Analyzing the Impact of the Amazon-Whole Foods Merger on Product Prices: A Difference-in-Differences Approach

Jingrui Wu, Sofía Lozano-Samper

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Abstract

We examine the impact of the Amazon-Whole Foods merger on food prices. While the merger is profitable from an industrial perspective, its benefits to consumers remain unclear. Using third-party data on food and non-food products from Keepa, we employ a Difference-in-Differences (DiD) model to estimate the merger's treatment effect on food prices. Our analysis reveals a negative causal effect, indicating that food prices decreased following the merger, ultimately benefiting consumers.

1 Introduction

The 2017 acquisition of Whole Foods Market by Amazon for $13.7 billion marked a pivotal moment in the retail and e-commerce sectors. This strategic merger allowed Amazon to strengthen its foothold in the highly competitive grocery industry, leveraging its e-commerce infrastructure and logistics expertise. At the same time, it aimed to address challenges faced by Whole Foods, including declining sales and competition from lower-priced grocery chains. Amazon's immediate price reductions on select Whole Foods products and integration of its

Prime membership benefits highlighted its intent to disrupt the traditional grocery market and make organic foods more accessible. As a result, the merger has raised questions about its broader impact, particularly on food prices. This paper investigates the causal effect of the Amazon-Whole Foods merger on food prices, using a Difference-in-Differences (DiD) model to assess whether the merger benefited consumers by lowering prices.

2 Literature Review

The economic implications of mergers and acquisitions have been a central focus in industrial organization and antitrust economics. The primary areas of investigation include the effects of mergers on prices, competition, consumer welfare, and efficiency. This review synthesizes insights from three seminal papers that explore these dimensions across various industries.

2.1 Price Effects of Mergers

The relationship between mergers and price changes has been extensively studied, with much of the literature emphasizing the potential for horizontal mergers in concentrated markets to result in higher consumer prices. Ashenfelter, Hosken, and Weinberg (2013) provide an empirical analysis of the Whirlpool-Maytag merger, a notable case in the appliance industry. They found that post-merger, prices for dishwashers and clothes dryers increased significantly, while prices for refrigerators and clothes washers remained largely unaffected (Ashenfelter et al., 2013) These findings contribute to the broader literature about price increases following mergers in concentrated markets, consistent with the notion that reduced competition can enhance firms' pricing power. Similar conclusions are observed in other industries. For example, Borenstein (1990) and Kim and Singal (1993) report that airline mergers led to increased ticket prices, while Vita and Sacher (2001) identify similar price effects in hospital mergers. Banking sector studies by Prager and Hannan (1998) and Focarelli and Panetta (2003) further corroborate these patterns, showing that mergers often result in higher interest rates for consumers. Theoretical models by Deneckere and Davidson (1985) reinforce these empirical findings, suggesting that firms in post-merger markets with differentiated products have diminished incentives to compete on price. Expanding on this discourse, Ashenfelter and Hosken (2008) analyze scanner data from five recent consumer product mergers, providing evidence that these mergers generally lead to price increases. Their findings highlight the challenges faced by U.S. horizontal merger policies in preventing adverse consumer outcomes, particularly in highly concentrated markets. Moreover, their study underscores the additional concern of reduced product variety, which may further erode consumer welfare by limiting choices (Ashenfelter & Hosken, 2008).

2.2 Efficiency Gains from Mergers

While the price effects of mergers often raise concerns, the potential for efficiency gains provides an important counterbalance in the evaluation of M&As. Williamson's (1968) seminal work suggests that mergers, while increasing market power, may also generate operational efficiencies that can offset welfare losses. This duality is particularly relevant in regulated industries where efficiency improvements are easier to measure. Demirer and Karaduman's study of M&As in the U.S. power generation sector offers valuable insights into this perspective. Their findings indicate that ownership changes following mergers increased efficiency by approximately 5%, primarily through operational enhancements, without compromising reliability. These results challenge the traditional view that mergers are primarily motivated by market power considerations and highlight the potential for resource reallocation to more efficient firms (Demirer & Karaduman, 2024). The efficiency argument is also supported by studies in other industries. Focarelli and Panetta (2003) observe that banking mergers, despite short-term price increases, may generate long-term cost savings that benefit consumers. However, Whinston (2007) and Asker and Nocke (2021) caution that many studies rely on hypothetical efficiency gains rather than direct empirical evidence, leaving the magnitude and consistency of these benefits open to debate.

