.27	-112.74	11.68	9.27
Deodorant	None				3.49	-0.99	-0.70
	Sustainable	7.98	14.01	8.25	73.04	52.20	99.21
Hair Care	None				12.11	25.59	39.24
	Sustainable	-27.81	-28.01	-19.91	15.28	28.04	16.28
Oral Hygiene	None				-1.90	-2.97	2.30
	Sustainable	-0.95	-7.57	1.12	-12.20	24.57	19.11
Skin Care	None				0.08	-2.93	-9.19
	Sustainable	24.28	6.87	10.15	-32.29	-23.89	-19.40
Regression FE		*Store + Size + Ing*					

This table supplements Table 4b and shows that although there is some variation across the five product groups, in most product groups, fringe brands' products with sustainability features are consistently priced higher than large brands' products with such features.

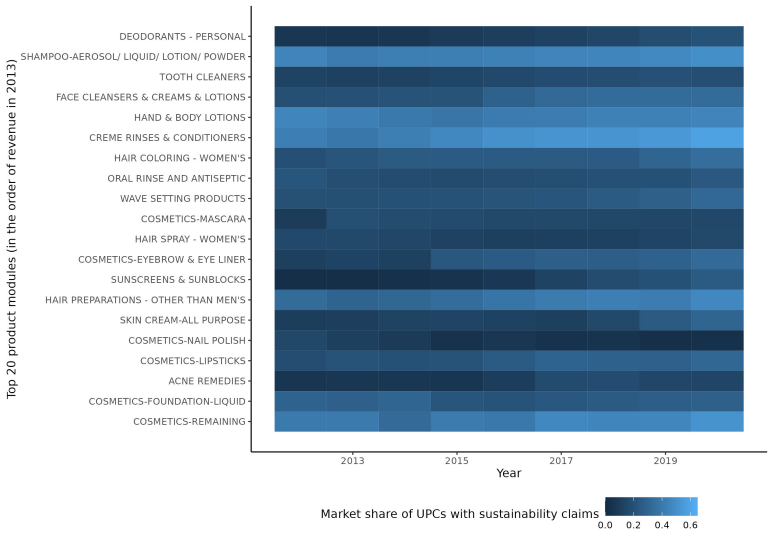


Figure A.1: Market shares of products with sustainability features by category

Figure A.1 shows the market shares of products with sustainability features by category by year as a heatmap. Product categories are ordered in the 2013 revenue size, with the top row being the highest revenue category. If the market shares of sustainable products are proportional to the market size (revenue), we should see the top rows uniformly brighter than the bottom rows. However, the scattered hues of the heatmap suggests that there are no strong correlation between the sustainable market shares and market sizes.

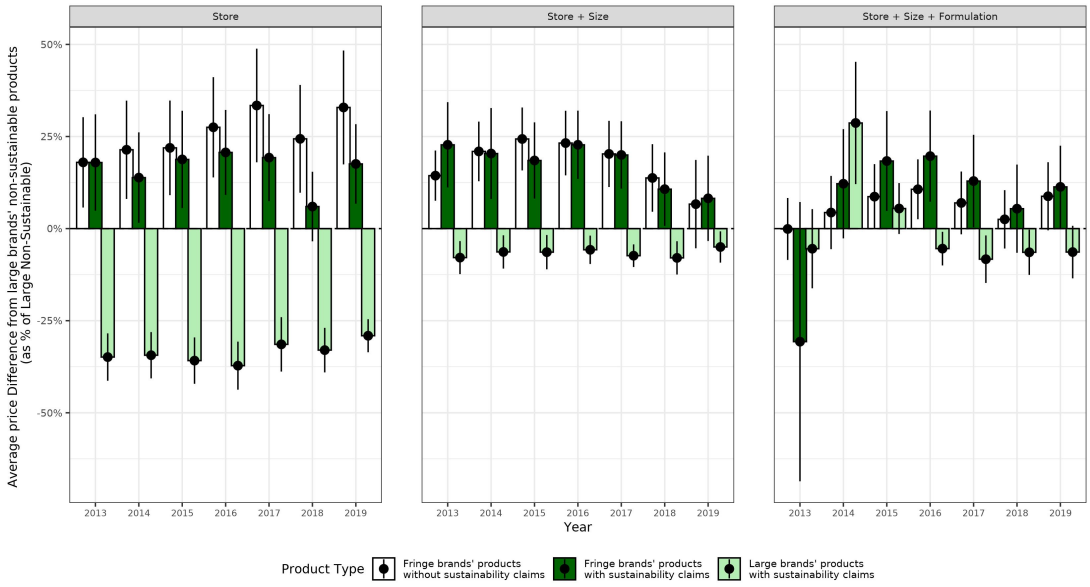


Figure A.2: % Price Difference Over Time (Products with Sustainability Features of Large / Fringe Brands)

Figure A.2 shows the average price difference (as % difference of large brands' non-sustainable product prices) by year and brand type, with varying sets of non-sustainable product attribute controls. The three panels show: (1) within-store price comparison with no other product attribute controls, (2) within-store price comparison among products of the same package size and (3) within-store like-for-like price comparison (estimates for all years from the full Specification 3a in Section 3.)

