Manhattan Rental Market

Is it as easy as supply and demand?

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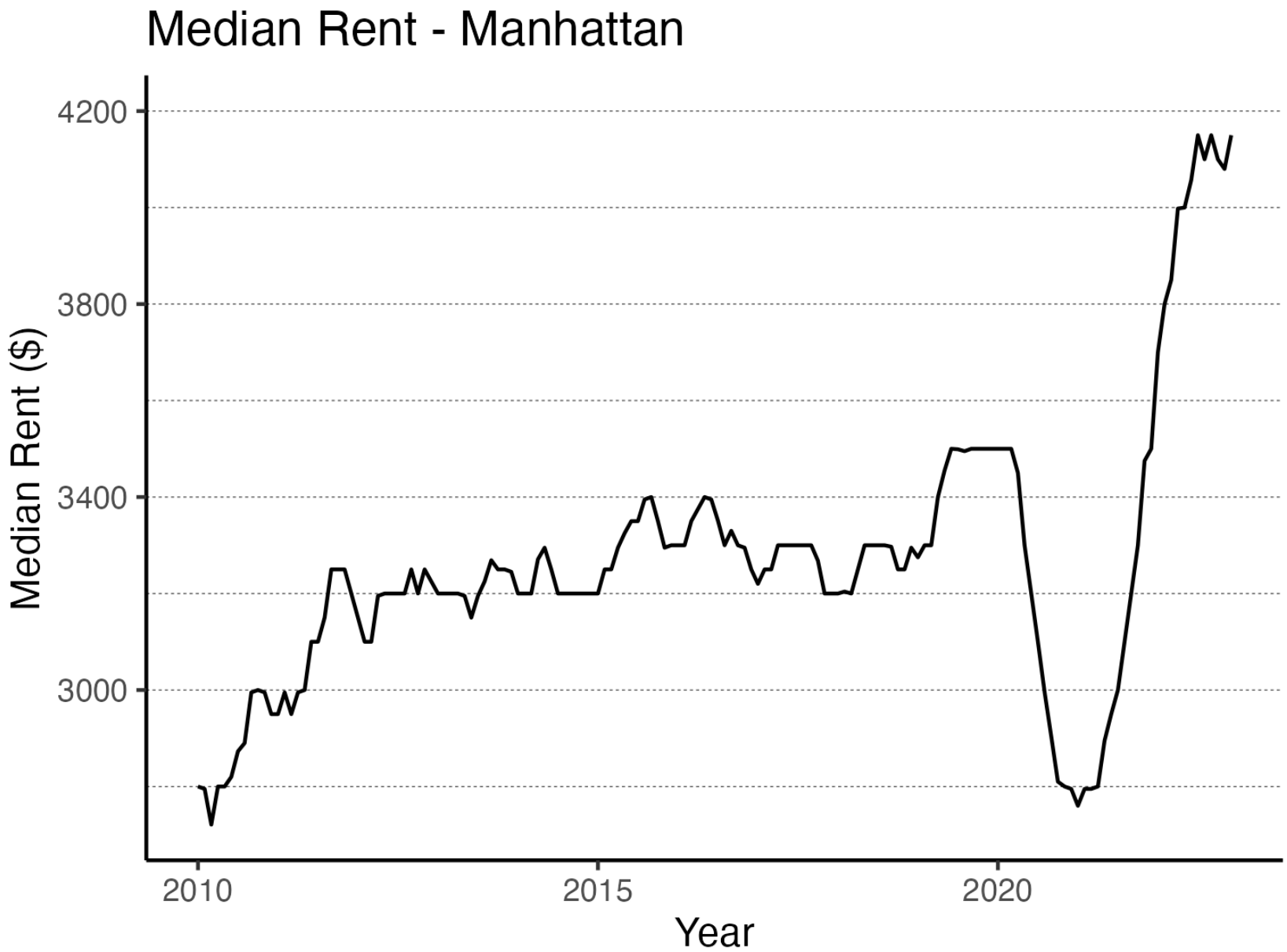
Introduction

- The onset of COVID-19 led to a pronounced urban flight, especially in New York City - the largest rental market in the United States (Whitaker, 2021; Coven et al., 2022)
- This rapid shift precipitated "COVID discounts" on rent...
- ... followed by a rebound period of returning residents and swift increase in rents
- We explore COVID's intertwined effects on NYC rent and rental inventory

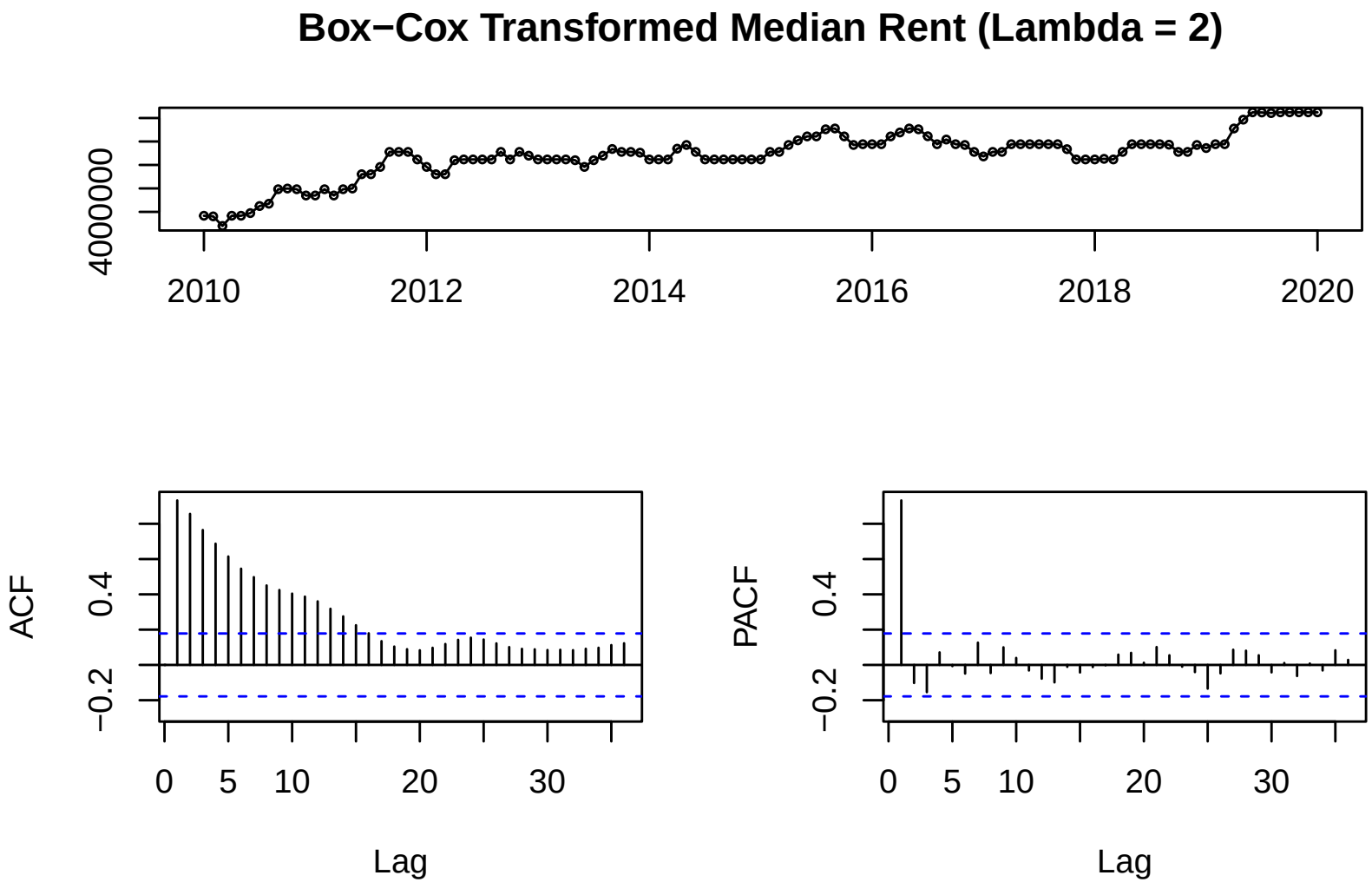
Data

- Data from StreetEasy, a NYC Zillow subsidiary
- StreetEasy publishes monthly series for a number of sale and rental indicators based on its thousands of listings
- To narrow scope, we specifically look at Manhattan monthly median asking rent and rental inventory
- We use January 2010 - January 2020 as training data and in a cross-validation approach to assess in-sample model performance
- We also estimate the effect of COVID in the February 2020 - December 2022 period