3 Data

The data used in this study is sourced from Keepa, a third-party platform that provides historical price tracking for products sold on Amazon. For our analysis, we categorize products into two groups: food products as the treatment group and non-food products as the control group.

Table 1: Summary Statistics Table

Product	Min	Max	Mean	Std	Count	First Date	Last Date
Panel A							
BarillaPasta	5.99	89.99	12.64	5.01	3446	2015-06-01	2024-11-26
RolandArborioSuperfino	13.10	59.99	28.16	6.49	4991	2011-03-26	2024-11-22
almondmilk	1.16	90.00	14.26	6.23	3669	2014-11-18	2024-12-03
arborio	3.08	39.49	11.18	6.83	3473	2015-05-14	2024-11-14
avocados	10.01	37.75	20.97	3.86	3454	2015-06-21	2024-12-03
nutmix	4.50	35.95	13.59	5.29	4408	2012-11-09	2024-12-03
Panel B							
CassioVintageWatch	3.99	58.70	12.19	9.41	4015	2013-11-26	2024-11-22
beanie	1.75	30.50	11.58	4.52	4769	2011-11-15	2024-12-04
blush	1.74	96.00	8.75	14.15	3797	2014-04-30	2024-12-03
dryeraseboard	50.71	85.90	62.43	5.44	3286	2015-12-07	2024-12-04
eyebrow	9.99	54.99	23.80	4.60	3725	2014-09-23	2024-12-03
foundation	1.49	20.74	10.47	3.16	3209	2016-02-11	2024-12-03
headbands	1.00	100.00	4.76	8.78	5005	2011-03-24	2024-12-04
hotwheels	1.00	100.00	8.96	17.11	5005	2011-03-24	2024-12-04
knife	11.99	115.99	34.74	8.94	3172	2016-03-30	2024-12-04
markers	2.76	49.67	18.95	6.03	4467	2012-09-12	2024-12-04
measuringcups	1.11	100.00	18.66	7.21	3755	2014-08-24	2024-12-03
stanley	3.66	75.00	23.89	6.08	3683	2014-10-24	2024-11-22
tents	1.99	53.95	21.10	6.10	4863	2011-08-01	2024-11-22
toasteroven	100.00	399.99	182.88	35.21	4049	2013-11-04	2024-12-04
toothbrush	23.33	87.52	41.60	6.43	3420	2015-07-26	2024-12-04
tshirt	3.42	18.00	6.82	2.21	3614	2015-01-13	2024-12-04
umbrella	3.88	36.95	23.55	4.07	3263	2015-12-29	2024-12-03
All Products	**1.00**	**399.99**	**26.30**	**37.49**	**90633**	**2011-03-24**	**2024-12-04**

Note: Min, Max, Mean, and Std correspond to the "Price" variable.

The treatment group consists of 6 food products, while the control group includes 17 non-food products. Price data for these products is obtained from Keepa's "new" price listings, which reflect the market price for each product across both the treatment and control groups.

We use Python to web-scrape and extract the price information from the Keepa website.

4 Methodology

To assess the impact of the Amazon-Whole Foods merger on food prices, we employ a Difference-in-Differences (DiD) approach. This methodology enables us to evaluate the treatment effect of the merger by comparing price changes for food products (the treatment group) with those for non-food products (the control group) before and after the merger.

4.1 Treatment and Control Groups

The treatment group consists of six food products sold on Amazon, while the control group includes seventeen non-food products. These groups were chosen to control for factors that may influence price changes, assuming that the non-food products were unaffected by the merger. This design allows us to isolate the price effects specifically attributed to the Amazon-Whole Foods merger.

4.2 Pre-Merger and Post-Merger

The merger was finalized on August 28, 2017; however, instead of using the exact date, we define August 2017 as the cutoff month separating the pre-merger and post-merger periods. Thus, the pre-merger period includes data up to July 2017, and the post-merger period begins in August 2017.

