Critique of USPS Elasticities
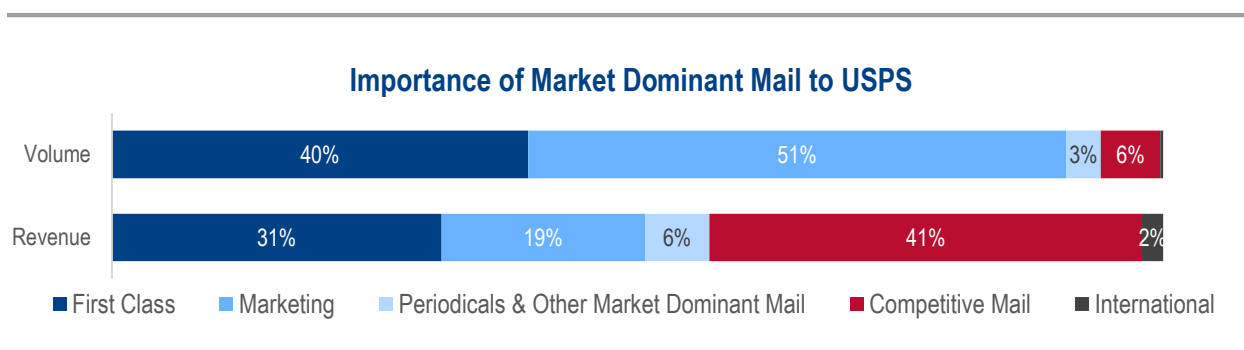
March 2024

ndp
analytics
turning data into action

Critique of USPS Elasticities

EXECUTIVE SUMMARY

The USPS has implemented higher and more frequent rate increases for market dominant mail to improve its financial position. Its demand model, which estimates the price sensitivity (elasticity) of market dominant products, is used to justify the rate increases. However, recent volume and revenue challenges signal an issue with the model. Our review of the USPS model revealed numerous shortcomings that hinder the model's ability to project volume and justify ratemaking decisions that impact millions of Americans.

Here is why this matters for policymakers:

1. **The USPS is the only option for sending and receiving market dominant mail**. Unlike its competitive products, USPS market dominant mail customers, including American households, businesses, and nonprofits, have no viable alternative to sending and receiving mail.

2. **Market dominant mail is critical to the USPS bottom line.** In FY2023, First Class and Marketing Mail accounted for 96% of the market dominant volume and 89% of revenue. Market dominant mail accounts for 94% of total USPS volume and 56% of revenue.

3. **The current rate regime is unprecedented and understudied**. In 2020, biannual rate increases that exceed CPI were introduced with *Delivering for America*. Under this schedule, new rates are proposed only three months after the previously proposed rate increases take effect, leaving minimal data to assess the impact.

4. **Missed volume targets contributed to $1.8B in FY2023 losses.** In FY2023, after a series of steep and frequent rate increases, lower-than-planned market dominant volume cost the USPS $1.8 billion and contributed to its total year-end losses of $6.5 billion.

5. **Inaction may lead to further deterioration.** If rate increases proceed at the current frequency and magnitude without critical review, they risk plummeting volume further and exacerbating USPS's financial challenges.

Importance of Market Dominant Mail to USPS

	First Class	Marketing	Periodicals & Other Market Dominant Mail	Competitive Mail	International
Volume	40%	51%	3%	6%	
Revenue	31%	19%	6%	41%	2%

Key Findings of the Critique

USPS Volume Forecasts are Increasingly Unreliable	• While the model may perform well in explaining historical volume, it has failed—and increasingly so—at accurately forecasting. • Over the past decade, excluding the pandemic, seven of the top ten market dominant products experienced their peak overestimation (actual volume lower than forecast) in FY2022 or FY2023.
USPS Model Characteristics Reduce Accuracy in Forecasting	• The current demand model has shortcomings that limit its ability to forecast volume. The primary concerns are that the model is overfitted and too subjective. • Some market dominant equations have over 20 explanatory variables. Too many variables take away from the explanatory power of price.
USPS Elasticity Estimates Reflect Model Shortcomings	• Historical estimates of price elasticities vary noticeably for some mail types. • Some demand equations produce unusually consistent elasticities given the nature and number of changes made to these equations each year, signaling that the model may be finessed to achieve similarity with previous results.
USPS Model is Sensitive to Small Changes	• The USPS model is susceptible to a high degree of subjectivity. As a result, price elasticities will differ if other judgment calls are made regarding the model's specifications. • Small, reasonable changes to the model lead to different elasticity estimates. In some cases, the tweaks result in *less inelastic* demand, while others turn *elastic*.
USPS Practices Limit Forecasting Accuracy & Accountability	• Some forecasting best practices followed by government agencies are currently not employed in the USPS model. • Following them could improve forecast accuracy, provide greater transparency, and reduce the likelihood of the model being pushed to achieve specific outcomes.

Critique of USPS Elasticities

March 2024

ndp | analytics[1]

Introduction

The mission of the United States Postal Service (USPS) is to "provide the American public with trusted, affordable, universal service."[2] It is a critical component of the country's infrastructure and commerce. The USPS is required to service the entire nation by collecting and distributing personal, commercial, and official mail (for which it has a monopoly) to households, organizations, and the government.

Ongoing USPS financial challenges due to volume declines, operational costs, and government-mandated funding obligations prompted the implementation of a new strategic plan, *Delivering for America*, in 2020. The plan includes biannual rate increases that exceed CPI for market dominant mail to help improve its financial position. The rate schedule is as follows: the first increase of the fiscal year is proposed in October and takes effect in January; the second is proposed in April, effective in July. Then, three months later, in October, the USPS proposed the first increase of the next fiscal year, and so on. As a result, each time the USPS proposes new rates, it does so with almost no data on the volume and revenue impact of the previous increase. While the pace and magnitude of ratemaking are unprecedented, scrutiny of USPS proposals has been minimal despite missed market dominant volume targets. In FY2023, this cost the USPS $1.8 billion and contributed towards the total years-end $6.5 billion in losses.[3]

USPS rate proposals have gone unchallenged, at least partly, because its demand model justifies the price increases. The model estimates the price sensitivity (*price elasticity of demand*) of market dominant products. In short, if demand for a product is not sensitive to price changes (*inelastic*), a rate increase may result in a decline in volume but will produce more revenue overall. However, misunderstanding customer sensitivity to price contributed to recent missed volume and revenue targets. Ignoring customer sensitivity to price may boost revenue in the short run but may threaten USPS solvency in the long run. That is because USPS customers who reduce or eliminate mailing are less likely to return.[4]

> **SECTION TAKEAWAY | Current ratemaking policies are unprecedented & their impact understudied**
>
> *Delivering for America* instituted biannual rate increases that are allowed to exceed the historical CPI cap. Under the current process, the **USPS proposes new rate increases before the impact of prior increases can be fully realized.** USPS demand models, which are used to justify rate increases, have never been tested in this way. USPS stands to lose considerably from miscalculating its customers' sensitivity to price. In FY2023, USPS unexpected volume losses for First Class & Marketing Mail contributed **$1.8B** of the USPS **$6.5B** year-end losses.

---

[2] USPS. "Universal Service Obligation." (Accessed Jan 2024)
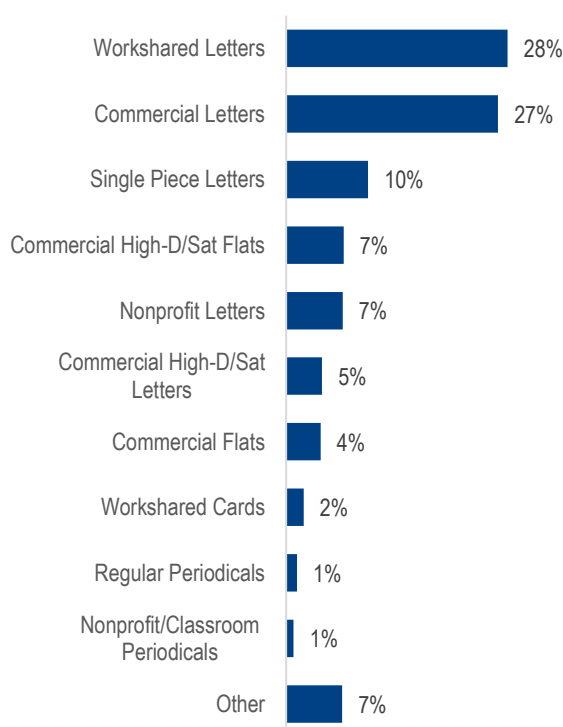[3] USPS. Integrated Financial Plans, FY2023 and FY2024.
[4] For example, the 2022 USPS Household Diary Study shows the decline in mailed bill payments; customers that switch to electronic transactions are not expected to return to mailing payments.

Developing the type of model implemented by the USPS is both a science and an art. Thus, the purpose of our research is <u>not</u> to determine if the model is "good" or "bad" but to evaluate the model characteristics and effectiveness in producing elasticities for *predictive* purposes as it relates to ratemaking that impacts millions of households and businesses across America.

This critique first reviews the importance of market dominant mail to the USPS bottom line. Then, it examines the accuracy of the USPS forecasts for 19 market dominant products, which combined account for 97% of total volume; the performance of the top products by volume is highlighted (Figure 1). Next, the research explores the specification of the USPS demand model to explore potential issue areas. The examination explores variations in USPS price elasticity estimates over time and their sensitivity to simple model changes. Lastly, the critique reviews USPS modeling practices and compares them with best practices in forecasting.

Figure 1.
Market Dominant Mail Included in Critique[5]

Highlighted Products: Top 10 by Volume, FY2023
94% of Market Dominant Volume

Product	Percentage
Workshared Letters	28%
Commercial Letters	27%
Single Piece Letters	10%
Commercial High-D/Sat Flats	7%
Nonprofit Letters	7%
Commercial High-D/Sat Letters	5%
Commercial Flats	4%
Workshared Cards	2%
Regular Periodicals	1%
Nonprofit/Classroom Periodicals	1%
Other	7%

All Products
97% of Market Dominant Volume

First Class Mail
Six categories; 99.6% of volume
• Single Piece Letters
• Single Cards
• Single Piece Flats
• Workshared Letters
• Workshared Cards
• Workshared Flats

Marketing Mail
Nine categories; 97.1% of volume
• Commercial Letters
• Commercial High-D/Sat Letters
• Commercial Flats and Basic Carrier Route
• Commercial High-D/Sat Flats
• Nonprofit Letters
• Nonprofit High-D/Sat Letters
• Nonprofit Flats
• Nonprofit High-D/Sat Flats
• Every Door Direct Mail

Periodicals
Three categories; 100% of volume
• Regular
• Nonprofit/Classroom
• In-County

High-D/Sat is "High Density and Saturation"

---

[5] USPS. Demand Equations, FY2024; USPS. "Preliminary Financials September 2023."

