Analyzing the Impact of Reporting Periods on Law Enforcement Officer Behavior

Stakeholder Report

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Introduction

This report examines the behavior of local law enforcement officers in response to the approaching end of a possible departmental reporting period. Specifically, we seek to explore whether the ticketing behavior of officers changes to make them more likely to issue citations, fines, or other monetary actions in response to incidents. We do this to determine if departments utilize quotas to evaluate officer behavior, set departmental goals, or generate revenue for the department or city.

The discussion about policing or ticketing quotas has been a fixture of the American consciousness for decades. Most people who grew up in the United States can recall a parent, grandparent, friend, or other person advising them to be extra cautious with their speed while driving close to the end of the month. "Watch out, they give extra tickets when the month is about to end," is a cliche many have heard. This myth has carried into journalism as well, with most investigations focusing on the impact of "policing for profit," as the alleged practice has become known.[1] Whether or not the practice is even effective at boosting local government revenue is an even trickier concept that has come to the surface as police behavior has become more closely examined in recent years.[2]

Background research indicates that there are at minimum 26 states that currently forbid the practice of establishing police quotas.[3] Upon reviewing these various laws, it is worth pointing out that there is a disparity that exists between some.[4] For instance, some states forbid police quotas *as a means to evaluate officer performance (California),* while others simply outlaw the practice altogether (North Carolina). Some states relied on legislative bills (Colorado), while others included these provisions in the state's legal code (Wisconsin). These differences are noteworthy when evaluating the effectiveness of legal attempts to stop the practice, although we find little practical impact when analyzing those approaches.

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[1] Keller, Michael H. "The Demand for Money Behind Many Police Traffic Stops (Published 2021)." *The New York Times*, 2 November 2021, https://www.nytimes.com/2021/10/31/us/police-ticket-quotas-money-funding.html

[2] Menendez, Matthew, et al. "The Steep Costs of Criminal Justice Fees and Fines." *Brennan Center for Justice*, 21 November 2019, https://www.brennancenter.org/our-work/research-reports/steep-costs-criminal-justice-fees-and-fines

[3] Fielding, Jackie. "Outlawing Police Quotas." *Brennan Center for Justice*, 13 July 2022, https://www.brennancenter.org/our-work/analysis-opinion/outlawing-police-quotas

[4] Ossei-Owusu, Shaun. "Police Quotas." *New York University Law Review*, vol. 96, no. 529, 2021, pp. 529-605. *Perma.cc*, https://perma.cc/NR59-FDUK

There is an additional consideration regarding the actual construct of police quotas. As noted in some recent reporting, even in states that explicitly outlaw the practice of quotas, there exist other ways for departments to influence officer behavior informally.[5] These practices evade legal statutes, but we would still expect to observe the impact when analyzing ticketing behavior over time.

In summary, we find by the preponderance of the evidence that there is little to no effect on law enforcement behavior posed by the end of a reporting period. When examined for month-end, quarter-end, or fiscal year-end, we find little to no evidence that officers are sensitive to the approaching deadline, regardless of the legal status of the practice in the state. Officer behavior appears to continue on trend and within a reasonable expected range throughout the period analyzed. There is one noteworthy exception to this conclusion, however. The city of Cincinnati, Ohio, displayed several interesting trends during our analysis of monthly aggregated data that points to the probable existence of policing quotas in several years. Ohio does not explicitly forbid the practice of police quotas, and this is the only city in which we detected this effect.

Methods

Overview

The analytical approach utilized in this project is three-pronged. We begin with an exploratory data analysis to narrow the cities and time horizons of interest. A LOESS curve was then used to gain further insight into the trends observed, with smoothing applied to make the curve more robust to fluctuations in the data. Finally, we used a fixed effects regression to estimate the statistical effect of the end of a month, quarter, or fiscal year and evaluate for statistical significance.

Exploratory Analysis

The data exploration focused on finding a pattern in citations issued by the local police force in selected cities during different periods. We made a sliding time window to define the best cutoff number of days leading to the end of each fiscal year, quarter, and month. We grouped analysis of month and quarter ends by the calendar year and grouped all fiscal years, and then explored the mean values of each subset. We hope that finding a pattern will allow us to focus more on the cities with potential alignment with our interests.

LOESS

LOESS (Locally Estimated Scatterplot Smoothing) is a regression analysis technique used to investigate the relationship between two variables displayed in a scatterplot. Instead of relying on assumptions about the data distribution and linearity, LOESS estimates a smooth curve by calculating weighted averages of nearby data points. As a result, it is more flexible, robust, and capable of modeling non-linear relationships and handling outliers.

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[5] SafeMotorist.org. “Do Traffic Ticket Quotas Really Exist?” *SafeMotorist.com*, https://www.safemotorist.com/articles/traffic-ticket-quotas/

In our study, we explored the relationship between the number of citations issued and the number of days until the end of the month. By applying LOESS to the scatterplot, we could visualize any patterns or trends and investigate the existence of policing-for-profit practices, such as ticket quotas. To fine-tune the curve fitting process, we controlled the smoothing parameter, α, which determines the number of data points used in each local fit. After testing different values, we found that using $\alpha=0.2$ provided the best fit for modeling the two variables across different cities and years.

Fixed Effects Regression

Fixed effects is a statistical method used to control for unobserved heterogeneity in panel data analysis. It allows us to estimate the effect of a variable of interest while holding constant other time-invariant factors, such as individual characteristics or regional differences. This is achieved by adding dummy variables for each entity (in this case, each city) to the regression model, which captures the average effect of unobserved characteristics specific to that entity.

In this setting, we applied fixed effects for the city and year to control for differences in citation rates specific to each city and each year, respectively. This allows us to isolate the effect of the number of days to the end of month/quarter/year on citation rates while controlling for other factors that may vary across cities and years, such as differences in law enforcement practices or socio-economic factors. By including fixed effects for city and year, we can better estimate the effect of the number of days to the end of month/quarter/year on citation rates and reduce the potential for omitted variable bias.