4.3 Difference-in-Differences Estimation

The core of our analysis is a DiD model, which compares the price changes of food products (treatment group) to those of non-food products (control group) before and after the merger. The DiD specification is as follows:

$$\log(Y_{it}) = \alpha + \beta_1(\text{Post}_t \times \text{Treat}_i) + \gamma_i + \delta_t + \epsilon_{it}$$

Where:

- $\log(Y_{it})$ represents the log price of product i at time t,
- Post_t is a binary indicator that equals 1 for months from August 2017 onwards (post-merger) and 0 for months before August 2017 (pre-merger),
- Treat_i is a binary indicator that equals 1 for products in the treatment group (food products) and 0 for products in the control group (non-food products),
- $\text{Post}_t \times \text{Treat}_i$ is the interaction term, capturing the DiD estimator—the difference in price changes between the treatment and control groups post-merger,
- γ_i represents product fixed effects, controlling for time-invariant product characteristics,
- δ_t represents time fixed effects, accounting for time-specific shocks affecting all products,
- α is the constant, and ϵ_{it} is the error term.

The coefficient β_1 on the interaction term is of primary interest, as it represents the causal effect of the merger on food prices.

4.4 Model Execution

In running the DiD model, we conducted seven iterations. The first six iterations used each treatment variable combined with all control variables. The seventh iteration pooled all treatment variables and control variables together to estimate the overall result. This iterative approach enhances the flexibility and robustness of the analysis. By examining each treatment variable individually in conjunction with all control variables in the first six iterations, we are able to isolate the specific effect of each treatment while controlling for other potential influences. The seventh iteration, in which all treatment variables are pooled together, provides a holistic assessment of the combined effect of the treatments. This methodology strengthens the reliability and robustness of the findings by capturing both individual and aggregate treatment effects.

5 Results

5.1 Event Study

In order to preliminarily assess the impact of the Amazon-Whole Foods merger on food prices, we conducted an event study prior to implementing the Difference-in-Differences (DiD) analysis.

The primary aim of the event study is to investigate the price dynamics of both food and non-food products surrounding the merger event, which occurred on August 2017. This approach allows for the identification of any immediate or delayed effects of the merger on food prices. Additionally, the event study serves to delineate the appropriate time window for the DiD model by establishing distinct pre- and post-merger periods. Through this process, the event study also facilitates a visual examination of the price trends in both the treatment (food) and control (non-food) groups, ensuring that the parallel trends assumption was met.

