Extended Abstract
6th PLATE 2025 Conference
Aalborg, Denmark, 2-4 July 2025

The Hidden Cost of Cheap: Are We Paying More for Short-Lived Goods?

Levon Amatuni[(a)], Jeremy Faludi[(a)], Benjamin Sprecher[(a)]
a) Delft University of Technology, Delft, The Netherlands

Keywords: sustainable consumption; cost of ownership; product lifetimes; economic benefits; repair

Introduction

There is a vast array of brands and models of the same product type available on the market, each with a wide range of quality, durability, longevity, and repairability. This raises a critical question: do higher-priced products last longer and ultimately cost less in the long term, or, in other words, do we end up paying more when opting for cheaper but less durable alternatives? From a sustainability perspective, making products more durable and repairable plays a vital role in extending their lifespans, reducing production frequency, and alleviating environmental pressures (Cooper, 2005; van Nes & Cramer, 2006). At the same time, price remains one of the most significant factors influencing purchase decisions (Bault & Rusconi, 2020). More sustainable products are often perceived as more expensive, leading to the belief that sustainable consumption may only be feasible for wealthier consumers (Raha & Mallya, 2022). However, in the long-term perspective, less expensive products may prove costlier due to shorter lifespans, more frequent replacements, and higher associated environmental costs.

The link between product costs and actual long-term expenditures remains poorly understood (we were not able to identify existing studies outside of the automotive field), and this study represents the first empirical effort to explore this connection using real-world data for consumer products. Building on the established Total Cost of Ownership (TCO) framework (Faludi & Ritsma, 2024), this study quantifies the annual ownership costs of products by incorporating their purchase price, expected service lifespan, and repair costs and frequencies. Recent data on the lifespans and repair patterns of various consumer electronics (Amatuni et al., 2023) significantly enhance this framework. By integrating these data sources with complementary consumer surveys and retail data from Action stores in the Netherlands, we offer a pioneering assessment of optimal "economical" prices, highlighting that the cheapest option does not always deliver the lowest total costs over time.

Methods

This study has three main objectives:

1. To measure TCO across various models and product categories.
2. To examine the relationship between higher prices, product longevity, and potentially lower TCO, which has not been adequately studied with real-world consumption patterns.
3. To determine the “optimal product price” for each category, balancing either minimal total costs or the total material impacts. Consumers paying above or below these prices risk either overly frequent replacements or overpayment for disproportionately expensive goods missing potential economic or environmental efficiencies.

This study leverages recent consumer surveys with empirical data on product electronics lifespans, failure and repair rates (Amatuni et al., 2023), and actual purchase and repair statistics from our ongoing partnership with Action stores. Given that failure and repair data were collected at the product level rather than at a component level as outlined in the original TCO framework, we adopt a simplified formula:

$$TCO = \frac{Cp + Pf \cdot ((1 - Pr) \cdot Cp + Pr \cdot Cr)}{LT}$$

where TCO represents the Total Cost of Ownership, calculated as the annualized costs of owning a product. Cp is the purchase price of the product, LT is its expected service lifespan in years, Pf is the probability of failure during LT, Pr is the likelihood of a successful repair

attempt, and Cr is the cost of repair. Using this formula, we assess the TCO for each product by gathering data on prices (from multiple market sources), lifespans, and repair probabilities (from published studies and our additional survey with Action consumers). To address uncertainties in input data, we aimed to base each parameter on at least five survey sources and evaluate outcomes across best- and worst-case scenarios to be able to track and depict the uncertainty of the final results.

Results & discussion

Within this preliminary assessment, by comparing TCOs (the sum of the upfront price of a new product with its total repair costs along use time) for two product groups (smartphones and vacuum cleaners) with a broad price spectrum, we observe the following:

Firstly, while existing repairability scores (such as iFixit and FRI) rank consumer electronics in terms of ease of repair, they do not indicate cost savings or replacement frequencies. In contrast, this study provides a clearer link between upfront prices, longevity, and long-term economic outcomes. For this purpose, we conducted two surveys (38-50 respondents per product) collecting data on purchase, repair and discard behaviour, estimating the total use times and the TCO for each device. Here, we depict the resulting scatterplots after data cleaning and removal of outliers. For each product category, we explore the relationship between the upfront price of the product (x-axis) and its eventual use time or the resulting annual cost of ownership considering the possible repair costs (y-axis).

For smartphones sold in Germany (Figure 1), there was no statistically significant correlation observed between price and longevity. If anything, lower-paying consumers even tend to use devices for longer.

