Summer Internship Report

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Summary

This project, carried out within Columbia Business School's Quantitative Marketing department, investigates gender-based pricing disparities in the fragrance industry. The findings highlight that while women's fragrances have a higher list price, this disparity disappears when taking into account store discounts, suggesting no significant price difference in the final net price paid by consumers.

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1 Introduction and Literature Review

Pink tax is the price disparity between products marketed to men and those marketed to women. This research project, carried out in the context of a research internship at Columbia Business School, focuses on investigating the pink tax in the product category of fragrances.

This project was inspired by an exploratory analysis made by Idealo [7] on the difference in pricing in perfumes across European countries, where they compared the average price per milliliter for 50 identical fragrances in both men's and women's versions across five European countries. This study reveals that women's perfumes are on average 13.5 % more expensive than men's perfumes.

The pink tax phenomenon is prevalent in many product categories. In fact, a study by the California State of Consumer Affairs in 1994 [10] showed that women payed $ 1,351 more every year for similar products as men. To follow on that, a study by the New York City Department of Consumer Affairs [4] compared prices in 35 categories including: children's toys and clothing, adult clothing and personal care products, and senior's home health care products. This study reflected that on average women's products were 7 percent more expensive than men's. Other studies focused more on the price disparities present in personal care products (Moshary et al. 2023 [9]), Gonzalez Guittar et al. 2022 [6]), real estate (Goldsmith-Pinkham and Shue 2023 [5]), and automotive vehicles (Ayres 1991 [2], Ayres and Siegelman 1995 [3]).

Our analysis aims to systematically study the pink tax phenomenon in the fragrance category. We use a publicly available dataset [8] with 549 observations, 25 brands and more than 7 sellers. We find a pink tax effect on the brand list price but not on the net price paid after store discount. Indeed, while the average list price per milliliter is higher for women's fragrances than for men's, the average discount per milliliter is also higher for women's fragrances, which offsets this initial disparity. As a result, there is no significant price difference in the net price paid after discount.

2 Data Preprocessing

Our initial dataset had 1003 observations, however, to ensure a rigorous analysis that focuses on "substantially similar products" [1], we only considered brands that had at least two products for each gender and appeared in at least five observations overall. After data preprocessing[2], we obtain a dataset with 549 observations with the following variables: price per milliliter (SAR[3]), discount per milliliter (SAR), net price per milliliter (SAR), brand, volume (ml), concentration, gender, seller, base notes and middle notes.

Additionally, since we had 220 base notes and 347 middle notes in our initial dataset, we applied Principle Component Analysis [4] (PCA) which narrowed them down to 20 base notes and 23 middle notes.

[1] The Pink Tax Repeal Act, a federal law introduced in 2020 in the state of New York, prohibits manufacturers from "selling substantially similar products at different prices based on the gender of the intended purchaser". [1]

[2] Data Preprocessing involved cleaning, reduction and lemmatization of the data.

[3] The currency in this study is expressed in Saudi Riyal (SAR) because the data has been gathered in Saudi Arabia (1 SAR = 0,27 $).

[4] Principal Component Analysis is a dimensionality reduction method which is used to reduce a large dataset into smaller components that still capture most of the information in the initial dataset.

3 Regression Analysis

We used an Ordinary Least Squares regression where the price per milliliter p is the dependent variable and $\beta \cdot$ women is the focal variable, such that:

$$\mathrm{p} \sim \beta \cdot \mathrm{women} + \gamma_{\mathrm{b}} + \gamma_{\mathrm{s}} + \gamma_{\mathrm{c}} + \gamma_{\mathrm{q}} + \gamma_{\mathrm{q}} \cdot \gamma_{\mathrm{c}} + \gamma_{\mathrm{notes}} + \varepsilon \tag{1}$$

where:

- p is the dependent variable: **price per milliliter**.
- $\beta \cdot$ women is the **focal variable**.
- γ_{b} is the **brand** fixed effects.
- γ_{s} is the **seller** fixed effects.
- γ_{c} is the **concentration** effects.
- γ_{q} is the **quantity** effects.
- $\gamma_{\mathrm{q}} \cdot \gamma_{\mathrm{c}}$ is the interaction term between the **quantity** and the **concentration**.
- γ_{notes} is the **base and middle notes** fixed effects.
- ε is the error term.

We used the same analysis for the discount per millilitre and the net price per millilitre (discounted price). Thus, we obtained the following results:

	List price per ml (SAR)	**Discount per ml (SAR)**	**Net price per ml (SAR)**
β.Women	.59***	.54**	.05
	(.23)	(.22)	(.10)
Brand FE	Y	Y	Y
Seller FE	Y	Y	Y
Volume	Y	Y	Y
Concentration	Y	Y	Y
Base notes	Y	Y	Y
Middle notes	Y	Y	Y
Observations	549	549	549
Adj. R squared	.70	.44	.71

Table 1: Regression Analysis Results. For the focal variable, the first row reports the coefficient, and the second row reports the standard error. $*p < 0.1$; $**p < 0.05$; $***p < 0.01$

4 Findings

Our analysis reveals a pink tax effect on brand list prices, though it does not persist after store discounts. Specifically, women's average list price per milliliter is 0.59 SAR higher than men's, while women receive an average discount of 0.54 SAR more per milliliter compared to men. Therefore, the price difference vanishes on the net price paid.

5 Limitations

It is important to acknowledge the limitations of this study, mainly the temporal and spacial variability of discounts. For example, a store will not have a discount on all its products all year long. Additionally, we lack precise information about when the data was collected. If the dataset reflects a period with heavy discounting, such as during the holiday season (e.g. Christmas), the results may be different from data gathered over the course of an entire year, which would capture periods with fewer discounts. This uncertainty could impact the generalizability of our findings.

6 Conclusion

This research project investigates gender-based discrimination in the fragrance category, also called the pink tax. Our findings highlight that while there is a pink tax effect on brand list prices prior to discount, this pink tax tax effect vanishes when taking into account store discounts.

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