Median Rent Data



Box-Cox Transformed Median Rent



Models

We fit 4 different models:

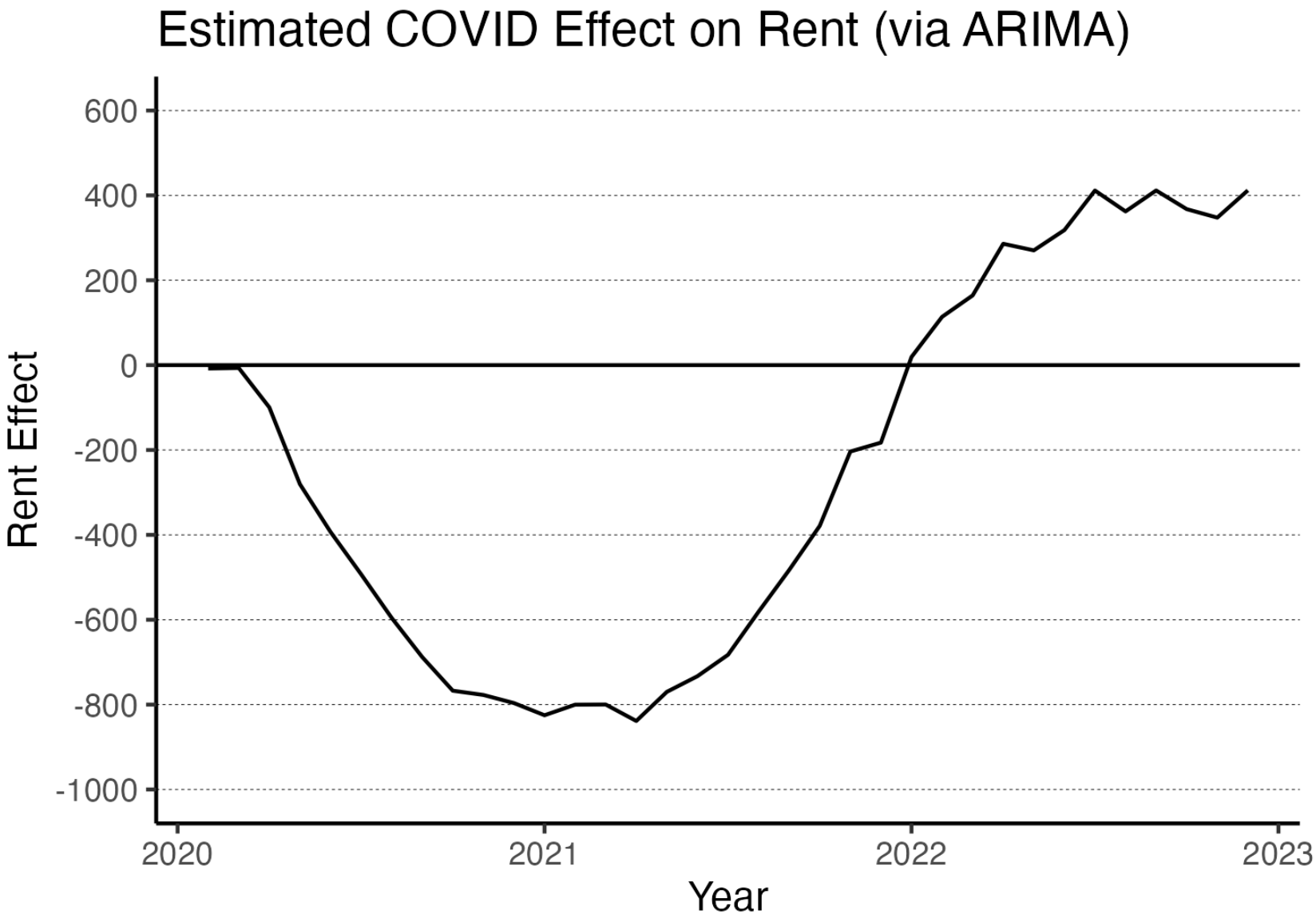
1. Seasonal Exponential Smoothing (ETS)
2. Seasonal Autoregressive Integrated Moving Average (sARIMA)
3. Regression with ARMA errors
4. Vector Autoregression (VAR)

- Each model is evaluated on in-sample performance and COVID-period analysis
- Seasonality is annual for all models

Exponential Smoothing and sARIMA

- Box-Cox transformation with $\lambda \approx 2$ stabilizes rent variance
- Minimum-AICc ETS model is damped additive, and dominated by error term: AAA with $\alpha \approx 1$, $\beta \approx \gamma \approx 2 * 10^{-4}$, $\phi = 0.97$
- Minimum-AICc model is $ARIMA(0,1,0),(2,0,0)_{12}$: nonseasonal component is just first difference, while seasonal component is $AR(2)$; no drift needed
- Both approaches produce white noise residuals as verified by Ljung-Box test

COVID-19 Effect on Median Rent

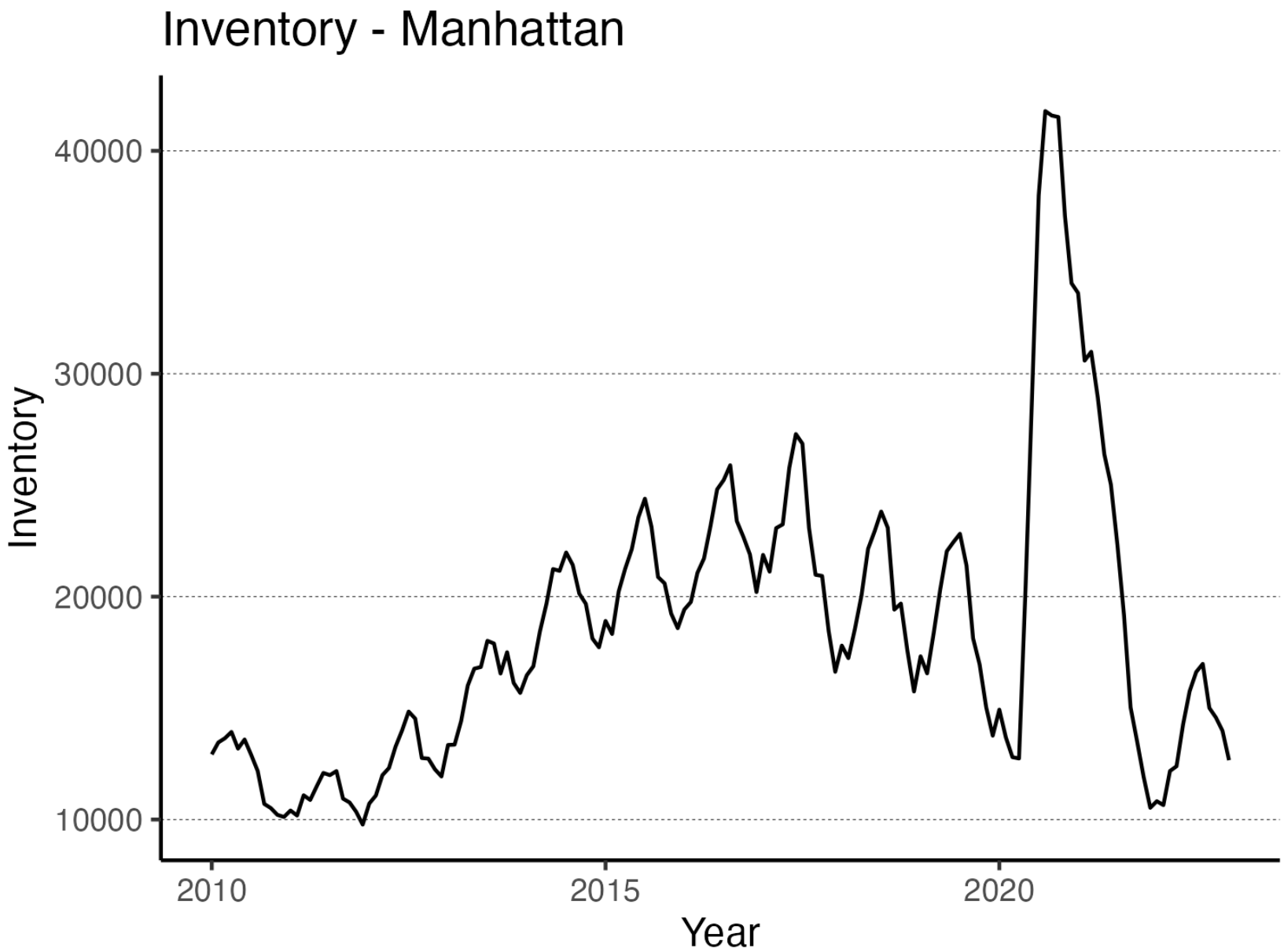


Effect in relation to pre-COVID model predictions.