B Provision and Pricing of Sustainability Features by Type

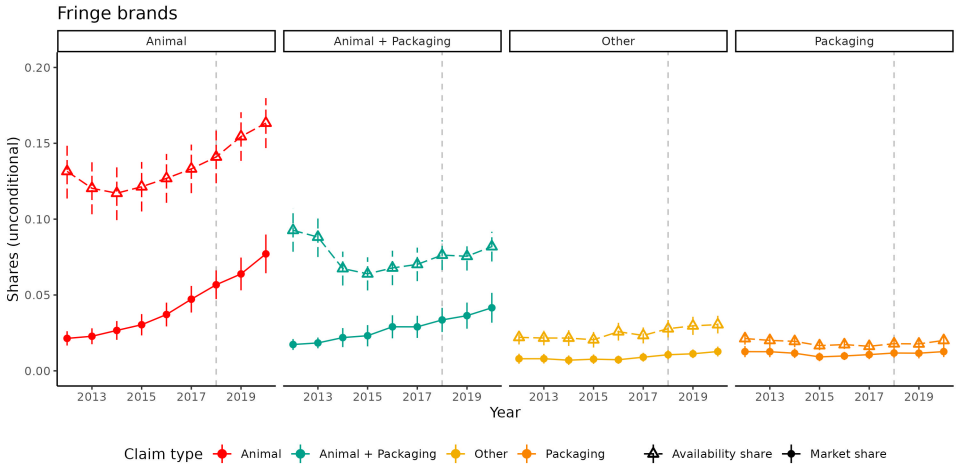
In this section, we decompose the descriptive patterns discussed in Section 3 by sustainability feature type. We first show the prevalence of the different feature types among large and fringe brands as well as their evolution over time. We then discuss feature type-specific price differences and how they vary across brand types and over time.

B.1 Prevalence by Feature Type

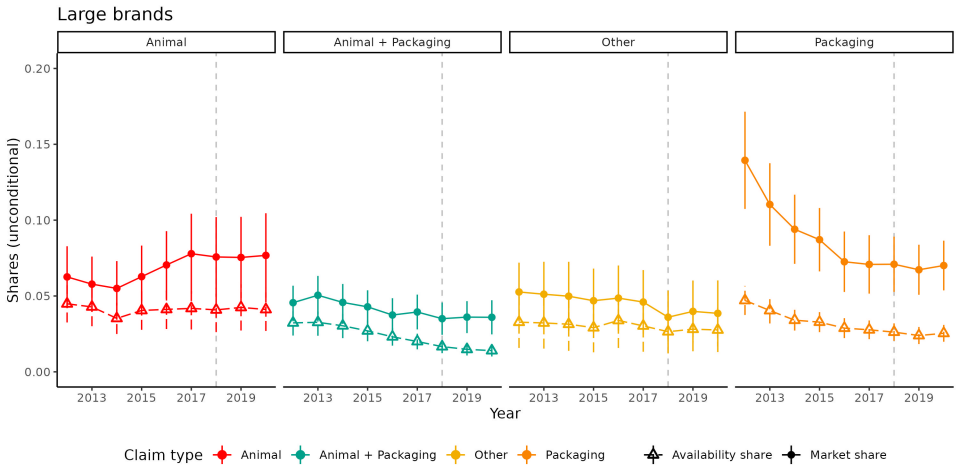
Figure B.1 decomposes the availability and market shares by brand size and feature type. Figure B.1a shows that fringe brands specialize in animal-welfare-related features, and products with these features see the steepest availability and market share growth among all feature-brand size combinations. Figure B.1b shows that large brands have consistently low availability shares across all feature types, decreasing availability shares of products with packaging-related features (packaging and animal, packaging & other), but (similarly to fringe brands) increasing market shares of products with animal welfare features. Finally, Figure B.1c shows the absolute count of *brands* with different feature types. This panel shows that the growth in share of UPCs with sustainability features is at least in part driven by increases along the extensive margin (i.e., more fringe brands with products with sustainability features) rather than exclusively by increases along the intensive margin (i.e., fringe brands with products with sustainability features introducing additional sustainable UPCs). It also reveals that the growth in the number of brands with sustainability features is particularly steep among fringe brands with animal welfare and animal welfare-related claims.

B.2 Price Differences by Feature Type

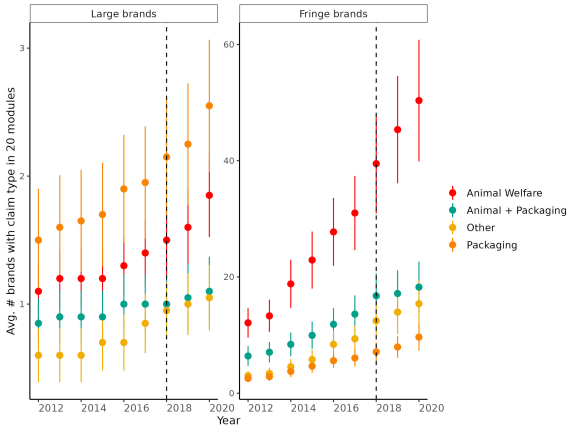
We estimate the feature-type sustainability price difference by regressing the price of UPC j in store s in year t on sustainability feature indicators $\mathbb{1}\{\text{sustainability feature} = l\}$, where $l \in \{$animal welfare, environmental packaging, animal & environmental packaging and/or other, all other$\}$; i.e., the mutually exclusive feature types summarized in Table 8. Thus, the baseline regression equation is:



(a) Fringe brands' shares by feature type



(b) Large brands' shares by feature type



(c) Large brands' shares by feature type

Figure B.1: Availability and market shares by brand size and feature type

$$p_{jst} = \sum_{l} \beta^{l} \mathbb{1}\{\text{sustainability feature}_j = l\} + \gamma_s + \varepsilon_{jst} \tag{B.1}$$

Table B.1: Average Price Difference (as % of Mean Non-Sustainable Product Price)