Market Dominant Mail is Critical to the USPS Bottom Line

USPS products are divided into two categories: market dominant (for which the USPS effectively has a monopoly and upholds its Universal Service Obligation to deliver and collect mail from households and businesses across the country) and competitive products (package services that compete with the UPS, FedEx, and other similar service providers). Unlike customers who use USPS competitive products, market dominant mail customers do not have marketplace alternatives. In other words, the USPS is their only choice for businesses and households sending and receiving First Class Mail, Marketing Mail, and Periodicals.
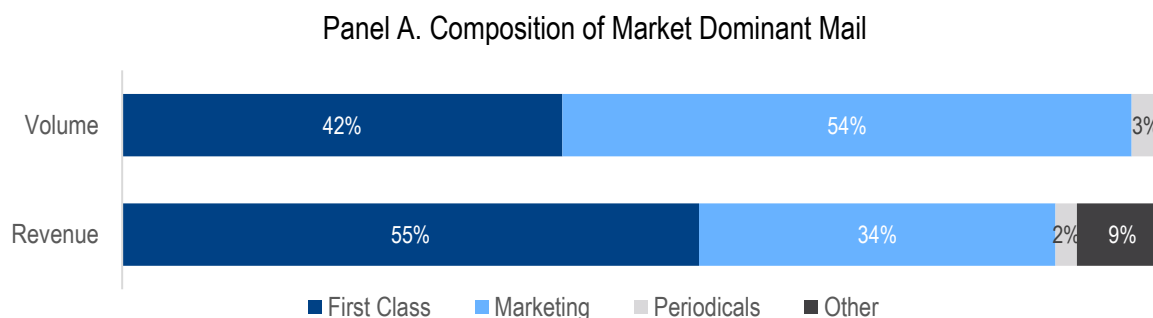
Due to the nature of market dominant products, USPS pricing decisions are made through a regulatory process. Each year, the USPS submits its demand equations for market dominant products that estimate their price elasticities and forecast volume for the coming year. The importance of the USPS model has increased significantly in recent years. The biannual above CPI rate increases, implemented as part of *Delivering for America*, are unprecedented. USPS proposes new rates well before the full effect of its prior increase is understood. Inaccurate or incomplete pricing decisions put the USPS at risk of accelerating volume decline and losing revenue on these products.

Market dominant mail is critical to the USPS bottom line, especially First Class and Marketing Mail, the two largest categories. In FY2023, First Class and Marketing Mail together accounted for 96% of volume and 89% of revenue for market dominant products covered by the USPS demand equations. Overall, market dominant mail accounted for 94% of total USPS volume and 56% of revenue. These products are critical to the financial stability of the USPS. (Figure 2)

SECTION TAKEAWAYS

1. **USPS is the only option for sending & receiving market dominant mail.** Unlike customers using competitive products, the households, businesses, and nonprofits who rely on market dominant mail have no viable alternative.

2. **Inaccurate or incomplete pricing decisions increase financial risk.** Without evaluating the accuracy of it demand model, USPS risks accelerating volume decline and losing revenue.

3. **In FY2023, 94% of volume & 56% of revenue came from market dominant mail.** First Class and Marketing Mail are the largest contributors to market dominant volume and revenue.

Figure 2.
USPS Volume & Revenue, FY2023

Panel A. Composition of Market Dominant Mail

	First Class	Marketing	Periodicals	Other
Volume	42%	54%	3%	
Revenue	55%	34%	2%	9%

Panel B. Market Dominant Mail as a Share of <u>All</u> Mail Volume and Revenue

	First Class	Marketing	Periodicals & Other MD	Competitive Mail	International
Volume	40%	51%	3%	6%	
Revenue	31%	19%	6%	41%	2%
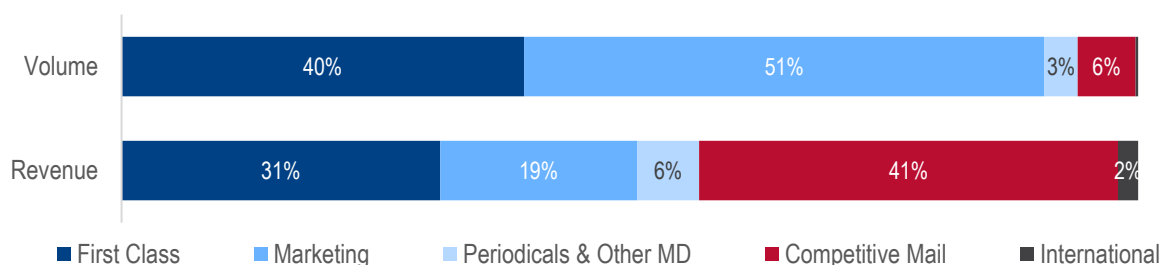
Other market dominant (MD) products include Package Services, Ancillary Services, and Special Services.

USPS Demand Equations Estimate Future Market Dominant Volume & Revenue

The USPS model includes 40 custom equations to estimate demand for its market dominant products. Each demand equation contains variables that impact mail volume based on economic foundations, such as price, the state of the economy, time trends, and other factors.[6] The equations use historical data to estimate the sensitivity of mail volume to price changes, known as *price elasticity*. The more sensitive demand is to price changes, the *more elastic* it is. If demand is not sensitive to price changes, it is considered *inelastic*.[7]

The USPS uses its model (and the price elasticities it produces) to forecast market dominant volume and revenue for each quarter of the coming year. For products with *inelastic* demand, rate increases could raise revenue. That is because the percentage decline in volume is smaller than the percentage increase in price. Conversely, for products with elastic demand, the percentage decline in volume is more significant than the percentage increase in price; thus, the price increase is not expected to generate more revenue.

According to the USPS model, demand for market dominant mail is *inelastic,* though the degree varies by product. As such, the USPS and Postal Regulatory Commission have justified aggressive rate increases to boost dwindling revenues. However, in FY2023, market dominant revenue fell $1.8 billion short of the USPS forecast, signaling a potential issue with the model used to defend rate increases. (Table 1)

> **SECTION TAKEAWAYS**
>
> 1. **The USPS demand model estimates sensitivity to price.** The model contains 40 unique equations for market dominant products.
>
> 2. **The model is used to justify rate increases** because it shows that market dominant products are not sensitive to price.
>
> 3. **Recent performance signals issues with the elasticity estimates.** In FY2023, market dominant revenue fell $1.8B short of the USPS forecast.

---

[6] The equations are based on historical quarterly data, and are estimated using Generalized Least Squares in the following form: $\ln V_t = \ln(a) + e_1 \ln(x_{1t}) + e_2 \ln(x_{2t}) + \cdots + e_n \ln(x_{nt}) + \ln(\varepsilon_t)$ where V is volume by mail category at time t, $x_{1\ldots n}$ represent explanatory variables, coefficients e equal estimated elasticities for the explanatory variables, and residual ε stands for other relevant factors not captured in the equations.

[7] Formally, if the absolute value of the price elasticity for a product is greater than one, then demand is considered *elastic*. If the absolute value of the price elasticity for a product is less than one, then demand is considered *inelastic*.

Table 1.
Projected & Actual Revenue from Market Dominant Mail, FY2023 ($B)[8]

	First Class	Marketing	Periodicals	Total
Actual Revenue	$24.5	$15.1	$0.9	**$40.5**
Projected Revenue	$24.9	$16.4	$1.0	**$42.3**
Difference	**-$0.4**	**-$1.3**	**-$0.1**	**-$1.8**

The USPS Volume Forecasts are Increasingly Inaccurate

The USPS forecasts are more inaccurate now than before the pandemic. CBO uses reports two methods to assess its accuracy: absolute error and a measure called the Root Mean Square Error (RMSE).[9] Regarding total projected and actual market dominant volume, the absolute error in the USPS projections doubled from 1.5% before the pandemic (and implementation of *Delivering for America*) to 3.0% in FY2022 and FY2023. The RSME measure increased from 1.9% before the pandemic to 2.5% in the last two years. Both measures indicate that the model is less accurate in the current environment than historically. (Figure 3)

Figure 3.
USPS Forecast Accuracy for Total Market Dominant Mail Volume[10]

Legend: ■ Pre-Pandemic (FY2014-19) ■ FY2022-23
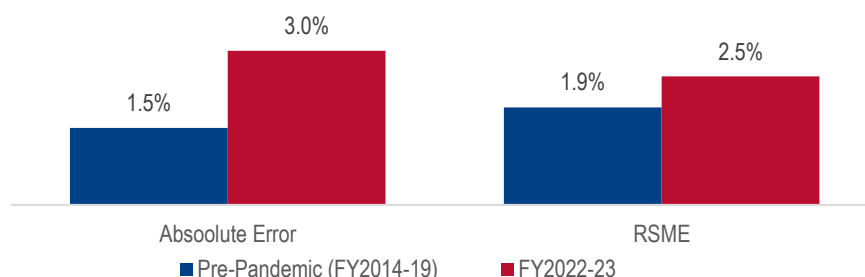
SECTION TAKEAWAYS

1. **Forecast performance for quarterly volume ranged drastically** for certain products over the past decade.

2. **Recent forecasts are more inaccurate.** Overall, forecasted volume for market dominant mail was less accurate in FY2023 than pre-pandemic.

3. **Top USPS categories have experienced above-average variance** Seven of the top ten products experienced their largest overestimation (actual was lower than forecast) in FY2022-23; during that time, three had their largest

---

[8] USPS. Integrated Financial Plans, FY2023 and FY2024.

[9] CBO's definitions are: "The average absolute error is the average of projection errors with the negative signs removed from the underestimates. The RMSE is calculated by squaring the projection errors, averaging those squares, and taking the square root of that average." See: An Evaluation of CBO's Past Revenue Projections. (Accessed Feb 2024)

[10] USPS. Demand Equations, FY2014-23; Includes all market dominant products.

