DISCUSSION PAPERS IN ECONOMICS

Working Paper No. 18-09

The Early Bird Gets the Worm: Analysis of Dynamic Effort Allocations from the New York City Police Department

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October 2018

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THE EARLY BIRD GETS THE WORM: ANALYSIS OF DYNAMIC EFFORT ALLOCATIONS FROM THE NEW YORK CITY POLICE DEPARTMENT

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October 2018

Abstract

Tasks that are time-sensitive in nature, and in which underperformance is punished, require that efforts be dynamically allocated in the face of an incentive structure that balances current work against future leisure and the risk of failing to complete the task. This particularly characterizes the work environment faced by most police officers, who face monthly performance goals with respect to their numbers of arrests made and summonses issued. Using data on Stop, Question, and Frisk practices, this paper investigates the dynamic effort allocations of police officers in the New York Police Department. Police officers are found to adopt a strategy of front-loading efforts in the earlier days of the month as a precautionary measure against falling short of performance goals. This is manifested in a greater share of stops conducted, summonses issued, and arrests made during the first two weeks of the month. Furthermore, as a month goes on, officers become more averse to difficult tasks and exert less effort in interactions that allow for an officer to use more discretion. This cyclical nature of criminal apprehensions holds even when accounting for confounding factors that affect contemporaneous crime conditions, such as the timing of welfare payments. In addition to uncovering evidence of monthly productivity cycles for police officers, this research demonstrates a rarely observed phenomenon of front-loading efforts, and raises potential concerns over the welfare implications of policing practices analogous to those employed by the NYPD.

JEL Codes: D81, H11, J22, J45, M52
Keywords: Effort allocation, uncertainty, performance evaluations, crime, stop-question-and-frisk

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* I am very thankful to Jeffrey Zax, Terra McKinnish, Stephen Billings, Richard Mansfield, William Ridley, and participants at the University of Colorado Applied Microeconomics workshop for their valuable comments and feedback. I would also like to thank Kinsey Dinan from the NYC Department of Social Services for sharing information on the department's procedures. All errors remain my own.

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I. Introduction

> "Oh man. They're retaliating against me because of my numbers. Commanding officers do it to bring your numbers up, but I would have to massively write summonses and arrest people to come up with the number close to the number that they want to come up with. You know… the goal."

The above transcript is taken from a recorded conversation between Officer Sandy Gonzales, an officer in the New York Police Department (NYPD), and Stephen Maing, a documentarian chronicling the struggles of a group of police officers against an illegal policing quota maintained by the NYPD.[1] Notwithstanding the repeated denials of the existence of monthly quotas by the upper echelons of the NYPD leadership, the other formal performance measures that the department is known to use could also inspire a conversation along the lines of the one cited above.

The elements of policing mentioned by Officer Gonzales—retaliation from superiors, expectations about productivity, and tacit uncertainty about being able to "make the numbers"—are not unique to his circumstances. To varying degrees, the influence of these factors on officers' performance extends to his colleagues in the department. Consequently, for a representative police officer, these attributes of the job determine the structure of the incentives faced when determining the optimal way to perform police duties.

Officer Gonzales dislikes the prospect of being retaliated against by his superiors, a reaction that is to be expected. Aversion to punishment is innate, and this aversion is only exacerbated when individuals are risk-averse, making the threat of punishment a compelling force within the justice system. The threat of punishment, however, is not solely a mechanism for deterring criminal acts; because of the nature of the performance measures that they are subject to, part of the incentive structure faced by police officers is characterized by punishment for inadequate performance. Such measures are intended to elicit a higher level of efforts from officers in the presence of moral hazard.

This moral hazard arises from the organizational structure of the NYPD, whereby the challenges of policing induce a principal-agent problem. The NYPD management is primarily concerned with low crime statistics, and perhaps revenue generation through the issuance of tickets, and in turn demand that their subordinates exert efforts to fulfill these objectives. Rank-and-file

[1] *Crime + Punishment*, Directed by Stephen Maing (*Hulu*, 2018).

officers, who themselves derive less value from meeting these objectives, have incentives to exert less effort so as to minimize the subjective costs of work.[2]

To resolve this dilemma, given that only the agents perfectly observe their true effort levels, the NYPD management maintains what it sees as an appropriate compensation schedule for their subordinates. In addition to standard wages, this schedule includes a return corresponding to the level of output relative to monthly performance goals or requirements imposed by a quota. This performance-based compensation scheme is not monetary. A police officer's failure to meet a monthly objective translates to a disutility for the officer resulting from punitive actions imposed by the commanding management. Conversely, successfully meeting the objective is not immediately met with a discrete material premium, as might be expected in other occupations. Still, over the course of time, officers that consistently meet their monthly goals could potentially be rewarded with career advancements and other benefits. To that end, the performance expectations that NYPD officers face are part of their job requirements with compensation designed to ensure that these expectations are met.

A satisfactory number of summonses issued and arrests made by the end of each month is not a deterministic outcome even for a determined policeman. Ex ante, the level of output an officer will be able to achieve in these metrics is inherently uncertain. The amount will be determined by a combination of factors, including the stochastic crime conditions and the level of effort a police officer undertakes in responding to crime. Ultimately, an officer needs to adopt a strategy of dynamic effort allocation consistent with their own preferences that also minimizes the risk of falling short of performance goals.

The manner in which police officers allocate their efforts over time will determine the overall policing climate in a city. Leaving aside the specific context of New York City, this will be the case in any jurisdiction. The allocation of police efforts comprises a fundamental aspect of governance, as police efforts help maintain order through the deterrence of crime and the apprehension of criminals (Di Tella and Schargrodsky, 2004). In contrast, the overexertion of efforts may intensify any abuses engendered by policing, such as the violation of individuals' constitutional rights. Given the critical role of police activities, the way in which officers formulate their monthly routines merits broad academic interest.

[2] Deputy Chief Michael Marino admitted to setting a quota while commanding the 75th precinct because police officers were not doing their job otherwise (Robert Gearty, "High-ranking cop testifies he set monthly quotas at Brooklyn precinct," *New York Daily News*, March 22, 2013, http://www.nydailynews.com/new-york/nypd-deouty-chief-admits-quotas-stand-article-1.1296395.

This paper examines an aspect of policing practices that has heretofore remained unexplored. Namely, the objective of this paper is to empirically identify the pattern of intra-month efforts chosen by police officers when they face uncertainty and potential punishment for underperformance. Although the specific details of this study relate to the operations of the NYPD, the effect of similar evaluation structure on the inter-temporal allocation of work effort may be more general.

Using data on NYPD Stop, Question, and Frisk (SQF) practices, this paper finds that more interactions between police officers and the community take place in the earlier days of a typical month. Based on data for the years 2003 through 2016, the last two weeks of a month are associated with 10.1% fewer arrests, 6.9% fewer summonses, and 3.3% fewer non-criminal stops compared to the first two weeks of a month, as depicted in Figure 1. Figure 2 shows that this decreasing pattern of police activity is not driven by the composition of crime and is evident for financially motivated, violent-in-nature, and controlled-substance related crimes. The results suggest that police officers preproperate, which in this paper's context is interpreted as a phenomenon of front-loading efforts.

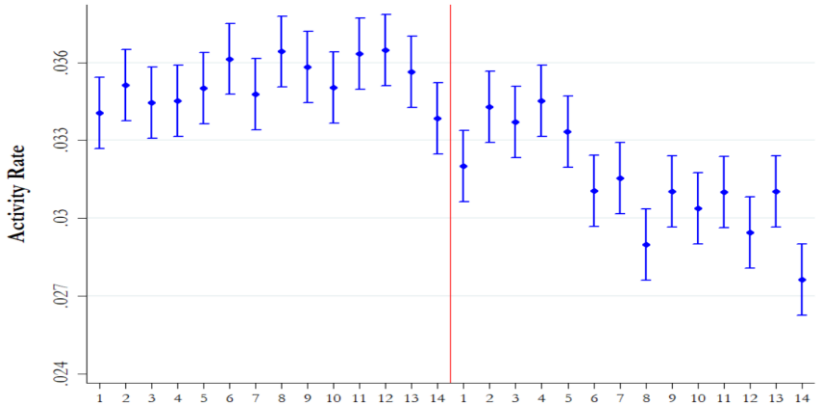
The empirical results of this paper could possibly be explained by the adoption of a strategy by NYPD officers where more efforts are allocated to earlier days of a month as a precautionary measure against failing to meet performance expectations, thereby reducing the likelihood of punishment for underperformance. During the first two weeks, this effort front-loading is manifested in performance that exceeds the level of productivity necessary to meet the expectations if such a level were maintained throughout a full month. Given little incentive to exceed monthly performance goals, police officers adjust efforts as a month progresses in a way that keeps the probability of failure to an acceptable minimum while avoiding the exertion of higher level of costly efforts than necessary. This translates to a diminished demonstration of efforts in favor of leisure during the final days of a month.

The findings of this paper stand in contrast to the majority of scholarly works, both empirical and theoretical, that study the allocation of efforts over time. Existing literature on the allocation of efforts predicts that work in early periods is delayed in favor of leisure; as deadlines approach, leisure is substituted with an increased workload. This phenomenon can be explained assuming time-consistent (Fischer, 2001) or dynamically-inconsistent, present-biased preferences (Akerlof, 1991; O'Donoghue and Rabin, 1999, 2001).[3] The empirical literature corroborates the attraction of

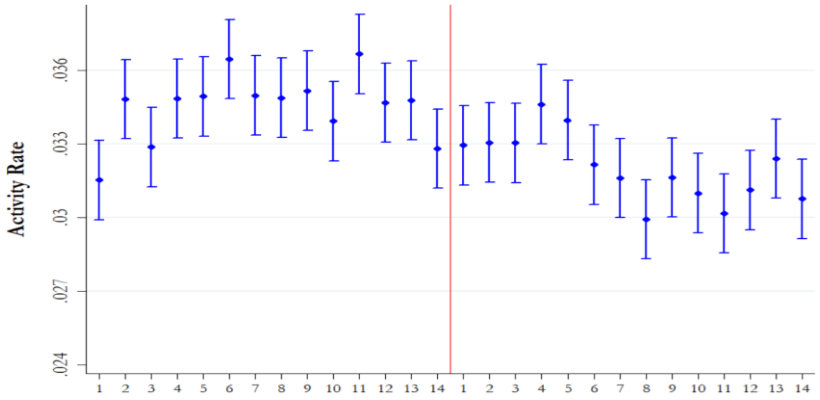
[3] Although not formally framing his analysis with time-inconsistent preferences, Akerlof first articulated an akin idea with regard to procrastination where the opportunity costs of today's work are salient whereas tomorrow's are vague. Agents thus feel more pressure from today's opportunity costs and postpone actions until later. Later works by O'Donoghue and Rabin add to Akerlof's conception of individuals that possess limited knowledge about the future by introducing quasi-hyperbolic discounting. They show that across all types of individuals that vary in their expectations of their time preferences in the future, time-inconsistent preferences introduce an incentive to procrastinate. Fischer (2001) shows that a model with dynamic consistency and a positive time preference can also lead to procrastination, albeit not as severe as under a model with dynamic inconsistency.