Data

This analysis relied on data from the Stanford Open Policing Project.[6] The Stanford Open Policing Project is one of the definitive sources of information on policing activity in the United States, with data available for many states and cities. The span of coverage for each city or state varies, but the general range is from roughly 2000 to 2019. Specifically, we collected data for cities in the Project that reported granular data about police incidents and, critically, the outcome. We downselect to the city level to gain the most granular data possible before processing it into a final dataset. Appendix B (Timeline of Examined Cities) displays an overlaid timeline of which cities had data available for which periods.

Analysis

In this analysis, we focused on four cities: Seattle, WA; Madison, WI; Cincinnati, OH; and Durham, NC. We chose these cities because they represented a decent cross-section of the full dataset regarding demographics, location, and legal status of quotas. In addition to a west coast, east coast, and midwestern city, we added Cincinnati after conducting some analysis. This city, in particular, exhibited some interesting behavior that warranted further inspection. In Seattle and Cincinnati, policing quotas are believed to be legal. We understand them to be illegal in Durham and probably illegal in Madison, but the timeline of when this determination was first made is uncertain. A full description of the cities, periods,

[6] Stanford Open Policing Project. “Data.” *The Stanford Open Policing Project*, 2023, https://openpolicing.stanford.edu/data/

and legal status of quotas can be found in Appendix A (Summary of Cities Examined) and Appendix B (Timeline of Examined Cities). The analysis for each city below presents a single-year plot for each city that we believe represents typical behavior from our data. Appendices C (Durham, NC), D (Madison, WI), E (Seattle, WA), and F (Cincinnati, OH) provide additional years for each city.

Durham, NC

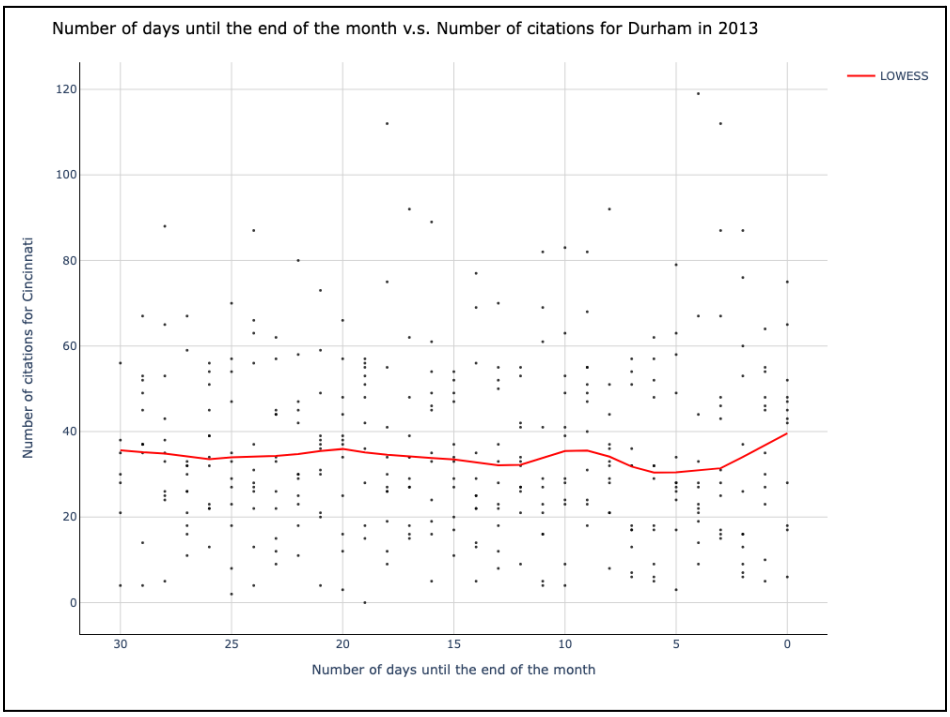

Figure 1. Durham, NC - Monthly Trend, 2013

The LOESS regression curve (Figure 1) depicting the number of citations issued against the number of days until the end of the month in Durham shows several fluctuations in the data without a discernible pattern. However, upon closer inspection, it is notable that in 2004, 2006, 2008, 2010, 2012, and 2015, the number of citations increased towards the end of the month after experiencing a decrease in the middle of the month (Appendix C). In contrast, 2013 exhibited a distinct pattern, with a relatively constant number of citations throughout the month, followed by an increase towards the end of the month. We call out 2013 as the year where an effect might be most noticeable, although it is slight. In other years we need to observe more of an impact to make a definitive claim.