At the product level, forecast performance for quarterly volume ranged drastically.[11] Among the top 10 market dominant products, First Class Workshared Cards had the most significant variance.[12] The maximum overestimation of quarterly volume was 32%, while the maximum underestimation was 30%; the average difference in the quarterly volume over the past decade was +/-11%. (Figure 4 and Appendix B)

Notably, 7 of the 10 top mail products experienced their largest quarterly overestimation in FY2022 or FY2023, and 3 experienced their largest underestimation in volume during that time. The most recent forecast performance is especially concerning for classes of mail that historically had low variance between USPS forecasts and actual volume performance. For example, Workshared letters have averaged a 2% difference between USPS quarterly forecasts and actuals, but most recently, the USPS has overestimated volume by 5%. There are similar patterns for Nonprofit Letters (averaged 3% difference and recently overestimated by 7%), Single Piece Letters (averaged 3% and recently overestimated by 7%), and Commercial Letters (averaged 4% and recently overestimated by 9%). (Figure 4 and Appendix B)

Figure 4.
USPS Quarterly Forecast Performance, FY2014-23, Excluding the Pandemic
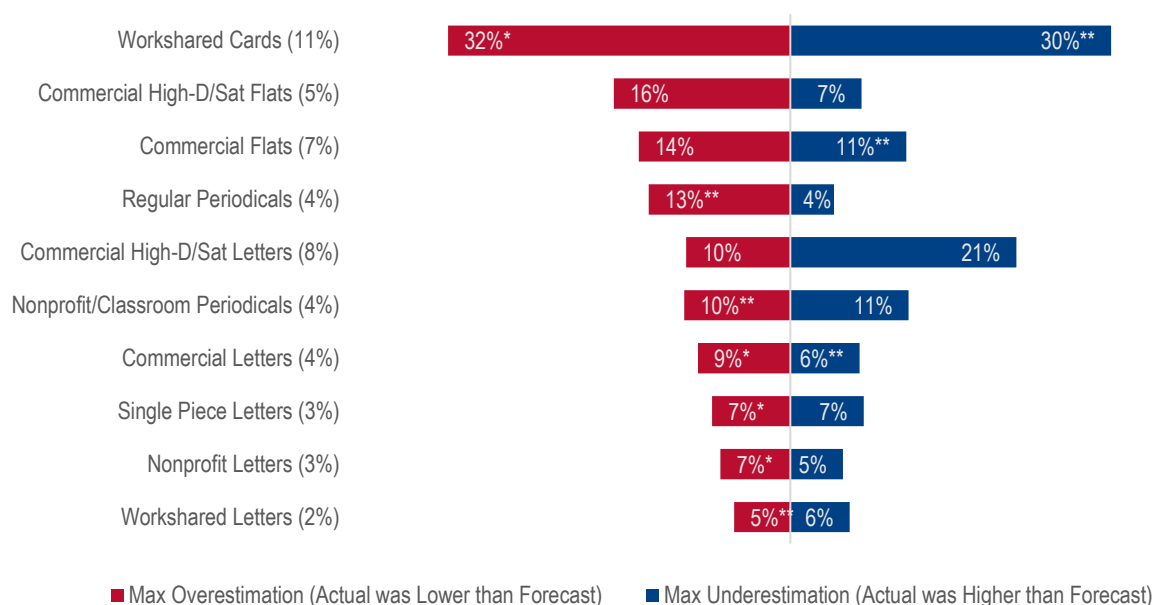
Parentheses include the avg. difference in actual & projected quarterly volume (absolute value), FY2014-23 ex. FY2020-21
*Indicates that overestimation or underestimation occurred in FY2023.
**Indicates that overestimation or underestimation occurred in FY2022.

---

[11] In this analysis, FY2020 and FY2021 are considered to be the primary COVID-19 pandemic years.
[12] Note: Changes to the allowable size of postcards may contribute to this variation. For example, in 2021, the USPS increased the allowable size for commercial presorted or automated First Class Mail postcards to 6x9 in. This could have a positive impact on volume that was not accounted for in the FY2021-22 model projections (see: FAQ's for the new Larger Sized Postcard | PostalPro (usps.com)).

USPS Model Characteristics Reduce Accuracy in Forecasting

When modeling demand, economists may reasonably follow different approaches in how the model is specified or the techniques used, given that econometrics is well-known as an art and a science. There are strengths and weaknesses to any model. While the USPS model is sophisticated and complex, it also has shortcomings. Those shortcomings merit review since the USPS rate increases—which impact millions of Americans and businesses—and are grounded in model results.

A primary concern about the model is that it has too many explanatory variables and is overfitted. An overfitted model explains historical data well but fails to make accurate forecasts. Furthermore, the model's specification is susceptible to a high degree of subjectivity, meaning econometricians can strongly guide outcomes through fine calibration of the model. So, the results—including price elasticities—will differ if other judgment calls are made.

SECTION TAKEAWAYS

1. **The USPS model is overfitted.** The USPS model has many variables, which takes away from the explanatory power of price. The implication is that the model may explain historical data well but fail to make accurate forecasts.

2. **The model specification is susceptible to a high degree of subjectivity.** This characteristic puts the model at risk of strongly guided outcomes.

USPS Model Characteristics

The USPS demand equations possess numerous explanatory variables—factors that are expected to influence changes in demand for market dominant mail products. The equations for each mail category have been fine-tuned with precision, each possessing unique price lags, dummy variables, time trends, and "interventions"—a catch-all for everything from the rise of email to the COVID-19 pandemic. (Table 2)

Table 2.
Common Types of Explanatory Variables in the USPS Demand Model[13]

	General Application in Modeling	Example
Own Price	Accounts for the impact of price on volume	USPS elasticity estimates.
Dummy Variables	Represents categorical data or changes inadequately modeled with historical data using binary values (1 or 0).	USPS uses these variables for rate or classification changes and events like COVID-19.
Lags	Accounts for delayed reactions to events using historical data.	USPS uses lags with postage rates to account for delayed reactions to price.
Macroeconomic Variables	Accounts for changes related to the broader economy using historical data.	USPS uses employment in its First Class demand equations.
Interventions & Time Trends	Accounts for new and changing impacts of events using an intervention technique.	USPS uses these techniques for e- diversion, recessions, COVID-19, and other events.
Seasonal Variables	Accounts for recurring fluctuations using historical data or dummy variables.	USPS uses these variables for non-delivery days and quarterly trends in mail.

---

[13] USPS. 2023. "Narrative Explanation of Econometric Demand Equations for Market Dominant Products Filed with Postal Regulatory Commission on January 20, 2023." Jul.

In FY2023, the explanatory variables in the top market dominant equations ranged from 11 to 23. The Single Piece Letter equation had the most variables to estimate the product's price elasticity and forecast volume over the next four quarters. Its 23 explanatory variables included six dummy variables, five seasonal variables, five variables related to own price, three non-linear interventions, two time trends, and a macroeconomic variable. (Single Piece Letters also had the most stable price elasticity over the past decade). Following Single Piece Letters, Workshared Letters and Nonprofit and Classroom Periodical equations had the most variables with 22 and 18, respectively. (Figure 5 and Appendix D)

Number of Variables in USPS Demand Equations for Top Product Categories, FY2023[14]
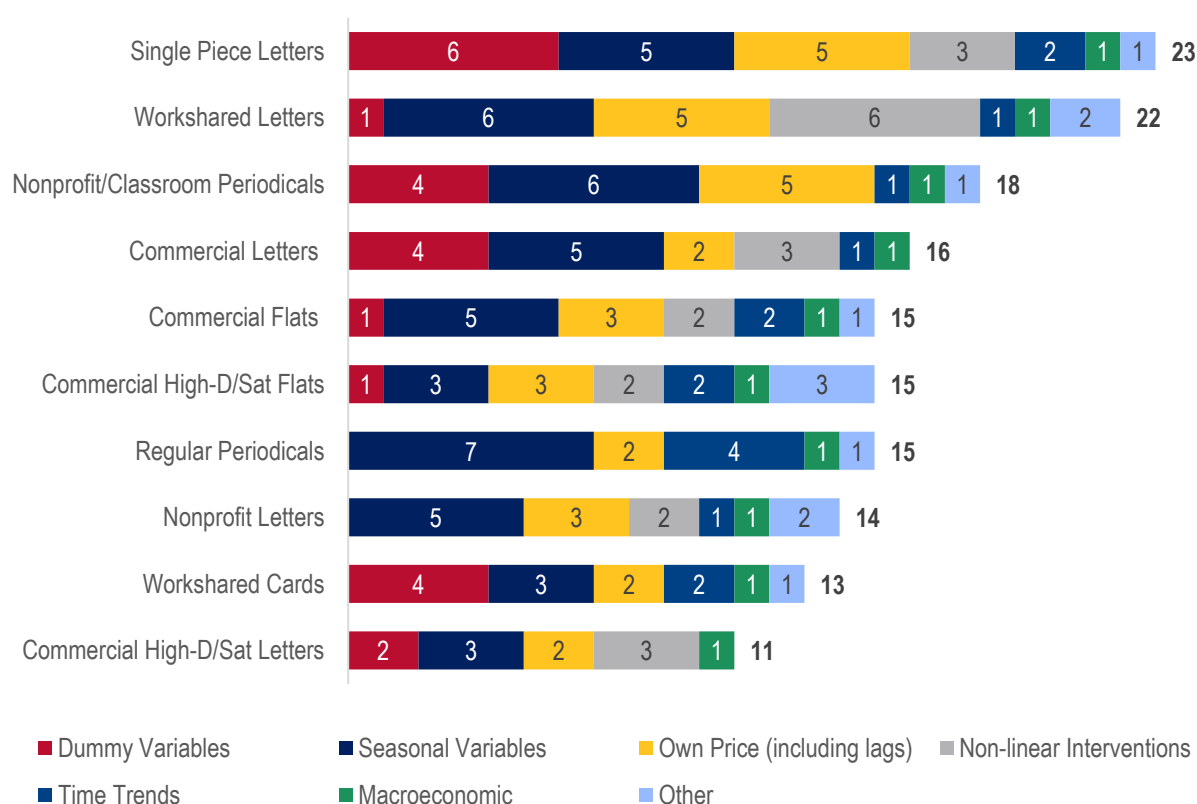
As expected, the FY2024 demand equations, released on January 22, 2024, are different from the year before. The Commercial Letter equation now has five new non-linear interventions and one new price lag, while the Workshared Letter has four price lags removed. Even products with the same number of variables as FY2023, like Regular Periodicals, have changed composition; this equation added a price lag and a dummy variable but removed two seasonal variables. (Figure 6 and Appendix D)

---

[14] USPS. Demand Equations, FY2023-24; Top product categories based on volume in FY2023.