FIGURE 1. POLICE ACTIVITY RATES OVER THE COURSE OF THE MONTH

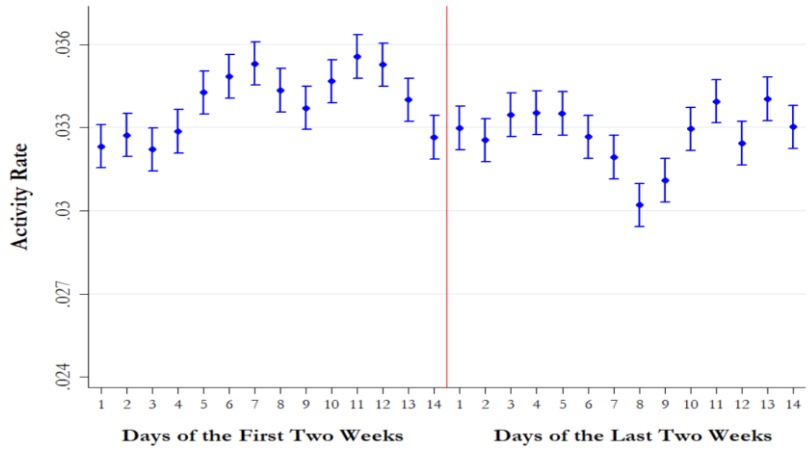
Panel A. Daily Fraction of Monthly Arrests



Panel B. Daily Fraction of Monthly Summonses



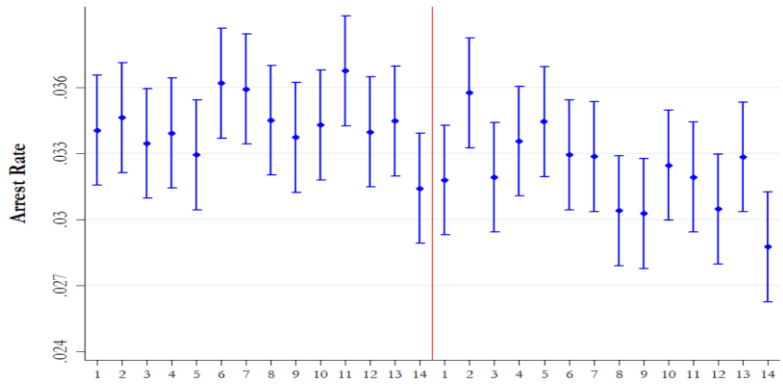
Panel C. Daily Fraction of Monthly Non-Criminal Stops



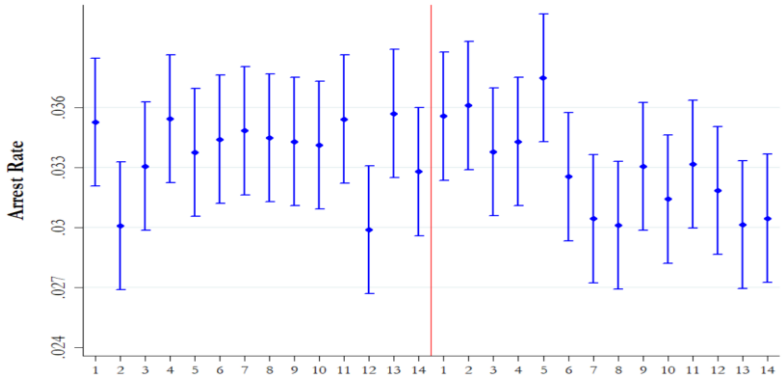
Notes: Daily shares of monthly activity based on SQF data for 2003–2016 (New York City). Panels A, B, and C display the daily shares of monthly arrests, summonses, and stops resulting in neither an arrest nor a summons, respectively. Vertical blue bars indicate 90% confidence intervals. Vertical red bar indicates a division between the first two weeks and the last two weeks of the month. The mean daily share of monthly activity is normalized to equal $0.03\overline{3}$ for each calendar month.

FIGURE 2. POLICE ARREST RATES OVER THE COURSE OF THE MONTH

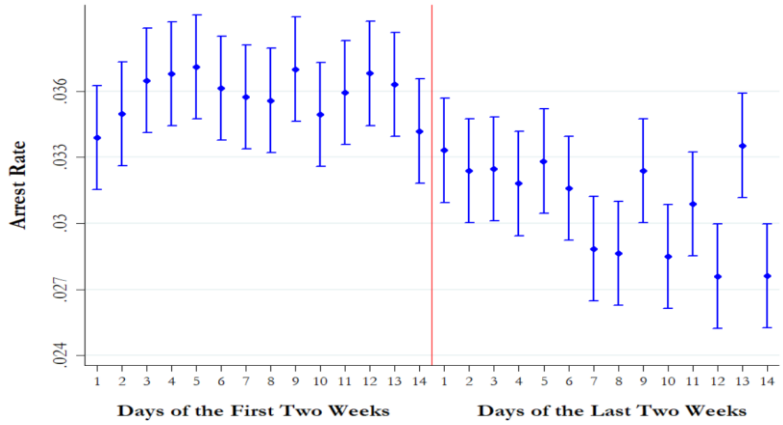
Panel A. Daily Fraction of Monthly Arrests for Financially Motived Crimes



Panel B. Daily Fraction of Monthly Arrests for Violent Crimes



Panel C. Daily Fraction of Monthly Arrests for Substance-Related Crimes



Notes: Daily shares of monthly arrests based on SQF data for 2003–2016 (New York City). Panel A displays the daily share of monthly arrests for financially motivated crimes (robbery, burglary, and all types of larceny). Panel B considers arrests for crimes that are violent in nature (all degrees of assault, sexual assault, menacing, harassment, kidnapping, and homicide). Panel C depicts arrests for substance-related crimes (consumption, possession, and distribution). Vertical bars indicate 90% confidence intervals. Vertical red bar indicates a division between the first two weeks and the last two weeks of the month. The mean daily share of monthly activity is normalized to equal $0.03\overline{3}$ for each calendar month.

immediate gratification and the postponement of work in various real-world contexts (Solomon and Rothblum, 1984; Schouwenburg and Groenewoud, 2001; Nguyen, Steel, and Ferrari, 2013).

Similar behavior of procrastination is observed within the literature on sales and compensation that focuses on the dynamic allocation of efforts as a response to different compensation packages for workers, which, similar to those of the NYPD, are characterized by nonlinearity. To elicit additional efforts from workers, many firms adopt plans that include nonlinear compensation schemes characterized by lump-sum returns for completion of assignments such as reaching a sales quota (Joseph and Kalwani, 1998). These nonlinear remuneration schedules in turn create incentives for the strategic manipulation of how efforts are timed.[4] For workers who discount future costs and benefits, efforts are increasingly allocated closer to the end of a work period so as to capture any rewards from meeting the quota (Asch, 1990; Oyer, 1998; Misra and Nair, 2011). If an unpredictable shock leads to a worker meeting the quota earlier, efforts are scaled down in settings where incentives for "above-and-beyond" performance do not exist (Jain, 2012; Kishore et al., 2013). This last reaction could reasonably characterize NYPD officers' behavioral response as they reach their numbers.

The settings in which procrastinating behavior prevails have been well explored in the literature; nonetheless, there are alternative theoretical environments that allow for the possibility of an ex ante chosen plan of front-loading efforts. Loewenstein and Prelec (1993) propose a model that considers preferences not only over the menu of distinct intertemporal choices (as conventional discounted utility models do), but also for the sequence in which these choices are made. That is, when a decision frame stresses the sequential nature of choices, people express their preferences toward an improving sequence, corresponding to improving utility levels over time (Barnes and Barnes, 1964; Loewenstein and Sicherman, 1991; Chapman, 2000; Story et al., 2013). General examples include choosing to incur the costs sooner rather than later as to "get it over with", or deferring today's gratification for a "brighter future" ahead (Frederick et al., 2002).

Although such preferences are theoretically plausible, empirical work provides little validation of such possibilities outside of experimental tests. The real world, with its complexities and exigencies, may not conform to the controlled settings of a lab. Preferences expressed in hypothetical scenarios might simply reflect their idealized self-images and the participants might still succumb to the enticements of immediate rewards and delayed work in real-world settings. Given that such response

[4] Oyer (1998) and Jensen (2003) also point out that salespeople can affect the timing of orders by delaying sales or pulling orders from future periods in order to maximize gains when facing quotas. This could be a concern for studying the behavior of police officers if they were able to move their numbers between months. Section IV discusses this possibility.

biases could potentially afflict experimental results, it is difficult to conclude whether a model such as Loewenstein and Prelec's would explain the mechanisms behind the actions of NYPD police officers.

One possibility is that the observed preproperation of efforts by police officers is illusory, and in reality, the intertemporal aspect of officers' effort levels does not necessarily deviate from notions in the existing literature on the optimality of procrastination. A significant challenge to identifying the pattern that underlies the allocation of efforts as a response to organizational structure is demonstrating that prevailing crime conditions are exogenous to adjustments in effort levels—that is, police officers do not vary their effort levels strictly as a response to the current overall level of crime being committed. An assumption of criminal acts being uniformly distributed throughout a typical month might not be innocuous and the routine-activity theory, popularized in the field of criminology, offers an explanation for why (Cohen and Felson, 1979).

The routine-activity theory stresses the importance of the temporal cycle in influencing the behavior of individuals involved in crime.[5] To exemplify this theory, consider the following explanation for why crime may vary throughout a typical week. Many individuals spend their weekends differently from the way in which they spend their weekdays. Weekends are more often characterized by participation in public activities (going to sporting events, visiting a park, etc.), which often entail the consumption of alcohol. This participation increases an individual's risk of being involved in a violent crime due to the enhanced potential to be either a perpetrator or victim of such a crime. While such a cycle might be apparent within a week, over the course of a typical month there should no within-month systematic adjustments in the activities governing the days of the majority of the population.

