# Data Replication

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## Introduction

- Objective: Reproduce the graphs using RStudio. These graphs show "Heterogeneity in Pricing Technology by Hour of the Week"
- Tools used: Data from `analysis_data.dta` , `data.table`, `ggplot2`, and `lubridate` packages
- Outcome: Understand retailer pricing behavior by hour and day of the week.
- In this paper, Brown & MacKay (2023), show that pricing behavior varies significantly across retailers.
- We used `ggplot2` for plotting (Wickham (2016)) and built this deck with Quarto (Posit, PBC (2022)).

## Replication Code

```
library(haven)
library(data.table)
library(dplyr)
library(ggplot2)


data <- read_dta("C:/Users/attef/OneDrive/Documents/Replicaproject/Replica/analysis/data/anal
df <- as.data.table(haven::read_dta("C:/Users/attef/OneDrive/Documents/Replicaproject/Replica


# Filter for Retailer A
retailer_A <- df_hourly[website == "A"]

ggplot(retailer_A, aes(x = hourofweek, y = hourly_dist)) +
  geom_line(color = "black", linewidth = 1) +
```

```r
  # X-axis: tick every 24 hours (no labels)
  scale_x_continuous(
    breaks = seq(0, 168, by = 24),
    limits = c(0, 168),
    expand = c(0, 0)
  ) +

  # Y-axis: 0% to 1% for Retailer A
  scale_y_continuous(
    limits = c(0, 1),
    breaks = seq(0, 1, by = 0.2),
    labels = function(x) sprintf("%.1f", x)
  ) +

  # Vertical dashed lines at day boundaries
  geom_vline(xintercept = seq(24, 144, by = 24), linetype = "dashed", color = "gray60") +

  # Add day labels as text (not tick labels)
  annotate("text", x = 12, y = 0, label = "Sat", vjust = 1.5, size = 4) +
  annotate("text", x = 36, y = 0, label = "Sun", vjust = 1.5, size = 4) +
  annotate("text", x = 60, y = 0, label = "Mon", vjust = 1.5, size = 4) +
  annotate("text", x = 84, y = 0, label = "Tue", vjust = 1.5, size = 4) +
  annotate("text", x = 108, y = 0, label = "Wed", vjust = 1.5, size = 4) +
  annotate("text", x = 132, y = 0, label = "Thu", vjust = 1.5, size = 4) +
  annotate("text", x = 156, y = 0, label = "Fri", vjust = 1.5, size = 4) +

  labs(
    title = "Panel A. Retailer A",
    x = "Hour of Week",
    y = "Percent of Price Changes"
  ) +
  theme_minimal(base_size = 14) +
  theme(
    panel.grid.minor = element_blank(),
    axis.text.x = element_blank(),   # Hide tick labels
    axis.ticks.x = element_blank(),
    plot.title = element_text(hjust = 0.5)
  )


ggplot(df_hourly[website == "B"], aes(x = hourofweek, y = hourly_dist)) +
  geom_line(color = "black", linewidth = 1) +
```