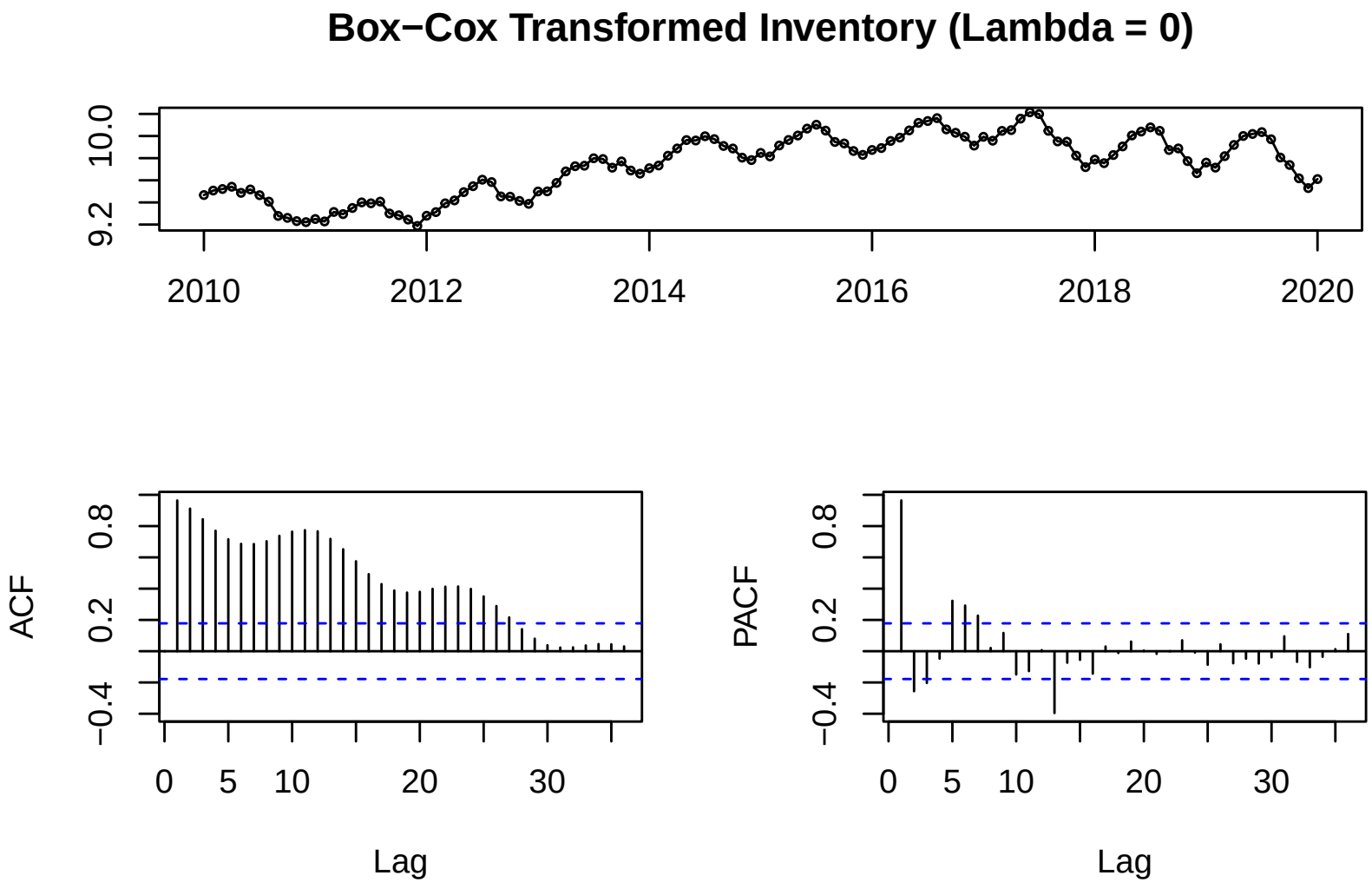
Regression with ARIMA Errors

- Interpretable way to factor in the relationship of an *exogenous* variable
- OLS estimation, while allowing for standard errors to follow ARIMA process
- Introduce listing inventory as a covariate
- Inventory forecasted using *auto.arima*(): $(0,1,0)(0,1,1)_{12}$ with $\lambda = 2$