Select Years, Varying Store and Product Characteristics Controls

	Avg. % Price Diff [# Categories]			Avg. % Price Diff [# Categories]			Avg. % Price Diff [# Categories]		
	Specification (1)			Specification (2)			Specification (3)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Feature Type	2013	2017	2019	2013	2017	2019	2013	2017	2019
Animal Welfare	-13.52	-14.96	-14.45	6.22	-2.24	-11.81	27.85	9.84	7.08
	[20]	[20]	[20]	[20]	[20]	[20]	[10]	[15]	[18]
Animal, Packaging and / or other	-19.84	-26.59	-18.2	0	-6.41	-12.67	68.08	8.44	7.75
	[19]	[19]	[19]	[19]	[19]	[19]	[3]	[8]	[11]
All Other	41.06	24.85	9.07	25.8	25.98	12.92	57.16	24.31	8.57
	[17]	[20]	[20]	[16]	[20]	[20]	[4]	[10]	[9]
Packaging	-5.83	-28.22	-21.64	-5.35	-2.06	10.9	1.82	-2.1	4.17
	[15]	[20]	[19]	[15]	[19]	[18]	[7]	[9]	[14]
Regression FE	*Store*			*Store + Size*			*Store + Size + Brand*		

This table shows the average sustainable feature % price difference. The product category-year level unit (per count or per ounce) price differences are obtained from regression according to equation (1), including the fixed effects specified in the last row of the table. The price differences are expressed as the percentage of the mean non-sustainable price in that product category and averaged across product categories. Columns 7-9 include only product categories that have more than two parent brands with both sustainable and non-sustainable products.

Table B.2: Average Price Difference Robustness to Price Measures

	Avg. % Price Diff [# Categories]			Avg. % Price Diff [# Categories]			Avg. % Price Diff [# Categories]		
	Price / oz or ct			Log (Price / oz or ct)			Unit Price		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Feature Type	2013	2017	2019	2013	2017	2019	2013	2017	2019
Animal Welfare	6.22	-2.24	-11.81	14.42	-1.99	-6.5	16.97	-0.68	-4.15
	[20]	[20]	[20]	[20]	[20]	[20]	[20]	[20]	[20]
Animal, Packaging, and / or other	0	-6.41	-12.67	-0.26	2.67	4.56	-0.02	-0.96	-1.26
	[19]	[19]	[19]	[19]	[19]	[19]	[19]	[19]	[19]
All Other	25.8	25.98	12.92	52.76	45.46	21.35	49.83	36.03	17.78
	[16]	[20]	[20]	[16]	[20]	[20]	[16]	[20]	[20]
Packaging	-5.35	-2.06	10.9	-5.21	-8.9	10.46	-8.98	-8.25	9.27
	[15]	[19]	[18]	[15]	[19]	[18]	[15]	[19]	[18]
Regression FE	*Store + Size*			*Store + Size*			*Store + Size*		

This table shows the robustness of the average sustainable feature % price difference in Table B.1 to different measures of price. Columns (1)-(3) show average price differences using prices per ounce or count, where applicable (the measures used in Table B.1). Columns (4)-(6) and (7)-(9) use log(prices per ounce or count) and unit prices, respectively.

We find that across feature types and years, there exists a consistently positive sustainability price premium after controlling for a comprehensive set of non-sustainable product attributes (columns (7)-(9) of Table B.1); however, in a comparison of within-store shelf prices, we find that products with the most popular types of sustainability features are typically lower priced (columns (1)-(3) of Table B.1). These results suggest that, as with

the average sustainability price difference, each sustainability feature type has only a modest impact on product prices, with non-sustainable features playing a more prominent role in product pricing.

C Estimation

C.1 Constructing Micro Moments

We take the following approach to computing micro moments for a given product category.

1. Adapting the approach of Döpper et al. (2022), for each DMA-year we sample the households in the NielsenIQ HMS panel with replacement, using the projection weights provided by NielsenIQ.
2. Taking this sampled set as representative households, we compute market-level average demographics of households that purchase products with sustainability features and pay below mean price in the NielsenIQ household purchase data.
3. We average across markets to obtain four micro-statistics that are then matched in estimation to the average demographics implied by each parameter guess. We use standardized income and age variables in estimation and to compute the micro statistics.

C.2 Cost Shifters: Producer Price Indexes

For the supply-side instruments, we approximate monthly changes in production and packaging costs for the in-sample health and beauty product categories using the producer price indexes obtained from the Federal Reserve Economic Database maintained by the St. Louis Fed. We include raw input material cost instruments, which are common to all the product categories (e.g., basic inorganic chemicals U.S. Bureau of Labor Statistics, 2024a, primary basic organic chemicals U.S. Bureau of Labor Statistics, 2024d, U.S. Bureau of Labor Statistics, 2024e), as well as product-specific cost instruments, which vary by product category. For example, we use the hair tonics, including hair and scalp

conditioners producer price index (U.S. Bureau of Labor Statistics, 2024b) to approximate changing costs of production in the conditioner product category and the other cosmetics producer price index (U.S. Bureau of Labor Statistics, 2024c) to approximate changing costs of production in the deodorant category.

D Validation of Estimation Results

D.1 Category-Specific Own Price Elasticities

We first evaluate the estimation results by plotting the category-specific distributions of the recovered own-price elasticities in Figure D.1. Category-level average price elasticities range from -1.17 (Deodorant) to -2.16 (Oral rinse). Across all 6 categories, only 2.1% of observations have elasticities greater than -1. By category, Deodorant has the highest share of elasticities greater than -1 (15.9%) followed by Hair Preparations (0.5%). In the five categories, less than 0.2% of price elasticities are greater than -1. Our own price elasticities overlap those reported in other papers that study a large set of consumer packaged goods categories (Hitsch et al. 2021, Döpper et al. 2022).