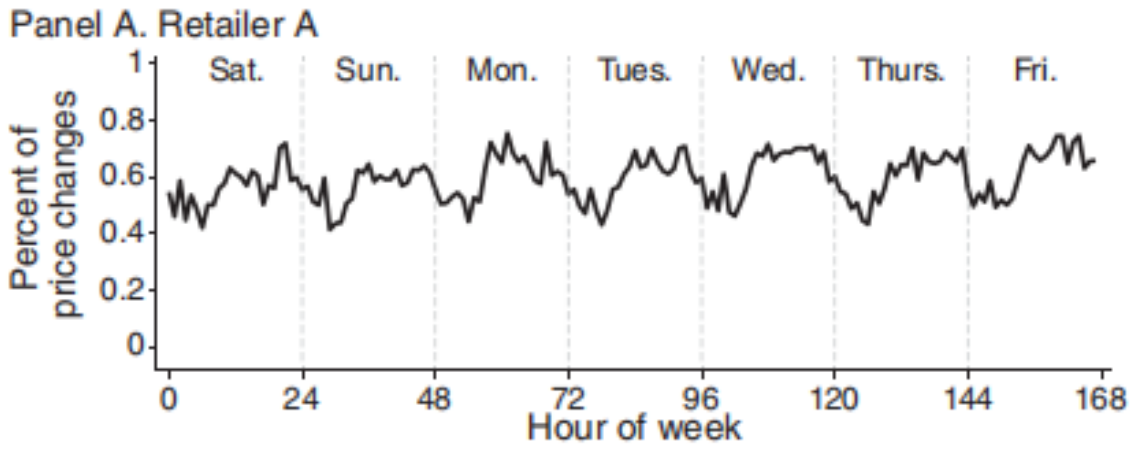
```
  scale_x_continuous(
    breaks = seq(0, 168, by = 24),
    limits = c(0, 168),
    expand = c(0, 0)
  ) +
  scale_y_continuous(
    limits = c(0, 1),
    breaks = seq(0, 1, by = 0.2),
    labels = function(x) sprintf("%.1f", x)
  ) +
  geom_vline(xintercept = seq(24, 144, by = 24), linetype = "dashed", color = "gray60") +
  annotate("text", x = seq(12, 156, by = 24), y = 0, label = c("Sat", "Sun", "Mon", "Tue", "
  labs(
    title = "Panel B. Retailer B",
    x = "Hour of Week",
    y = "Percent of Price Changes"
  ) +
  theme_minimal(base_size = 14) +
  theme(
    axis.text.x = element_blank(),
    axis.ticks.x = element_blank(),
    axis.text.y = element_text(size = 10),
    plot.title = element_text(hjust = 0.5),
  )


ggplot(df_hourly[website == "C"], aes(x = hourofweek, y = hourly_dist)) +
  geom_line(color = "black", linewidth = 1) +
  scale_x_continuous(
    breaks = seq(0, 168, by = 24),
    limits = c(0, 168),
    expand = c(0, 0)
  ) +
  scale_y_continuous(
    limits = c(0, 8),
    breaks = seq(0, 8, by = 2),
    labels = function(x) sprintf("%.0f", x)
  ) +
  geom_vline(xintercept = seq(24, 144, by = 24), linetype = "dashed", color = "gray60") +
  annotate("text", x = seq(12, 156, by = 24), y = 0, label = c("Sat", "Sun", "Mon", "Tue", "
  labs(
    title = "Panel C. Retailer C",
```

```
    x = "Hour of Week",
    y = "Percent of Price Changes"
  ) +
  theme_minimal(base_size = 14) +
  theme(
    axis.text.x = element_blank(),
    axis.ticks.x = element_blank(),
    axis.text.y = element_text(size = 10),
    plot.title = element_text(hjust = 0.5),
  )

ggplot(df_hourly[website == "D"], aes(x = hourofweek, y = hourly_dist)) +
  geom_line(color = "black", linewidth = 1) +
  scale_x_continuous(
    breaks = seq(0, 168, by = 24),
    limits = c(0, 168),
    expand = c(0, 0)
  ) +
  scale_y_continuous(
    limits = c(0, 25),
    breaks = seq(0, 25, by = 5),
    labels = function(x) sprintf("%.0f", x)
  ) +
  geom_vline(xintercept = seq(24, 144, by = 24), linetype = "dashed", color = "gray60") +
  annotate("text", x = seq(12, 156, by = 24), y = 0, label = c("Sat", "Sun", "Mon", "Tue", "
  labs(
    title = "Panel D. Retailer D",
    x = "Hour of Week",
    y = "Percent of Price Changes"
  ) +
  theme_minimal(base_size = 14) +
  theme(
    axis.text.x = element_blank(),
    axis.ticks.x = element_blank(),
    axis.text.y = element_text(size = 10),
    plot.title = element_text(hjust = 0.5),
  )


ggplot(df_hourly[website == "E"], aes(x = hourofweek, y = hourly_dist)) +
  geom_line(color = "black", linewidth = 1) +
  scale_x_continuous(
```