Madison, WI

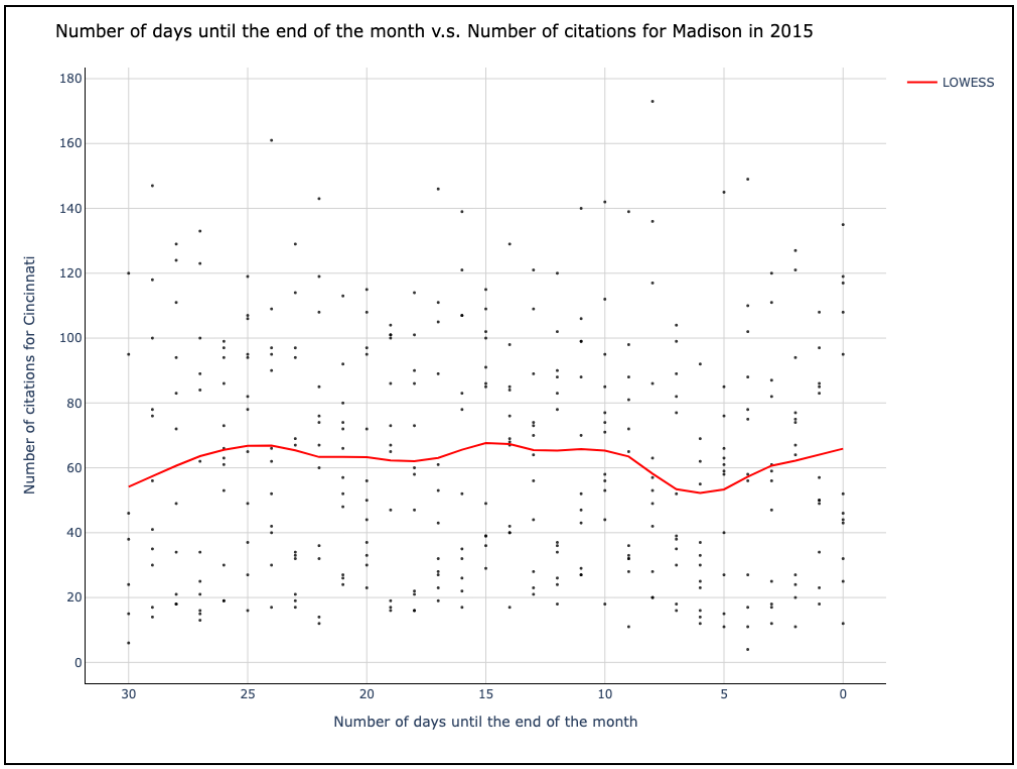

Figure 2. Madison, WI - Monthly Trend, 2015

The LOESS regression curve (Figure 2) for Madison in 2015 displays a typical behavioral pattern for this city from our analysis. There were multiple instances where the number of citations issued appeared to rise towards the end of a month, but it was usually associated with a dip shortly before. (Appendix D) We do not assess that this behavior is consistent with an attempt to make up for "lost opportunity," but rather a natural balancing of activity. Despite the potential legality of policing quotas in Madison, we do not observe a pattern of behavior that would support the existence of explicit or implicit ticketing quotas.

Seattle, WA

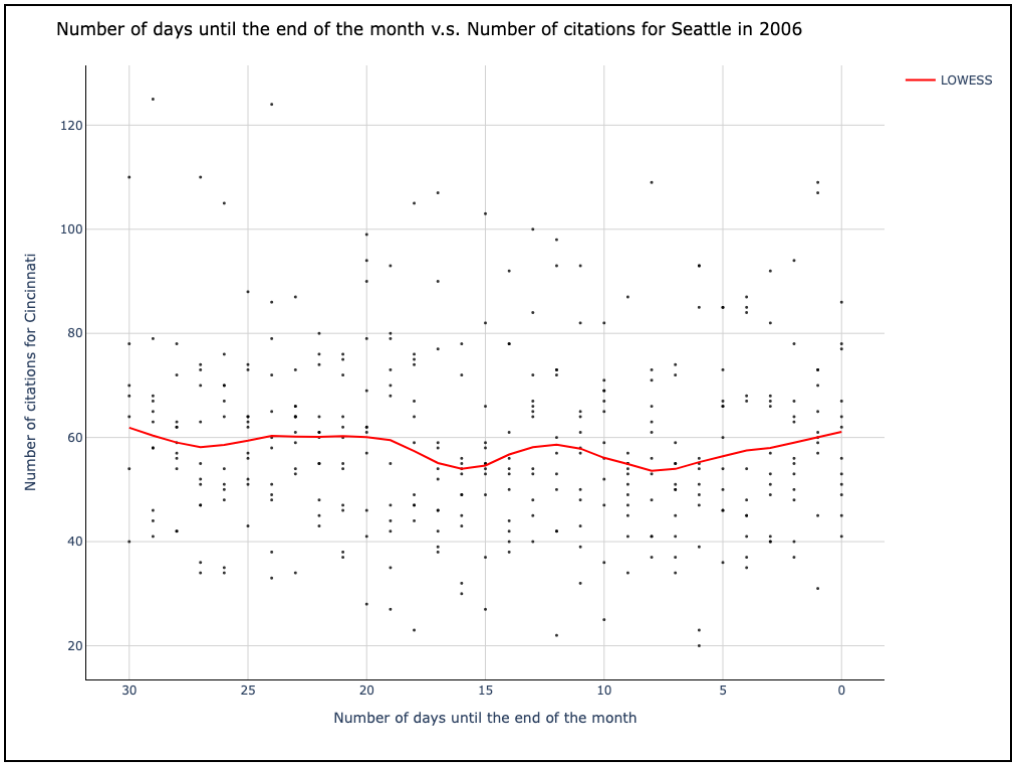

Figure 3. Seattle, WA - Monthly Trend, 2006

Figure 3 above displays a general pattern that we feel is approximate for Seattle throughout the time covered in our analysis, with some exceptions. The trend in this curve is generally flat throughout the monthly period; however, in 2007, 2008, and 2011 we did observe a noticeable uptick in citations issued as the end of a month drew near (Appendix E). We do not assess that the observed patterns indicate the presence of policing quotas in Seattle, and we believe the three years where we observed upticks towards the end of the month may reflect anomalies given the general bow shape in the curves (higher at the beginning and end of the month than the middle).