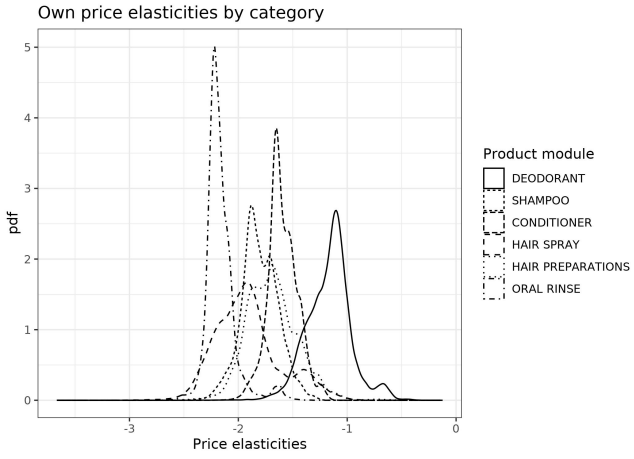


Figure D.1: Price elasticities by category

D.2 Marginal Costs

To validate whether the estimated marginal costs reflect substantive variations in marginal costs, we perform a regression analysis using variables that were not directly

included in the cost estimation but are theoretically predicted to influence marginal costs. These variables are:

Table D.1: Validation checks: Estimated marginal costs

Dependent Variable:	Estimated marginal costs (standardized)					
Data:	All observations			Observations from brands with changes in manufacturers		
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Fringe brands	0.5341***	0.5362***		0.2534***	0.2617***	
	(0.0031)	(0.0031)		(0.0117)	(0.0115)	
Size (in oz, standardized)	-0.3322***	-0.3330***	-0.2161***	-0.3733***	-0.3756***	-0.2182***
	(0.0016)	(0.0016)	(0.0012)	(0.0034)	(0.0033)	(0.0034)
Average income (DMA-level, standardized)	0.0021***			0.0053**		
	(0.0006)			(0.0023)		
Fringe brands × Top 2 manufacturers	-0.1690***	-0.1702***	-0.0300***	0.0363**	0.0212	-0.0215***
	(0.0024)	(0.0024)	(0.0062)	(0.0155)	(0.0150)	(0.0080)
Category-Retailer-Year-Quarter FE	Yes			Yes		
Category-DMA-Retailer-Year-Quarter FE		Yes	Yes		Yes	Yes
Category-Parent brand FE			Yes			Yes
Observations	1,371,223	1,371,223	1,371,223	65,999	65,999	65,999
R^2	0.25627	0.26127	0.71597	0.41610	0.44061	0.87994
Within R^2	0.24230	0.24391	0.09590	0.12303	0.12561	0.08331

Clustered (DMA-Retailer-level) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

- Brand size: We predict that larger brands will incur lower marginal costs due to economies of scale.
- Product size: We predict that larger-sized products will incur lower marginal costs compared to smaller-sized products, owing to savings in manufacturing and distribution costs.
- Average income: We predict that higher-income areas will have higher marginal costs, as these costs encompass distributional and retail expenses.
- Fringe brands × Owned by Top 2 manufacturers: We predict that fringe brands owned or launched by top manufacturers will have lower marginal costs than those not owned by them because of their lower manufacturing and distribution costs. We analyze this by running regressions on the entire dataset and on subsets of brands that experienced changes in ownership during the data period, to observe how ownership by the top 2 manufacturers influences marginal costs.

Table D.1 summarizes the results. Across specifications, all estimated coefficients match

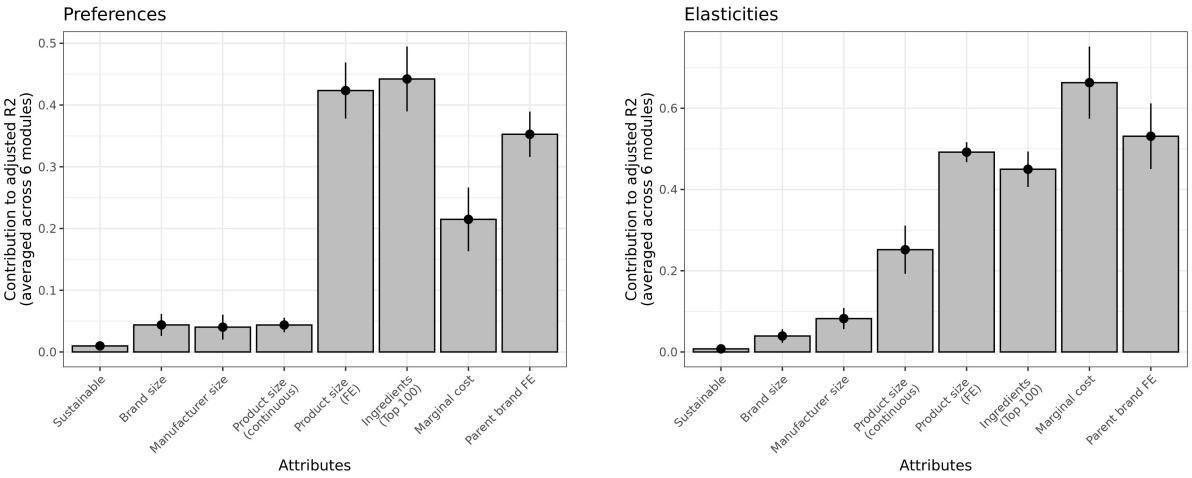
our predictions.

E Role of Product Features in Consumer Demand

E.1 Analysis of R^2 Measures

To assess the importance of individual sustainable and non-sustainable product features in explaining demand, we adapt the framework of Equation 11 and, for each product category, regress the standardized product-market-level demand parameters (preferences and price elasticities) on individual sustainable and non-sustainable product characteristics, comparing the resulting R^2 measures.