Nonetheless, for certain parts of the population, the potential to observe significant cycles in monthly behavior does arise, due to the uneven distribution of resources over the course of a month. Welfare payments are paid out on a monthly basis, with the disbursement schedule typically falling on the earlier days of the month.[6] These payments mitigate the liquidity constraints of their recipients and enable some to purchase behavior-altering substances the consumption of which might be a crime on

[5] The same theory also explains annual, weekly, and daily cyclical variations in crime rates. Violent crimes spike during the summer (Quetelet, [1842] 1969), presumably because nicer weather increases interactions between people, hence increasing the risk of violent assault; similarly, hotter summer temperatures may induce aggression (Anderson, 1989). Crimes of violence are predominant during nocturnal hours and on the weekends, presumably due to increased alcohol consumption. This is in contrast to property crimes that tend to occur during daytime hours and weekdays, presumably due to property being unattended while property owners are at work (Ceccato and Uittenbogaard, 2012, 2014; Andresen and Malleson, 2015).

[6] The three largest welfare programs in terms of benefit outlays are: the Supplemental Nutrition Assistance Program (SNAP), Temporary Assistance for Needy Families (TANF), and Supplemental Security Income (SSI). SSI payments are made on the first day of the month, unless the disbursement date falls on the weekend or a holiday, in which case the payment is made on the first business day prior. TANF distributions depend on the state, with most states paying out in the first few days of the month (Hsu, 2017). SNAP benefits are also state-dependent with disbursement typically taking place early in the month; SNAP payments tend to be more staggered and tend to span more days of the month (Cotti et al., 2016).

its own, or whose use is positively correlated with the commission of other types of crimes. Several works have connected increased drug consumption (typically measured by the recorded numbers of overdose hospitalizations and drug-related deaths) to the arrival of welfare checks (Riddell and Riddell, 2006; Dobkin and Puller, 2007; Cotti et al., 2016; Hsu, 2017).[7] Furthermore, welfare recipients are more vulnerable to substance abuse than the general population, further increasing the discussed risk (Grant and Dawson, 1996; Pollack and Reuter, 2006).

In addition, welfare payments may reduce certain types of crimes in the period shortly after their disbursement, or alternatively, increase the number of crimes on the days after which the payments have been exhausted. Shapiro (2005) finds that the caloric intake of SNAP recipients declines over a month, behavior that is consistent with quasi-hyperbolic discounting. This suggests that welfare recipients exhaust their resources relatively quickly, leaving them to depend on other means to obtain resources. These alternative means could be criminal in nature. Foley (2011) finds that financially motivated crimes increase over the course of a month in jurisdictions where SNAP benefits are distributed early in the month.[8,9]

In light of the above studies, the supply of criminals may systematically fluctuate throughout a month. Correspondingly, the endogenous police response will consist of police deployments and efforts matching this distribution of crime. In order to disentangle the police response to the "first-of-the-month" welfare narrative from voluntary adjustments in officers' effort levels, this paper presents several ancillary empirical results that lend credibility to the latter explanation.

These auxiliary results show that the decrease in officers' efforts manifests itself through a higher aversion to difficult tasks, with difficulty of a task proxied by the physical characteristics of detained individuals. That is, the probability that a police officer stops a larger individual declines with days of the month. Furthermore, more pronounced monthly cycles of police apprehensions are found for interactions that were self-initiated by an officer, suggesting that police officers' discretion is a fundamental determinant of intra-month fluctuations in criminal activities. Lastly, differences in participation rates in social assistance programs across precincts do not produce discernable

[7] Cotti et al. (2016), in contrast to the listed works, find a decrease in alcohol related fatalities on the weekdays of SNAP disbursements and no effect if SNAP distributions fall on the weekend.

[8] Foley (2011) does not find a similar effect for other crimes that are not financially motivated. This gives credence to the influence of welfare timing rather than police deployment changes or differential incentives to report crimes on different dates. Furthermore, he finds that the staggering of SNAP payments smooths crime rates, presumably due to improved consumption smoothing for payment recipients, which lowers the marginal utility of consumption towards the end of the month. Carr and Packham (2017) find similar results where the staggering of SNAP payments reduced overall theft by 20% and grocery store theft by 28%.

[9] In addition to the aforementioned literature, several other works have found support for intra-month systematic variations when considering non-criminal outcomes such as consumption, mortality, and various economic activities driven by earlier-in-the-month receipts of various payments (Phillips et al., 1999; Stephens, 2003; Evans and Moore, 2009, 2012; Andersson et al., 2015).

differences in the cycles of arrests and summonses, suggesting that welfare-induced crime is limited in its explanation of the empirical results of this paper.

The remainder of the paper is organized as follows. The next section provides institutional information on NYPD operations, the incentive structures faced by officers, recounts allegations of the existence of an informal quota system, and summarizes the public assistance regime in New York City. Section III discusses police behavior within an economic framework. Section IV describes the data and primary methodology used in estimation of intra-month cycles. Section V presents the main results. Section VI provides further evidence of effort allocations that are independent of prevailing crime conditions. Section VII concludes.

II. Institutional Background

The NYPD is the largest police force in the U.S., employing a little over 38,000 uniformed members as of 2018. The department is divided into twenty bureaus, with the Patrol Service Bureau being the most visible among them due to its oversight over the majority of uniformed police officers. This bureau is partitioned into eight borough commands which is further separated into 77 police precincts.[10] Each of these precincts will constitute a geographical unit of analysis in later sections.

The purpose of this paper necessitates at least a partial understanding of the NYPD command structure. Similar to the military, the NYPD hierarchy of rank is rigid. The upper echelon of management consists of several higher ranks, with the police commissioner being the highest among them. The duties of the commissioner include the planning of departmental missions and oversight of their execution. At the level of the precinct, captains — who serve a role of commanding officers — tend to exert the highest authority, and are held responsible by the top management for the performance of officers in their charge. Below them are lieutenants who generally supervise their own platoon (a unit of police force), and who are responsible for all operations of command during their patrol tours. The lowest commanding rank is sergeant who is the immediate field supervisor of patrolling officers. Police officers comprise the majority of uniformed employees who carry out orders and perform patrolling duties.

[10] Information from New York City Police Department www.nyc.gov/html/nypd

A. Formal evaluations of officers' performance

In a January, 2015 press conference, NYPD commissioner William Bratton was quoted saying "[t]here is no specific target number that we go for. There are no quotas, if you will."[11] The commissioner echoed the same sentiment a year later in insisting that "[t]here are no numerical quotas in the NYPD. However, we expect our members to do their jobs. Just like any other organization, there are performance standards through which employees are evaluated."[12]

The NYPD top brass has always denied the existence of a quota as it would be in violation of New York State Labor Law § 215-a and would be an overall unpopular measure with the public. Even in the absence of quotas, however, police officers are quantitatively evaluated on their performance.

The NYPD Patrol Guide, an official document detailing the duties associated with each rank in the police department, contains an extensive process for evaluation of police officers. The following summarizes selected parts of this document.

Police officers and detectives must submit their Officer Profile Report, which measures their performance levels, to the designated supervisor (often sergeants) for a monthly assessment by the second day of the following month. The supervisor's assessment includes an evaluation of uniformed officers' performance by assessing "the quality and caliber of the member's efforts by carefully reviewing activity." This activity is also compared with other officers with similar duties. At the end of the evaluative report, positive feedback is provided for "proactive and quality activity" or "guidance and direction for improvement" with "regular follow-ups, when a deficiency is identified." In case of unsatisfactory performance, the guide specifies that "appropriate steps" be taken in order to "improve the uniformed member's performance." If these steps do not resolve the performance issue, officers are to "confer with [their] platoon commander/special operations lieutenant or next higher supervisor." Following this protocol, their supervisor delivers the Officer Profile Report to the platoon commander (often lieutenant) or another reviewer by the fifth day of the month. The platoon commander reviews the report and forwards it to the operations coordinator by the seventh day for filing. At the end of this monthly evaluation process, the commanding officer (often captain) reviews the report and logs the information that it contains into the Performance Evaluation System. Commanding officers are ultimately the ones responsible for "determining performance standards

[11] Joel Rose, "Despite Laws and Lawsuits, Quota-Based Policing Lingers," *NPR*, April 4, 2015, https://www.npr.org/2015/04/04/395061810/despite-laws-and-lawsuits-quota-based-policing-lingers.

[12] Sarah Wallace, "I-team: More NYPD Officers Say There's Proof of Quota-Driven Arrests," *NBC New York*, April 1, 2016, https://www.nbcnewyork.com/investigations/NYPD-Officers-Arrest-Quota-Exclusive-Interview-Pressure-Numbers-374077091.html.

within their respective commands and resolving all issues within their command relative to the Monthly Performance Review."

Police officers who repeatedly fail to meet acceptable performance standards are placed under performance monitoring, with "possible impositions of sanctions by the Personnel Review Board concerned." This board can take corrective actions including, but not limited to, a "change of assignment within the command, intraborough or interborough transfer, transfer from administrative command and/or disciplinary action."[13]

On the other hand, police officers' who continually demonstrate exceptional performance have their exemplary conduct noted on the Performance Evaluations. Such commendations, when considered alongside other factors listed in the Patrol Guide, can be used for promotional decisions, lucrative reassignments, and additional overtime. Overall, rewards are granted to those who "consistently perform their assignments in an exceptional manner."

Police officers, therefore, are rewarded or punished based on their performance which is agglomerated over time intervals as short as one month. The chronology of this performance appears to start on the first of the month and conclude at the end of the month.[14]

The evaluative standards are established in line with the average performance of the unit, which is not the same as the establishment of a numerical quota. Whereas the average performance will vary as a reflection of the current crime conditions, a quota sets a minimum floor on productivity regardless of existing conditions. The latter creates an undesirable potential scenario where police officers may be compelled to issue more summonses and make more arrests than crime conditions warrant. To do so, police officers may resort to improper measures that violate the fourth and fifth amendments, such as false summonses, groundless arrests, and unreasonable searches.

Although, arguably, the formal measure of performance is preferable to a quota, it still may incentivize some police officers to make up the numbers if they are falling behind their peers. Even in the absence of realized underperformance, a forward looking and motivated police officer may anticipate the risk of not meeting the average. This too can lead to over-policing in the earlier periods. Excessive policing, in turn, can lead to a higher incidence of the use of force as unnecessary stops might lead to worsened interactions with the public. In addition, worrying about making the numbers

[13] "Once you get in that program, they got you," said police Sergeant Cyress Smith, a 19-year veteran of the NYPD, referring to the Performance Monitoring program for those who do not meet the performance standards. He continues, "no matter how well you perform, it's not going to be good enough. The Performance Monitoring program and evaluation is supposed to be tools to measure performance whether cop is doing his job or not. They are both used as weapons of retaliation and weapons of abuse. They don't do stuff by the books," (Crime + Punishment).