Cincinnati, OH

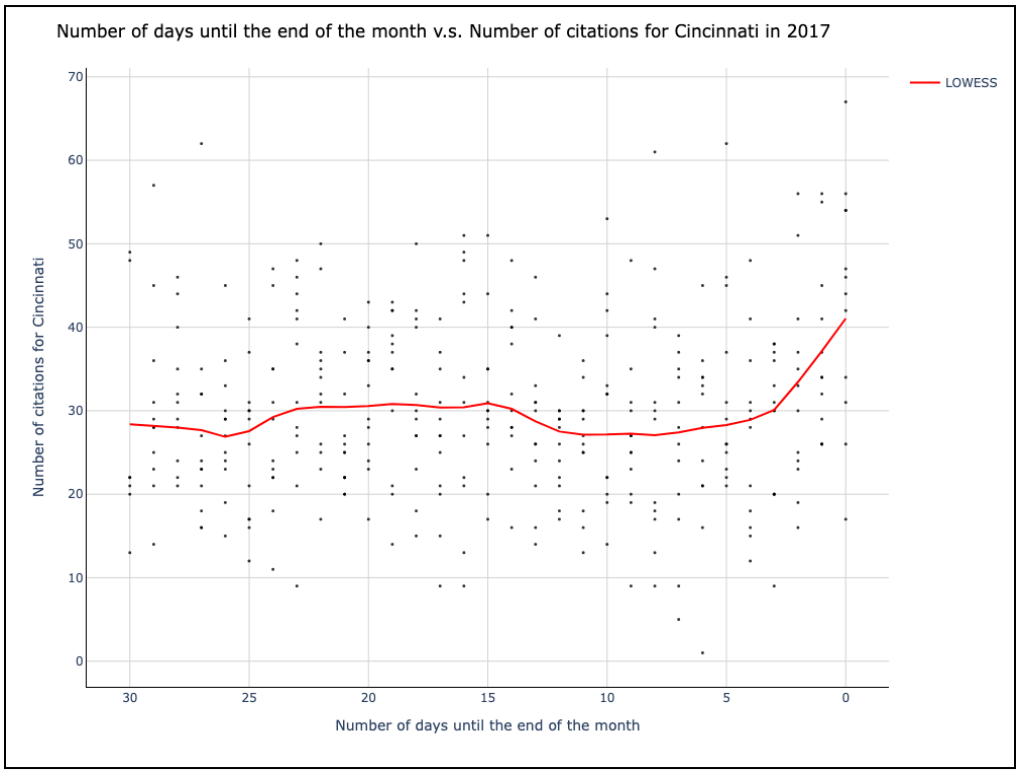

Figure 4. Cincinnati, OH - Monthly Trend, 2017

Cincinnati is the most noteworthy city in the study. In 2010, 2011, 2014, 2015, 2017 (above), and 2018 we observed significant and noticeable increases in the number of citations issued as the end of a month drew near (Appendix F). The later years in that span showed the most apparent increases, with the trendline for 2017 showing roughly a 50% increase in ticketing behavior over the last five days of a month. The number of years where we observed this trend and the magnitude of the change makes a strong argument that, at least in the city of Cincinnati, law enforcement officers were likely under pressure to increase ticketing activity as reporting periods approached.

Fixed Effect Regression Analysis

The fixed effect regression results (Appendices G, H, I) show that there is a weak, positive association between the number of days left to the end of the month/quarter and the number of citations issued in Durham, NC; Madison, WI; Seattle, WA; and Cincinnati, OH. However, this relationship is not statistically significant at the 5% significance level. Meanwhile, there is a weak, negative association between the number of days left to the end of the year and the number of citations issued. Still, this relationship is not statistically significant at the 5% significance level. It is worth mentioning that because the predictor we investigated is counting down, the effects are actually inverted. For instance, our finding is that citations actually *decrease* as the month end nears. In conclusion, while some evidence suggests that police officers may issue more citations as deadlines approach, the findings are not strong enough to support a definitive conclusion.

Limitations

The team identified several areas worth noting when evaluating the validity of this analysis. We are primarily concerned with the murky nature surrounding the disparate legal statuses of policing quotas and the associated timelines. There are at least 26 states that do not allow quotas presently, but when those statutes came into effect, has proved to be less than an exact science. This makes our analysis largely observational.

A second area that requires additional investigation is the impact of local budgetary practices that might affect policing practices. This topic was the primary focus of some recent journalistic investigations.[7] Upon examining the financial disclosures of Durham, NC, we found no mention of revenues generated from police or court activity; however, this does not mean that other constituencies we explored adhere to the same practice. It is certainly possible that officers' behavior might be influenced if the department at least partially relies on that revenue stream. Investigating this effect requires significant research and a robust methodology to quantify these approaches. This is outside the scope of our analysis presented here.

Conclusion

We evaluated this effect as the month, quarter, and fiscal year ended for 20 U.S. cities spanning 20 years. The outcome of our analysis is that we do not detect a response from law enforcement officers to the approaching end of a reporting period. The legitimacy of departmental quotas does not appear to influence behavior, except for select years in Cincinnati. In those instances, we observed an apparent uptick in the volume of citations issued as the end of the month approached. While we could not find direct evidence of a ticket quota in the city for those years, this behavioral pattern implies that a quota existed at at least an informal level.

[7] Menendez, 2019

Appendix A - Summary of Cities Examined

Table 1. Summary of Cities Examined (Call-out Cities Highlighted)

City	State	Time Period[8]	Quota Legality[9]	Notes
Bakersfield	California	Mar 2008 - Mar 2018	Illegal - 2020 (Statute)	Updated in 2020, existed in forms prior
San Francisco	California	Dec 2006 - Jun 2016	Illegal - 2020 (Statute)	Updated in 2020, existed in forms prior
San Jose	California	Aug 2013 - Mar 2018	Illegal - 2020 (Statute)	Updated in 2020, existed in forms prior
Aurora	Colorado	Dec 2011 - Jul 2020	Illegal - 2010 (Bill)	
Denver	Colorado	Dec 2010 - Jul 2018	Illegal - 2010 (Bill)	
New Orleans	Louisiana	Dec 2009 - Jul 2018	Illegal - 2020 (Statute)	Prior legality uncertain
Baltimore	Maryland	Dec 2010 - Dec 2017	Illegal - 2020 (Statute)	Prior legality uncertain
Saint Paul	Minnesota	Dec 2000 - Dec 2016	Illegal - 2020 (Statute)	Prior legality uncertain
Charlotte	North Carolina	Dec 1999 - Dec 2015	Illegal - 2020 (Statute)	Updated in 2020, existed prior
Durham	North Carolina	Dec 2001 - Dec 2015	Illegal - 2020 (Statute)	Updated in 2020, existed in forms prior
Fayetteville	North Carolina	Jan 2000 - Dec 2015	Illegal - 2020 (Statute)	Updated in 2020, existed in forms prior
Greensboro	North Carolina	Jan 2000 - Dec 2015	Illegal - 2020 (Statute)	Updated in 2020, existed in forms prior
Raleigh	North Carolina	Dec 2001 - Dec 2015	Illegal - 2020 (Statute)	Updated in 2020, existed in forms prior
Winston-Salem	North Carolina	Jan 2000 - Dec 2015	Illegal - 2020 (Statute)	Updated in 2020, existed in forms prior
Cincinnati	Ohio	Dec 2008 - May 2018	Legal	
Oklahoma City	Oklahoma	Dec 2010 - Nov 2020	Legal	
Houston	Texas	Dec 2013 - Nov 2020	Illegal - 2019 (Statute)	Prior legality uncertain
San Antonio	Texas	Dec 2011 - Jun 2020	Illegal - 2019 (Statute)	Prior legality uncertain
Seattle	Washington	Dec 2005 - Dec 2015	Legal	Became illegal in 2020 (Bill)
Madison	Wisconsin	Sep 2007 - Jun 2020	Illegal - 2019 (Statute)	Prior legality unceratin