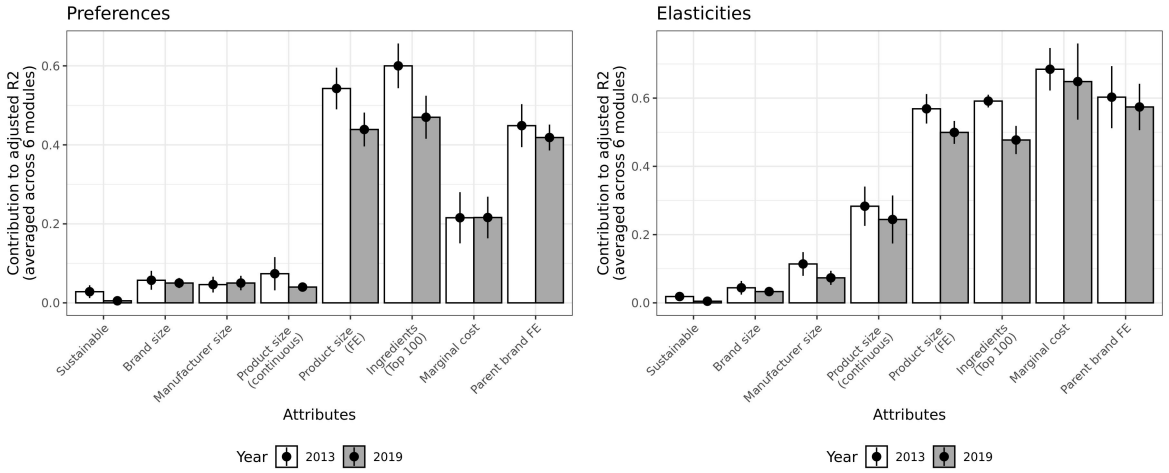
Figure E.1 reports each individual attribute's contribution to the adjusted R^2. Sustainability features have the least predictive power for both preferences (Figure E.1a) and elasticities (Figure E.1b) among all the features tested. These results indicate that sustainability features alone have minimal influence on consumer demand, with other product attributes bundled with sustainability features explaining a much larger share of the variation in the observed demand for sustainable products. Importantly, despite the rising demand for sustainability, the explanatory power of sustainability features in consumer preferences declines even further from 2013 to 2019 (Figure E.2).



(a) Attributes explaining preferences

(b) Attributes explaining elasticities

Figure E.1: Product attributes predicting preferences and elasticities



(a) Attributes explaining preferences by year (b) Attributes explaining elasitcities by year

Figure E.2: Product attributes predicting preferences and elasticities by year

Figure E.2 compares the R^2 measures contributed by individual product attributes in 2013 and 2019. Consistent with the literature that shows the rise of niche brands and horizontal differentiation (Brand 2021, Döpper et al. 2022, Neiman and Vavra 2023), preferences become less predictable with observed product attributes according to the lower R^2 measures in 2019. The explanatory power that sustainability features have in consumer preferences drops even further from 2013 to 2019.

E.2 Variance Decomposition Analysis

In addition to using the R^2 measures to assess the importance of sustainability features in consumer preferences, we conduct a variance decomposition analysis to explain how much of the variations in the estimated preferences for products ($\widehat{\beta}_{jry(t)}$) are explained by the observed variations in sustainability feature presence.

$$
\begin{aligned}
var(\widehat{\beta}_{jry(t)}) =& var(\overline{\beta}_m) && \text{(across-market)} \\
&+ \frac{1}{N}\sum_{m} N_m var(\overline{\beta}_{sm}|m) && \text{(across-sustainability feature presence)} \\
&+ \frac{1}{N}\sum_{s,m} N_{s,m} var(\overline{\beta}_{pb,m}|s,m) && \text{(across-parent brand)} \\
&+ \frac{1}{N}\sum_{pb,s,m} N_{pb,m} var(\overline{\beta}_{b,m}|pb,s,m) && \text{(across-brand)} \\
&+ \frac{1}{N}\sum_{b,s,m} N_{b,m} var(\overline{\beta}_{j,m}|b,s,m) && \text{(across-product)}
\end{aligned}
\tag{E.1}
$$

Figure E.3 shows the variance decomposition results. Consistent with Figure E.1, the variance across sustainability feature presence explains only a small portion of the preference variance (the bottom red bars), while the variance across parent brands (the top blue bars) and across brands (the middle yellow bars) explain the majority of the preference variance.

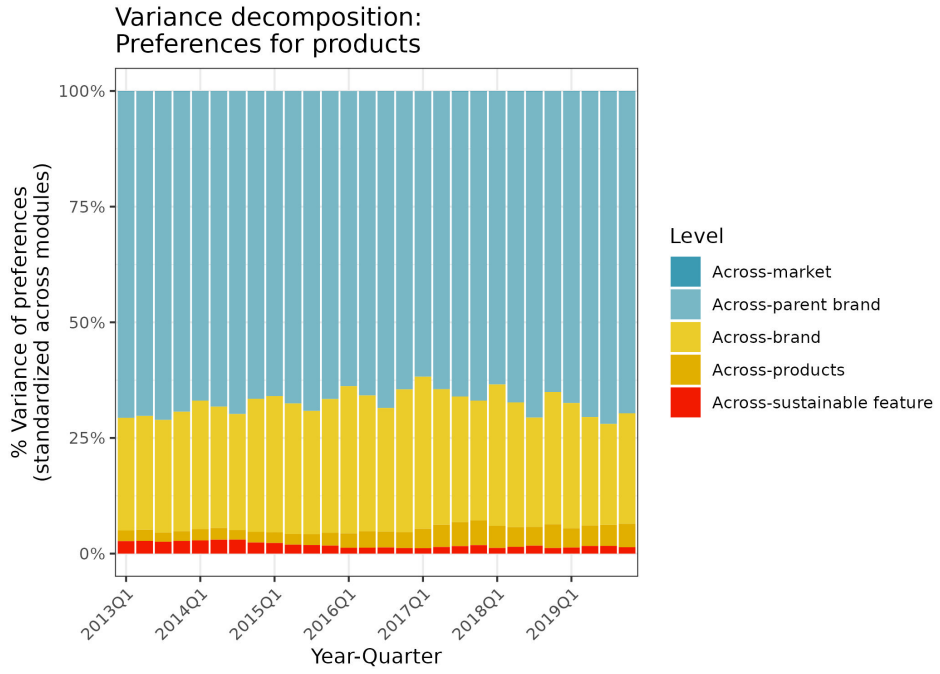


Figure E.3: Variance decomposition of consumer preferences for products over time