[14] Although this information is taken from the 2016 version of the Patrol Guide, it appears to be in line with the Patrol Guide from the year 2000. In the earlier years, there is an additional mention of a Police Officer Monthly Performance Report (PD439-1414) which is used for monthly assessments. The 2016 document suggests that this monthly report is now a part of the Officer Profile report. Taken together, these reports show the existence of monthly assessments between the years 2000 and 2016.

on a monthly basis can detract from the quality of policing in pursuit of a quantitative outcome. These concerns are only exacerbated by additional presence of a quota. And, although the existence of a quota system has officially been denied, many believe that the NYPD surreptitiously operates under an evaluative process that considers both average performance and quotas.

B. Quota system

The earliest accusations of the NYPD adhering to a quota system extend back to 1957 in a lawsuit filed against New York City over an alleged quota on the issuances of traffic summons.[15] In the early 1970s, the Knapp Commission (a commission charged with investigating corruption within the NYPD) concluded that elements of corruption in the Department could be attributed to the existence of quotas on narcotics and gambling arrests, and as part of its recommendations to reduce corruption, advocated for the elimination of such quotas (Bronstein, 2015). The allegations of the existence of quotas did not disappear with time and have only gained traction in the 21st century.

The Patrolmen's Benevolent Association (PBA), a labor union representing New York City's police officers, maintain the position that such quotas continue to persist. In 2016, an organizational survey conducted by the PBA found that 89% of its members believe that supervisors mandate quotas.[16] This belief parallels the statement by Patrick Lynch, the union's president, in reference to claims of excessive policing in the city, "… end illegal quotas and the issue will be resolved."[17]

Although clandestine in nature, the effects of a quota are experienced by those who must adhere to it. As discussed previously, quota systems could incentivize improper police actions, which could lead to violations of individuals' rights and deteriorated relations between the police and the public they serve. Many residents of New York City feel that their rights have been infringed upon when dealing with the police, presumably due to police pressure to meet a quota, and as a result have filed series of lawsuits against the city and the department. These lawsuits include Floyd v. City of New York, Ligon v. City of New York, Stinson v. City of New York, Daniels v. City of New York, and Davis v. City of New York.[18] Some of the litigation was initiated by the NYPD's own police

[15] "Kennedy Summoned Over Ticket Quotas," *New York Times*, October 18, 1957, http://query.nytimes.com/mem/archive/pdf?res=F40B15FE3A5C127A93CAA8178BD95F43 8585F9.

[16] "New York Patrolmen's Benevolent Association Membership Study," McLaughlin (Mar. 15, 2016).

[17] Daniel Beekman, "Ivy League Law Professor to Help Implement Stop-and-Fisk Reforms," *New York Daily News*, September 19, 2013, http://www.nydailynews.com/news/crime/ivy-league-law-professors-implement-stop-and-frisk-reforms-article-1.1459589#ixzz2fJhclXYo.

[18] The most prominent among them is Floyd v. City of New York (2013). In this class action lawsuit, the plaintiffs alleged that the defendants, which included police commissioner Raymond Kelly and mayor Michael Bloomberg, maintained an organizational practices resulting in unconstitutional and unreasonable stops and frisks based on race and national origin. In August 2013, Judge Scheindlin ruled that the plaintiffs' 4th and 14th Amendment

officers. In 2006, arbitrator ruled that the NYPD maintained a traffic citation quota in violation of the state labor law (Case #A-10699-04, 2006). In 2015, an NYPD officer was awarded a $280,000 settlement from a federal lawsuit in which he alleged retaliation from his superiors over his exposing the existence of a quota system (Matthews v. City of New York).

Since then, more members of the NYPD have come forward as whistleblowers alleging the existence of quota such as Officers Pedro Serrano, Adil Polanco, and Adrian Schoolcraft, among many others. Renegades to this system, they claim to have been persecuted as a result. Some of them have provided secret audio recordings of their supervisors calling for numbers. "If you think 1 and 20 is breaking your balls, guess what you're going to be doing. You're going to be doing a lot more, a lot more than what they're saying," said an officer in the 41st precinct referring to 1 arrest and 20 summonses over the course of a month. "Next week, 25 and 1, 35 and 1, and until you decide to quit this job to go to work at a Pizza Hut, this is what you're going to be doing till then," uttered another 41st precinct officer on a different date.[19,20]

Although not all of the 77 NYPD precincts were involved in quota scandals, then-PBA president Patrick Lynch believed that quotas were "a department-wide problem" (Fisk and Richardson, 2016). This echoes the sentiment shared by the overwhelming majority of police officers from the results of aforementioned PBA survey.

C. Welfare disbursement schedules

Intra-month cycles of crime fueled by the early-in-month disbursement of welfare payments could act as a confounding factor for the purposes of this paper.

In New York City, welfare recipients have access to the following major assistance programs: Supplemental Nutritional Assistance Program (SNAP), Supplemental Security Income (SSI), Family Assistance (FA), and Safety Net Assistance (SNA). FA is New York's analogue to the Temporary Assistance for Needy Families (TANF) program. SNA is a New York City-specific welfare program provided for those who are not eligible for other social assistance programs, and can be thought of as

rights were violated by the police department due to the prevalence of unreasonable searches and discriminatory stops. Similar allegations were made against the city a decade earlier, Daniels v. the City of New York (1999). The plaintiffs in Stinson v. City of New York alleged that police officers issued summons that were deficient in the necessary probable cause. Davis, Ligon v. City of New York cases claimed that police officers were abusing trespass laws in housing areas.

[19] Jim Hoffer, "NYPD Officer Claims Pressure to Make Arrests," *ABC New York*, March 2, 2010, https://abc7ny.com/archive/7305356/.

[20] There are other recordings mentioning concrete numbers. Al Baker and Ray Rivera, "Secret Tape has Police Pressing Ticket Quotas," *New York Times*, September 9, 2010, https://www.nytimes.com/2010/09/10/nyregion/10quotas.html. Graham Rayman, "The NYPD Tapes: Inside Bed-Stuy's 81st Precinct," *Village Voice*, May 4, 2010, https://www.villagevoice.com/2010/05/04/the-nypd-tapes-inside-bed-stuys-81st-precinct/.

FIGURE 3. WELFARE DISBURSEMENT SCHEDULE

Form EBT-52A
Rev. 1/2/13

NYC Human Resources Administration Department of Social Services | Family Independence Administration

EBT Pick-up Schedule
January – June 2013

Note: As of August 29th, 2012, any reference to the Food Stamp Program shall mean the Supplemental Nutrition Assistance Program (SNAP), and any reference to Food Stamps shall mean SNAP benefits.

Toe Digit	January CA & SNAP		February CA & SNAP		March CA & SNAP		April CA & SNAP		May CA & SNAP		June CA & SNAP	
	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B	6A	6B
0	1/2	1/16	2/1	2/16	3/1	3/16	4/1	4/16	5/1	5/16	6/1	6/17
1	1/3	1/17	2/2	2/19	3/2	3/18	4/2	4/17	5/2	5/17	6/3	6/18
2	1/4	1/18	2/4	2/20	3/4	3/19	4/3	4/18	5/3	5/20	6/4	6/19
3	1/7	1/19	2/5	2/21	3/5	3/20	4/4	4/19	5/6	5/21	6/5	6/20
4	1/8	1/22	2/6	2/22	3/6	3/21	4/5	4/22	5/7	5/22	6/6	6/21
5	1/9	1/23	2/7	2/23	3/7	3/22	4/8	4/23	5/8	5/23	6/7	6/22
6	1/10	1/24	2/8	2/25	3/8	3/25	4/9	4/24	5/9	5/24	6/10	6/24
7	1/11	1/25	2/11	2/26	3/11	3/26	4/10	4/25	5/10	5/25	6/11	6/25
8	1/12	1/28	2/12	2/27	3/12	3/27	4/11	4/26	5/11	5/28	6/12	6/26
9	1/14	1/29	2/13	2/28	3/13	3/28	4/13	4/29	5/13	5/29	6/13	6/27

Note: Toe digit is the last digit of your case number.

an extension to FA once FA benefits run out (NYC Human Resources Administration). Taken together, FA and SNA are referred to as Cash Assistance (CA).

In 2013, New York City's average monthly benefits per individual receiving assistance were $155, $562, $460 (in 2013 dollars) for SNAP, SSI, and CA respectively, with program participation rates of 22%, 5.1%, 4.3% (Report # Q03, NYC Human Resources Administration and SSI Annual Statistical Report 2013, Social Security Administration).

With regard to the schedule of the programs' payments, SNAP benefits are staggered during the first ten banking days of the month, SSI is disbursed on the first business day of the month, and CA is disbursed bimonthly (starting at the beginning of the first and second halves of a month). There were no changes to this schedule during the years covered in this paper (Office & Evaluations, NYC Department of Social Services).[21]

Figure 3 shows an example of New York City's EBT (Electronic Benefit Transfers) form which announces the dates during which SNAP and CA benefits will be available. This regime is

[21] A special thanks to Kinsey Dinan, Deputy Commissioner – Officer of Evaluations & Research, for clarifying the municipal government's procedures and providing *EBT-52* and *EBT-52A* forms outlining the welfare schedule for the years 2003–2016.

characterized by a staggered payment schedule in which SNAP benefits are distributed in line with schedule A (the first 10 banking days of the month, as indicated by the letter "A" in Figure 3), and CA benefits according to both schedules A and B. This suggests that the "first-of-the-month" effect should not be as strong, as welfare payments are still available later in month. Nonetheless, a larger proportion of welfare resources are distributed in the earlier part of the month as only parts of CA are distributed during the second half (schedule B in Figure 3).

III. Economic Implications

The conditions faced by New York's police produce economic implications for policemen as well as the community they patrol. The following provides a possible framework for interpreting the empirical findings of preproperation in efforts.

A. Conditions

Police officers operate in an environment that calls for attaining a certain level of output by the end of each month. Such output counts the number of arrests, summonses, and stops conducted. This requirement, in addition to salary, creates a nonlinear compensation schedule for a typical police officer. Nonlinearity arises from discrete returns to an officer's performance relative to expectations on minimum levels of productivity in monthly performance. Failure to reach this expectation results in severe punitive measures. Consistent satisfactory and exceptional monthly performance, on the other hand, might be rewarded. Therefore, end-of-the-month performance can result in either a positive or negative shock to the utility of the police officers.

For a police officer, ex ante monthly productivity is unknown. Among many factors, it will depend on "market" conditions, which are semi-random. Positive shocks can be thought of as exogenous increases in crime during some days of the month. These shocks improve the likelihood that costly efforts translate to valuable outcomes such as arrest and summons. Furthermore, the monthly distribution of crime may not be entirely random. Early days of the months may correspond to an increase in certain criminal activities that are positively correlated with the temporarily augmented financial resources of welfare recipients.

Therefore, given the above conditions, a representative police officer decides how to optimally allocate his labor efforts with respect to dynamic conditions within a month.