Figure 6.
Changes in USPS Equations for Top Product Categories, FY2023-24[15]
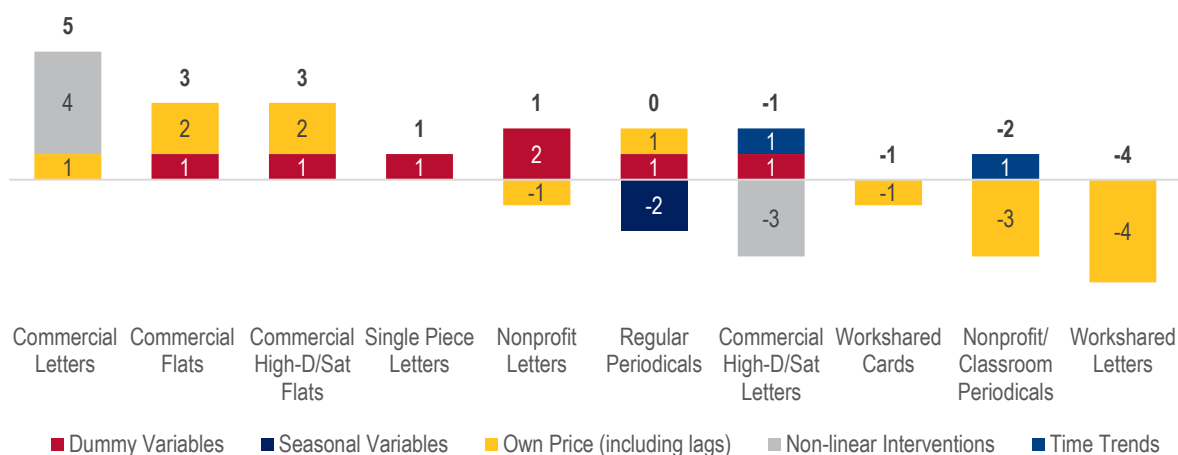
The selection of variables in the USPS equations impacts the interpretation of the factors driving volume change. The USPS demand equation output includes the contribution to volume decline over the past five years by variable. To illustrate the impact of changing variables, year over year, we compared the contribution to volume loss in FY2023 and FY2024 for market dominant mail equations.

According to the FY2023 Single Piece Letter equation, total volume loss over the prior five years was primarily driven by interventions (35%) and partially offset by other factors (4%). In the FY2024 equation, the USPS added a dummy variable. The FY2024 output shows that the historical volume losses were explained mainly by interventions (35%) and other variables (6%), but now, dummy variables account for 5% of the decline. The USPS added four new interventions to the FY2024 equation for Commercial Letters. In FY2024, interventions and time trends were responsible for a 28% decline in Commercial Letter volume (offset by factors accounted for in the macroeconomic, dummy, and other variables) compared to explaining 14% of the decline in the FY2023 model. In all cases, the impact of price on volume decline is negligible. (Figure 7 and Appendix C)

---

[15] USPS. Demand Equations, FY2023-24; Top product categories based on volume in FY2023.

Figure 7.
Contributions to Volume Change Over Last Five Years, FY2023-24 Model Estimates[16]

Single Piece Letters	Commercial Letters	Workshared Letters

Single Piece Letters
- 2023: -31% (4% Other, -35% Interventions & Time Trends)
- 2024: -32% (6% Other, -35% Interventions & Time Trends)

Commercial Letters
- 2023: -8% (7% Macroeconomic Variables, -14% Interventions & Time Trends)
- 2024: -20% (-28% Interventions & Time Trends)

Workshared Letters
- 2023: -12% (-13% Interventions & Time Trends)
- 2024: -14% (4% Other, -10% Interventions & Time Trends, -7% Dummy Variables)

Legend: ■ Own Price ■ Macroeconomic Variables ■ Interventions & Time Trends ■ Seasonal Variables ■ Dummy Variables ■ Other

Characteristics of the USPS Model Impact Forecast Accuracy

We observed several characteristics that hinder confidence in the USPS model's ability to accurately estimate price elasticities and forecast mail volume. For the USPS, model accuracy is more important than ever. Historically, rate increases remained relatively stable and predictable, typically occurring annually and tracking inflation. Now, increases have become biannual, in January and June, and can exceed CPI. Thus, there is an increased reliance on the accuracy of USPS price elasticities to forecast volume and revenue.

First, the model is overly complex, with potentially too many explanatory variables. In econometrics, throwing everything (except the kitchen sink) into a model to prevent omitting something that matters is tempting. However, in overly fine-tuning each equation to fit historical data, the model is at risk of being *overfitted*. Overfitting occurs when a model that has been trained to precisely explain historical data (such as volume) fails to perform well in out-of-sample forecasts, rendering the model useless.[17] In other words, complexity does not improve accuracy. One review found that complexity increases error by 27%, on average.[18] In addition, by including so many variables in the analysis, the USPS risks reducing the explanatory power of prices, meaning that price elasticity estimates may differ (less inelastic) from what the model currently estimates.

Second, the model's specification is highly calibrated, meaning model outcomes can be finessed by subjectively including or excluding certain variables (model changes happen annually). While it is common in economic modeling to tweak outcomes through the model's specification or "add-factors," the high degree to which the USPS demand equations are calibrated merits attention—especially since the model outcomes

---

[16] USPS. Demand Equations, FY2023-24.

[17] IBM. "What is Overfitting?" (Accessed Jan 2024)

[18] Green, Kesten C., and J. Scott Armstrong. 2015. "Simple versus complex forecasting: The evidence." Journal of Business Research. 68:1. Aug.

impact millions of Americans and businesses through rate decisions. While the USPS documents how they fine-tune each equation with precision, they do not explain *why* all variables are justified. With high subjectivity at play, elasticity estimates and model forecasts are likely to differ if other judgment calls were made.

Third, several equations that estimate mail demand are based on limited historical data. As a result, price elasticity estimates may be less reliable and more imprecise. This limitation is particularly concerning for Marketing Mail equations.

Table 3.
Observed Characteristics That Reduce the Explanatory Power of Price & Forecasting Accuracy

Observed Concern	Implications	Explanation & Evidence
Overuse of Dummy Variables	There is a higher risk of being overfitted and more highly calibrated	Dummy variables represent categorical data and account for non-numeric characteristics or trends. Dummy variables account for over 20% of all explanatory variables in four of the top ten demand equations, which leads to an overfitted model and influences results.
Multiple Variables for the Same Event	There are higher risks of being overfitted and more highly calibrated.	USPS demand equations use multiple variables to explain the same event or trend. For example, rather than a simple treatment of time, equations often use linear and non-linear interventions, as well as dummy variables.[19] In other cases, equations contain both non-linear interventions and dummy variables to explain the same phenomena, such as Covid-19. This duplication reduces the explanatory power of price and creates overfitted equations, which can sway model outcomes.
Inconsistent Modeling Choices Across Equations	There is a higher risk of being more highly calibrated	Factors like COVID-19 and electronic diversion are modeled using non-linear interventions and are treated differently across USPS equations. These inconsistencies demonstrate subjectivity in the model.
Number of Variables Relative to Historical Data	There are higher risks of being overfitted and less reliable	When a model possesses many explanatory variables and limited historical data, estimates of model coefficients—including price elasticities—can be less precise. This is particularly concerning for the Marketing Mail equations.

---

[19] Autoregressive models are historical data to predict future performance whereas interventions and time trends rely on econometric functions to model changes in behavior due to event; dummy variables add to the complexity of the model.

USPS Elasticity Estimates Reflect Model Shortcomings

The USPS publishes annual elasticity estimates based on the most recent historical data and model changes. We examined variations —or lack thereof— in USPS price elasticity estimates that have varied over time. The historical elasticities produced by USPS demand equations reinforce concerns about the model characteristics and demonstrate that they could be problematic for forecasting.

Demand is generally estimated to be the most inelastic for First Class Mail categories. At the same time, it is less inelastic for Commercial Mail, meaning that business demand for mail products drops more significantly with rate increases than for other customers. Still, given demand for USPS products is inelastic according to the model, rate increases have been justified to boost revenues.

Demand equations with less historical data to rely on, like many Commercial Mail products and Workshared Cards, were more likely to produce a broader range of elasticity estimates. For example, from FY2014 to FY2023, elasticities for Commercial Flats ranged by 0.55 (-0.31 to -0.85), Commercial High-Density/Saturation Flats by 0.52 (-0.33 to -0.85), and Commercial High-Density/Saturation Letters by 0.44 (-0.42 to -0.85). (Figure 6)

Demand equations with more historical data had more consistent elasticity estimates. Elasticities for Single Piece Letter estimates ranged by 0.09 over the past ten years; Workshared Letters varied by 0.22. However, because the equations changed over time with annual model revisions, it is possible that elasticity estimates were finessed with new dummy variables, time trends, and non-linear interventions to achieve similarity with previous estimates. (Figure 8 and Appendix E)

> ## SECTION TAKEAWAYS
>
> 1. **Demand equations with less historical data were more variable.** Commercial Mail products and Workshared Cards rely on less historical data than other products.
>
> 2. **Despite frequent changes, elasticities for some products remained unusually stable.** Annual model changes indicate a higher degree of subjectivity. Elasticities for key products, like Single Piece Letters, barely changed over the past decade.
>
> 3. **The elasticity estimate for Regular Periodicals nearly doubled in one year**. Its elasticity moved from -0.26 in FY2023 (its maximum over the past decade) to -0.50 in FY2024.