F Marginal Costs and Markups on Sustainability Features

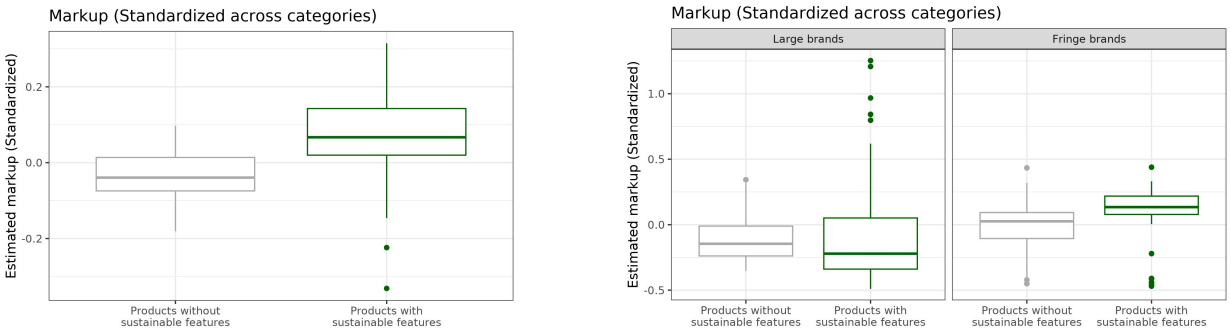
Figure F.1 and F.2 summarize the distribution of estimated markups of products with and without sustainability features by brand type and over time. Similar to the results on preferences and marginal costs, we find systematic differences between large and fringe brands in their markups. Although products with sustainability features generally have higher markups than those without (Figure F.1a and F.2a), this higher markup is driven by fringe brands rather than large brands (Figure F.1b and F.2b).

Next, we examine in more detail how the presence of sustainability features is associated with marginal costs and markups after accounting for other non-sustainable product attributes. We perform the same regression analysis as in Section 6.1 but using the esti-

mated marginal costs and markups as the outcome variables.

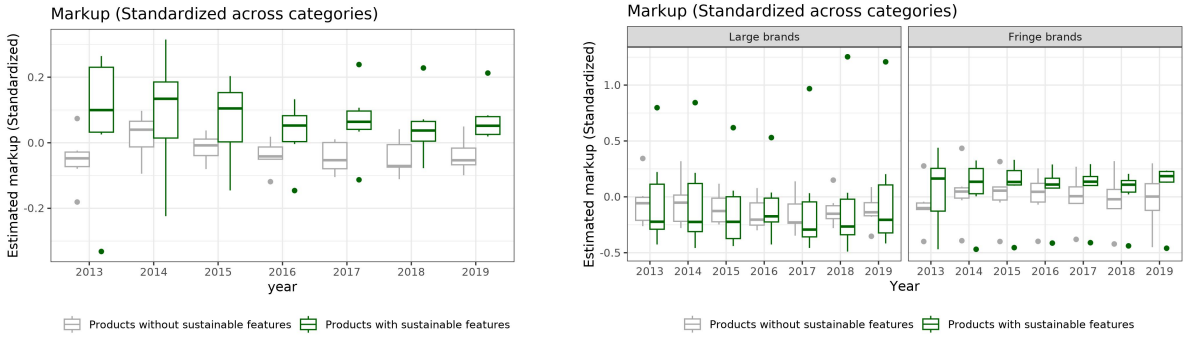
Table F.1 summarizes the results on marginal costs. The negative (positive) coefficient of Sustainable × Large (Sustainable × Fringe) across all specifications in Table F.1 indicates that sustainability features are consistently associated with lower marginal costs for large brands and higher marginal costs for fringe brands, even after accounting for differences in other non-sustainable product attributes.

Table F.2 reports the results on markups. Column 1 shows that products with sustainability features exhibit higher average markups than those without when other non-sustainable characteristics are not considered, consistent with Figure F.1a. Columns 2-8 suggest that this positive markup on sustainability features is driven by fringe brands rather than large brands; the Sustainable × Large coefficient is lower than the Sustainable × Fringe coefficient in all but one specification (Column 6).