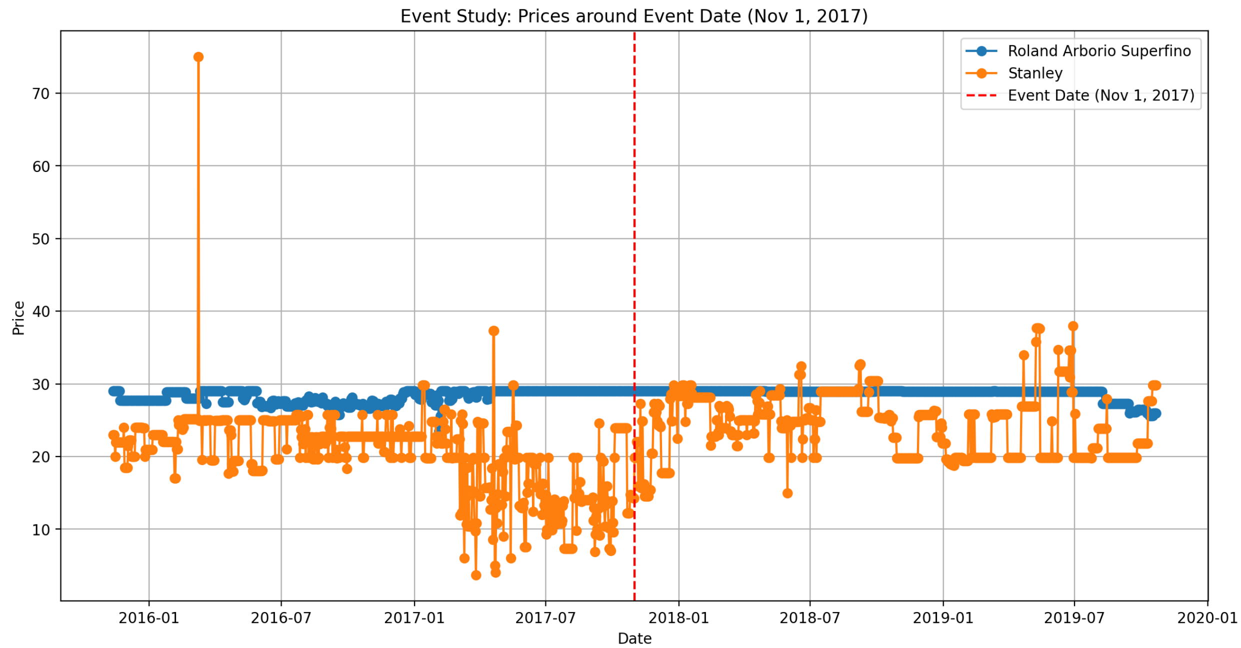

Figure 1: Event Study: Prices Around the Merger Date

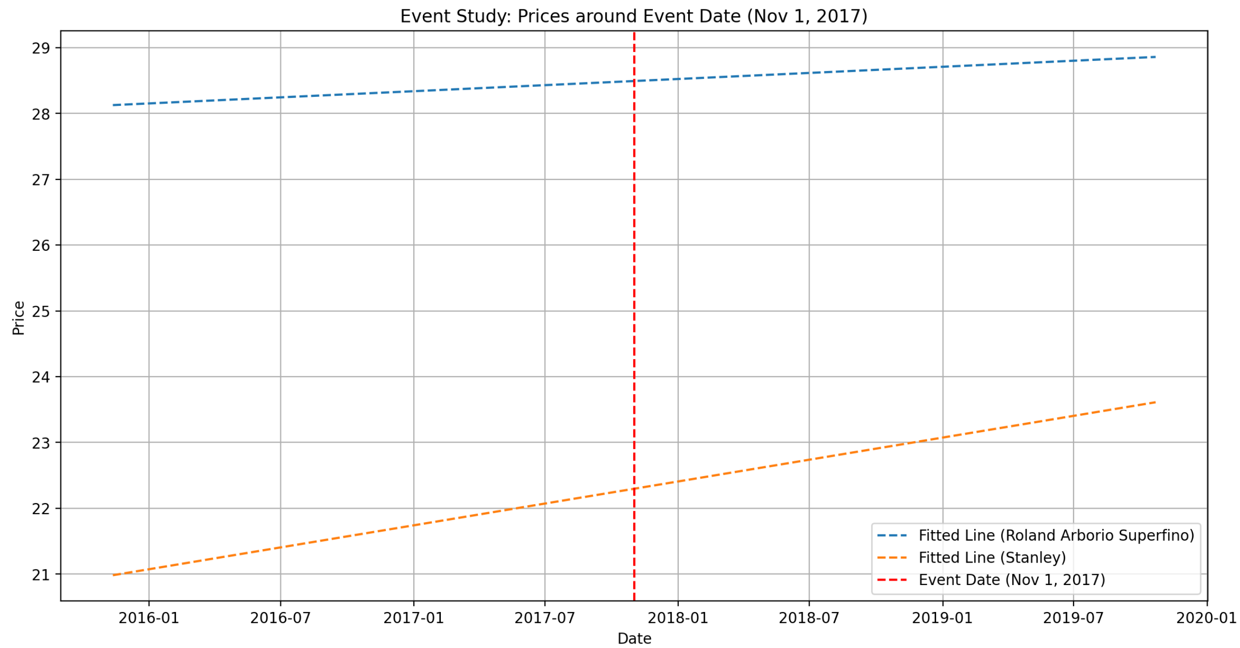

Figure 2: Event Study: Fitted Lines

5.2 DiD Results

Table 2: Model Results for Treatment Effects

Model	Treatment*Post	P-Value	Standard Error	HC3 Standard Error
Avocados	-0.271893	3.295986e-71	0.015221	4.738143e-08
Almondmilk	-0.446268	1.724919e-216	0.014160	2.835916e-06
Nutmix	-0.396696	5.893669e-236	0.012049	1.406440e-07
BarillaPasta	-0.173270	9.110340e-30	0.015283	1.412264e-02
Arborio	-0.950947	0.000000e+00	0.015204	1.132617e-07
RolandArborioSuperfino	-0.060312	2.750820e-08	0.010853	1.366752e-04
General	-0.345581	0.000000e+00	0.006049	6.309041e-03