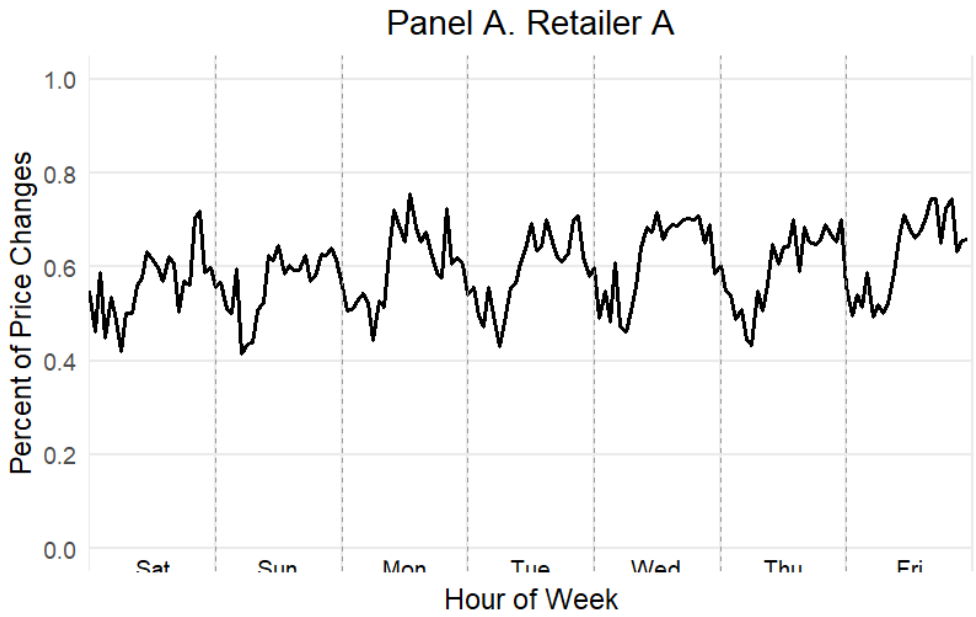
```
  breaks = seq(0, 168, by = 24),
  limits = c(0, 168),
  expand = c(0, 0)
) +
scale_y_continuous(
  limits = c(0, 60),
  breaks = seq(0, 60, by = 10),
  labels = function(x) sprintf("%.0f", x)
) +
geom_vline(xintercept = seq(24, 144, by = 24), linetype = "dashed", color = "gray60") +
annotate("text", x = seq(12, 156, by = 24), y = 0, label = c("Sat", "Sun", "Mon", "Tue", "
labs(
  title = "Panel E. Retailer E",
  x = "Hour of Week",
  y = "Percent of Price Changes"
) +
theme_minimal(base_size = 14) +
theme(
  axis.text.x = element_blank(),
  axis.ticks.x = element_blank(),
  axis.text.y = element_text(size = 10),
  plot.title = element_text(hjust = 0.5),
)
```