[8] Stanford Open Policing Project, 2023
[9] Ossei-Owusu, 2021

Appendix B - Timeline of Examined Cities

Table 2. Timeline of Examined Cities (Call-out Cities Highlighted)

City	Data Begin	Data End	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Bakersfield	Mar-08	Mar-18																					
San Francisco	Dec-06	Jun-16																					
San Jose	Aug-13	Mar-18																					
Aurora	Dec-11	Jul-20																					
Denver	Dec-10	Jul-18																					
New Orleans	Dec-09	Jul-18																					
Baltimore	Dec-10	Dec-17																					
Saint Paul	Dec-00	Dec-16																					
Charlotte	Dec-99	Dec-15																					
Durham	Dec-01	Dec-15																					
Fayetteville	Jan-00	Dec-15																					
Greensboro	Jan-00	Dec-15																					
Raleigh	Dec-01	Dec-15																					
Winston-Salem	Jan-00	Dec-15																					
Cincinnati	Dec-08	May-18																					
Oklahoma City	Dec-10	Nov-20																					
Houston	Dec-13	Nov-20																					
San Antonio	Dec-11	Jun-20																					
Seattle	Dec-05	Dec-15																					
Madison	Sep-07	Jun-20																					

Appendix C - Durham, NC Analysis

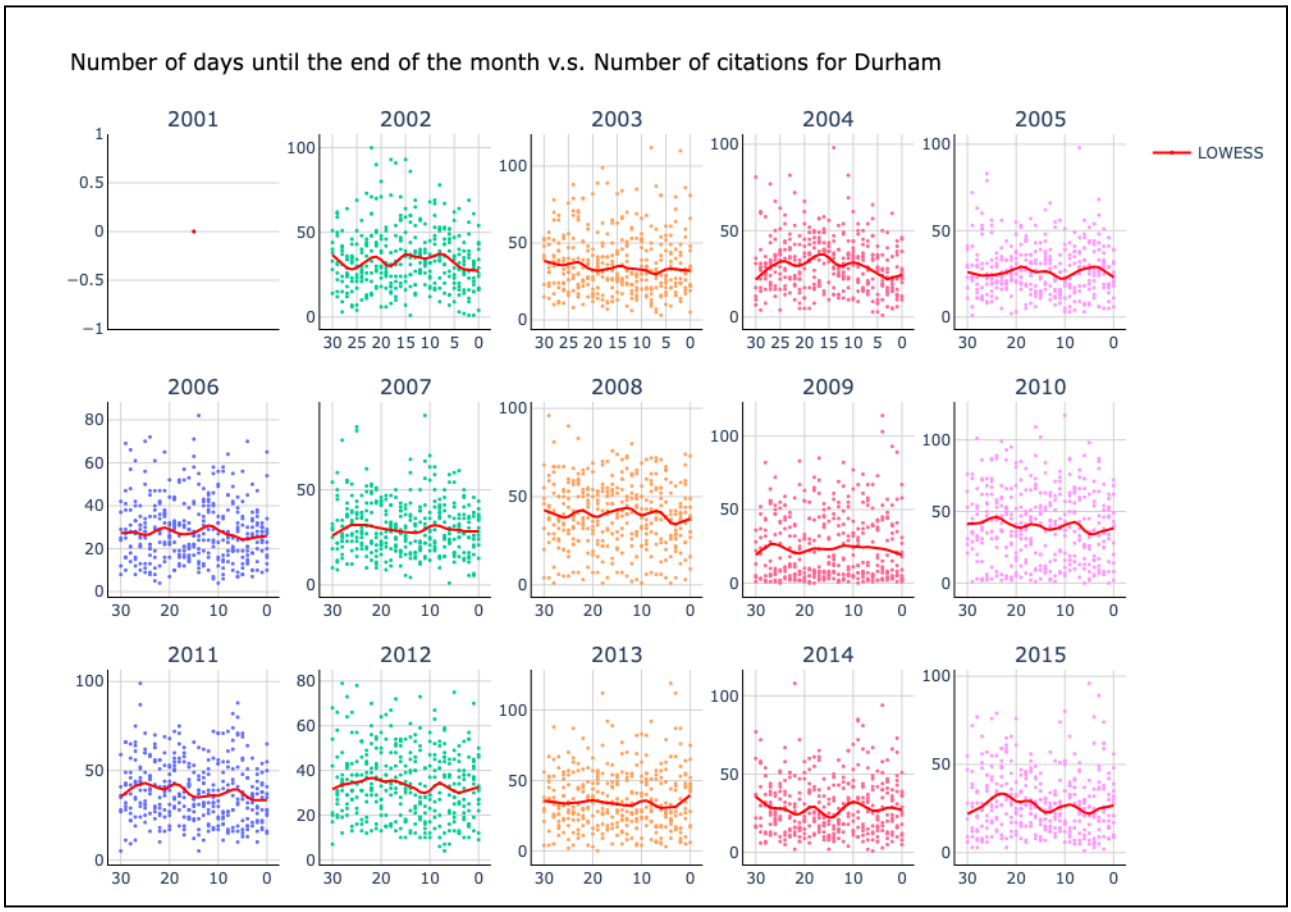

Figure 5. Durham, NC - Monthly Trends, All Years

Figure 5 above displays the LOESS curves for the monthly citation data grouped by year in Durham. We observed some interesting fluctuations in the data, such as in 2013, but determined that no significant or observable effect was introduced by the approaching end of the month. 2001 appears as a single point because only one row of data in our original dataset detailed an incident that year.