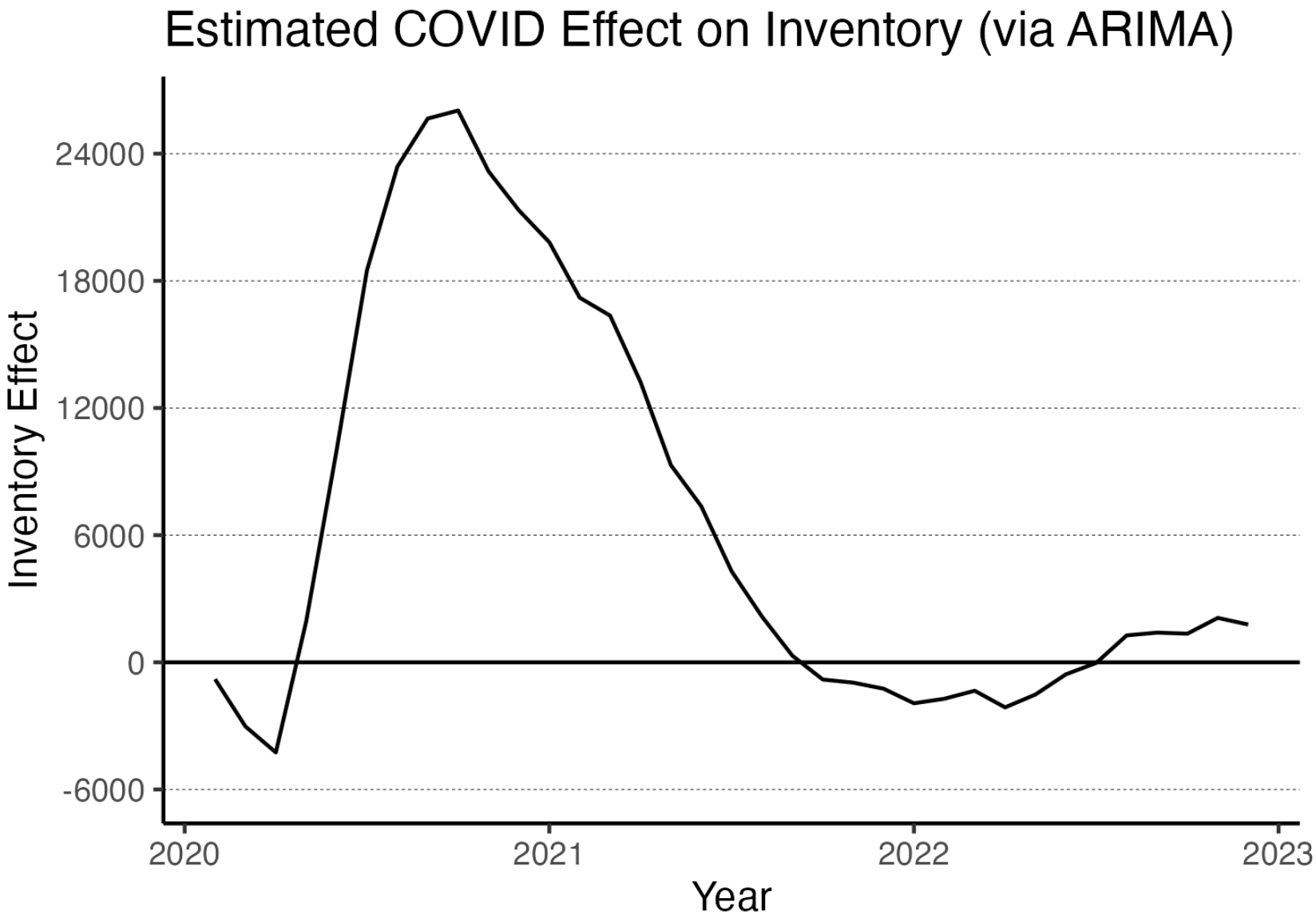
Listing Inventory Data



Box-Cox Transformed Listing Inventory

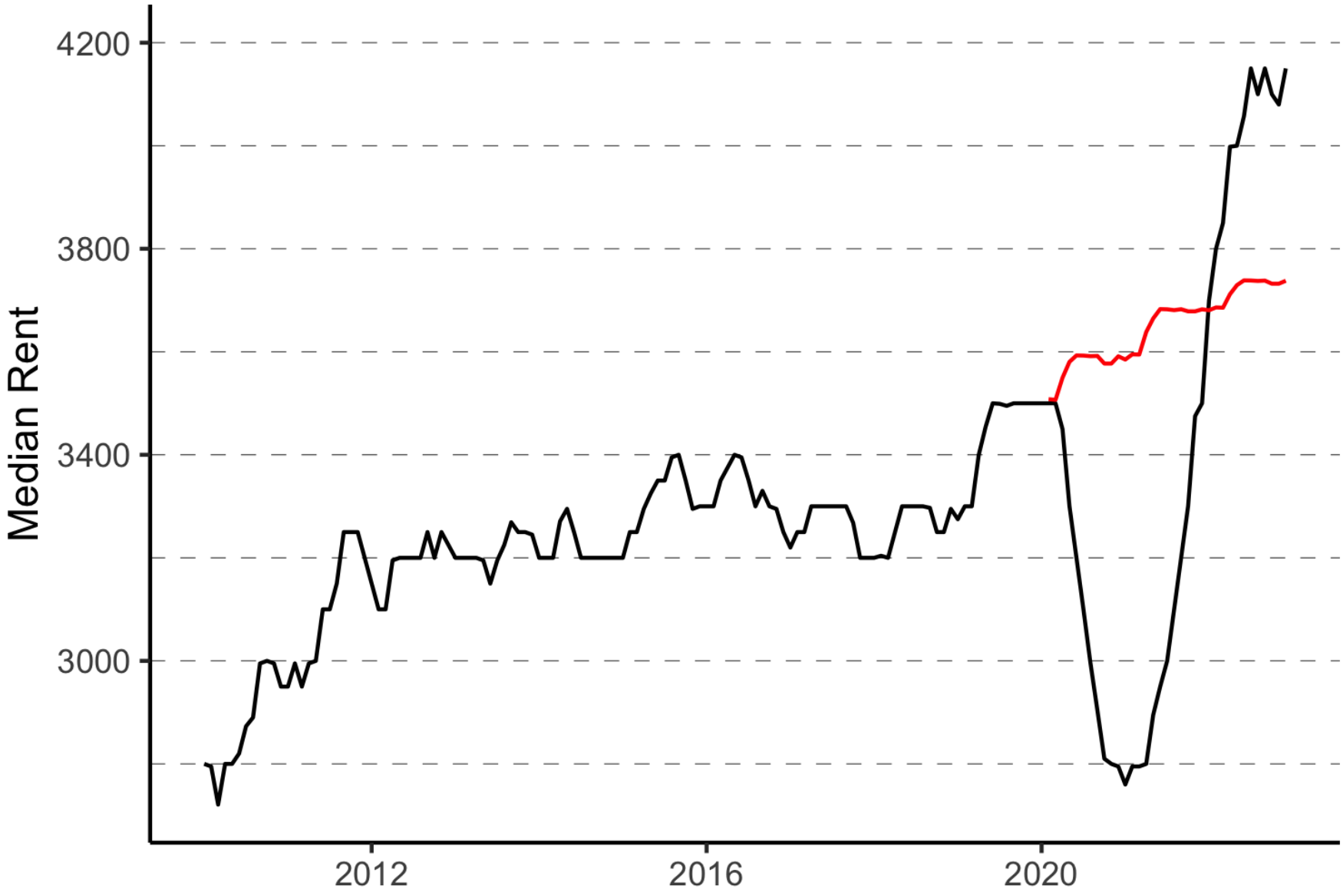


COVID-19 Effect on Inventory



Effect in relation to pre-COVID model predictions.

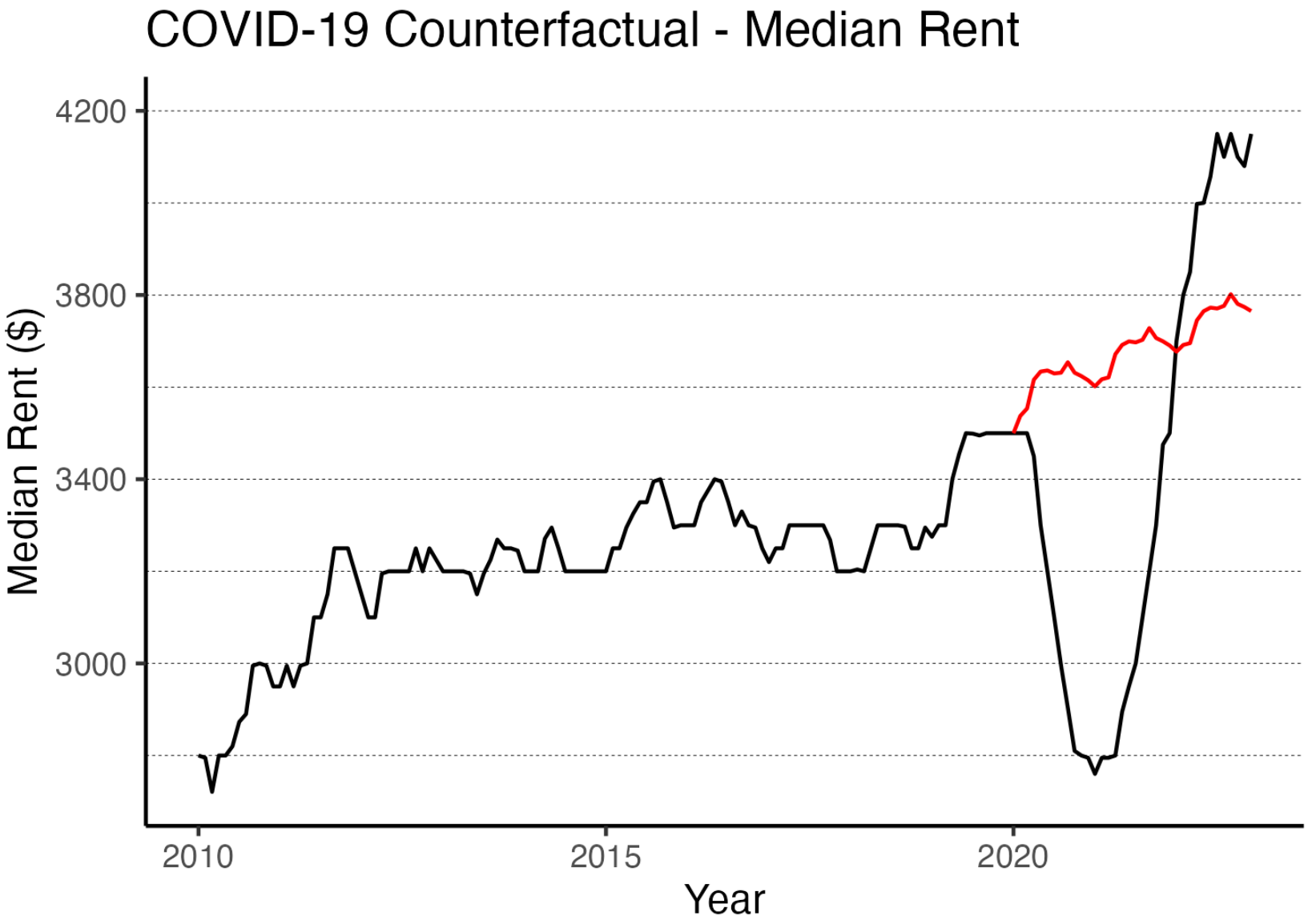
Rent Counterfactual (Regression w/ ARIMA Errors)