B. Behavioral Response

Given the scarcity of time as a resource, a police officer's intra-month effort allocation will depend on many factors, such as monthly goals or quotas, monthly compensation with subjective response to it, uncertainty of output, prevailing crime conditions, preference for leisure over work, and time preferences.

Conventional literature, whether it analyzes salespersons' responses to quotas or the efforts of representative agents faced with time-sensitive tasks, predicts an unequal allocation of effort where the amount of work performed increases as the deadline approaches. The reason for procrastination stems from individuals' disutility of work coupled with positive time discounting, leading to an immediate undiscounted gratification with discounted delayed costs.

There is no reason why police officers should deviate from the described behavior under the assumptions that typify the literature. They too prefer leisure and exhibit time preferences. Therefore, absent of any uncertainty, each day a representative police officer would balance the costs of efforts against the chosen level of output such that the difference between the expected monthly target and the police officer's accumulated monthly output approaches zero by the end of a month.[22] This leads to intertemporal effort-smoothing consistent with the time-preference parameter of the officer. In this case, a police officer will always meet the expectations by the end of each month by choosing to work harder closer to the deadline. To invert this pattern and observe more efforts in early periods, the existence of a strong countervailing behavioral responses would be required.

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[22] In this case, police officers maximize their utility over a month by choosing to allocate their time between leisure and work:

$$\max_{a_t \in [0,h]} U(Q,T) \text{ where } U(Q,T) = \sum_{t=1}^{T} \delta^{t-1} u(h - a_t) - \lambda_t (Q - \sum_{t=1}^{T} a_t)$$

where $t = 1, \dots, T$(with T representing the final day of the month); Q is the monthly arrest quota; a_t is the number of arrests performed in period t with $a_0 = 0$; $l_t = (h - a_t)$ is leisure in period t under the assumption that there are h hours available in a work day, and each 1 hour spent working deterministically leads to 1 arrest; λ_t is the shadow value of another hour to the work day; $\delta^{t-1} < 1$ is a time consistent discount rate in period t. Utility is assumed to be increasing and concave. The solution to this utility maximization problem implies a rule for the optimal exertion of efforts (or alternatively, leisure):

$$U'(l_t)\delta^{t-1} = \lambda_t \text{ such that } \lim_{t \to T} (a_t - \frac{Q - \sum_{t=1}^{T} a_{t-1}}{T - t + 1}) = 0$$

According to this equality, the marginal utility of leisure will be growing with t: $\frac{\partial \lambda}{\partial t} > 0$. This means that arrests derived from efforts will grow monotonically, and hence efforts will increase closer to the end of the period.

A nonlinear compensation scheme at the conclusion of each month invites a different equilibrium behavior in the presence of uncertainty. Depending on the random distribution of crime and the form of the functional relationship that transforms efforts into output, continual deferral of effort in each month will yield a series of unmet monthly goals in the long run resulting in utility-decreasing penalties. And, procrastination behavior becomes suboptimal when the sum of the discounted disutilities outweighs the accumulated ex ante benefits of delaying work. As a result, a forward-looking police officer might exert more efforts in the beginning of the month as a precautionary measure.

Moreover, the Patrol Guide stresses that benefits are likely to be given to those who consistently, from month to month, provide the department with satisfactory performance. This system of penalties and rewards leads to the existence of two potential levels of compensation corresponding to two mutually exclusive states, which thereby creates a sizeable difference between the two outcomes in terms of utility lost or gained. This additionally incentivizes a police officer to reach the numbers and minimize the risk of failure, an incentive which is only exacerbated in the presence of risk-aversion.

If an officer chooses to front-load their efforts to the early days of a month, a high level of output is likely to be achieved in these early periods. And if the officer were to maintain their early-period effort level for the entire duration of the month, they would be likely to exceed the minimum quantitative requirements imposed by the performance standards or quota.[23] Given that there are fewer incentives to exceed required performance targets, a police officer will adjust efforts each day in a way that continues to keep the probability of a failure to an acceptable minimum while avoiding exerting more costly efforts than are required. Therefore, as police issue more summonses in the early days of the month than the period-proportional target mandates, the risk of underperformance drops, allowing officers to reduce their efforts and enjoy leisure. If this behavior characterizes a representative police officer in New York City, then it would be captured in the SQF data where a greater number of arrests, summonses, and overall stops occur in the first half of the month followed by a scaling down in these numbers as a month progresses.

Alternative explanations may complement the above mechanisms. Police officers could prefer a sequence of improvements, as discussed in Loewenstein and Prelec (1993). Given the short difference in times between when the daily choices of efforts are made throughout a month, police

[23] If this is not the case on average, then it implies that the standards call for the maximum effort exertion for the full month. Given the observed data, it would mean that the average police officer does not meet his goal by the end of each month as the numbers fall off closer to the end. In this case, the NYPD would have a difficult time attracting and retaining officers. Such a scenario is unlikely.

officers are more likely to view these efforts as a sequence, as opposed to independent decisions. Matching this view, police officers might choose to work less as a month progresses, corresponding to a sequence of increasing leisure and a reduction in the costs incurred by efforts. As police officers stay on this trajectory, they reduce the dread of falling short of their performance goal, which consequently improves their current wellbeing.

Finally, police officers do not have to be homogenous in their preferences. Heterogeneity with regard to how officers view labor and leisure could explain why some police officers' anecdotal accounts describe an increase in efforts at the end of the month to meet the quotas while testimonies of preproperation are noticeably absent.[24] As long as the majority of police officers exhibit preferences that conform to the arguments of this section, preproperation will triumph over procrastination. This might also partially explain why only a handful of police officers have spoken out against the department, as most of them were able to adapt to the work conditions prescribed by the department by adopting the rarely observed strategy of front-loading efforts.

An important consideration in analyzing the behavior described above is the potential existence of a non-random intra-month variation in crime. If crime increases at the start of the month, it incentivizes police officers to exert more efforts in that period due to higher returns on their work. This mechanism could be complementary to the precautionary work or could entirely override it, rendering it unnecessary. Even in the absence of these strategic effort responses, higher crime rates in early periods could lead to similar empirical results even under the presence of procrastination. Consider a scenario where a police officer allocates an increasing sequence of efforts $\{e_1, e_2, e_3\}$ over three periods such that $e_1 < e_2 < e_3$. It is possible to observe a decreasing number of arrests under certain assumptions on the functional form of the transformation function. Assume that the production function is $a_t = e_t t^{-\alpha} + \varepsilon_t$ where a_t is number of arrests in period $t \in \{1,2,3\}$ and ε_t is a period-specific random shock such that $E(\varepsilon_t) = 0$. This production function represents higher returns to efforts in earlier periods as a result of the prevalence of crime. On average, the observed numbers of arrests will be decreasing in t, $a_1 > a_2 > a_3$, as long as $2^{\alpha} e_1 > e_2 > 2^{\alpha} 3^{-\alpha} e_3$. Therefore, the presence of intra-month crime cycles allows for multiple potential effort allocation levels while generating a larger amount of output in the earlier days of the month. Later sections

[24] "At the end of the month, these officers who don't have that arrest or those few summonses, they're pressured to find something. You might not see anything but you go hunting, like bounty hunting for an arrest, locking up some old guy, some homeless guy, finding someone who's spitting on the sidewalk, and you bring them in," said Derick Waller, one of the NYPD 12 who came out as a whistleblower.

provide a careful examination of these possibilities and conclude that the front-loading of efforts as a precautionary measure persists even when considering these other factors.

IV. Data and Primary Methodology

The primary data used in this paper comes from the NYPD Stop, Question, and Frisk (SQF) database which documents daily interactions between NYPD officers and the community.[25] The SQF collects information on New York City's "stop and frisk" program which emerged as a controversial strategy in the 1990s with the appointment of William Bratton as New York's Police Commissioner.[26] The SQF program was aggressively used to expand community policing by increasing focus on lower level criminal violations accompanying the department's new focus on order-maintenance and adoption of CompStat crime mapping (Spitzer, 1999).

Pedestrians are stopped by a police officer and questioned during an SQF interaction. A frisk of the suspect is warranted and may lead to search if the officer reasonably suspects that a suspect may inflict physical harm.[27] The officer can either release the individual without further action, issue a criminal summons, or make an arrest following the interaction. Arrest is the most severe of these outcomes, as an arrest involves placing a suspect into police custody and is generally only conducted for more egregious crimes. A criminal summons, unlike an arrest, does not lead to the suspect being taken into custody. Similar to an arrest, an individual receiving a summons is accused of a criminal infraction and is required to appear in court to answer for the alleged charges.

At the conclusion of the interaction, an officer fills out a UF-250 form recording which of the aforementioned actions was performed. This includes additional details describing the characteristics of the individual, the exact timing of the stop, the area of the incident, the circumstances leading to the stop, and the offense with which the individual was charged if appropriate.

Police officers are not required to record each interaction with the public. All police interactions based on factors that fall short of a reasonable suspicion of a criminal act are legally permissible, but are exempt from needing to be documented (such encounters are classified as level 1

[25] Since 2008, the data is publically available following a Freedom of Information Law and court order (NYCLU v. NYPD, 2008). It can be accessed at https://www1.nyc.gov/site/nypd/stats/reports-analysis/stopfrisk.page

[26] Brief individual detentions by police, absent of probable cause, were ruled not to be in violation of the United States Constitution by the United States Supreme Court in Terry v. Ohio (392 U.S. 1, 1968). Henceforth, police were allowed to conduct stops and frisks on articulable suspicion that the suspect was, currently is, or will be involved in a criminal act.

[27] Stops and searches are governed by the New York Criminal Procedure Law §140.50 (1) and (3), respectively. During a frisk, a police officer runs his hands over a suspect's clothing. If the officer suspects that an object concealed on the person could be a weapon, a search is allowed in which it is permissible for the officer to put their hands in the interior parts of the suspect's clothing (Patrol Guide 2016).