Appendix D - Madison, WI Analysis

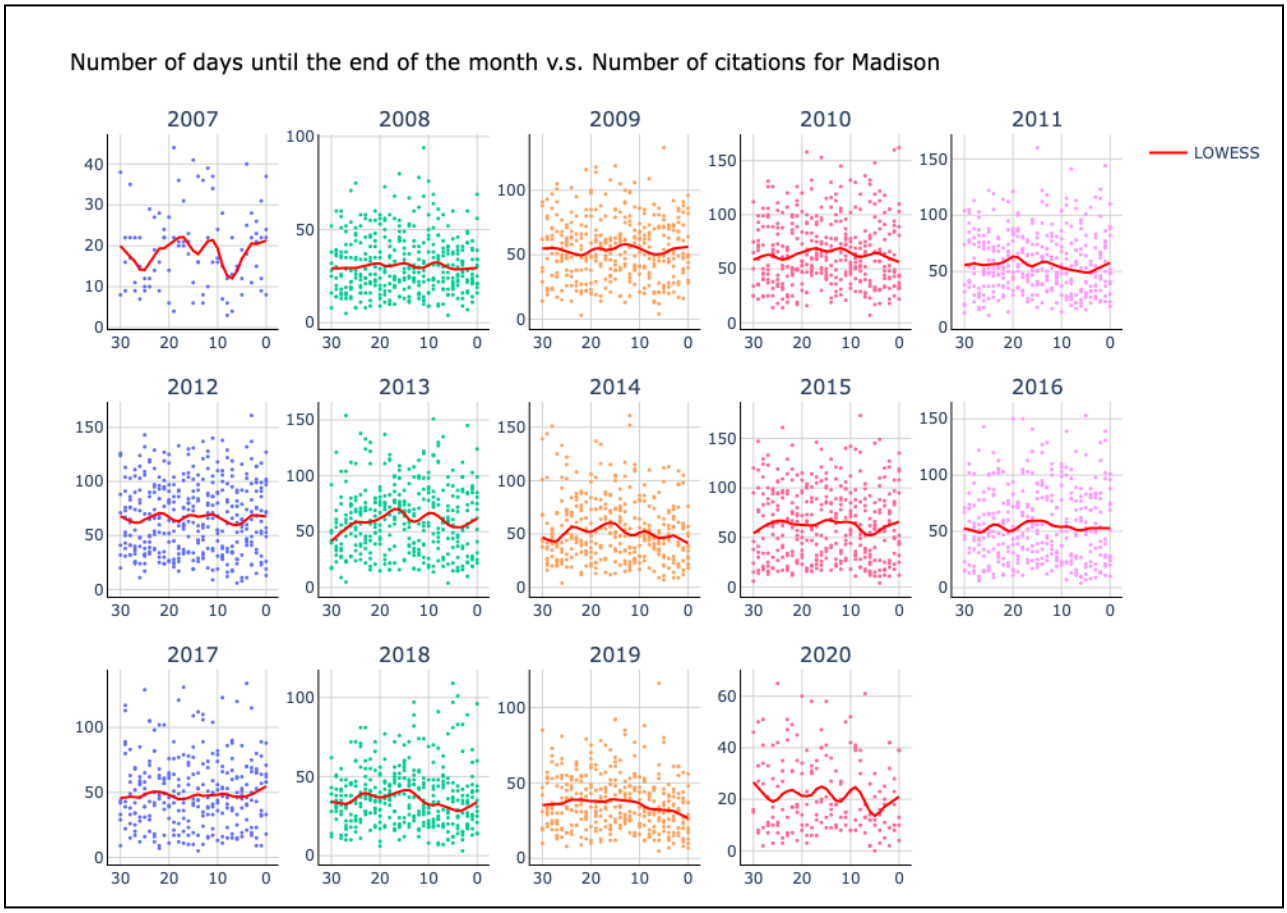

Figure 6. Madison, WI - Monthly Trends, All Years

The plots above for Madison display generally benign activity by law enforcement officers as the end of the month approached. In a few cases (2011, 2013, 2015, 2017, 2018), there may be an effect from the end of the month. However, in all cases except 2017, we observed a noticeable dip in activity before the rise in citations, or other parts of the month showed higher activity levels. This supports the conclusion that police activity in Madison is not sensitive to an approaching reporting period or an implicit or explicit quota.