VAR

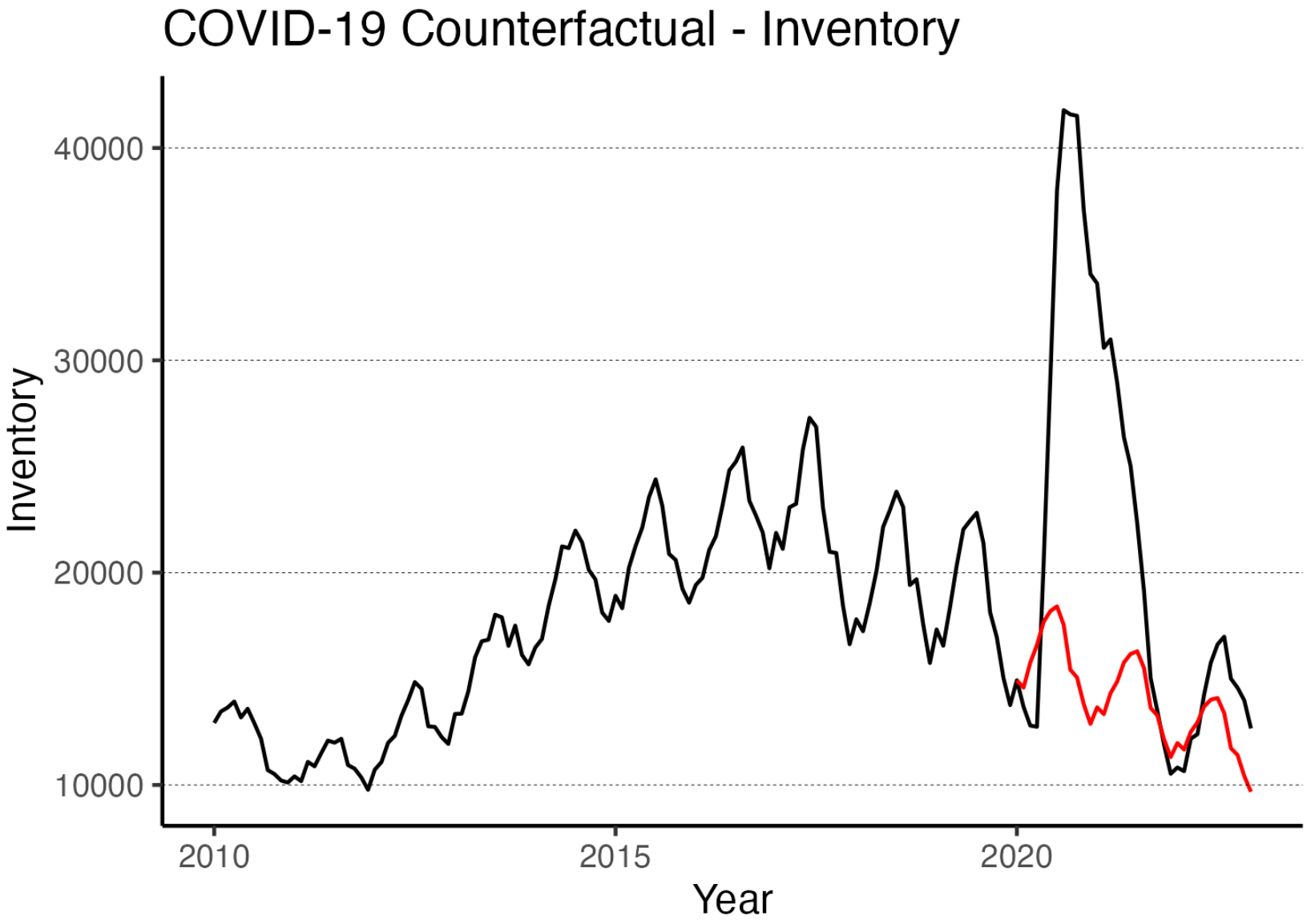
- We test the hypothesis that inventory and rent are *endogenous* with a $VAR(5)$ model
- Surprisingly, there is largely no significant predictive relationship between the two (simultaneous determination?)
- Though intervention analysis is more complex in the multivariable case, this provides us with another "COVID counterfactual"— what if COVID-19 never happened?

Rent Counterfactual (VAR)



Forecasted values of VAR(5) model in red.

Inventory Counterfactual (VAR)



Forecasted values of VAR(5) model in red.

In-Sample Cross-Validation on Median Rent

Conclusion

- Multiple basic approaches produce solid, fairly equivalent models of Manhattan rent in the pre-COVID period
- COVID's onset marked a major departure from stationarity; intervention analysis methods show it has had a lasting impact on rent (despite a return to baseline of rental inventory)
- Rental inventory has limited use as a predictor of future rents

Future Work

- Continued impact of COVID: With more time will rent slowly return to "steady state" level and trend?
- Would data from a more comprehensive sample of rental units yield different results? Does StreetEasy have an upward/downward bias in rental price or inventory?
- What is the interaction between rents (and inventory) in different neighborhoods, or even different cities? Can we estimate spillover effects?
- Is inventory too aggregated of a variable? It represents equilibrium effects—would showing more demand/supply side variables of the rental market be more advantageous?

References

Coven, J., Gupta, A., Yao, I. (2022). JUE Insight: Urban Flight Seeded the COVID-19 Pandemic Across the United States. Journal of Urban Economics, 103489.

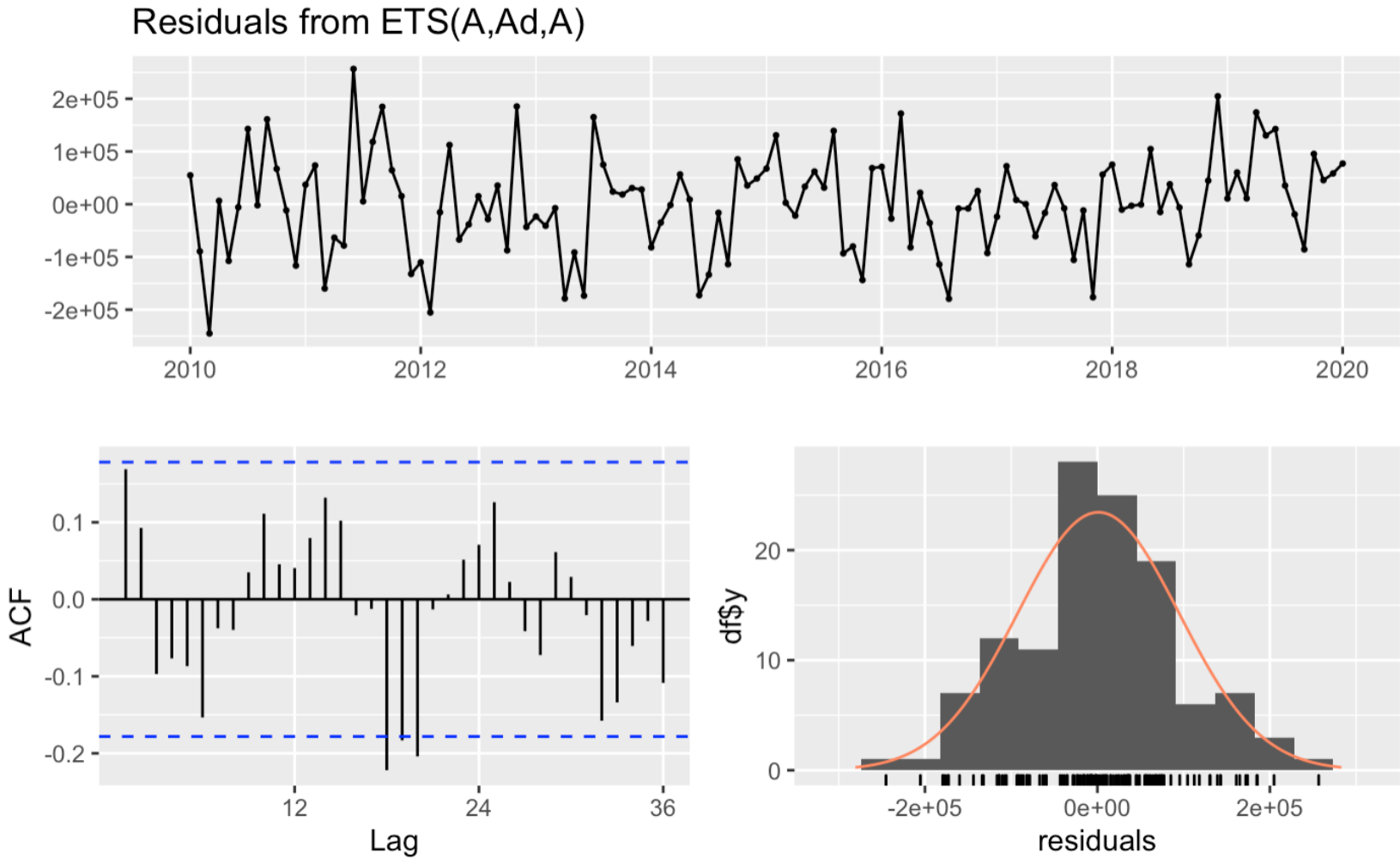
Whitaker, Stephan D. 2021. "Did the COVID-19 Pandemic Cause an Urban Exodus?" Federal Reserve Bank of Cleveland, Cleveland Fed District Data Brief . https://doi.org/10.26509/frbc-ddb-20210205