Figure 8.
USPS Price Elasticities for Top Market Dominant Products, FY2014-23[20]
Elasticities closer to -1 are more price-sensitive
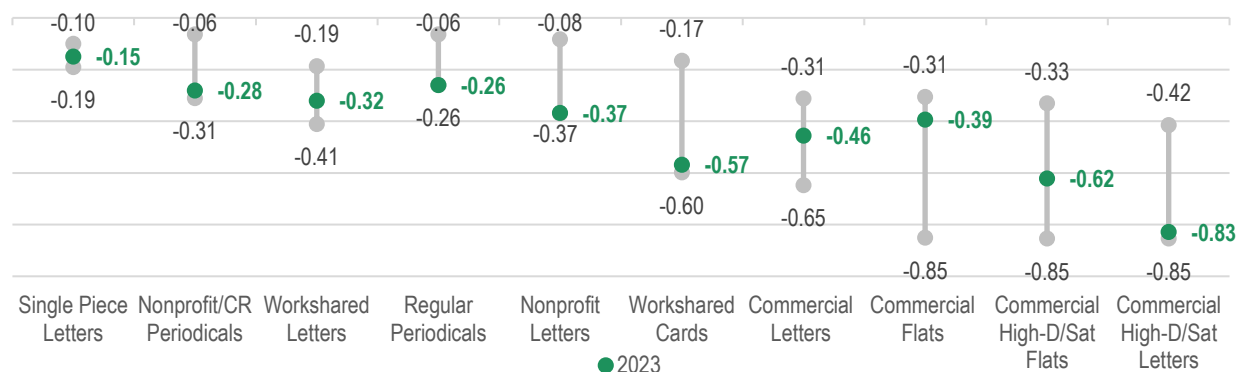
In the newest FY2024 elasticity estimates, some categories remained similar to past estimates while others had substantial variation. Again, while the number of variables and their explanatory power has changed from FY2023 to FY2024, the elasticity estimates for First Class Mail products remained nearly unchanged. Meanwhile, the elasticity of Regular Periodicals moved from -0.26 (its maximum elasticity over the past decade) to -0.50, nearly double. The price sensitivity of Commercial Letters changed from -0.46 to -0.65. Commercial High-Density/Saturation letters were the least inelastic product, with a new price elasticity of -0.83. (Figure 9)

Figure 9.
USPS Price Elasticities for Top Market Dominant Products, FY2023-24[21]
Elasticities closer to -1 are more price-sensitive

---
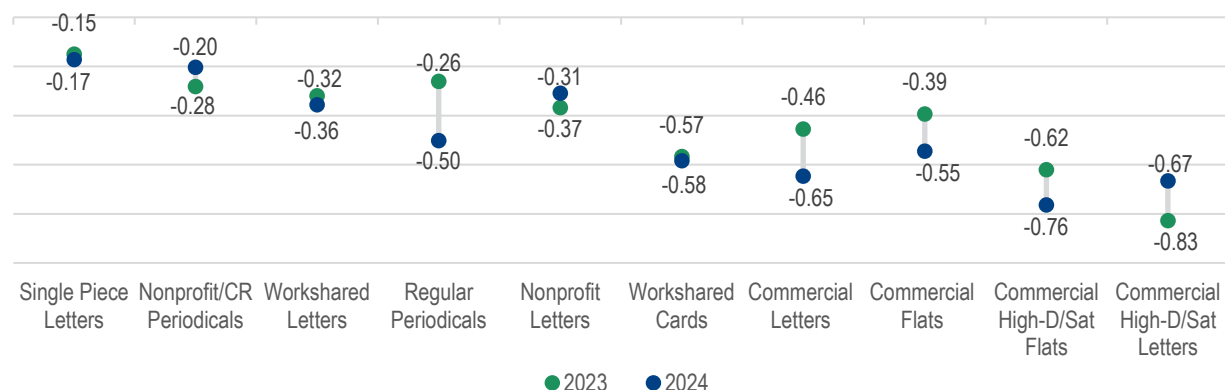
[20] USPS. Demand Equations, FY2014-23; Top product categories based on volume in FY2023.
[21] USPS. Demand Equations, FY2023-24; Top product categories based on volume in FY2023.

The USPS Model is Sensitive to Small Changes

We conducted sensitivity analyses to assess how minor tweaks to the FY2023 USPS model impact its elasticity estimates. Small changes led to different price elasticity estimates in magnitude and direction. Demand is sometimes less inelastic than the current model's results; other times, it actually turns elastic. In addition to the First Class and Marketing Mail examples below, we found that removing dummy variables can "break" the model.

First Class Mail Equations

A standout characteristic of the USPS First Class demand equations, inconsistent with common practice, is its macroeconomic variable. Each equation includes employment per person. In general, employment as a macroeconomic variable may not be a good fit for short-term forecasting because changes in employment typically lag what is happening in the economy. Hence, the data is less responsive to current conditions and may not be sensitive enough to reflect macroeconomic trends. Moreover, "employment per person" is not a standard macroeconomic indicator.

Therefore, we tested the impact of changing the macroeconomic input in the First Class Mail equations. Instead of employment per person, we entered real personal disposable income per person to represent the state of the economy, which is in line with typical macroeconomic variables used by federal agencies. When doing so, price elasticity estimates became less inelastic than currently reported. (Table 4)

SECTION TAKEAWAYS

1. **Small tweaks to the model results in notable changes to USPS elasticity estimates.** To test the sensitivity of USPS model, small, reasonable changes were made to First Class and Marketing Mail equations.

2. **USPS may lose more volume than expected with rate increases.** By making one change to the demand equations, many products became less inelastic.

3. **USPS may lose revenue on some products due to rate increases**. By making one change to the demand equations, some Marketing Mail products turned from inelastic to elastic.

The single change in the macroeconomic variable altered the estimated price elasticity for First Class Mail. For example, the USPS Single Piece Letter equation indicates that a 1% increase in price would produce a 0.15% decrease in volume. By changing the macroeconomic variable, the equation produces less inelastic results: a 1% increase in price would result in a 0.35% decrease in volume. Workshared Letters had a similar outcome: instead of the 1% change in price resulting in a 0.32% decline in volume, it changed to a 0.50% decline. Workshared Flats, however, had the opposite outcome: changing the macroeconomic variable made it more inelastic. According to the USPS model, this is the *least* inelastic market dominant product, and when the macroeconomic variable changes, it becomes the *most* inelastic. (Table 4)

Table 4.
First Class Mail Elasticity Results, FY2023[22]

| | | Elasticity Estimate | | Difference in Elasticity | % Difference in Elasticity |
		Original Equation	Macroeconomic Variable Change		
Single Piece	Letters	-0.15	-0.35	-0.20	132%
	Cards	-0.42	-0.51	-0.09	22%
	Flats	-0.54	-0.46	-0.07	-13%
Workshared	Letters	-0.32	-0.50	-0.18	57%
	Cards	-0.57	-0.59	0.02	4%
	Flats	-0.71	-0.05	-0.66	-93%

Marketing Mail Equations

A standout characteristic of USPS Marketing Mail equations is the number of variables used to model time. We tested the impact of simplifying how time is modeled in these equations. Currently, time enters through a series of linear time trends and non-linear interventions. (The non-linear interventions are supposed to explain a range of unique events but have not been thoroughly documented). Because historical data for the Marketing equations is limited—just over ten years of quarterly data—having many variables to model time strongly influences the results. They also risk overfitting the model. Instead, we limited time to enter the equation as one linear trend, dating approximately to when the historical data began. When doing so, price elasticity turned elastic for some mail categories. (Table 5)

Table 5.
Marketing Mail Elasticity Results, FY2023[23]

| | | Elasticity Estimate | | Difference in Elasticity | % Difference in Elasticity |
		Original Equation	Simplified Time Trend		
Commercial	Standard Letters	-0.46	-2.52	-2.06	453%
	High-D/Sat Letters	-0.83	-0.45	0.38	-46%
	Basic Flats/CR	-0.39	-1.90	-1.51	384%
	High-D/Sat Flats	-0.62	-1.39	-0.77	124%
	Every Door Direct Mail	-0.36	-0.31	0.05	-14%
Nonprofit	Basic Letters	-0.37	-0.56	-0.20	53%
	High-D/Sat Letters	-0.56	-2.55	-1.99	359%
	Basic Flats	-0.49	-0.63	-0.14	29%
	High-D/Sat Flats	-0.46	-1.69	-1.23	265%

---

[22] USPS. Demand Equations, FY2023; ndp | analytics.
[23] USPS. Demand Equations, FY2023; ndp | analytics.

USPS Modeling Practices Limit Accuracy & Accountability

While there is a large degree of judgment (and debate) in econometric modeling, there are accepted best practices in the discipline. Some of those best practices are currently not employed in the USPS demand model. Following them could improve forecast accuracy, provide greater transparency, and reduce the likelihood of the model being too highly calibrated to achieve specific outcomes.

USPS Modeling Practices

Each January, the USPS releases its new demand equations and volume forecasts for the upcoming year. The outcomes are used to estimate expected revenue and to inform future ratemaking for market dominant products. The documentation released with these estimates includes detailed data files, a change log, summaries of the equations and their outputs, and a narrative explaining select changes and observations.

Each year, numerous changes are made to the USPS demand equations. As seen in the changes from FY2023 to FY2024, even when the number of variables does not change, the composition of the model changes. Going one step further, we examined the types of changes made to the USPS equations year over year, including changes within each category of variables (i.e., while there may be no change in the number of dummy variables in a product's demand equation year-over-year, the types of dummy variables themselves may change). Such extensive model changes each year demonstrate the large degree of subjectivity when estimating the model and make it challenging to test for accuracy. In addition, the model changes do not provide justification. Most questionable are frequent changes to dummy variables, time trends, and non-linear interventions, which may not be expected to change as often. Without justification, changes may be made to stabilize results relative to previous estimates.

SECTION TAKEAWAYS

1. **The USPS model has frequent changes which make it challenging to test for accuracy.** Each January USPS publishes its new demand equations and documentation. In FY2024 there were 63 items in its change log. Such extensive modifications show the large degree of subjectivity when estimating the model.

2. **Justification for model changes is not well documented.** Often USPS does not provide the rationale for specific model adjustments.

3. **The USPS does not follow some common best practices.** Agencies like CBO and BLS that publish forecasts also produce publicly available performance assessments and sensitivity analyses and use external panels of experts.

From FY2014 to FY2023, the number of equations used to model USPS market dominant products and the composition of the variables in each equation changed often. We aggregated the "sets" of changes imposed by the USPS annually; a set could be that one variable was added or removed or that a new condition was applied to multiple variables, such as a change in a start date for multiple seasonal variables or an addition of a COVID-19 dummy across multiple equations. This approach underestimates the actual number of tweaks to USPS equations.