Appendix E - Seattle, WA Analysis

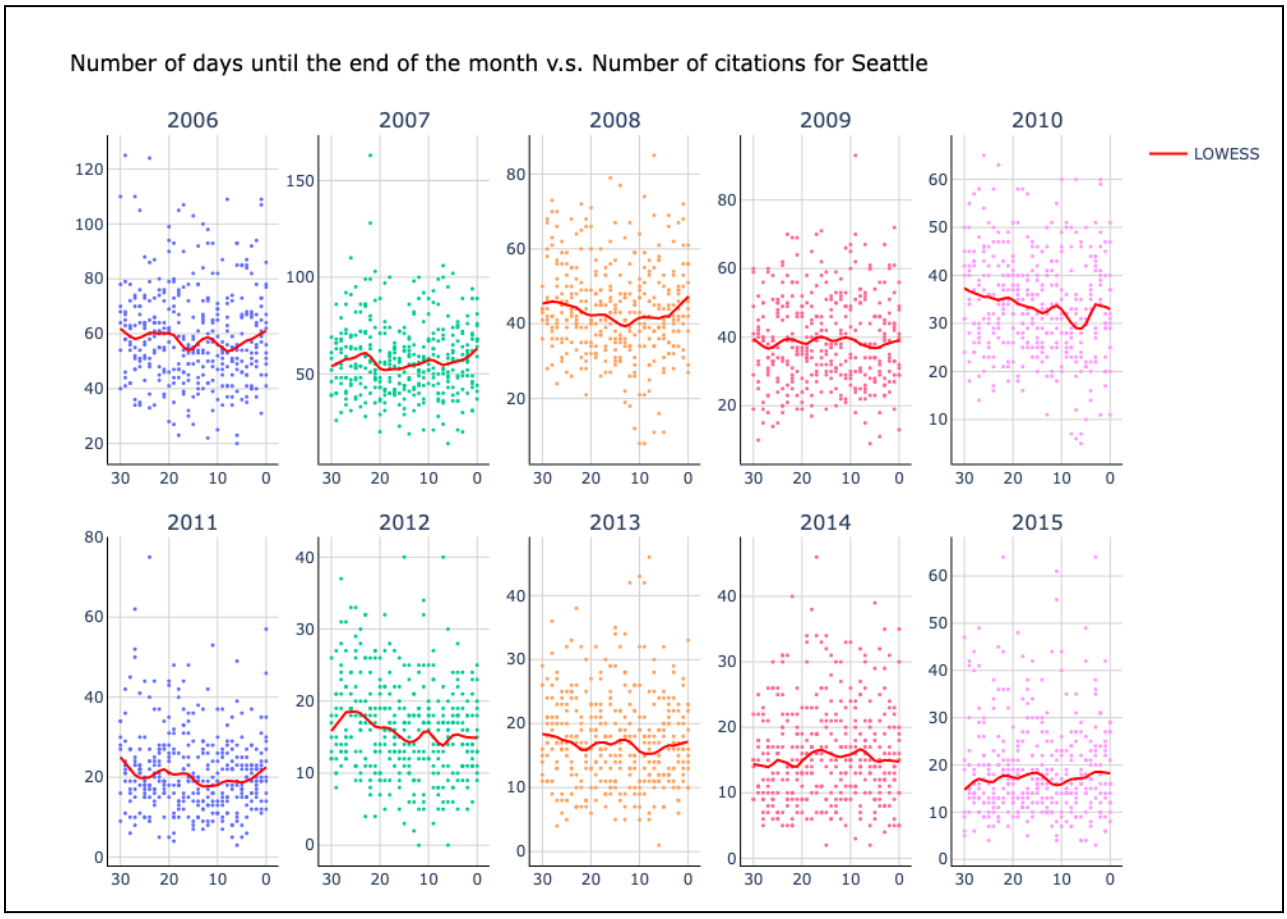

Figure 7. Seattle, WA - Monthly Trends, All Years

Figure 7 above displays the most varied law enforcement behavior in the cities we elected to examine. The trends are generally consistent across most years; however, in 2007, 2008, and 2011 there was a noticeable uptick in citations issued as the end of a month approached. Identifying this pattern as evidence of a quota is difficult because of the general shape of the LOESS curves in 2008 and 2011. Those two years show prominent bows in the middle of the month, where activity appears to drop off from a higher level initially. In both cases, the end level was approximately equal to the starting level, indicating that police activity continued at a certain level through the end of the month.