The results from the Difference-in-Differences (DiD) analysis show statistically significant negative treatment effects across all product categories, indicating that the Amazon-Whole Foods merger led to a reduction in prices for the majority of food products. For Avocados, the treatment effect is -0.271893, with a highly significant p-value of 3.295986e-71, suggesting a substantial price decrease post-merger. Similarly, Almondmilk shows a treatment effect of -0.446268 and a p-value of 1.724919e-216, pointing to a significant drop in price. Nutmix also exhibits a significant price reduction with a treatment effect of -0.396696 and a p-value of 5.893669e-236. The price for BarillaPasta decreased by -0.173270, with a p-value of 9.110340e-30, confirming a statistically significant reduction post-merger. The treatment effect for Arborio is particularly pronounced at -0.950947, with a p-value of 0.000000e+00, indicating a sharp decline in price. Roland Arborio Superfino shows a more moderate price reduction of -0.060312 (p-value = 2.750820e-08), while the General model, which aggregates all products, shows an overall treatment effect of -0.345581 (p-value = 0.000000e+00), indicating a significant reduction in food prices across the board. The standard errors and HC3 standard errors for all models are small, further supporting the precision and robustness of the findings. These results collectively suggest that the Amazon-Whole Foods merger led to significant price decreases across various food products, benefiting consumers in these categories.

6 Discussion

6.1 Data

The data employed in this project diverges from the data initially intended for use. Ideally, for the purposes of this analysis, we would have had access to detailed pricing data for food products sold exclusively at Whole Foods, both before and after the merger, as well as for comparable food products not sold at Whole Foods during the same periods. The former would have served as the treatment group, while the latter would have constituted the control group. In an ideal scenario, we would also have been able to compare the prices of food products at Whole Foods with similar items sold at other major grocery chains, such as Kroger, Walmart, and Costco. However, due to time constraints and limited resources, obtaining such granular, store-specific data was not feasible. Consequently, we opted to use food products as the treatment group and non-food products as the control group in our analysis.

In addition to the aforementioned limitations, we relied on Keepa's *new* data rather than the *Amazon* data for our analysis. The *new* data offers more comprehensive and longer-term historical price information, providing a broader view of price trends across various products. By utilizing this data, we are effectively incorporating third-party price information that reflects market-level pricing, rather than data specific to Amazon's platform. As a result, the treatment effects derived from market-level prices are likely to be smaller than those that would be obtained from store-specific data, as market prices aggregate a wider array of pricing strategies and may not fully capture the individual pricing behavior at Whole Foods. This introduces an additional layer of uncertainty in our estimates, as the effects observed using market-level data may understate the true impact of the merger on prices at Whole Foods.

6.2 Results

The results from the seven iterations of our analysis consistently yield negative treatment effects, providing strong evidence that the Amazon-Whole Foods merger led to a decrease in food prices. These findings suggest that the merger not only benefited the companies involved but also had positive implications for consumers, as the price reduction can be interpreted as a direct benefit to consumer welfare. The decline in prices consequently enhances consumer surplus, as consumers are able to access food products at lower prices, thereby improving their overall welfare.

7 Conclusion

This analysis investigates the impact of the Amazon-Whole Foods merger on food prices, leveraging data from Keepa to estimate treatment effects using a Difference-in-Differences (DiD) approach. Due to data constraints, we used food products as the treatment group and non-food products as the control group, with market-level pricing information sourced from Keepa's "new" data. While this approach introduces some limitations in terms of granularity, it allowed us to assess the broader market trends resulting from the merger.

The results from seven iterations of our analysis consistently indicate negative treatment effects, suggesting that the merger led to a reduction in food prices. These findings imply that the merger not only benefited the companies involved but also provided significant advantages to consumers, as the price decreases contribute to an increase in consumer surplus. The lower prices following the merger suggest that consumers experienced improved welfare, highlighting the broader economic benefits of such corporate consolidations.

While the data used in this study was not as granular as initially desired, and the use of market-level rather than store-specific pricing may have led to a slight underestimation of the true impact, the evidence still strongly supports the conclusion that the Amazon-Whole Foods merger had a positive effect on food prices. Future research could benefit from more detailed, store-specific data to further refine these estimates and explore the long-term effects of the merger on both consumer behavior and market dynamics.