TABLE 1. Levels of Permissible Interactions with the Public

TYPE OF ENCOUNTER	LEVEL OF KNOWLEDGE REQUIRED	NATURE AND EXTENT OF PERMISSIBLE QUESTIONING	AUTHORITY TO SEARCH	FORCE AND DETENTION
I. Request for Information	An objective, credible reason to approach. Suspicion of criminality is not required. However, the UMOS must be able to articulate a basis beyond mere whim and caprice.	Non-accusatory questions concerning the reason for the approach.	At this level of suspicion, there is no basis to search. A request for consent to search the person or a bag, pocketbook, luggage, or other item of personal property is improper.	Force may not be used to detain a subject at this level of suspicion. The subject is free to walk away from the UMOS if they so desire. They need not answer questions.
II. Common-Law Inquiry	A founded suspicion that criminality is afoot. This could be triggered by false responses to questions posed during the request for information, as well as observations by the UMOS.	UMOS may conduct more extensive questioning. Accusatory-type (guilt-seeking) questions may be asked.	A subject may be asked to consent to the search of an item of personal property. This consent must be voluntary on the subject's part.	Force may not be used to detain a subject at this level of suspicion. The subject is free to leave if they desire. They need not answer questions.
III. Stop, Question, And Possible Frisk	An officer has *individualized, reasonable suspicion that the subject is committing, has committed, or is about to commit a crime.* The New York State Legislature has limited the term crime, for purposes of a stop, to mean a felony or a misdemeanor in the Penal Law. (CPL § 140.50(1)). Reasonable suspicion exists when the information known to the UMOS is of such weight and persuasiveness as to make the UMOS reasonably suspect criminality on the part of the person being stopped.	The UMOS may stop the subject, ask for his or her name and address, an explanation of conduct, and detain the person while an expeditious investigation is conducted to determine if there is probable cause to arrest the subject.	In addition to the consent search described above, the UMOS may frisk the subject for a deadly weapon or any instrument or article readily capable of causing serious physical injury, and of a sort not ordinarily carried in public places by law-abiding persons, if the UMOS reasonably suspects the person is armed and dangerous.	A stop occurs whenever *a reasonable person would not feel free to disregard the officer and walk away.* A UMOS is permitted to use reasonable force to stop and question a subject. The type and amount of physical force used must be objectively reasonable under the circumstances facing the UMOS.
IV. Arrest	Probable cause to believe that (a) an offense was committed and (b) that the subject arrested committed it. Probable cause requires the existence of facts and circumstances which when viewed together would lead a reasonable person possessing the expertise of the arresting officer to conclude that an offense has been committed.	An UMOS may engage in constitutionally permissible custodial interrogation (i.e., *Miranda* waiver must be lawfully obtained. *Miranda* waiver is not required to obtain pedigree information).	"Search incident to arrest" (i.e., a search of a subject conducted immediately after the arrest to secure weapons, prevent evidence destruction). "Inventory," etc.	A UMOS is permitted to use reasonable force to arrest and detain a subject.

Notes: The information in this table is copied from NYPD's *Investigative Encounters Reference Guide* that was used for training conference in 2015. http://nypdmonitor.org/wp content/uploads/2016/02/InvestigativeEncountersRefGuideSept162015Approved.pdf

and level 2). Any summonses and arrests resulting from immediately observed probable cause (considered as a level 4 encounter) do not need to be recorded. Only stops involving level 3 encounters, also known as "Terry stops," require completion of a UF-250. These stops require a reasonable suspicion that the detained person has committed, is committing, or intends to commit a criminal act. Table 1 provides detailed information on the distinction between these various categories of encounters.[28]

Measurement errors due to recording practices are a concern. The boundaries between permissible interactions are often thought to be vague despite their formal definitions. This can cause

[28] Additional guidelines specify that if level 1 and 2 encounters escalate to level 3, records are made. A level 4 outcome of an arrest or summons is also recorded as long as the encounter involved a level 3 interaction during the process. In addition, stops are recorded if force was used to stop a person, a frisk or search was conducted, or a person failed to identify themselves (USCCR Report, 1999).

confusion for officers with regard to the necessity of recording an interaction. This would not pose a serious concern if such errors occur randomly throughout the course of the month.

Systematically misreported records, on the other hand, would present an obstacle to accurately identifying effort allocations. One such misreport could involve the record of the date on which an interaction took place. If police officers are able to transpose their numbers between months, they might move their surplus output (numbers exceeding expectations) from the final days of a month towards the next month. However, this possibility is unlikely to arise with regard to the NYPD's data on arrests and summonses. Ever since the introduction of CompStat, a computer system for the recording of information on police activities, the real-time entry of information on crime statistics is required. This forces the numbers to be entered in a central computer system within a short period of time (Silverman 1999, 97–124). Nonetheless, this could be a problem for recorded stops that yield no criminal outcome. Such stops would be of no relevance to the recording of statistics on committed crimes and offer no additional evidence of police activity taking place, unlike arrests and summonses where suspects are formally charged.

Notwithstanding concerns about recording practices, this data provides a significant advantage in that it records high-frequency interactions between police and the community. This makes it possible to identify, albeit noisily, the effort allocations on the part of police officers.

Over five million stops were recorded across all 77 precincts in New York City between January 2003 and December 2016 (all available SQF years). For the main analysis, stop-level observations (which comprise SQF data) are converted into day-precinct observations by counting the daily total precinct-level number of stops without a criminal outcome, stops involving summonses, and stops leading to arrests (denoted henceforth as non-criminal stops, summonses, and arrests, respectively). This produces 358,708 distinct daily precinct-level observations over the duration of sample.

The following precinct-level model is estimated using OLS to find evidence for intra-month labor efforts cycles:

$$(1) \qquad ActivityRate_{dmyp} = \beta_L LastTwoWeeks_{dmyp} + \boldsymbol{X}'_{dmyp}\gamma + \varepsilon_{dmyp}$$

Equation (1) measures the temporal variation in recorded intra-month police activity where $d = 1, 2, \ldots, 31$ corresponds to the days in a month; $m = 1, 2, \ldots, 12$ represents the months of the year,

$y = 2013, 2014, \ldots, 2016$ the years in the sample; and $p = 1, 2, \ldots, 77$ denotes each of New York City's police precincts. The spatial unit of analysis is the precinct due to it being the unit at which enforcement policies are set. Errors are likely to correlate over time within precincts, and therefore standard errors are clustered at the precinct level.

The dependent variable $ActivityRate_{dmyp}$ is constructed using the following formula:

$$ActivityRate_{dmyp} = \frac{Activity_{dmyp}}{\sum_{d=1} Activity_{dmyp}},$$

where $Activity$ is a placeholder for arrests, summonses, and non-criminal stops. Arrests are also broken down between financially motivated, violent, and controlled-substance-related types to see if any particular types of crime drive the results.[29,30] These dependent variables measure precinct-specific and temporally distinct daily activity shares relative to officers' monthly activities.

Consider one of the six dependent variables:

$$ArrestRate_{dmyp} = \frac{Arrest_{dmyp}}{\sum_{d=1} Arrest_{dmyp}}.$$

This dependent variable calculates the fraction of total monthly arrests within a precinct that occur on a particular day of the month.[31] The remaining five dependent variables (summonses, non-criminal stops, and fragmented arrests) are defined analogously.

Given the construction of the dependent variables, this model mechanically includes precinct-month-year fixed effects which control for unobserved heterogeneity across precincts and time, and also account for the unequal number of days across months. These fixed effects are important to include since commanding officers set the goals and practices of the precincts as reflections of the

[29] For the purposes of this paper, all crimes that are expected to produce material gains for the perpetrator at the expense of victim(s) are considered as financially motivated crimes. By this definition, these crimes include robbery, burglary, as well as petty and grand larceny. This definition excludes other crimes that might be financially motivated but lacking victims such as unlicensed vending or gambling. The reason for exclusion of the latter activities is to limit the confounding effects of welfare payments on this cycle. Welfare payments produce a shock to the availability of financial resources that enables crimes such as gambling and encourages illegal vending due to positive demand shocks. The former definition attempts to restrict the analysis to crime driven by scarcity as opposed to crime driven by abundance. Violent crimes are considered to be those that harm or threatens to harm another person. These include all degrees of assault, sexual assaults, menacing, harassment, kidnapping, and homicide. Controlled substance crimes include all violations of the New York City and the state of New York penal laws governing narcotics. These include consumption, possession, and distribution of all illegal substances.

[30] Identification of different types of arrests is not trivial in the SQF data. Police officers, using their own words, summarize the violations for which arrests occur. These summaries are string variables that include typographical errors, abbreviations, acronyms, and other challenges to accurate classification. Diligent steps were taken to ensure accuracy.

[31] A hypothetical example: June of 2005 had 30 days during which a total of 30 arrests took place in the 5th precinct. Assume that each day in that month (and precinct) is responsible for 1 arrest. In this case, the dependent variable takes on a value of $0.03\overline{3}$ for each day.

current socio-economic and crime conditions, which vary across New York City and change over time. Furthermore, the way in which SQF was used underwent a substantial change during the years covered by the data. Police activity peaks in the year 2011 with 686,056 stops and drops to its lowest level in 2016 with 33,983 stops. This signals temporal changes in police practices resulting from public outcry over excessive policing. For robustness, separate analyses were considered in Section V omitting the years of low SQF utilization. No substantive changes are observed.

The main explanatory variable is $LastTwoWeeks$. To divide each month in a symmetric fashion (given that some months have more days than others), this variable divides a month into periods corresponding to the first and last two weeks of the month. Therefore, this binary variable equals one if a day belongs to the last 14 days of the month and zero if it belongs to the first 14 days. Similar 28-day time windows were used for analysis in Stephens (2003) and Dobkin and Puller (2007).

If $E(ActivityRate_{dmyp}) = E(ActivityRate_{(d+1)myp}) \approx 0.033 \ \ \forall \ d$, then it suggests that crime is uniformly distributed and yields an equal response throughout a month, in which case coefficient β_L would be equal to zero. This would indicate no strategic and unequal allocation of police efforts.

$\boldsymbol{X}'$ is a vector of control variables. Continuous controls include average daily temperatures, lunar luminosity, rainfall, snowfall, and daylight. Other control variables include indicators for the days of the week and holidays.[32] These variables can potentially influence both the commission of crime and apprehension of criminals.

Daylight measures the number of minutes of available light emitted from the sun in a day. Lunar luminosity ranges from zero to one, encompassing all possible linear combinations of luminosity between the new and full moon; both of the above variables influence visibility throughout a full day, and visibility is a fundamental element in the decision to commit a crime given that darkness helps to conceal the act. The data on daylight and lunar luminosity comes from the United States Naval Observatory.[33]

Snowfall and rainfall are measured in inches of precipitation. Precipitation is relevant in many scenarios. It can affect the number of potential victims, perpetrators, and officers on the streets and act as an impediment to interactions between these agents. Temperature (measured in degrees Fahrenheit) is relevant along the lines of the earlier explanations of the temperature-aggression theory

[32] *Holiday* is a dummy variable indicating days such as federal holidays and other publically celebrated occasions. These dates include all federal holidays and adjacent weekends and Fridays. If a federal holiday fell on a Sunday, the following Monday is included due to its "in lieu of" observance (the U.S. Office of Personnel Management). In addition, Saint Patrick's Day, New Year's Eve, Cinco de Mayo, Halloween, Super Bowl Sunday, and Christmas Eve are also included with their weekends and Fridays if those days were adjacent. These holidays differ with regard to how they are celebrated and, therefore, have varying relationships with prevailing levels of crime. A consideration of these differences is provided in Section V.