Appendix F - Cincinnati, OH Analysis

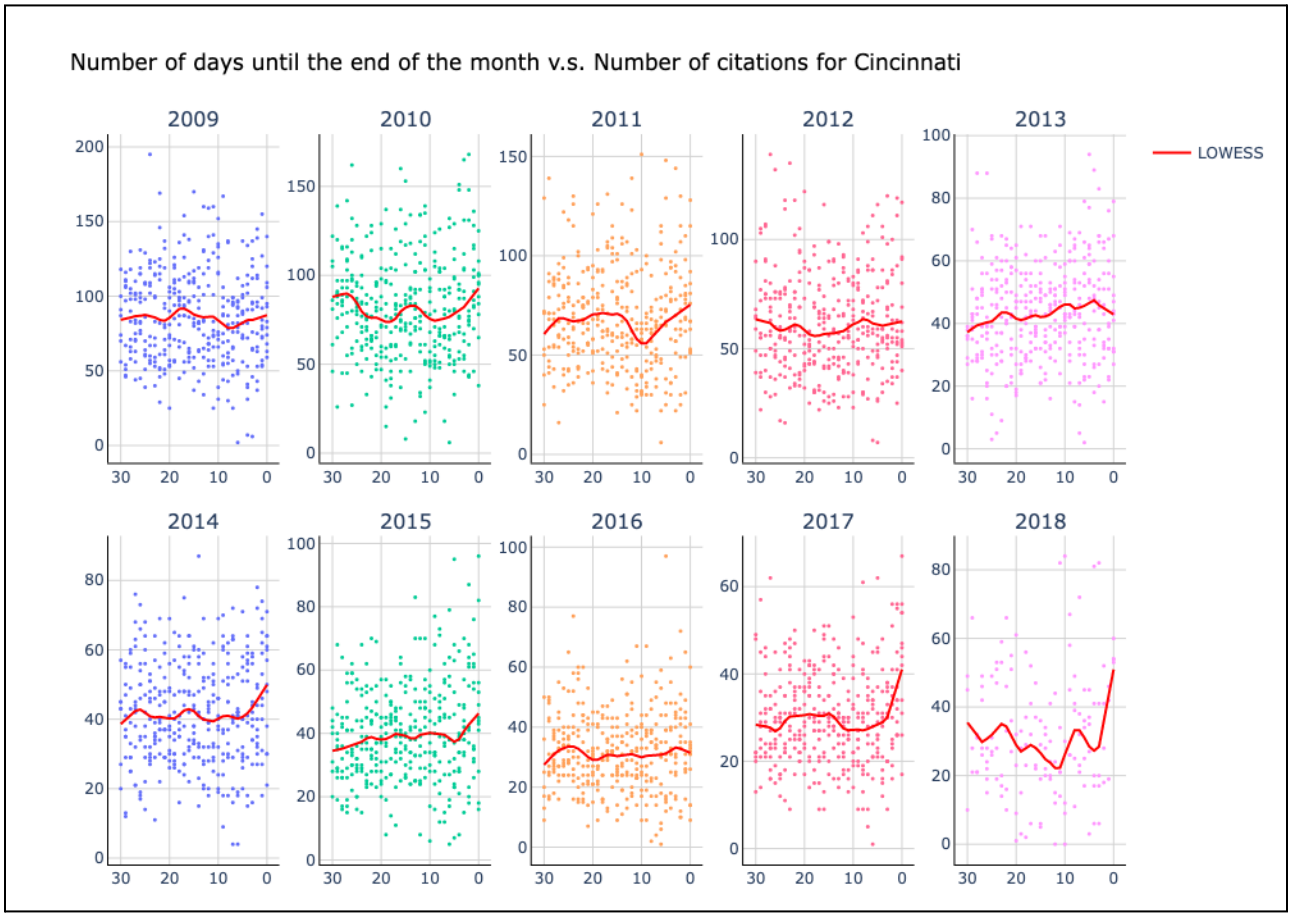

Figure 8. Cincinnati, OH - Monthly Trends, All Years

Figure 8 above displays the most remarkable results from our investigation for any city. In 2010, 2011, 2014, 2015, 2017, and 2018 there is a noticeable uptick in the number of citations issued as the end of the month approached. In 2010 the effect is more muted because of the bow shape in the curve, but the remained of the years clearly point to the existence of either an implicit or explicit quota at the local police department level. The magnitude of the increases over the final 5 days of the month is shocking, reaching almost 50% in 2017, with a more significant increase observed for the partial year 2018 data.

Appendix G - Fixed Effects Regression Table (Month End)

PanelOLS Estimation Summary

Dep. Variable:	citation_issued	R-squared:	0.0003
Estimator:	PanelOLS	R-squared (Between):	-0.0025
No. Observations:	16740	R-squared (Within):	0.0002
Date:	Wed, Apr 19 2023	R-squared (Overall):	0.0002
Time:	01:59:19	Log-likelihood	-7.634e+04
Cov. Estimator:	Clustered		
		F-statistic:	5.0340
Entities:	4	P-value	0.0249
Avg Obs:	4185.0	Distribution:	F(1,16716)
Min Obs:	3428.0		
Max Obs:	5112.0	F-statistic (robust):	2.4801
		P-value	0.1153
Time periods:	20	Distribution:	F(1,16716)
Avg Obs:	837.00		
Min Obs:	1.0000		
Max Obs:	1464.0		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
Intercept	41.283	0.4271	96.650	0.0000	40.446	42.121
days_end_month	0.0457	0.0290	1.5748	0.1153	-0.0112	0.1025

...

P-value: 0.0000
Distribution: F(22,16716)

Included effects: Entity, Time

Table 3. Fixed Effects Regression Results: Citations Issued by Days to End of Month

A coefficient of 0.0457 for `days_end_month` means that all other variables held constant, a one-unit increase in the number of days left to the end of the month is associated with an increase of 0.0457 in the number of citations issued. The p-value of 0.1153 indicates the statistical significance of the coefficient estimate. In this case, the p-value is more significant than the conventional threshold of 0.05, suggesting that the positive relationship between the number of days left to the end of the month and the number of citations issued is not statistically significant at the 5% level of significance.

Appendix H - Fixed Effects Regression Table (Quarter End)

PanelOLS Estimation Summary

Dep. Variable:	citation_issued	R-squared:	0.0003
Estimator:	PanelOLS	R-squared (Between):	-0.0023
No. Observations:	16740	R-squared (Within):	0.0002
Date:	Wed, Apr 19 2023	R-squared (Overall):	0.0002
Time:	01:59:19	Log-likelihood	-7.634e+04
Cov. Estimator:	Clustered		
		F-statistic:	4.5812
Entities:	4	P-value	0.0323
Avg Obs:	4185.0	Distribution:	F(1,16716)
Min Obs:	3428.0		
Max Obs:	5112.0	F-statistic (robust):	3.5960
		P-value	0.0579
Time periods:	20	Distribution:	F(1,16716)
Avg Obs:	837.00		
Min Obs:	1.0000		
Max Obs:	1464.0		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
Intercept	41.298	0.3470	119.00	0.0000	40.618	41.978
days_end_quarter	0.0145	0.0077	1.8963	0.0579	-0.0005	0.0296

...

P-value: 0.0000
Distribution: F(22,16716)

Included effects: Entity, Time

Table 4. Fixed Effects Regression Results: Citations Issued by Days to End of Quarter

A coefficient of 0.0145 for `days_end_quarter` means that all other variables held constant, a one-unit increase in the number of days left to the end of the quarter is associated with an increase of 0.0145 in the number of citations issued. The p-value of 0.0579 indicates the statistical significance of the coefficient estimate. In this case, the p-value is more significant than the conventional threshold of 0.05, suggesting that the positive relationship between the number of days left to the end of the quarter and the number of citations issued is not statistically significant at the 5% level of significance.

Appendix I - Fixed Effects Regression Table (Year End)

PanelOLS Estimation Summary

Dep. Variable:	citation_issued	R-squared:	0.0022
Estimator:	PanelOLS	R-squared (Between):	0.0008
No. Observations:	16740	R-squared (Within):	0.0004
Date:	Wed, Apr 19 2023	R-squared (Overall):	0.0008
Time:	01:59:20	Log-likelihood	-7.633e+04
Cov. Estimator:	Clustered		
		F-statistic:	36.232
Entities:	4	P-value	0.0000
Avg Obs:	4185.0	Distribution:	F(1,16716)
Min Obs:	3428.0		
Max Obs:	5112.0	F-statistic (robust):	3.4181
		P-value	0.0645
Time periods:	20	Distribution:	F(1,16716)
Avg Obs:	837.00		
Min Obs:	1.0000		
Max Obs:	1464.0		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
Intercept	43.811	1.0035	43.658	0.0000	41.844	45.778
days_end_year	-0.0103	0.0056	-1.8488	0.0645	-0.0212	0.0006

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P-value: 0.0000
Distribution: F(22,16716)

Included effects: Entity, Time

Table 5. Fixed Effects Regression Results: Citations Issued by Days to End of Year

A coefficient of -0.0103 for `days_end_year` means that all other variables held constant, a one-unit increase in the number of days left to the end of the quarter is associated with a decrease of 0.0103 in the number of citations issued. The p-value of 0.0645 indicates the statistical significance of the coefficient estimate. In this case, the p-value is more significant than the conventional threshold of 0.05, suggesting that the negative relationship between the number of days left to the end of the quarter and the number of citations issued is not statistically significant at the 5% level of significance.

Appendix J - References

Works Cited

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