8 References

References

Ashenfelter, O., & Hosken, D. (2008). *The effect of mergers on consumer prices: Evidence from five mergers on the enforcement margin*. National Bureau of Economic Research. https://doi.org/10.3386/w13859

Ashenfelter, O., Hosken, D., & Weinberg, M. (2013). The price effects of a large merger of manufacturers: A case study of maytag-whirlpool. *American Economic Journal: Economic Policy*, *5*(1), 239–261. https://doi.org/10.1257/pol.5.1.239

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Note on AI use: This paper was developed with assistance from AI tools, including GitHub Copilot, Claude, and ChatGPT. These tools were utilized for coding support, drafting text, and refining content. All outputs were reviewed and edited to ensure accuracy, originality, and alignment with the paper's objectives.

9 Appendix

Figures in the appendix were created for reference. A GitHub Repository is included for replication purposes: https://github.com/sofials2002/Econ521Project

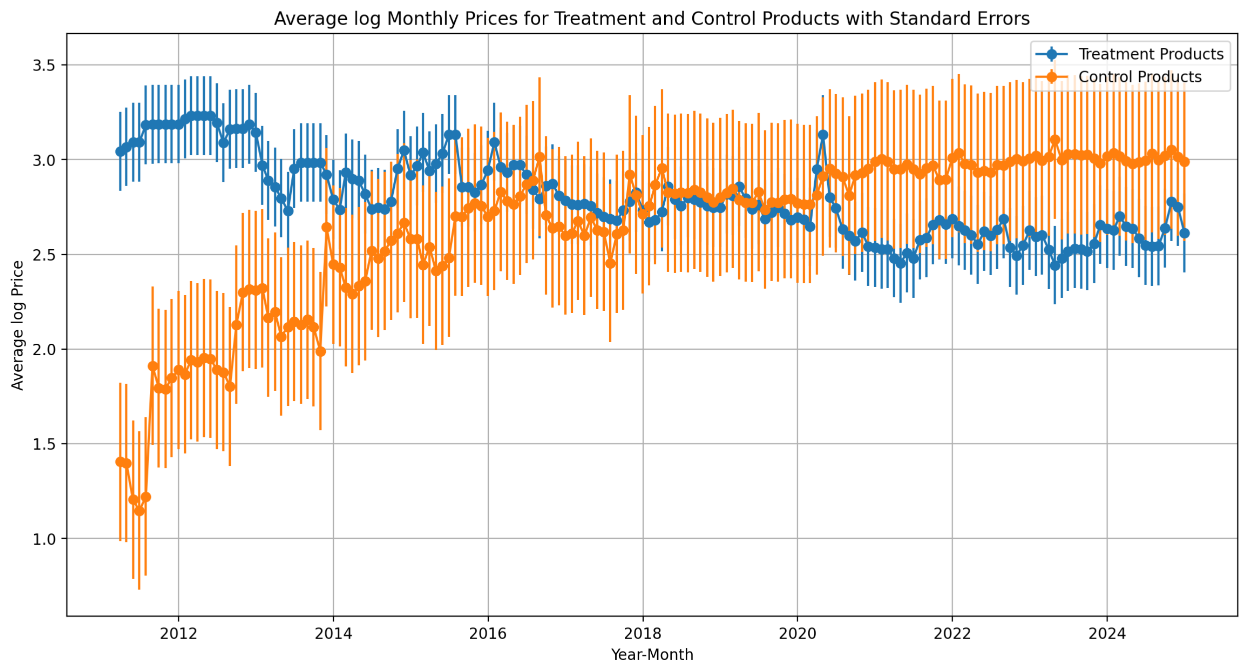

Figure 3: Average log Monthly Prices for Treatment and Control Products with Standard Errors