### First Graph

#### Original

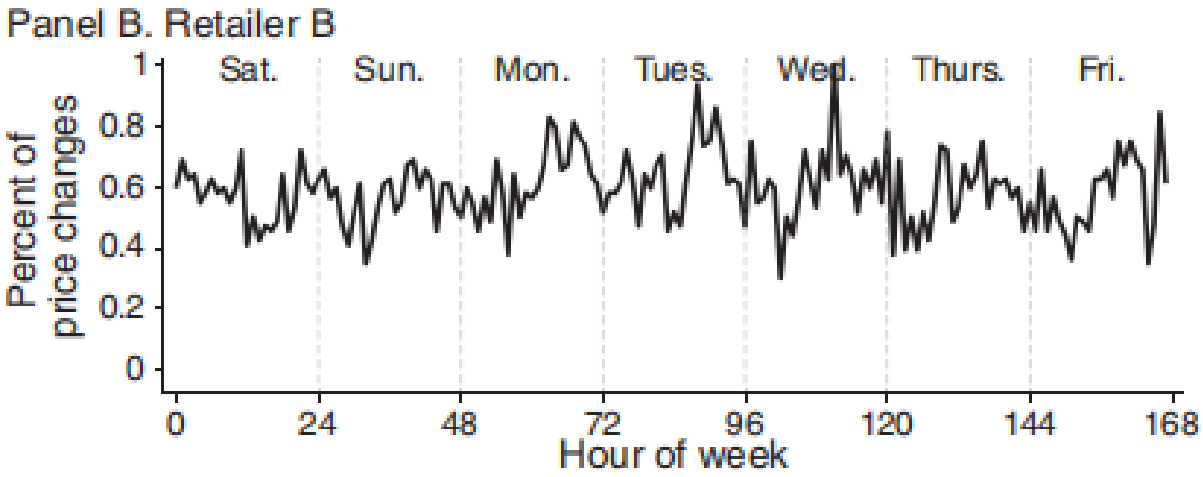


**Replication**

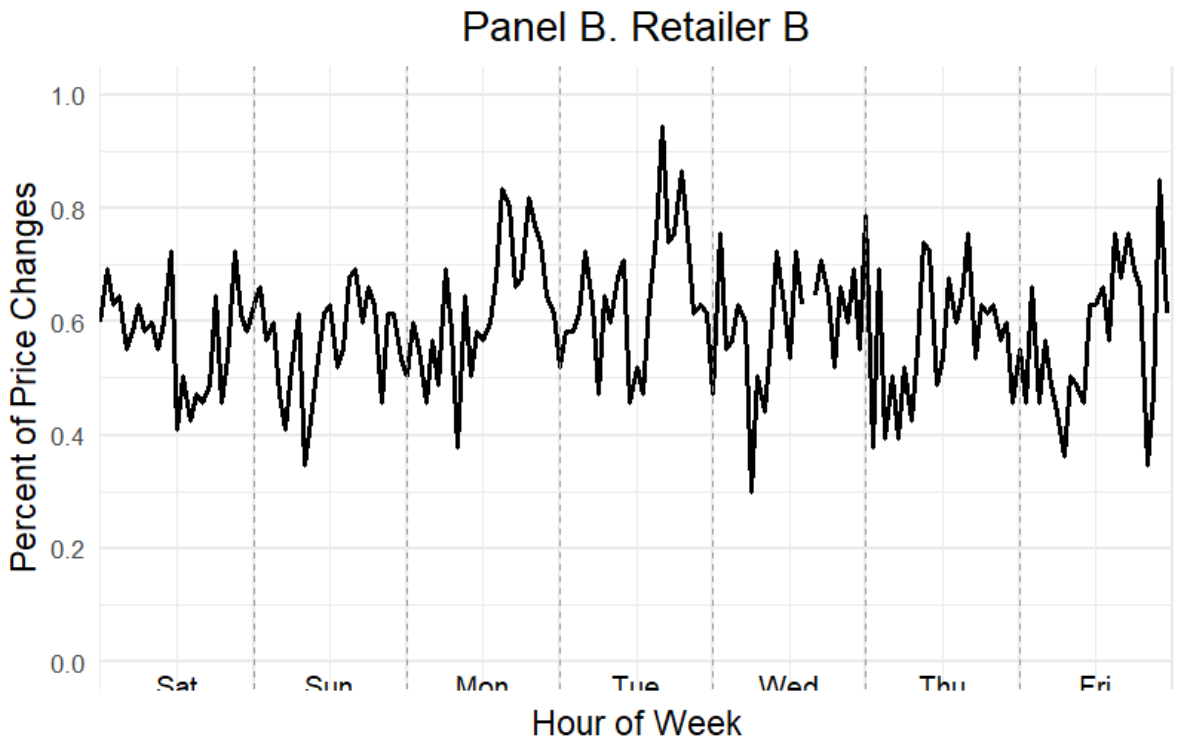



**Second Graph**

**Original**

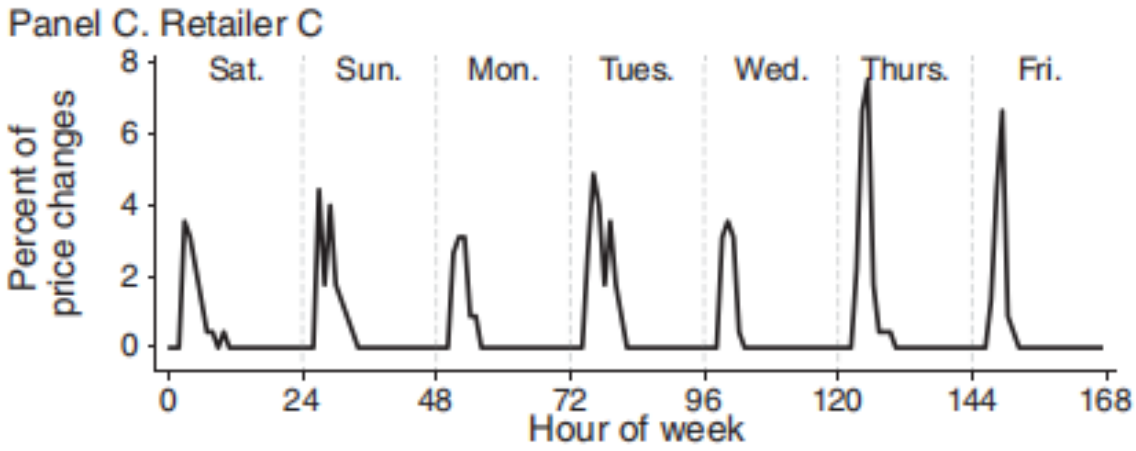


**Replication**

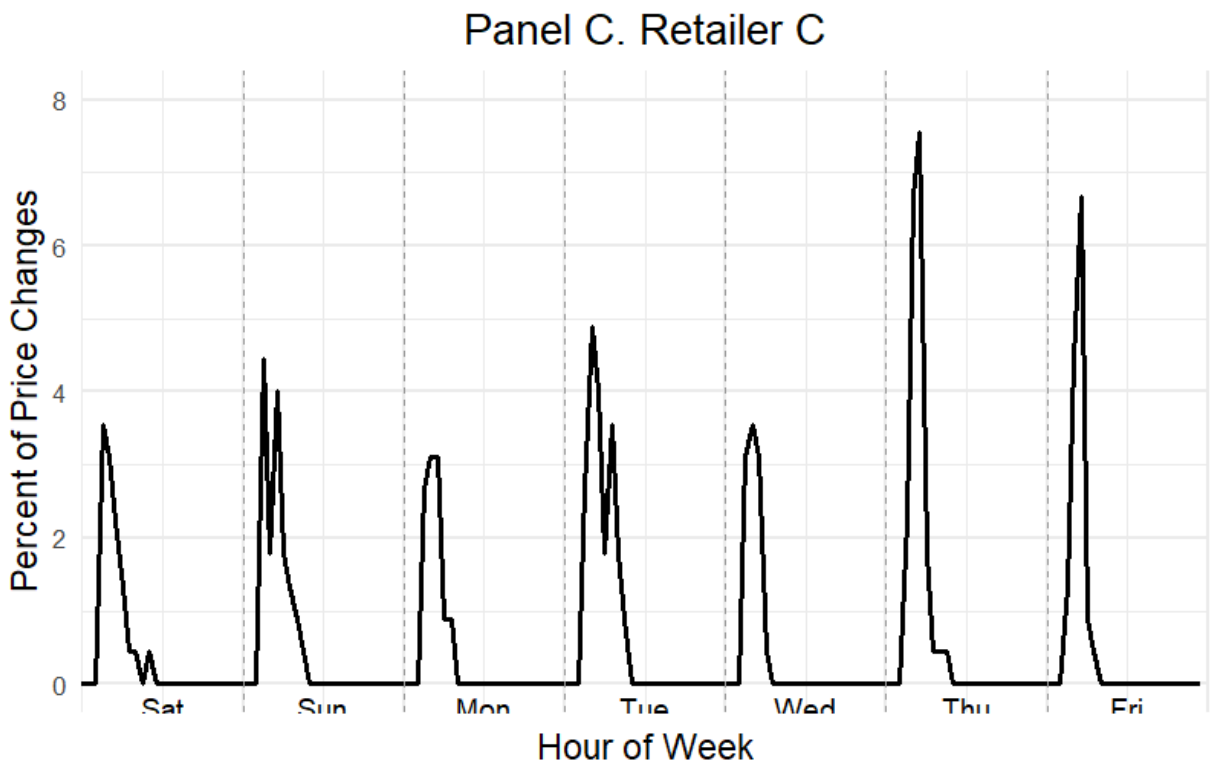



**Third Graph**

**Original**

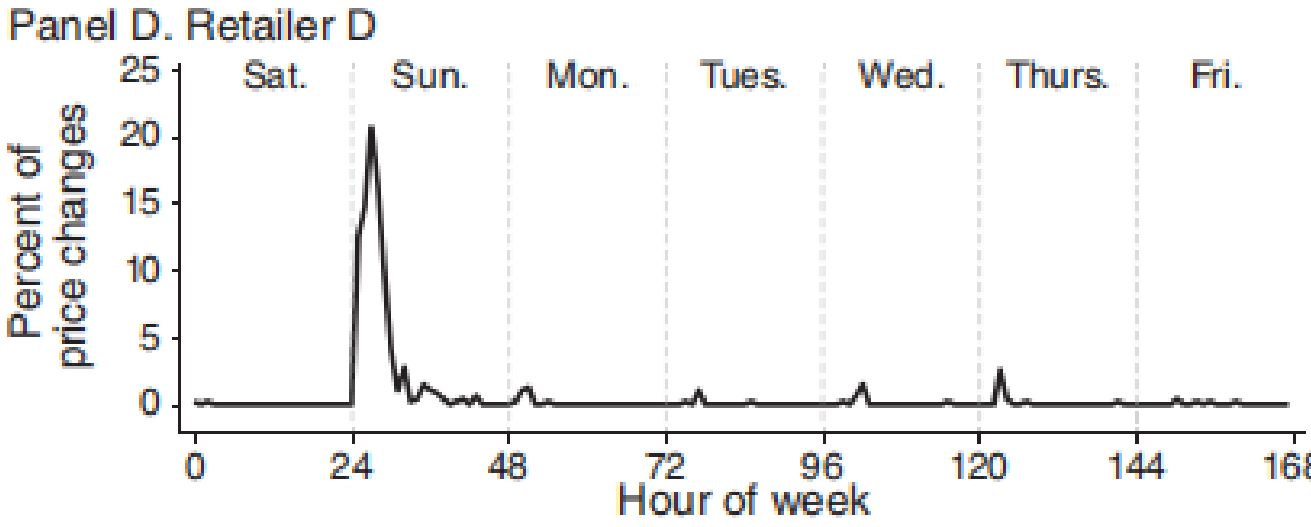


**Replication**

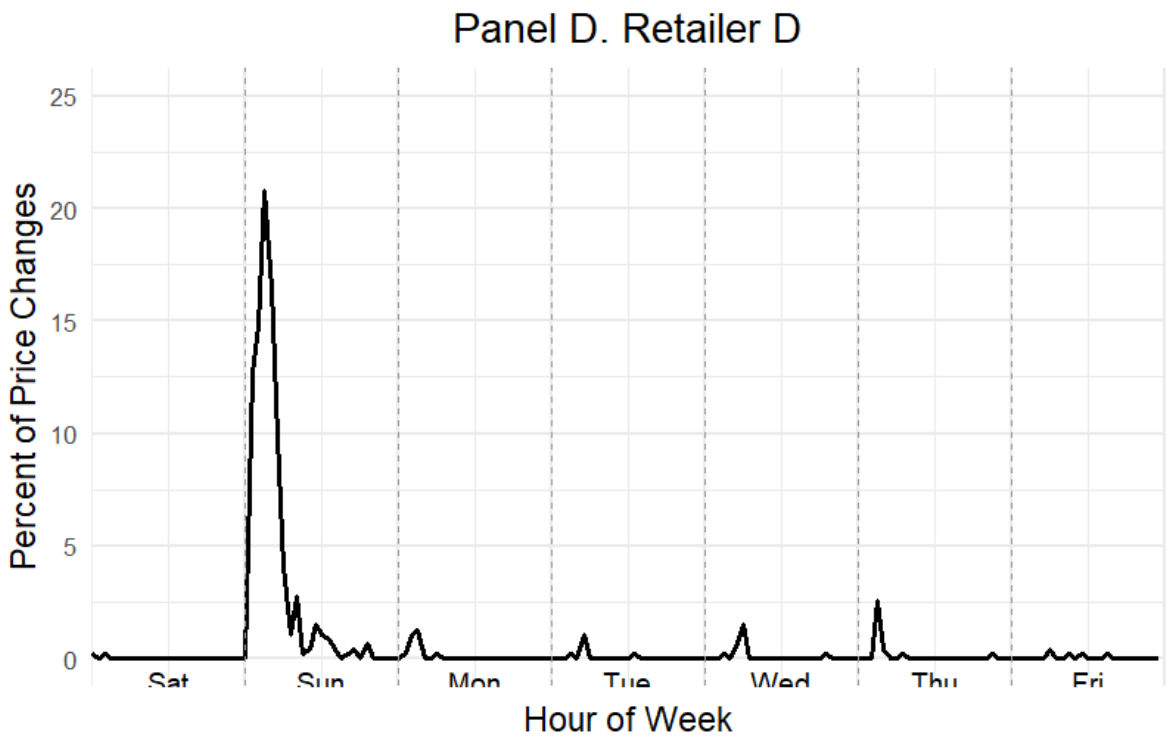