(a) All brands (b) By brand type

Figure F.1: Estimated markups of products with and without sustainability features



(a) All brands (b) By brand type

Figure F.2: Estimated markups of products with and without sustainability features by year

Table F.1: Product Features Predicting Marginal Costs: Regression Results

Dependent Variable:	Estimated marginal costs (standardized)							
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fringe brands	0.5588***	0.4213***	0.3866***	0.3564***	0.2979***	0.2709***		
	(0.0027)	(0.0026)	(0.0026)	(0.0025)	(0.0025)	(0.0026)		
Sustainable	2.31×10^{-5}							
	(0.0015)							
Sustainable × Large		-0.2730***	-0.0280***	-0.1440***	-0.0911***	-0.0994***	-0.2504***	-0.0987***
		(0.0013)	(0.0015)	(0.0016)	(0.0019)	(0.0019)	(0.0017)	(0.0018)
Sustainable × Fringe		0.1288***	0.0629***	-0.0079***	0.0126***	0.0139***	0.1737***	0.0898***
		(0.0022)	(0.0025)	(0.0022)	(0.0023)	(0.0023)	(0.0020)	(0.0021)
By top 2 manufacturers						-0.0864***	-0.0050	-0.0138**
						(0.0027)	(0.0053)	(0.0054)
By top 10 manufacturers						-0.0346***	-0.0225***	-0.0335***
						(0.0026)	(0.0052)	(0.0054)
Fixed-effects								
Category-Market-Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Category-Product Size			Yes		Yes	Yes		Yes
Category-Ingredients				Yes	Yes	Yes		Yes
Category-Parent brand							Yes	Yes
Observations	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223
R^2	0.10115	0.11209	0.56078	0.45844	0.67090	0.67130	0.68339	0.84684
Adjusted R^2	0.09684	0.10783	0.55849	0.45565	0.66907	0.66948	0.68169	0.84591

Clustered (Market-level) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table F.2: Product Features Predicting Markups: Regression Results

Dependent Variable:	Estimated markups (standardized)							
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fringe	0.2349***	0.1435***	0.0734***	0.0950***	0.0031	-0.1898***		
	(0.0042)	(0.0035)	(0.0036)	(0.0038)	(0.0039)	(0.0028)		
Sustainable	0.0895***							
	(0.0017)							
Sustainable × Large		-0.0919***	0.0459***	-0.0444***	-0.0135***	0.0663***	0.0224***	0.0392***
		(0.0033)	(0.0026)	(0.0031)	(0.0030)	(0.0027)	(0.0017)	(0.0026)
Sustainable × Fringe		0.1751***	0.1716***	0.0164***	0.0649***	0.0534***	0.0741***	0.0578***
		(0.0022)	(0.0025)	(0.0026)	(0.0026)	(0.0013)	(0.0017)	(0.0020)
By top 2 manufacturers						0.1022***	0.1288***	0.1105***
						(0.0024)	(0.0058)	(0.0057)
By top 10 manufacturers						0.0272***	-0.0135***	-0.0267***
						(0.0018)	(0.0044)	(0.0045)
Marginal costs						0.7585***	0.5907***	0.5670***
						(0.0034)	(0.0044)	(0.0067)
Fixed-effects								
Category-Market-Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Category-Product Size			Yes		Yes	Yes		Yes
Category-Ingredients				Yes	Yes	Yes		Yes
Category-Parent brand							Yes	Yes
Fit statistics								
Observations	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223	1,371,223
R^2	0.05409	0.05841	0.45709	0.35882	0.57288	0.74217	0.73126	0.79364
Within R^2	0.04955	0.05389	0.45426	0.35553	0.57050	0.74074	0.72981	0.79239

Clustered (Market-level) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

G Measures of Sustainability Feature Arrangements

We define certification status (Third-party-certified $\in$ [0,1]) as a product-level continuous variable that captures the share of a product's UPCs that incorporate certified features.[1] Examples of certified features include B-corporation, Terracycle, Rainforest

[1]Our definition of product groups multiple UPCs as one product, which results in a continuous variable of certification status at the product level. For example, if four UPCs are grouped as one product and one of them

Alliance Certified, and Forest Stewardship Council. We create the certification status variable by examining each detailed pre-codified sustainability feature provided by Label Insight and checking if the feature is third-party certified based on its name (Table 2). For instance, we classify the "B-corporation" feature as certified while classifying the "Reduced Greenhouse Gases" feature as not certified because it is not possible to determine whether this latter feature has third-party certification based on the name of the feature. After classifying these granular sustainability features into certified and non-certified categories, we calculate what percentage of the product's UPCs have any certified feature. Although this variable does not capture all certified features in the data, it serves as a noisy proxy for certification status.[2]

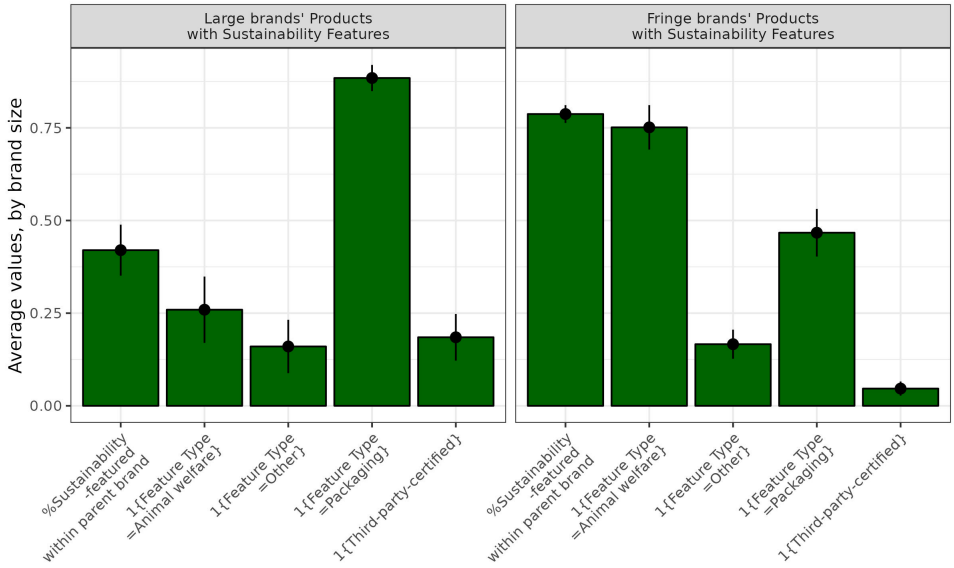


Figure G.1: Comparisons of sustainability feature arrangements between large and fringe brands

Figure G.1 presents the average values of sustainability feature-related dimensions by brand size, conditional on products having any sustainability features. The figure illustrates that large and fringe brands tend to specialize in different types of sustainability features when they offer them. Specifically, large brands are more likely to include packaging-related features, while fringe brands are more likely to incorporate animal welfare-related features.