Changes in Marketing Mail equations were most common. On average, 17 sets of changes were made to the explanatory variables in these demand equations each year, ranging from six in FY2016 (all new equations) to 42 in FY2021 during the COVID-19 pandemic. First Class Mail typically had eight changes per year, ranging from three sets of revisions in FY2019 to 14 in FY2018 and FY2021. (Figure 10, Panel A)

The most common changes relate to dummy variables and time or seasonality trends. The FY2023 demand equations had 14 sets of dummy variable changes, nine adjustments to time and seasonal variables, eight changes related to own price and lags, and seven revisions to interventions and other variables. (Figure 10, Panel B)

Figure 10.
Sets of Changes to Prior Year Demand Equations to Prior Year Demand Equations, FY2014-23[24]

Panel A. Changes by Class of Mail

Legend:
- Changes to First Class Mail Equations
- New First Class Mail Equations
- Changes to Marketing Mail Equations
- New Marketing Mail Equations
- Changes to Periodical Equations
- New Periodical Equations

Panel B. Changes by Type

Legend:
- Dummy Variables
- Time & Seasonal Variables
- Own Price & Lags
- Interventions & Other
- New Equations
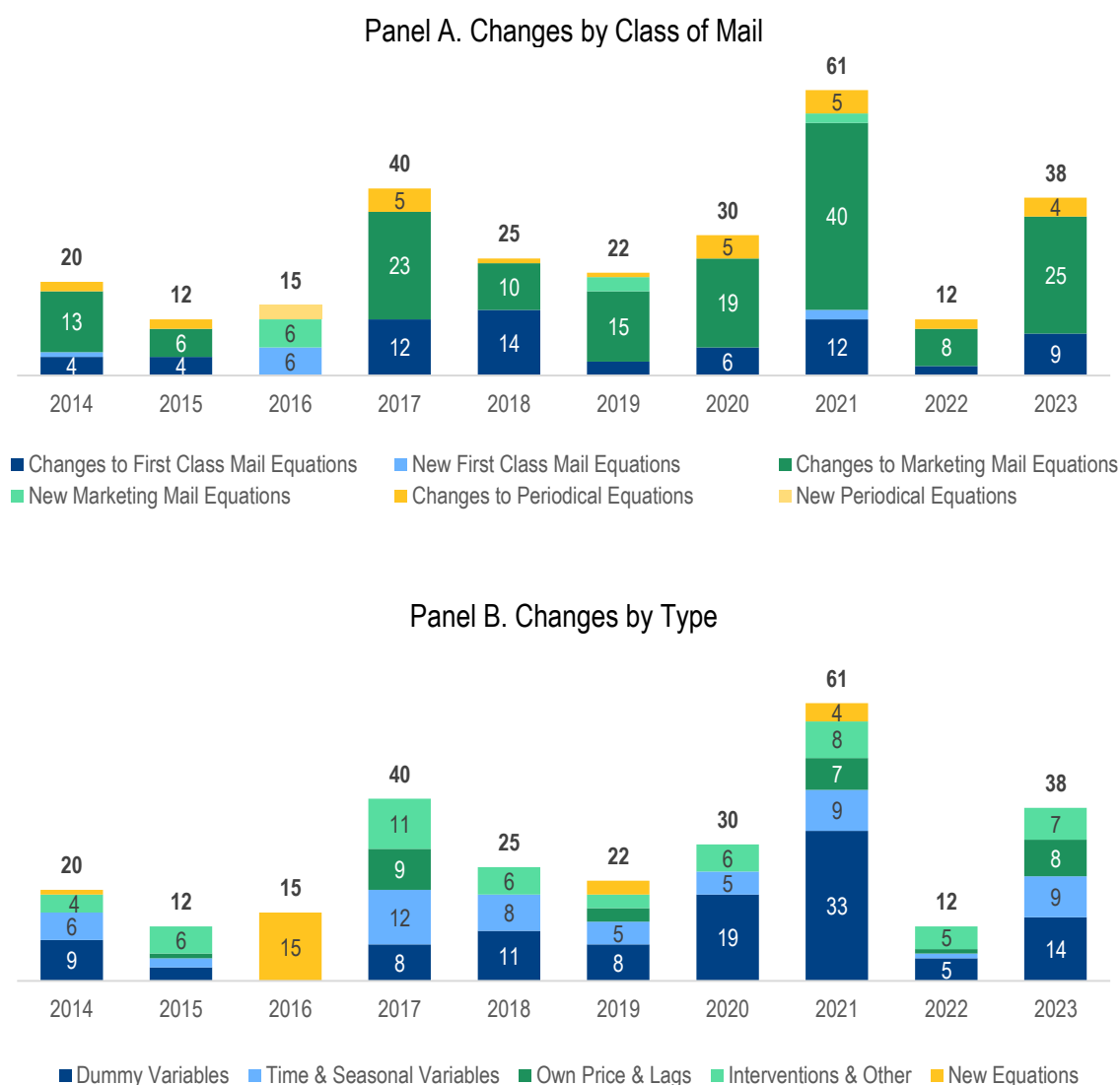
Values of 3 or less are not displayed.

---

[24] USPS. Demand Equations, FY2014-23.

The same pattern was observed in the FY2024 USPS demand model. These equations had 63 sets of changes to explanatory variables from FY2023. The top market dominant products had 33 revisions, including changes to dummy variables, time trends, price lags, interventions, and other factors. (Table 6)

Table 6.
Changes to the FY2024 Demand Equations for Top Market Dominant Products[25]

	Change Log	Types of Changes
All Market Dominant Products	**63**	
Top Market Dominant Products	**33**	
Single Piece Letters	1	Dummy variables
Workshared Letters	1	Own price lag
Workshared Cards	3	Dummy variable & time trends
Commercial Letters	4	Dummy variables, own price, & non-linear intervention
Commercial High-D/Sat Letters	3	Dummy variable, time trend, & non-linear intervention
Commercial Flats	2	Dummy variable & own price
Commercial High-D/Sat Flats	4	Dummy variable, own price, & time trend
Nonprofit Letters	3	Dummy variables & own price
Regular Periodicals	4	Dummy variable, own price, & seasonal variables
Nonprofit/Classroom Periodicals	8	Dummy variables, own price, time trends, & other variables

Improving Forecast Accuracy & Transparency

The characteristics of the USPS demand model raise red flags when relying on it for *predictive* purposes. Decisions that impact millions of American households and businesses should adhere to best practices that increase accuracy and transparency. Based on a review of practices by the USPS and other government agencies, and published literature, we identified three principal best practices USPS does not currently follow: published performance assessments, sensitivity analyses, and inclusion of external experts. (Table 7)

Published Performance Assessment: It is best practice to periodically assess the accuracy of forecasts relative to actual history. Because of the frequent changes to variables within equations and changes to the products covered by each equation, there are fewer opportunities to review the model's usefulness, leading to potentially erroneous decision-making based on its results. U.S. government agencies that forecast, like the Congressional Budget Office (CBO) and Bureau of Labor Statistics (BLS), publish evaluations of their projections.[26] This process improves transparency and establishes a public track record that adds legitimacy. According to CBO: "By assessing the quality of its projections and identifying the factors that might have led to under- or overestimates of particular categories of federal revenues and outlays, CBO seeks to improve the accuracy of its work."[27]

---

[25] USPS. Demand Equations, FY2024.
[26] For example, see CBO (https://www.cbo.gov/publication/59682) and BLS (https://www.bls.gov/emp/evaluations/projections-evaluations.htm).
[27] Congressional Budget Office. 2023. "The Accuracy of CBO's Budget Projections for Fiscal Year 2023." Dec 15.

Published Sensitivity Analyses: The results of the USPS demand equations—including price elasticities—can range when model inputs, assumptions, or specifications are tweaked. While economists can defend a wide range of possibilities when crafting a demand model, even small, reasonable changes to the USPS model can lead to different outcomes. As a result, the reported price elasticities should not be taken as fact but rather as the results of one model's specification. To deal with this issue, it is common (and good practice) for economists to report the sensitivity of model results based on different specifications, assumptions, or inputs (such as macroeconomic growth). For example, CBO regularly discusses the uncertainty of its budgetary and economic projections.[28] The USPS forecast documentation excludes sensitivity analyses, so a reasonable range of price elasticities is unknown.

External Experts: The USPS forecasting could be improved with the ongoing involvement of external experts. Research has suggested that for short-term forecasts, like the USPS projections, panels of experts provide more accurate projections than economic modeling.[29] This is a best practice among government agencies that produce forecasts. CBO has a standing panel of external subject matter experts that review and provide feedback on its models. CBO acknowledges that this process "greatly enhances" their work.[30] BLS also incorporates experts into its employment projection process, noting that "adjustments to the initial estimates of the final demand matrix are made based on research and analysis by industry experts."[31]

Table 7.
3 Best Practices that Improve Forecast Accuracy & Transparency

Best Practice	Descriptions
Performance Assessments	It is best practice to test for accuracy and publish results. CBO and BLS publish evaluations of their forecast performances. Frequent revisions to USPS equations make assessing accuracy and establishing a track record challenging. This reduces confidence in the model's ability to predict volume losses caused by rate increases.
Sensitivity Analyses	It is best practice to evaluate the sensitivity of a model and its output. Due to the volume of variables and frequent changes, the USPS should publish sensitivity analyses to determine potential elasticity ranges for its products before determining rate increases.
External Experts	Short-term forecasts are more accurate with input from experts. It is best practice to seek outside input on forecasting models. Agencies like CBO and BLS convene panels of experts to provide input on and review their projections.

---

[28] For example, see *2023 Long-Term Budget Outlook* (CBO, June 2023), https://www.cbo.gov/system/files/2023-06/59014-LTBO.pdf.
[29] Buturac, Goran. 2021. "Measurement of Economic Forecast Accuracy: A Systematic Overview of the Empirical Literature." Journal of Risk and Financial Management. 15:1. Oct 26.
[30] CBO. Panels of Advisers | Congressional Budget Office (cbo.gov)
[31] BLS. "Employment Projections Methods Overview."

Policy Implications and Closing

The current USPS ratemaking regime is unprecedented and understudied. The biannual rate increases that exceed CPI, introduced with *Delivering for America*, are proposed, and implemented with little data on the impact of these rate increases on consumer and business behavior. USPS ratemaking and rate increases merit close attention because they impact millions of U.S. households and businesses. Moreover, USPS is the only option for sending and receiving market dominant mail. This category is critical to the USPS bottom line and cannot be ignored.