[33] Data is taken from http://aa.usno.navy.mil/data/docs/RS_OneDay.php.

TABLE 2. SUMMARY STATISTICS

Variables	Mean	SD	Min	Max	Number of instances
Dependent variables					
Arrest rate	0.0328	0.076	0	1	282,211
Summons rate	0.0328	0.0846	0	1	285,159
Stop rate (non-criminal outcome)	0.0328	0.0444	0	1	4,105,454
Financially motivated crime	0.0327	0.124	0	1	49,944
Violent crime rate	0.0328	0.139	0	1	23,999
Controlled substance crime rate	0.0329	0.114	0	1	67,903
Explanatory variables					
Last two weeks	0.5	0.5	0	1	
Each day of week	0.142	0.349	0	1	
Holiday	0.117	0.322	0	1	
Temperature (in °F)	55.19	17.33	4	94	
Rainfall (in inches)	0.144	0.407	0	7.57	
Snowfall (in inches)	0.102	0.903	0	27.3	
Lunar luminosity	0.5	0.351	0	1	
Daylight (in minutes)	731.87	120.23	555	906	

Notes: Financially motivated crime includes robbery, burglary, and all types of larceny. Violent crimes include homicide, assault, sexual assault, kidnapping, menacing, and harassment. Controlled substance crimes include possession, consumption, and distribution of all narcotics prohibited in New York City. Number of instances column is the total count of activities in rate variables. The total number of unique day-precinct observations is 358,708.

(see footnote 5), and can similarly influence the amount of interactions between agents. The data on rain, snowfall, and temperature is taken from the National Weather Service Forecast Office.[34]

The importance of weekdays and holidays is explained through the routine-activity theory, where weekends and specific holidays may lead to excessive drinking and a greater incidence of interactions between the police and the public. In addition, many people are paid weekly with paychecks disbursed on Fridays, further altering incentives for crimes across days of the week. These variables can also affect police presence given that more police officers might be deployed over weekends in anticipation of public disorder, or conversely, might have a lower presence during certain holidays.

Table 2 contains summary statistics of the dependent and control variables that are used in the main estimation. The dependent variable ranges from zero to one. In the extreme cases, a zero indicates that no activities took place on that day, and a one indicates that a particular day accounts for all of the activities undertaken in a single month. The indicator variable representing monthly divisions of first and second halves has a mean of 0.5. This indicates a symmetrical division with equal

[34] Data is taken from http://w2.weather.gov/climate/xmacis.php?wfo=okx.

number of days in the first and the second half of each month. The mean of 0.117 on the holiday dummy indicates that over ten percent of all days are considered celebratory. The inclusion of the adjacent weekend in addition to the actual day of the holiday is responsible for the large mean (see footnote 32).

The rightmost column of Table 2 provides total counts of each of the activities used in the activity rate calculations. Stops leading to arrests (282,211 stops) or summonses (285,159) comprise only 5.97% and 6.03% of stops respectively. Most stops (4,105,454) result in neither of these outcomes.[35] A quarter of all arrests are made over controlled substances, representing the largest category of crime committed. Within this category, 59.9% of arrests involve marijuana (not shown in Table 2).

V. Main Results

This section estimates the model in equation (1) which considers the intra-month variation of labor efforts on the part of NYPD's rank-and-file. If there exists an unequal display of performance throughout a month, it will be captured by the coefficient on the indicator variable separating a month into two halves. This unequal performance could be a product of unequal distributions of efforts, cyclical crime supply shocks driven by disbursements of welfare payments, or a mixture of both. The main results presented here are only partially able to discern between these explanations, though a later discussion attempts to distinguish between the two.

Table 3 presents the estimates of equation (1) for arrests, summonses, and non-criminal stops. Columns (1) and (2) differ with regard to their inclusion of particular control variables. The following discussion focuses exclusively on columns (2) as the results are similar across both columns.

The control variables have similar impact on the three dependent variables. More daylight leads to fewer arrests, summonses, and non-criminal stops. Each hour of additional daylight is associated with a 3.1% drop in arrests. This is presumably because more hours of daylight limits the available time for committing crimes under the cover of darkness.[36] More light reflected by the moon similarly reduces criminal activity. Days with full moon are associated with 1.6% lower arrests than

[35] The literature refers to the likelihood of a stop resulting in a tangible outcome as the hit-rate. Given a small (12%) hit-rate, police officers in New York City were criticized for excessive use of SQF (Ridgeway, 2007).

[36] In addition, more daylight may lead to improved detection by the police or public which, in turn, should increase the likelihood that a suspect engaged in a crime will be apprehended. Given the associated decline of 3.1%, the former effect of a drop in crime is likely to outweigh this possibility.

TABLE 3. OLS ESTIMATES OF STOP OUTCOMES

Explanatory variables	(1) Arrests	(2) Arrests	(1) Summonses	(2) Summonses	(1) Non-criminal Stops	(2) Non-criminal Stops
Last two weeks	-0.00344***	-0.00348***	-0.00231***	-0.00234***	-0.00109***	-0.00111***
	(0.000261)	(0.000321)	(0.000308)	(0.000314)	(0.000148)	(0.000175)
Holiday		-0.00376***		-0.00226***		-0.0026***
		(0.000459)		(0.000461)		(0.000278)
Tuesday		0.0153***		0.00742***		0.011***
		(0.000628)		(0.00077)		(0.000467)
Wednesday		0.0191***		0.00995***		0.0143***
		(0.000674)		(0.000737)		(0.000564)
Thursday		0.0173***		0.00997***		0.0129***
		(0.000642)		(0.000701)		(0.000478)
Friday		0.0169***		0.0141***		0.015***
		(0.000648)		(0.000676)		(0.000542)
Saturday		0.012***		0.0149***		0.0113***
		(0.000788)		(0.000892)		(0.00063)
Sunday		0.00114*		0.00631***		0.0017***
		(0.000644)		(0.000866)		(0.00054)
Temperature		0.000064***		0.000067**		0.000044***
		(0.000019)		(0.000026)		(0.000013)
Lunar luminosity		-0.00102**		-0.000784		-0.000642***
		(0.000456)		(0.000501)		(0.000222)
Rainfall		-0.00259***		-0.00376***		-0.00303***
		(0.000341)		(0.000353)		(0.000176)
Snowfall		-0.00106***		-0.00116***		-0.00098***
		(0.000125)		(0.000155)		(0.000058)
Daylight		-0.000017**		-0.000016*		-0.000009*
		(0.000008)		(0.000008)		(0.000004)
Constant	0.0311***	0.0298***	0.0317***	0.0323***	0.0323***	0.0277***
	(0.000179)	(0.00536)	(0.000215)	(0.00574)	(0.000102)	(0.0032)
Observations	338,968	338,968	301,000	301,000	356,860	356,860
Month×Year×Precinct FEs	Y	Y	Y	Y	Y	Y

Notes: Standard errors are clustered at the precinct level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

the days with first quarter moon. Interestingly, coefficients on daylight and lunar luminosity are largest for arrest outcomes and the lowest for non-criminal stops. One possible explanation behind this is that perpetrators of severe crimes are most sensitive to potential exposure due to greater adverse legal risks of their actions when visibility is high.

Precipitation of rain and snow both decrease activities. An additional inch of rain or snowfall are associated with 7.9% and 3.2% fewer arrests, respectively. This could be explained through several

channels, for instance, the reduction of the number of potential victims, aversion to precipitation by criminals, or similar aversion by police officers who might view inclement weather as an inconvenience, leading to lower apprehensions.

A 10° F increase in temperature is associated with a 1.9% increase in arrests. Higher temperatures are consistent with the temperature-aggression theory where warmer temperatures lead to more criminal activity. Conversely, colder temperatures may lower the level of public interaction or discourage police officers from exerting high levels of effort.

Days that fall on holidays or their adjacent weekends are associated with lower arrests (11.5%), summonses, and non-criminal stops. The explanation for this is ambiguous. Some holidays are spent quietly within the walls of one's home (e.g. Thanksgiving or Christmas) whereas other holidays (St. Patrick's Day or Cinco de Mayo) induce people to venture out and partake in alcohol consumption. The former types of holiday should be associated with a lower incidence of the commission of crimes while the latter should be associated with the opposite. Crime apprehension could additionally be reduced owing to the efforts of the police if officers view holidays as days associated with higher leisure and decreased efforts. Separate regression analyses were performed (not shown here) which introduced a holiday dummy variable based on the public's inclination to engage in drinking in an effort to explore whether the latter effect of decreased police efforts drives the above results.[37] Holidays associated with drinking retain the qualitative result of lower arrest rates (6.9% fewer arrests relative to non-holiday days). This effect was larger for non-drinking holidays (12.1% fewer arrests), consistent with an additional drop in crime due to the less boisterous nature of these holidays. In addition, there was no discernible change in summonses issued or non-criminal stops conducted on the days of drinking holidays. This might contrast with what one might expect of the "holiday effect," which is associated with greater public interactions characterized by excessive drinking potentially leading to additional criminal conflicts. These results suggest that the drop in police officers' efforts are primarily responsible for the reduction in activities.

The last set of control variables include indicators for the individual days of the week. Mondays appear to have the lowest levels of activity whereas weekends are associated with the largest number of interactions as recorded from the SQF. This observation is consistent with the routine-activity theory.

[37] The holidays associated with drinking included St. Patrick's Day, Cinco de Mayo, Halloween, Super Bowl weekend, New Year's Eve, and the Fourth of July. The non-drinking holidays included the remainder of holidays listed in footnote 32.