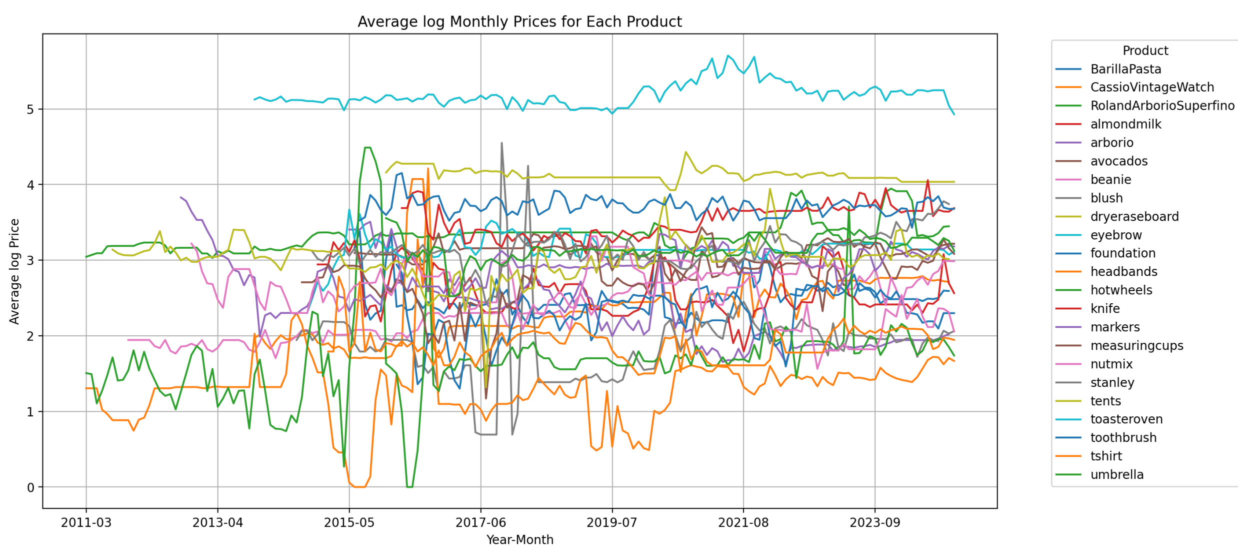

Figure 4: Average log Monthly Prices for Each Product

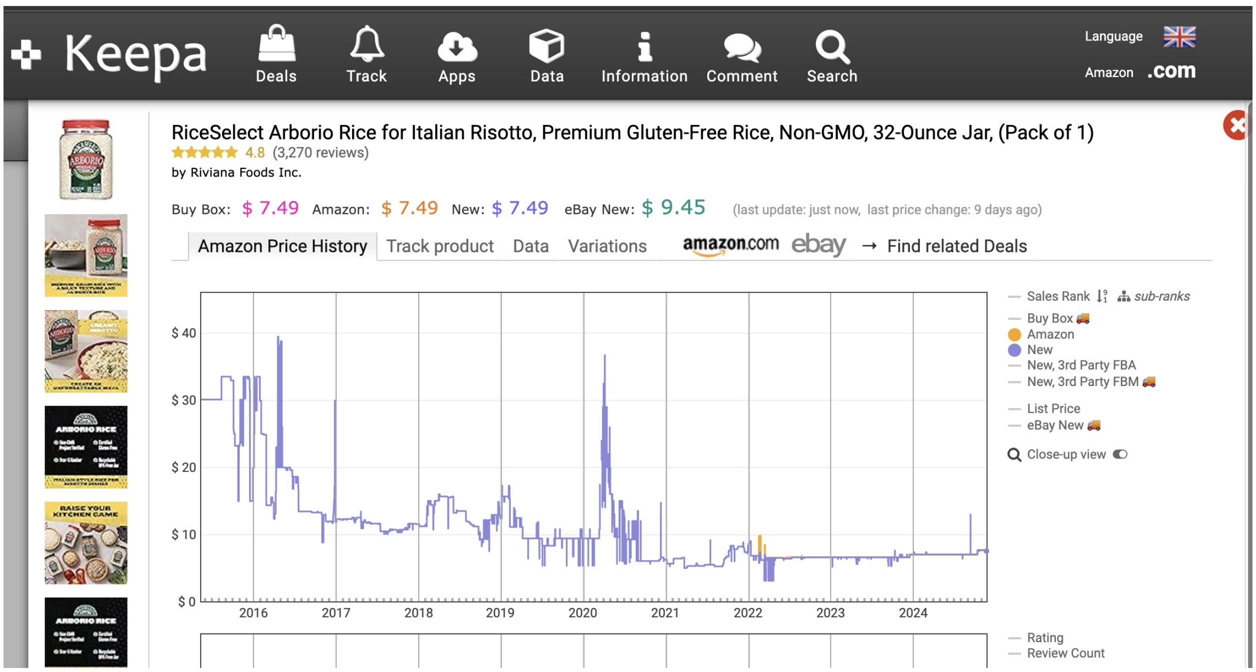

Figure 5: Example of Price Data used During Web Scraping