Appendix

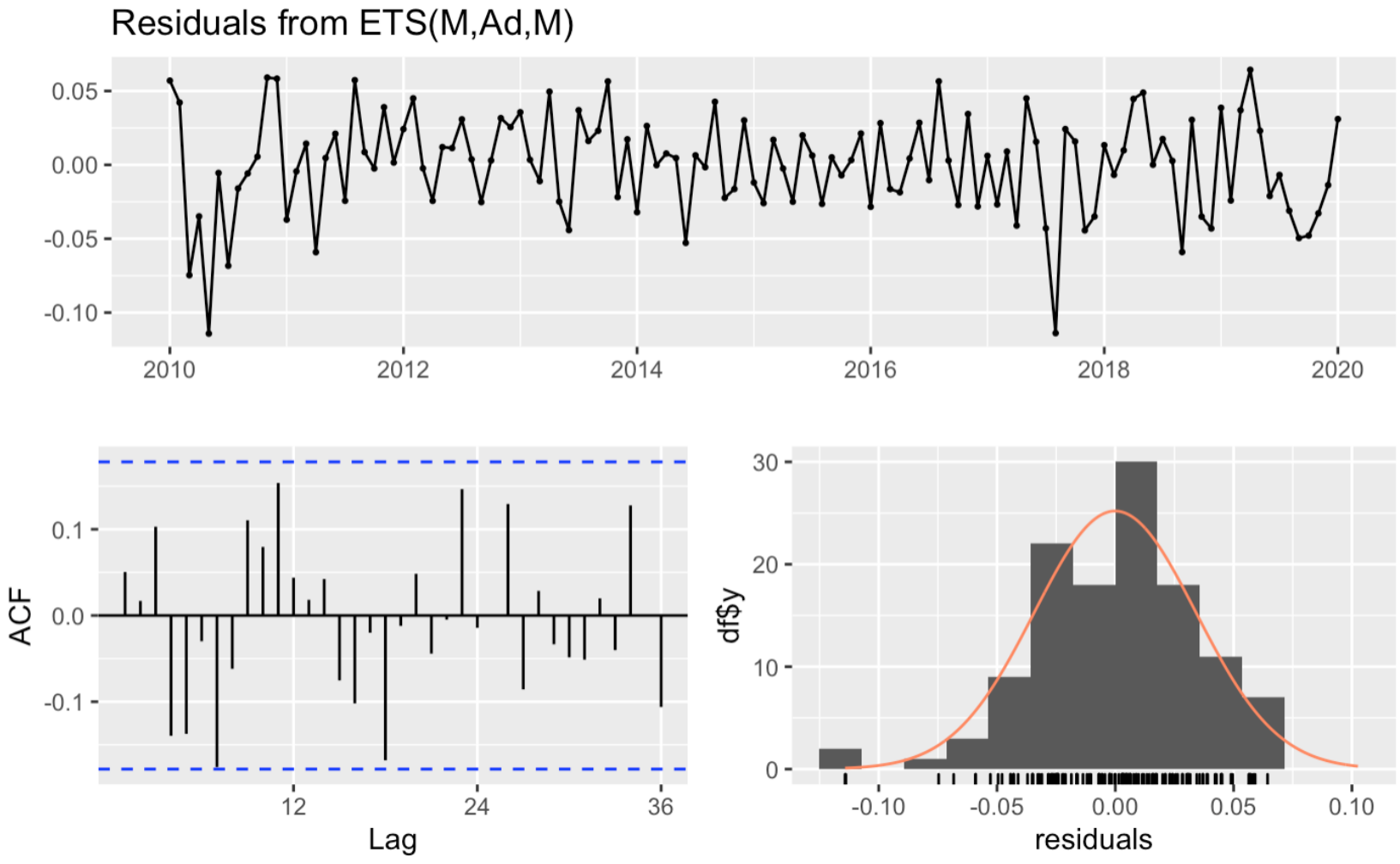
Individual Contributions

- Wesley: Quality control on modeling, futile attempt at sVARIMA model, slide creation logistics
- Drew: sARIMA and ETS modeling, base cross-validation script
- Sergio: VAR modeling, slide editing
- Michael: Regression with ARIMA Errors modeling, slide editing

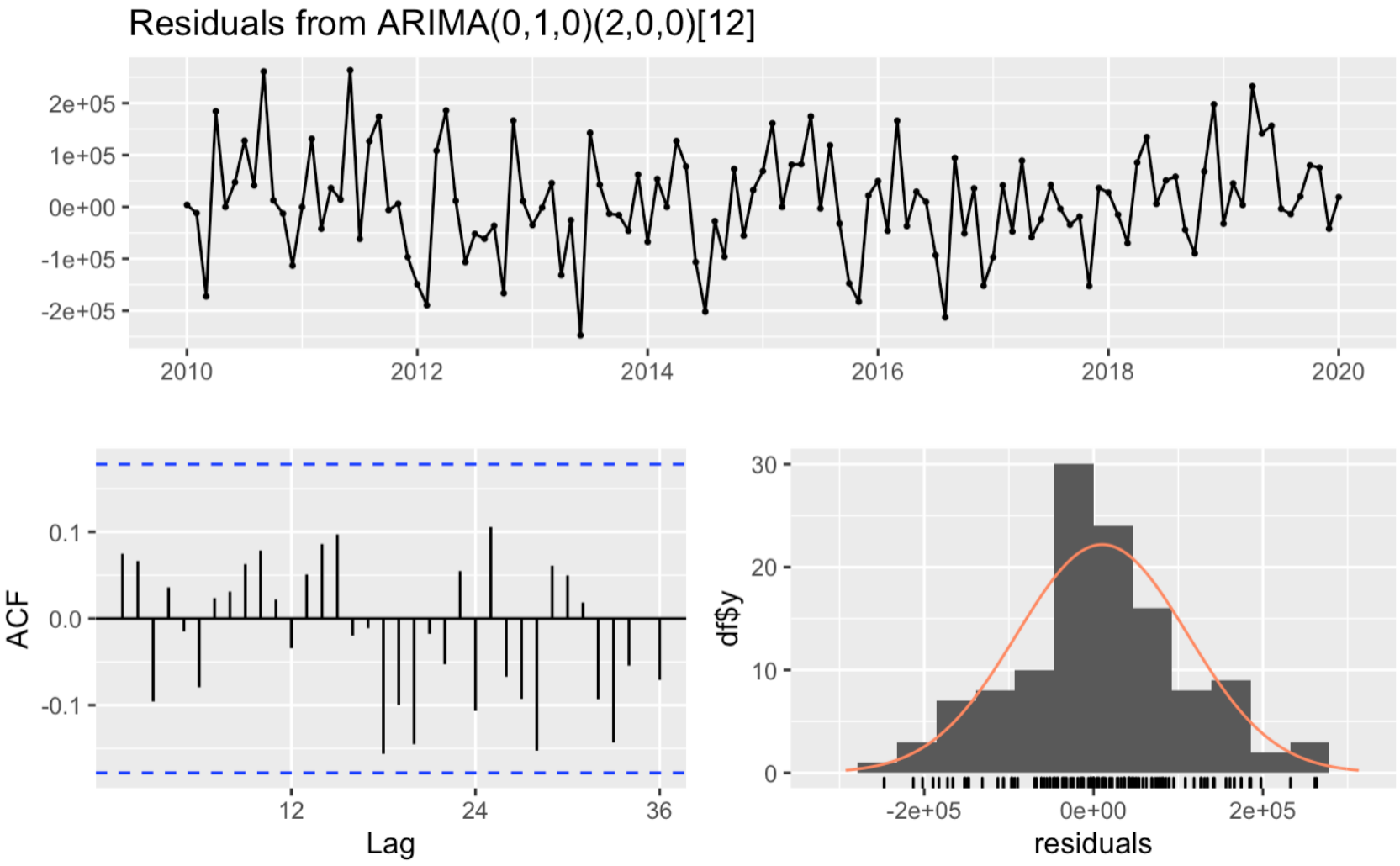
ETS Model Residuals (Median Rent)