Brand-level commitment to sustainability feature provision (%Sustainability-featured products $\in [0, 1]$) is a parent-brand-level continuous variable, which indicates the share of

has a certified sustainability feature, the certification status for the product is 0.25.

[2]Third-party certification is more common among large brands (Figure G.1), thereby making it an unlikely explanation for the lower demand for large brands' products with sustainability features; however, because past literature has documented that demand can be positively affected by quality certification (Elfenbein et al. 2015), we also consider sustainability certification as a potential driver of demand here.

a parent brand's products with sustainability features. If all products from a parent brand have sustainability features, this measure is 1; if none of the products have sustainability features, the measure is 0. As Figure G.2 shows, there is significant variation in the share of products with sustainability features within parent brands, with many fringe brands clustered around 1. If consumers discount sustainability features from brands offering both sustainable and non-sustainable product lines more than from brands offering only sustainable product lines, the interaction between this measure and sustainability features will have a positive correlation with the estimated preferences.

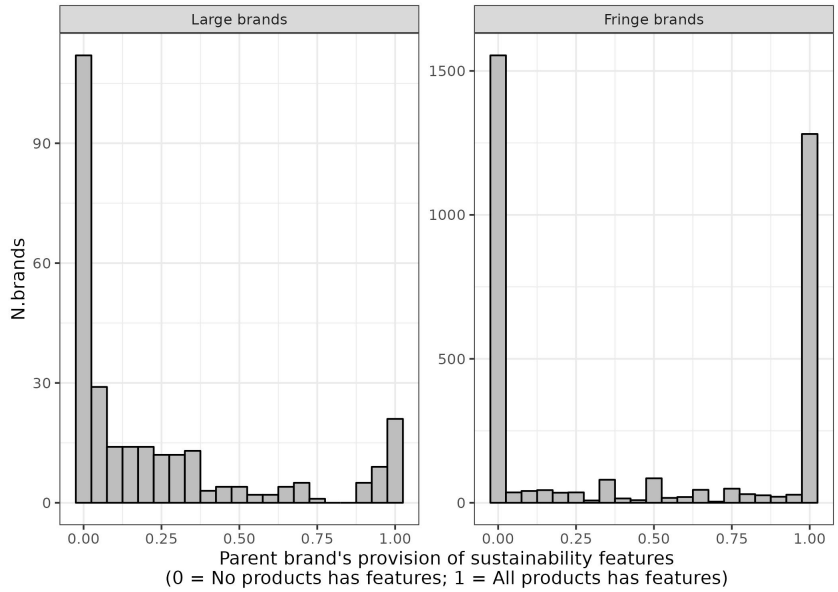


Figure G.2: Brand-level commitment: Within-parent-brand rate of provision of sustainability-featured products by brand type

Figure G.2 illustrates the variation across parent brands in their provision of sustainability-featured products, represented as within-parent-brand availability shares of UPCs with sustainability features. A value of 1 indicates that all UPCs of a given parent brand have sustainability features, while a value of 0 indicates that none of the UPCs have sustainability features. The right panel shows that fringe brands are significantly more likely to have all their products featuring sustainability attributes, indicated by the concentration of fringe brands around the value of 1.

References

Brand, J. (2021). Differences in differentiation: Rising variety and markups in retail food stores. *SSRN 3712513*.

Döpper, H., MacKay, A., Miller, N., & Stiebale, J. (2022). Rising markups and the role of consumer preferences. *Harvard Business School Strategy Unit Working Paper 22-025*.

Elfenbein, D. W., Fisman, R., & McManus., B. (2015). Market structure, reputation, and the value of quality certification. *American Economic Journal: Microeconomics*, *7*(4), 83–108.

Hitsch, G. J., Hortacsu, A., & Lin, X. (2021). Prices and promotions in us retail markets. *Quantitative Marketing and Economics*, *19*, 1–80.

Neiman, B., & Vavra, J. (2023). The rise of niche consumption. *American Economic Journal: Macroeconomics*, *15*(3), 224–264.

U.S. Bureau of Labor Statistics. (2024a). Producer Price Index by Commodity: Chemicals and Allied Products: Basic Inorganic Chemicals [WPU0613]. https://fred.stlouisfed.org/series/WPU0613,%20January%2026,%202024

U.S. Bureau of Labor Statistics. (2024b). Producer Price Index by Commodity: Chemicals and Allied Products: Hair Tonics and Hair Dressings Including Professional and Consumer Use [WPU0675040702]. https://fred.stlouisfed.org/series/WPU0675040701,%20January%2031,%202024.

U.S. Bureau of Labor Statistics. (2024c). Producer Price Index by Commodity: Chemicals and Allied Products: Other Cosmetics and Toilet Preparations [WPU06751501]. https://fred.stlouisfed.org/series/WPU06751501,%20January%2026,%202024.

U.S. Bureau of Labor Statistics. (2024d). Producer Price Index by Commodity: Chemicals and Allied Products: Primary Basic Organic Chemicals [WPU061401]. https://fred.stlouisfed.org/series/WPU061401,%20January%2026,%202024

U.S. Bureau of Labor Statistics. (2024e). Producer Price Index by Commodity: Pulp, Paper, and Allied Products: Recycled Paperboard [WPU09141105]. https://fred.stlouisfed.org/series/WPU09141105,%20January%2026,%202024