**Fourth Graph**

**Original**

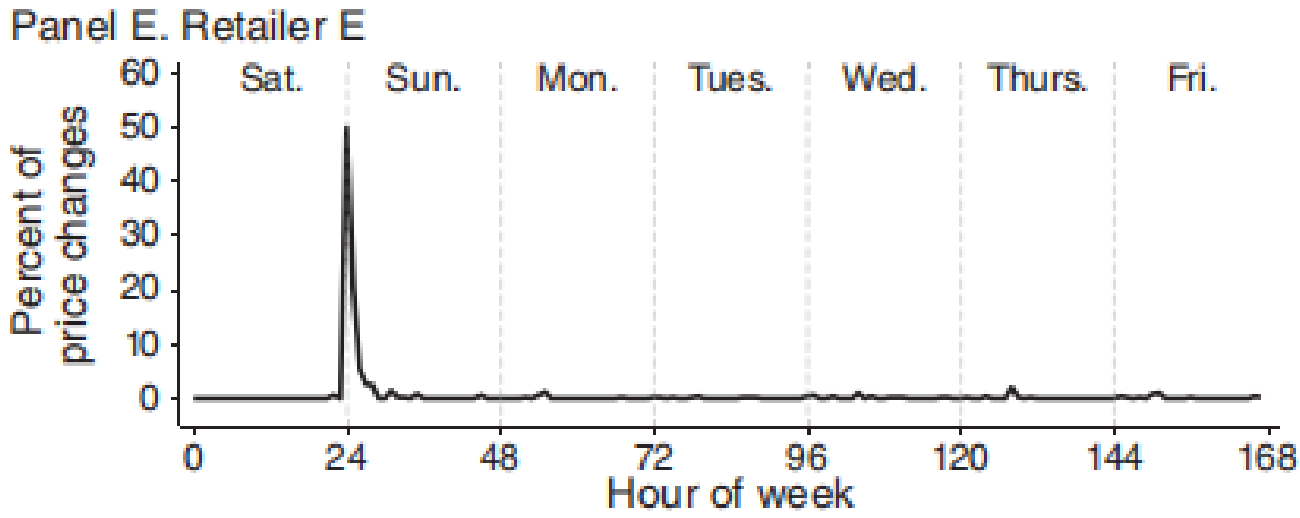


**Replication**

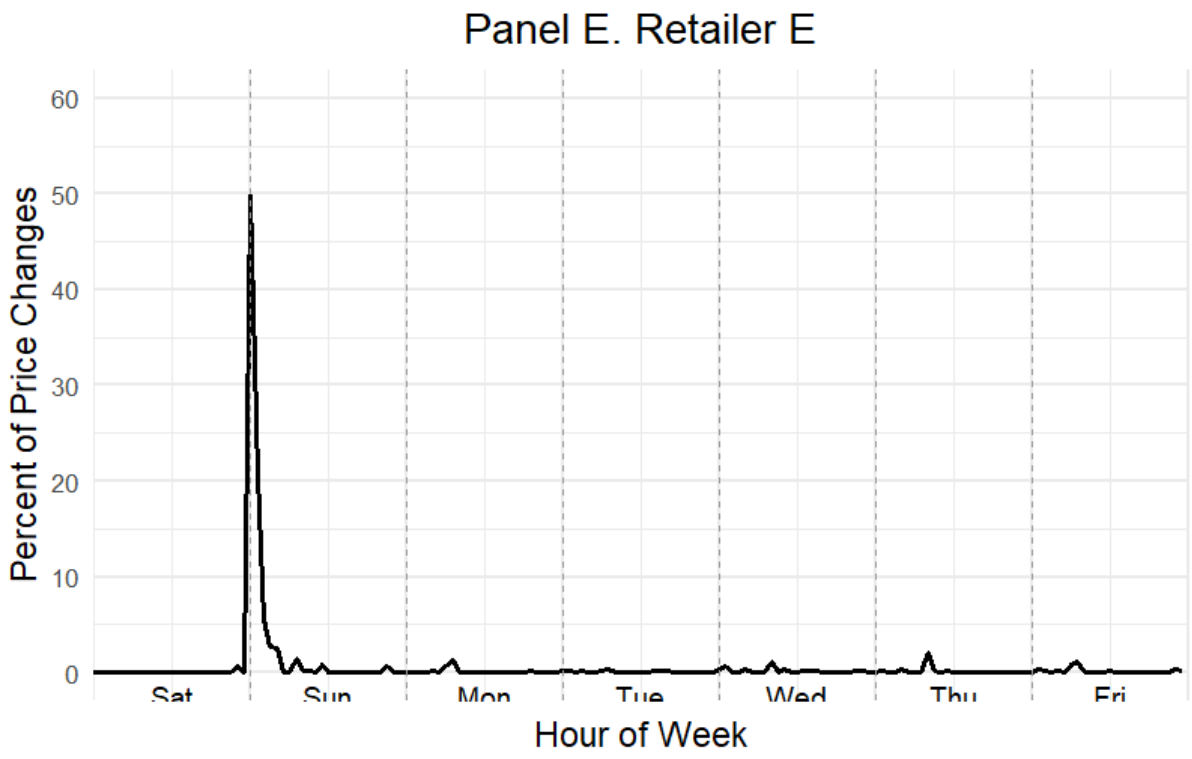


**Fifth Graph**

**Original**



## Replication




## Problems

1. Pushing to GitHub Rejected Due to Large File Size

**Solution:**

Created a `.gitignore` file to exclude the large data file from being tracked.

Used `git rm --cached` to untrack the file.

Attempted to clean Git history using BFG Repo-Cleaner, which required downloading and setting up **Java** on the system to run `.jar` files.

Once cleaned, the project was pushed successfully to GitHub.

2. Missing or Misaligned axis

## Problems

3. Missing packages or functions in R.
4. Data File not found/ Path errors.
5. Quarto reference file not found

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## Conclusion

- Successfully replicated the *Hour-of-Week Price Change* plots from , Brown & MacKay (2023), albeit challenges with displaying graphs fully.
- Addressed challenges with data formatting, visualization, and GitHub publishing
- Leveraged R, Quarto, and ggplot2 for reproducible and shareable analysis

**Looking ahead:** - Extend this work to other figures in the paper - Explore dynamic or interactive presentations using Quarto + Shiny

## References


Brown, Z. Y., & MacKay, A. (2023). Competition in pricing algorithms. *The Quarterly Journal of Economics*, *138*(1), 113–157. https://doi.org/10.1093/qje/qjac035

Posit, PBC. (2022). *Quarto: Scientific and technical publishing system*. https://quarto.org

Wickham, H. (2016). *ggplot2: Elegant graphics for data analysis*. Springer. https://ggplot2.tidyverse.org