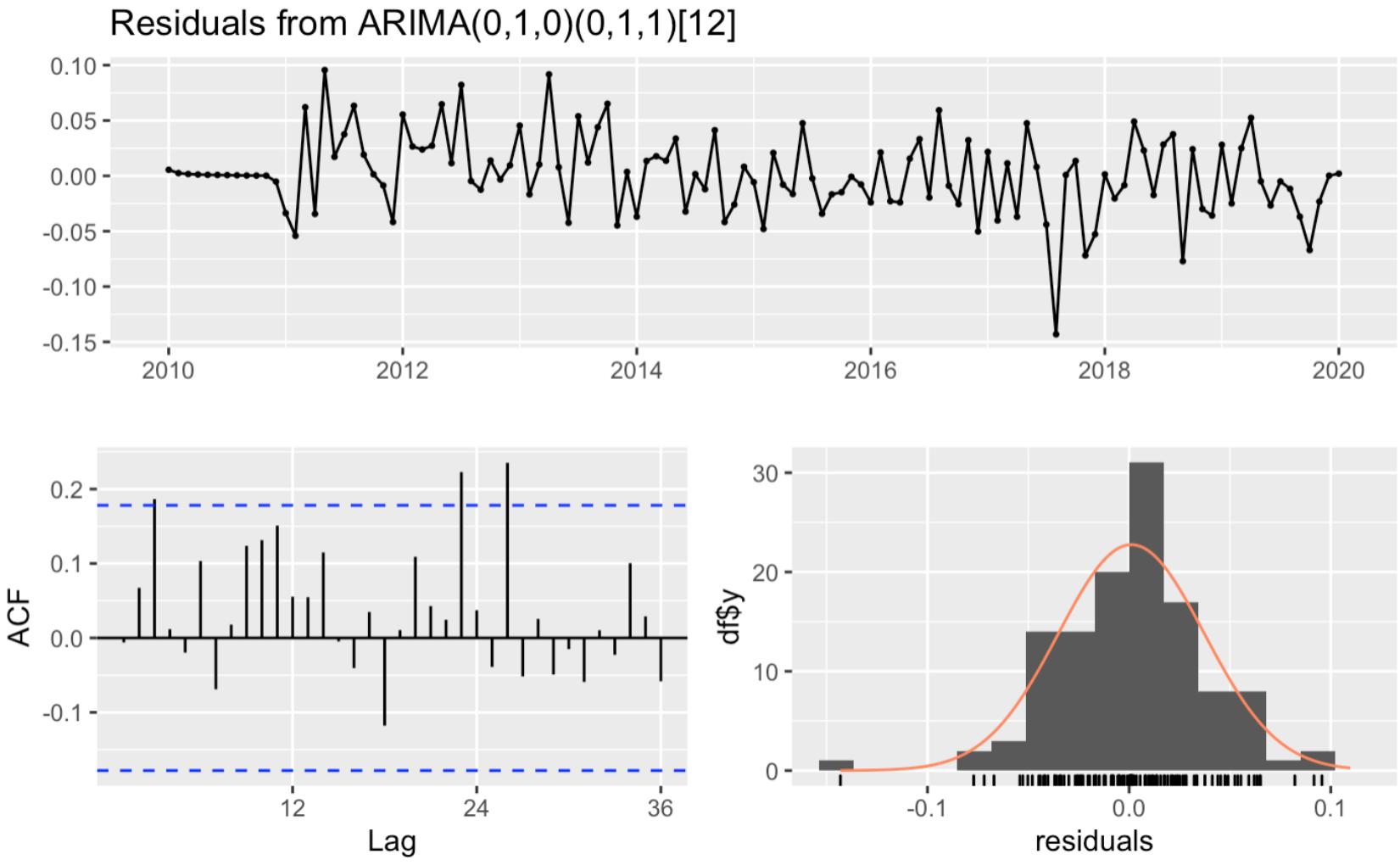
ETS Model Residuals (Listing Inventory)



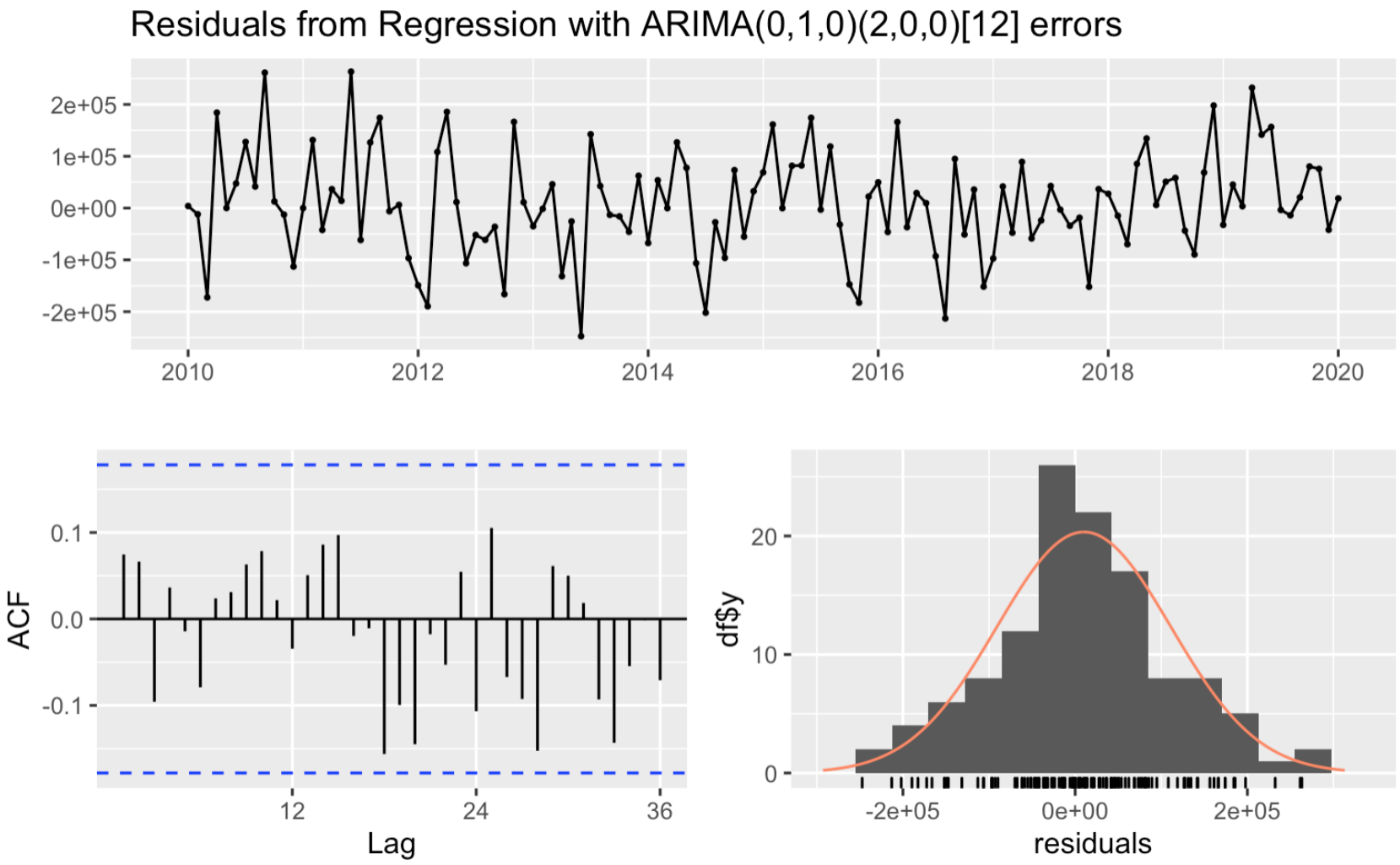
SARIMA Model Residuals (Median Rent)