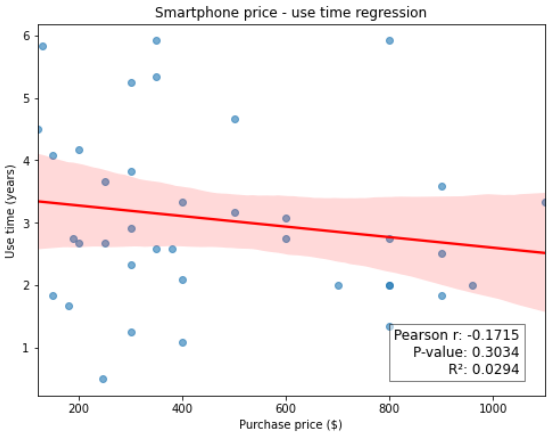

Figure 1: Relationship between upfront smartphone price in Germany and its resulting use time (n = 38). Linear model

At the same time, a higher upfront smartphone price is associated with a higher total annual cost of ownership in the long run (Figure 2).

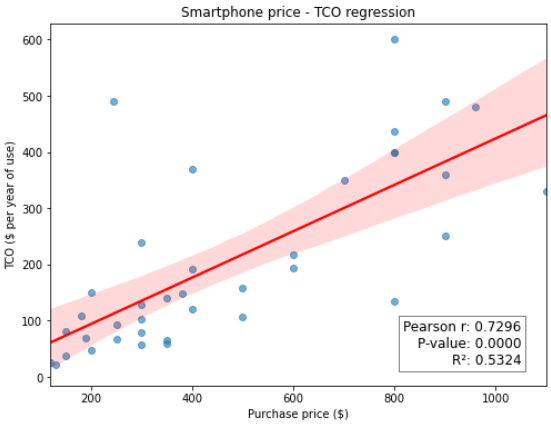

Figure 2: Relationship between upfront smartphone price in Germany and the resulting annual cost of ownership, TCO (n = 38). Linear model

For vacuum cleaners, considering the coefficient of determination R^2, quadratic regression fits the data better than the linear model, both for the use time and the annual cost of ownership. In particular, use time is extended with either the cheapest or the most expensive goods but not the ones in between (Figure 3).

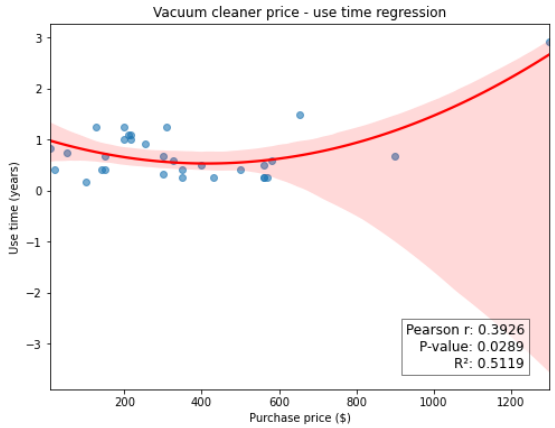

Figure 3: Relationship between upfront vacuum cleaner price in the US and its resulting use time (n = 31). Quadratic model

At the same time, there is also a moderate quadratic relationship observed that suggests that middle-cost goods cost the most in the long-run (Figure 4).

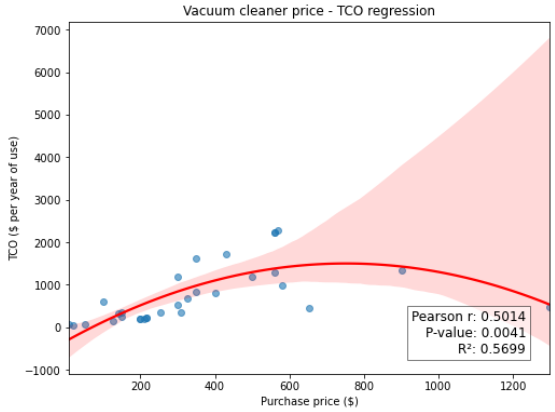

Figure 4: Relationship betIn ween upfront vacuum cleaner price in the US and the resulting annual cost of ownership (n = 31). Quadratic model

As a result, this preliminary assessment presents evidence against the common assumption of the gap between the most economical and the most sustainable consumption strategies. We show that for both products, replacement rates are rising with increasing prices and are later dropping again for vacuum cleaners. At the same time, expectedly, for both products, higher product price is associated with higher annual costs of ownership (TCO might rebound back for more expensive vacuum cleaners however).

In essence, contrary to expectations, we show that for selected categories, the cheapest products consistently offer the optimal balance of long-term cost-efficiency and sustainability.

Yet, results are expected to vary significantly across product categories, and within the later stage of this study, with a bigger sample size and a more diverse range of products, optimal economical and sustainable price ranges for each product category that minimize both consumer expenses and environmental impacts will be identified.

To conclude, this study is the first to empirically link product prices, use patterns, and repair data with long-term monetary and environmental outcomes. By identifying price points that align with sustainable consumption, this research offers valuable insights for consumers, retailers, and policymakers aiming to foster economic and environmental sustainability.

Acknowledgments

We highly appreciate help with the surveys provided by Christian Clemm from The University of Tokyo, Tokyo, Japan.

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