The USPS demand model justifies rate increases. While economic modeling is both a science and an art, much is at stake with the USPS model. The USPS model characteristics and practices, such as the number of variables, frequent changes to equations, and high degree of subjectivity, and lack of best practices, present challenges when using it for *predictive* purposes. Misunderstanding price sensitivity can contribute to missed volume and revenue targets. Unlike other products, customers who reduce or eliminate mailing are less likely to return to this behavior. Ignoring price sensitivity may boost revenue in the short run, but USPS must retain volume to achieve and maintain solvency in the *long run*.

Recent volume and revenue results signal issues with the current USPS model used to set rates. In FY2023, after ongoing steep and frequent rate increases, lower-than-planned market dominant mail volume cost USPS $1.8 billion and contributed to $6.5 billion in total losses for the year. If rate increases continue to proceed at this frequency and magnitude without critical review, it risks plummeting volume further and exacerbating USPS's financial challenges. Implementing best practices followed by government agencies may produce a better model for future USPS projections.

References

BLS. "Employment Projections Methods Overview." (Accessed Jan 2024)

Buturac, Goran. 2021. "Measurement of Economic Forecast Accuracy: A Systematic Overview of the Empirical Literature." Journal of Risk and Financial Management. 15:1. Oct 26. Available: https://doi.org/10.3390/jrfm15010001.

CBO. 2023. "The Accuracy of CBO's Budget Projections for Fiscal Year 2023." Dec 15.

CBO. "Panels of Advisors." (Accessed Jan 2024)

Green, Kesten C., and J. Scott Armstrong. 2015. "Simple versus complex forecasting: The evidence." Journal of Business Research. 68:1. Aug. Available: https://doi.org/10.1016/j.jbusres.2015.03.026.

IBM. "What is Overfitting?" (Accessed Jan 2024)

USPS. 2024. "United States Postal Service's Demand Equation Estimation and Volume Forecasting Methodologies, Application of USPS for Non- Public Treatment of Materials." PRC Filing. Jan 22.

_____. 2023. "Narrative Explanation of Econometric Demand Equations for Market Dominant Products Filed with Postal Regulatory Commission on January 20, 2023." Jul.

_____. 2023. "United States Postal Service's Demand Equation Estimation and Volume Forecasting Methodologies, Application of USPS for Non- Public Treatment of Materials." PRC Filing. Jan 20.

_____. 2023. Fiscal Year 2024 Integrated Financial Plan (usps.com)

_____. 2023. "The Household Diary Study: Mail Use & Attitudes in FY 2022." PRC Filing. Jul 7.

_____. 2022. "United States Postal Service's Demand Equation Estimation and Volume Forecasting Methodologies, Application of USPS for Non-Public Treatment of Materials." PRC Filing. Jan 20.

_____. 2022. Fiscal Year 2023 Integrated Financial Plan - United States Postal Service (usps.com).
_____. 2021. "Postal Service Econometric Estimates of Demand Elasticity for All Postal Products, FY 2020." PRC Filing. Jan 20.

_____. 2020. "Postal Service Econometric Estimates of Demand Elasticity for All Postal Products, FY 2019." PRC Filing. Jan 21.

_____. 2019." Postal Service Econometric Estimates of Demand Elasticity for All Postal Products, FY 2018." PRC Filing. Jan 28.

_____. 2018. "Postal Service Econometric Estimates of Demand Elasticity for All Postal Products, FY 2017." PRC Filing. Jan 19.

_____. 2017. "Market Dominant Demand Analyses, FY 2016." PRC Filing. Jan 23.

_____. 2016. "Market Dominant - United States Postal Service's Demand Equation Estimation and Volume Forecasting Methodologies, January 2016." PRC Filing. Jan 20.

_____. 2015." Market Dominant Products, FY 2014: USPS Demand Equation Estimation and Volume Forecasting Methodologies." PRC Filing. Jan 20.

_____. 2014. "Letter from Daniel J. Foucheaux, Jr., USPS to Shoshana M. Grove, Secretary, Postal Regulatory Commission." PRC Filing. Jan 21.

_____. 2013. "Demand Analyses FY 2012 - Market Dominant." PRC Filing. Jan 22.

_____. "Universal Service Obligation." (Accessed Jan 2024)

APPENDIX A. Market Dominant Demand Equations and Elasticity Estimates, FY2014-24

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
First Class Mail											
Single-Piece	-0.16	-0.14									
All Letters & Cards											
Letters			-0.10	-0.10	-0.13	-0.14	-0.19	-0.15	-0.18	-0.15	-0.17
Metered								-0.13	-0.20	-0.24	-0.44
Stamped								-0.16	-0.27	-0.06	-0.18
Cards			-0.22	-0.50	-0.59	-0.38	-0.28	-0.37	-0.36	-0.42	-0.45
Flats			-0.12	-0.12	-0.28	-0.40	-0.26	-0.25	-0.16	-0.54	-0.74
Workshared	-0.34	-0.30									
Letters			-0.26	-0.19	-0.41	-0.38	-0.32	-0.23	-0.29	-0.32	-0.36
Cards			-0.17	-0.30	-0.36	-0.31	-0.20	-0.41	-0.60	-0.57	-0.58
Flats			-0.52	-0.37	-0.34	-0.51	-0.48	-0.32	-0.42	-0.71	-0.57
Periodical											
All	-0.09	-0.06									
Regular			-0.18	-0.22	-0.17	-0.09	-0.17	-0.19	-0.15	-0.26	-0.50
Nonprofit/Classes			-0.20	-0.31	-0.27	-0.23	-0.22	-0.28	-0.29	-0.28	-0.20
Within-County			-0.11	-0.04	-0.15	-0.16	-0.23	-0.13	-0.14	-0.23	-0.65
Marketing Mail											
Commercial											
Basic/Regular	-0.46	-0.48									
Letters			-0.44	-0.48	-0.46	-0.31	-0.44	-0.54	-0.53	-0.46	-0.65
Flats			-0.45	-0.48	-0.58	-0.85	-0.84	-0.31	-0.42	-0.39	-0.55
High-D/Sat	-0.89	-0.85	-0.82	-0.85							
Letters					-0.75	-0.42	-0.48	-0.59	-0.62	-0.83	-0.67
Flats & EDDM					-0.33						
Flats						-0.78	-0.65	-0.44	-0.69	-0.62	-0.76
EDDM						-0.32	-0.36	-0.39	-0.28	-0.36	-0.92
Nonprofit											
Basic/Regular	-0.37	-0.16									
Letters			-0.11	-0.08	-0.28	-0.30	-0.28	-0.35	-0.37	-0.37	-0.31
Flats			-0.18	-0.31	-0.67	-0.67	-0.46	-0.56	-0.43	-0.49	-0.45
High-D/Sat	-0.43	-0.27									
Letters			-0.45	-0.41	-0.86	-0.87	-0.80	-0.74	-0.68	-0.55	-0.55
Flats			-0.57	-0.40	-1.03	-1.24	-0.63	-0.92	-0.39	-0.46	-0.63

APPENDIX B. Quarterly Forecast Performance

Table B.1. All Products, FY2014-23, Excluding Primary COVID Years (2020-21)

	2023 Annual Volume (B)	Max Quarterly Underestimation Actual /Forecasted Volume		Max Quarterly Overestimation Actual /Forecasted Volume		Avg. Difference in Projected & Actual Quarterly Volume Absolute Value
First Class Mail						
Single Piece						
Letters	11,415.3	**-7%**	2023 Q4	**7%**	2014 Q3	**3%**
Flats	507.5	**-13%**	2014 Q1	**7%**	2018 Q2	**5%**
Cards	369.5	**-15%**	2017 Q3	**18%**	2022 Q3	**7%**
Workshared						
Letters	30,811.3	**-5%**	2022 Q3	**6%**	2014 Q4	**2%**
Cards	2,437.8	**-32%**	2023 Q3	**30%**	2022 Q1	**11%**
Flats	465.5	**-21%**	2017 Q3	**21%**	2019 Q1	**10%**
Periodicals						
Regular	1,516.1	**-13%**	2022 Q4	**4%**	2016 Q1	**4%**
NP & Classroom	1,025.0	**-10%**	2022 Q2	**11%**	2018 Q3	**4%**
In-County	451.8	**-8%**	2022 Q3	**11%**	2023 Q2	**4%**
Marketing Mail						
Commercial						
Letters	29,480.3	**-9%**	2023 Q4	**6%**	2022 Q1	**4%**
HD/Sat Letters	4,996.1	**-10%**	2019 Q4	**21%**	2015 Q3	**8%**
Flats & Basic CR	4,800.0	**-14%**	2016 Q3	**11%**	2022 Q1	**7%**
HD/Sat Flats	7,987.8	**-16%**	2014 Q1	**7%**	2019 Q4	**5%**
EDDM	537.6	**-6%**	2022 Q4	**26%**	2023 Q4	**4%**
Nonprofit						
Letters	7,866.8	**-7%**	2023 Q3	**5%**	2018 Q1	**3%**
HD/Sat Letters	281.2	**-23%**	2015 Q1	**44%**	2014 Q3	**14%**
Flats & Basic CR	956.7	**-31%**	2019 Q1	**19%**	2015 Q1	**8%**
HD/Sat Flats	435.6	**-21%**	2016 Q3	**43%**	2017 Q1	**16%**

Table B.2. All Products, FY2014-23, All Years

	2023 Annual Volume (B)	Max Quarterly Underestimation Actual /Forecasted Volume		Max Quarterly Overestimation Actual /Forecasted Volume		Avg. Difference in Projected & Actual Quarterly Volume Absolute Value
First Class Mail						
Single Piece						
Letters	11,415.3	**-7%**	2023 Q4	**7%**	2014 Q3	**3%**
Flats	507.5	**-13%**	2014 Q1	**7%**	2018 Q2	**4%**
Cards	369.5	**-15%**	2020 Q3	**22%**	2021 Q1	**7%**
Workshared						
Letters	30,811.3	**-8%**	2020 Q3	**6%**	2014 Q4	**2%**
Cards	2,437.8	**-32%**	2023 Q3	**39%**	2021 Q3	**12%**
Flats	465.5	**-50%**	2020 Q3	**21%**	2019 Q1	**10%**
Periodicals						
Regular	1,516.1	**-21%**	2020 Q3	**7%**	2021 Q1	**5%**
NP & Classroom	1,025.0	**-12%**	2021 Q1	**11%**	2018 Q3	**4%**
In-County	451.8	**-9%**	2020 Q3	**11%**	2023 Q2	**4%**
Marketing Mail						
Commercial						
Letters	29,480.3	**-46%**	2020 Q3	**15%**	2021 Q4	**6%**
HD/Sat Letters	4,996.1	**-29%**	2020 Q3	**21%**	2015 Q3	**8%**
Flats & Basic CR	4,800.0	**-36%**	2020 Q3	**11%**	2022 Q1	**8%**
HD/Sat Flats	7,987.8	**-26%**	2020 Q3	**7%**	2019 Q4	**6%**
EDDM	537.6	**-6%**	2021 Q2	**53%**	2020 Q3	**6%**
Nonprofit						
Letters	7,866.8	**-16%**	2020 Q3	**6%**	2020 Q1	**3%**
HD/Sat Letters	281.2	**-57%**	2021 Q2	**51%**	2020 Q4	**18%**
Flats & Basic CR	956.7	**-31%**	2019 Q1	**19%**	2015 Q1	**9%**
HD/Sat Flats	435.6	**-21%**	2016 Q3	**121%**	2020 Q4	**19%**