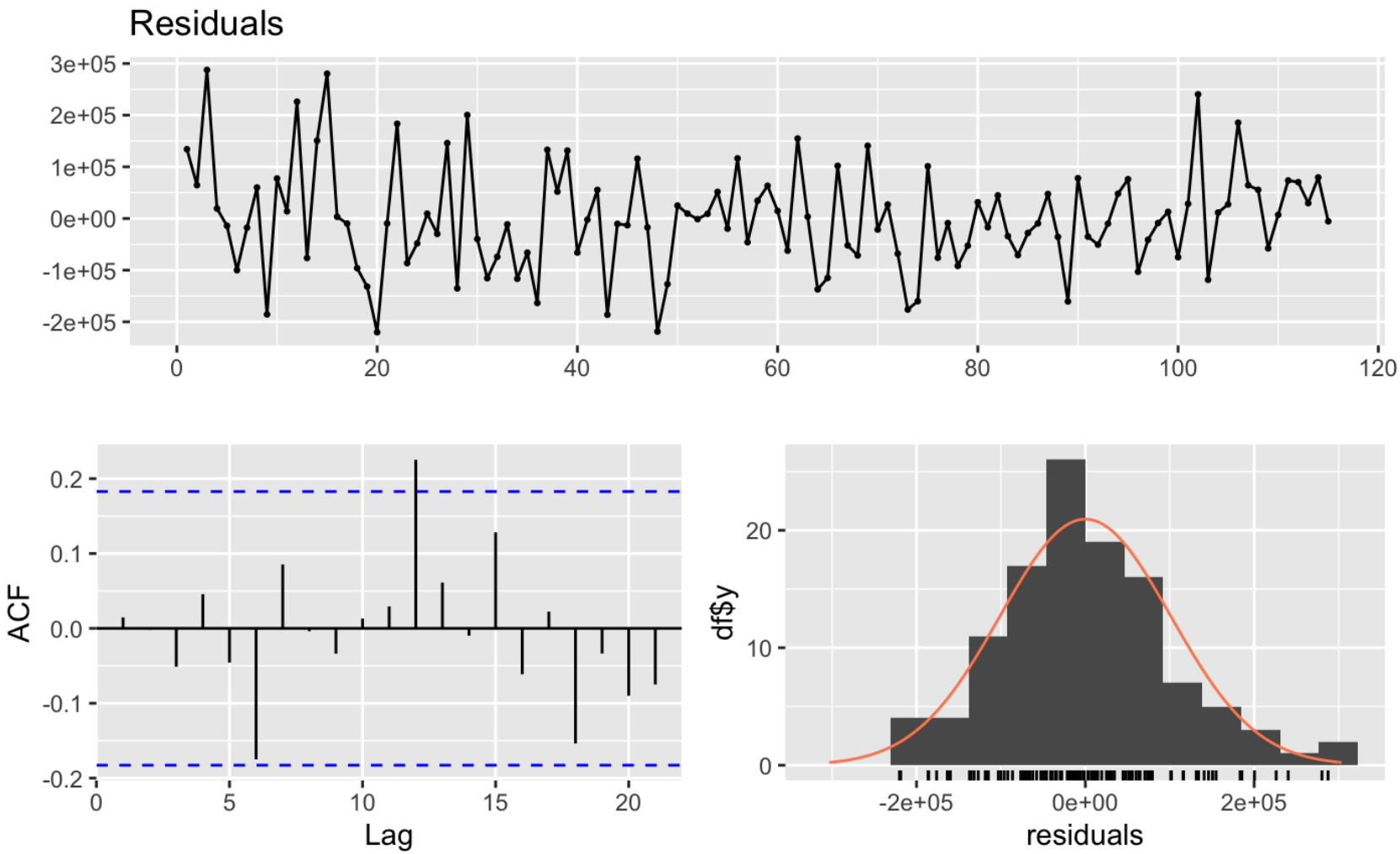
SARIMA Model Residuals (Listing Inventory)



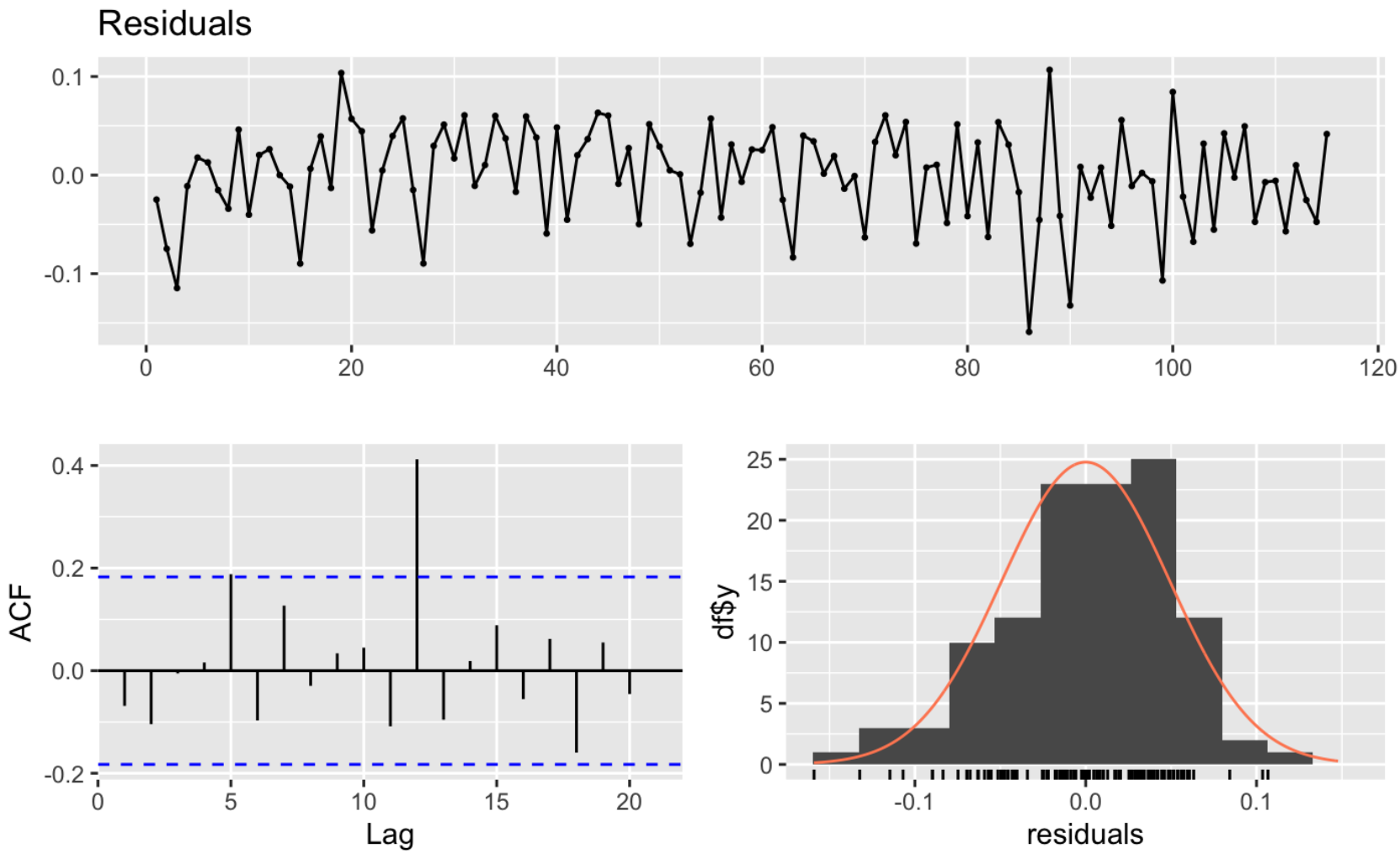
Regression with ARIMA Errors Residuals



VAR(5) Model Residuals (Median Rent)



VAR(5) Model Residuals (Listing Inventory)



VAR(5) Model CCF of Residuals