APPENDIX C. Explanatory Power of USPS Variables

Table C.1. Contributions to Change in Volume Over Last Five Years, FY2023 USPS Estimates

	Own Price	Macro-economic	Time Trends & Inter-ventions	Seasonal Variables	Dummy Variables	Other	Total Change in Volume
First-class							
Single Piece							
Letters	-0.12%	0.53%	-35.15%	0.00%	0.00%	4.02%	**-30.72%**
Metered	0.38%	0.65%	-27.81%	0.00%	0.00%	-6.39%	**-33.17%**
Stamped	-0.14%	0.20%	-31.11%	0.00%	0.00%	1.72%	**-29.33%**
Cards	-0.65%	0.60%	-47.95%	0.96%	0.00%	8.09%	**-38.95%**
Flats	3.51%	0.13%	-39.28%	0.00%	-6.18%	5.00%	**-36.82%**
Workshared							
Letters	0.79%	0.39%	-12.57%	0.10%	-0.24%	-0.74%	**-12.27%**
Cards	-2.30%	0.80%	65.61%	0.00%	0.00%	-31.32%	**32.79%**
Flats	5.13%	1.03%	-44.03%	0.00%	39.28%	-8.81%	**-7.40%**
Periodicals							
Regular	-0.44%	0.50%	-60.75%	1.38%	0.00%	12.67%	**-46.64%**
Nonprofit/CR	0.26%	0.13%	-17.58%	0.00%	0.00%	2.62%	**-14.57%**
Within-County	0.27%	0.50%	-18.63%	0.00%	2.02%	0.02%	**-15.82%**
Marketing							
Commercial							
Letters							
Basic	0.60%	7.19%	-14.45%	-1.17%	-2.89%	2.82%	**-7.90%**
High-D / Sat	-1.12%	6.52%	-19.31%	0.00%	0.00%	0.86%	**-13.05%**
Flats/ECR							
Basic	-2.03%	6.03%	-54.47%	0.40%	0.00%	8.03%	**-42.04%**
High-D / Sat	3.01%	3.25%	-29.10%	0.00%	0.00%	3.87%	**-18.97%**
EDDM	1.99%	5.92%	-44.86%	0.00%	0.00%	3.48%	**-33.47%**
Nonprofit							
Letters							
Basic	0.04%	4.39%	-13.70%	0.17%	0.00%	2.81%	**-6.29%**
High-D / Sat	-4.46%	6.64%	-54.34%	0.00%	-5.07%	10.29%	**-46.94%**
Flats/ECR							
Basic	-1.85%	4.39%	-31.79%	0.00%	0.00%	2.74%	**-26.51%**
High-D / Sat	-0.09%	6.75%	-19.11%	0.00%	0.00%	5.41%	**-7.04%**

Table C.2. Contributions to Change in Volume Over Last Five Years, FY2024 USPS Estimates

	Own Price	Macro-economic	Time Trends & Inter-ventions	Seasonal Variables	Dummy Variables	Other	Total Change in Volume
First-class							
Single Piece							
Letters	-0.19%	1.40%	-34.94%	0.00%	-4.86%	6.29%	**-32.30%**
Metered	-2.28%	1.96%	-38.90%	0.00%	0.00%	5.68%	**-33.54%**
Stamped	-0.36%	0.48%	-31.06%	0.00%	-5.13%	4.50%	**-31.57%**
Cards	-4.79%	1.51%	-48.10%	0.00%	0.00%	9.88%	**-41.50%**
Flats	1.74%	0.54%	-39.72%	0.00%	-7.45%	6.00%	**-38.89%**
Workshared							
Letters	-1.20%	0.98%	-9.98%	0.00%	-7.39%	3.75%	**-13.84%**
Cards	-6.64%	2.18%	64.59%	0.00%	-6.95%	-35.68%	**17.50%**
Flats	0.06%	2.64%	-36.52%	0.00%	18.69%	-0.98%	**-16.11%**
Periodicals							
Regular	-1.38%	1.46%	-60.21%	0.00%	-11.73%	19.10%	**-52.76%**
Nonprofit/CR	-1.89%	0.33%	-20.67%	0.00%	-0.19%	2.85%	**-19.57%**
Within-County	-1.41%	1.39%	-16.78%	0.00%	4.83%	0.50%	**-11.47%**
Marketing							
Commercial							
Letters							
Basic	-0.76%	3.51%	-28.44%	0.54%	1.66%	3.28%	**-20.21%**
High-D / Sat	-4.48%	3.20%	-21.13%	0.00%	-5.87%	3.29%	**-24.99%**
Flats/ECR							
Basic	-3.35%	2.73%	-53.05%	0.35%	-6.64%	12.15%	**-47.81%**
High-D / Sat	0.06%	1.46%	-29.68%	0.00%	-3.94%	5.39%	**-26.71%**
EDDM	8.95%	2.73%	-37.38%	0.00%	0.00%	2.32%	**-23.38%**
Nonprofit							
Letters							
Basic	-0.19%	1.36%	-12.71%	0.70%	-4.68%	2.68%	**-12.84%**
High-D / Sat	-2.39%	3.32%	-50.77%	0.00%	0.00%	4.70%	**-45.14%**
Flats/ECR							
Basic	-7.28%	1.01%	-34.02%	-1.82%	0.00%	6.72%	**-35.39%**
High-D / Sat	-7.50%	7.12%	-12.10%	0.00%	-10.91%	5.18%	**-18.21%**

APPENDIX D. Variable Count & Degrees of Freedom

Table D.1. FY2023 Demand Equations

	Total	Own Price	Time Trends & Inter-ventions	Dummy Variables	Seasonal Variables	Macro-economic & Other	Degrees of Freedom
First-class							
Single Piece							
Letters	**23**	5	5	6	5	2	**51**
Metered	**8**	1	2	0	3	2	**24**
Stamped	**8**	1	1	1	3	2	**24**
Cards	**13**	2	2	4	3	2	**62**
Flats	**20**	4	5	4	5	2	**55**
Workshared							
Letters	**22**	5	7	1	6	3	**52**
Cards	**10**	1	3	0	4	2	**65**
Flats	**13**	3	2	3	3	2	**61**
Periodicals							
Regular	**15**	2	4	0	7	2	**76**
Nonprofit/CR	**18**	5	1	4	6	2	**72**
Within-County	**9**	1	2	1	3	2	**50**
Marketing							
Commercial							
Letters							
Basic	**16**	2	4	4	5	1	**25**
High-D / Sat	**11**	2	3	2	3	1	**30**
Flats/ECR							
Basic	**15**	3	4	1	5	2	**26**
High-D / Sat	**15**	3	4	1	3	4	**27**
EDDM	**10**	1	5	0	3	1	**28**
Nonprofit							
Letters							
Basic	**14**	3	3	0	5	3	**27**
High-D / Sat	**17**	1	3	6	6	1	**58**
Flats/ECR							
Basic	**11**	1	3	2	3	2	**32**
High-D / Sat	**11**	2	5	0	3	1	**26**

Table D.2. FY2024 Demand Equations

	Total	Own Price	Time Trends & Inter-ventions	Dummy Variables	Seasonal Variables	Macro-economic & Other	Degrees of Freedom
First-class							
Single Piece							
Letters	**24**	5	5	7	5	2	**54**
Metered	**11**	3	1	2	3	2	**24**
Stamped	**8**	1	2	0	3	2	**28**
Cards	**12**	1	2	4	3	2	**67**
Flats	**21**	5	5	4	5	2	**58**
Workshared							
Letters	**18**	1	7	1	6	3	**61**
Cards	**11**	1	3	1	4	2	**68**
Flats	**15**	5	2	3	3	2	**63**
Periodicals							
Regular	**15**	3	4	1	5	2	**80**
Nonprofit/CR	**16**	2	2	4	6	2	**79**
Within-County	**10**	1	2	2	3	2	**53**
Marketing							
Commercial							
Letters							
Basic	**21**	3	8	4	5	1	**24**
High-D / Sat	**10**	2	1	3	3	1	**35**
Flats/ECR							
Basic	**18**	5	4	2	5	2	**27**
High-D / Sat	**18**	5	4	2	3	4	**27**
EDDM	**15**	5	4	2	3	1	**25**
Nonprofit							
Letters							
Basic	**15**	2	3	2	5	3	**32**
High-D / Sat	**17**	1	3	6	6	1	**62**
Flats/ECR							
Basic	**13**	1	4	2	4	2	**34**
High-D / Sat	**11**	1	5	1	3	1	**31**

APPENDIX E. Descriptive Statistics of USPS Elasticities, FY2014-23

	Range (Min to Max)	Average	Median	Standard Deviation
Single Piece Letters	0.09	-0.14	-0.14	0.03
Regular Periodicals	0.20	-0.17	-0.17	0.06
Workshared Letters	0.22	-0.30	-0.30	0.07
Commercial Letters	0.23	-0.46	-0.46	0.07
Nonprofit/Classroom Periodicals	0.25	-0.24	-0.27	0.07`
Nonprofit Letters	0.29	-0.26	-0.28	0.11
Workshared Cards	0.43	-0.36	-0.31	0.15
Commercial High-D/Sat Letters	0.44	-0.69	-0.75	0.17
Commercial High-D/Sat Flats	0.52	-0.67	-0.69	0.18
Commercial Flats	0.55	-0.53	-0.48	0.19