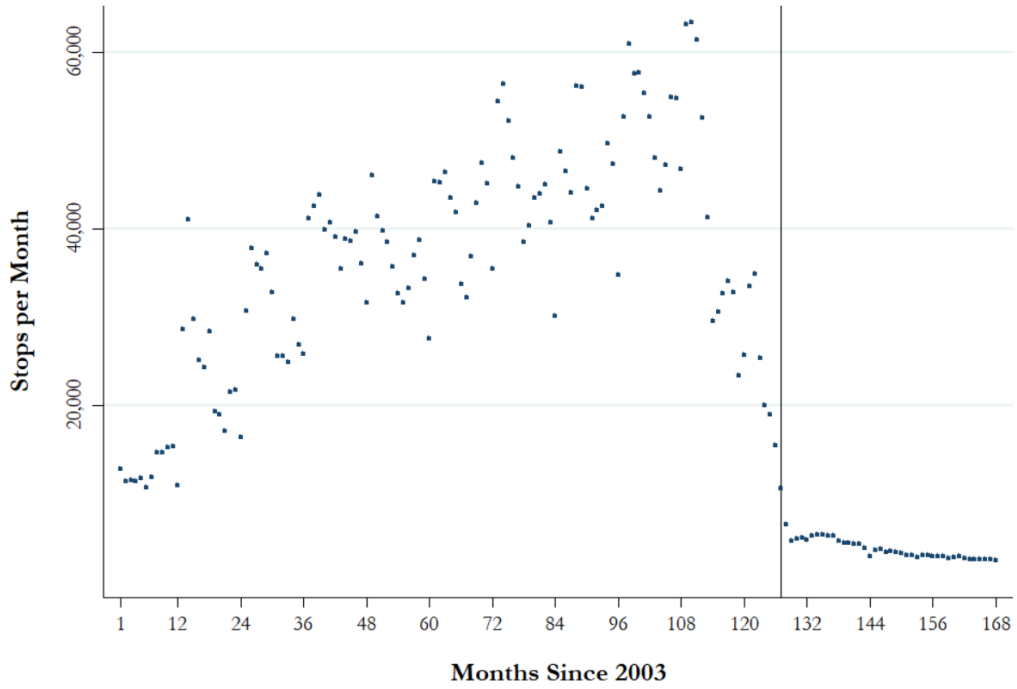
The first row in Table 3 summarizes the main results of interest. The coefficients presented across columns in Table 3 depict the differences in arrests, summonses, and non-criminal stops between the first and the second halves of a typical month. All three coefficients are statistically significant at the 1% level, negative, and sizable in their magnitudes. These results translate to 10.1% fewer arrests, 6.9% fewer summonses, and 3.3% fewer criminal stops during the last two weeks of a month relative to its first two weeks. These results suggest that officers make more arrests, issue more summonses, and conduct more unproductive stops early in the month, consistent with the strategy of front-loading efforts.

Arrests and summonses are likely to be valued more highly than simple stops due to their successful apprehension of criminals, which could lead to safer streets and additional revenue generation for the city. Therefore, police officers' behavioral responses should be primarily driven by achieving these outcomes. This might explain larger cyclical effects for arrests and summonses in contrast with the attenuated cycle of non-criminal stops.

It is worth noting the unequal number of observations between the dependent variables used in equation (1). During some months, some of the precincts did not record any instances of the associated activities (arrests, summonses, or non-criminal stops), and therefore, these precinct-month observations cannot be included (as the denominator of the dependent variable for such observations is equal to zero). Such precinct-month observations with zero instances of a particular activity being recorded constitute 5.5%, 16.1%, and 0.5% of the full sample for arrests, summonses, and non-criminal stops, respectively. Of these observations with zero recorded activities within a month, around 90% fall in the interval of time between July 2013 and December 2016. The overabundance of zero-valued observations in this period can be attributed to procedural reforms in response to a series of accusations against the city and the department over its excessive use of SQF tactics (Mummolo, 2017), and an ensuing reduction in police interactions with the public involving SQF. Figure 4 illustrates this drastic reduction in the number of monthly stops following the changes, with a vertical line (July, 2013) representing a stabilized new trend. To address this break in the data, equation (1) was re-estimated by excluding this period of lower monthly activities. Restricting the sample in such a way preserves statistical significance and does not substantially change the magnitude of the main results (not formally presented).[38]

[38] When equation (1) is re-estimated excluding years post-SQF reforms, the magnitudes on the last two weeks become somewhat lower for arrests (0.00073 percentage points lower relative to the coefficient found using the full sample, representing a 21.1% difference in magnitudes) and non-criminal stops (0.0006 percentage points), and slightly higher for summonses (0.000046 percentage points).

FIGURE 4. TOTAL NUMBER OF STOPS PER MONTH



Notes: Number of stops per month recorded in SQF data, 2003–2016 (New York City). The vertical black line indicates July, 2013.

The next table explores whether specific types of crime are responsible for the observed patterns. Table 4 presents results of equation (1) using dependent variables that disaggregate arrests into three categories of financially driven, violent-in-nature, or controlled-substance-related.[39] All coefficients on the $LastTwoWeeks$ variables are again statistically significant and negative. Arrests are 4.9%, 3.9%, and 13.6% lower for financial, violent, and controlled substance crimes respectively during the second half of a month. These results suggest that there is less overall activity in the last two weeks irrespective of crime composition.

These findings suggest the existence of both: the intra-month cyclical nature of crime and discretionary adjustments of labor efforts on the part of police officers, which exists independently of the former. The largest intra-month cycle in arrests is found in the illicit narcotics category. This discovery is consistent with the literature connecting welfare disbursements to illegal substance use. A liquidity-constrained individual is financially enabled to procure drugs upon receiving a welfare check, leading

[39] Similar to the explanation provided with regard to Table 3, the difference in the number of observations is due to precincts making zero arrests for particular crimes during some months. Analyses were again performed excluding post-reform SQF years. The results were qualitatively unchanged, with similar statistical significance and magnitudes for financially-motivated and substance-related crimes but not for violent crimes (p-value: 0.18).

TABLE 4. OLS ESTIMATES OF DISAGGREGATED ARREST RATES

Explanatory variables	Financially Motivated	Violent	Controlled Substance
Last two weeks	-0.00162***	-0.0013**	-0.00481***
	(0.000474)	(0.000593)	(0.00052)
Holiday	-0.00387***	-0.000626	-0.00477***
	(0.000828)	(0.000993)	(0.000659)
Tuesday	0.015***	0.0065***	0.0179***
	(0.000909)	(0.00113)	(0.000897)
Wednesday	0.0185***	0.00674***	0.024***
	(0.00106)	(0.00119)	(0.000953)
Thursday	0.0152***	0.00813***	0.0213***
	(0.000913)	(0.00116)	(0.000955)
Friday	0.0134***	0.00947***	0.0216***
	(0.00103)	(0.00136)	(0.0011)
Saturday	0.00684***	0.0133***	0.0128***
	(0.00115)	(0.00138)	(0.000986)
Sunday	-0.00227***	0.00827***	0.000692
	(0.000813)	(0.00135)	(0.000815)
Temperature	0.000059	0.00015***	0.000115***
	(0.000036)	(0.000044)	(0.000037)
Lunar luminosity	-0.000922	0.000201	-0.00182**
	(0.000688)	(0.000942)	(0.000717)
Rainfall	-0.00189***	-0.00178**	-0.00323***
	(0.000468)	(0.00072)	(0.000488)
Snowfall	-0.00113***	-0.000669*	-0.00107***
	(0.000278)	(0.000381)	(0.000182)
Daylight	-0.000013	0.000007	-0.000009
	(0.000014)	(0.000014)	(0.000013)
Constant	0.0299***	0.0112	0.0185**
	(0.0106)	(0.0102)	(0.00928)
Observations	277,256	212,884	262,164
Month×Year×Precinct FEs	Y	Y	Y

Notes: Standard errors are clustered at the precinct level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

to increased consumption and possession of such substances. This might also expand the presence of narcotics merchants on the streets, who are eager to capitalize on favorable demand conditions. This further increases the number of apprehensions of substance-related violators.

The intra-month cycle in arrests for violent crimes follows a similar trajectory of that for substance-related arrests by exhibiting an intra-month decline. It is hard to conclude what drives this result. It could reflect the effort adjustments of police officers, or it could be complementary to the drug-related cycle where substance consumption is positively correlated with risk-taking behavior leading to violent crime. Another plausible channel for this is the increased competition between drug dealers over ephemerally larger markets. The methods with which such conflicts are settled are notoriously violent due to the unavailability of formal property rights or dispute settlement mechanisms for conflict resolution (Goldstein, 1985).

The final result on the declining intra-month cycle of financially motivated crimes is inconsistent with the previous literature connecting crime to the welfare disbursement schedule. The end-of-month scarcity of resources owing to the exhaustion of welfare funds should produce a higher marginal utility of consumption due to lower levels of consumption.[40] This creates an incentive for some to obtain resources through crime. More arrests would therefore be expected during the ending days of a month, but in fact, fewer are recorded. This declining number of arrests nonetheless parallels the decline in the number of arrests for other crimes. This is strong evidence for the idea that police undertake a lower effort level as a month progresses, and further, this mechanism is independent of the type of crimes that officers deal with.

VI. Exogeneity of Police Officers' Efforts Adjustments with Respect to Crime Levels

This section presents more direct evidence of the front-loading of efforts and the immateriality of non-random welfare disbursements in affecting the behavior of police officers. It also further extends the original analysis by considering police officers' aversion to difficult tasks and the discretionary nature of effort adjustments, and testing for differences in police behavior across precincts with high and low rates of welfare participation.

[40] The consumer goods also include behavior-altering substances. Given that some fraction of welfare recipients struggle with addiction, their marginal utility of consumption for these drugs will be immense.

A. Complexity of the Task at Hand

Police enforcement is a series of temporal interactions with tasks, often criminal in nature. These tasks are not homogenous and vary in complexity. If there exists a reduction in effort on the part of a police officer, then some of the more difficult tasks may be ignored. One dimension of such difficulty lies in the physical attributes of suspects. Larger individuals pose additional risk to officers' safety and the prospect of a successful detainment. As a result, a reduction in effort may materialize in aversion towards individuals possessing such attributes.

The SQF data contains variables describing the physical attributes of those stopped, including the individual's weight, height, and physical build. Unfortunately, the data does not report the physical attributes of the officer that conducted the stop; therefore, estimating the officer-specific difficulty of a stop is not possible. Nonetheless, on average, the difficulty of a stop should increase with the degree with which individuals possess the aforementioned physical attributes. As a result, within each of these three variables on physical characteristics, two different subdivisions were employed to create a total of six separate binary variables. Each division characterizes stops as belonging to one of two categories of lower or higher difficulty with the second division further intensifying the severity of a higher difficulty group.

Variables $Heavy$ and $Tall$ are constructed using suspects' body weight and height information. In the first division, the variables $Heavy$ and $Tall$ are equal to one if the suspect's reported weight or height were at least one standard deviation above the sample mean and zero otherwise, respectively. In the second division, variables $Heavy$ and $Tall$ are equal to one if the suspect's reported weight or height were at least two standard deviations above the sample mean and zero otherwise, respectively.[41] Thus, the second divisions potentially indicate a more difficult stop.[42]

The variable $Large$ is initially constructed from the information on the physical build of a suspect. At first, it is defined as an indicator equaling one if a suspect's body build was described as muscular or heavy and equaling zero if medium or thin. In the second specification, the variable's construction considers information on all of the three physical characteristics. $Large$ equals one if the

[41] The cutoffs for these measures are 197 pounds and 72 inches for one standard deviation above the mean for weight and height; 228 pounds and 76 inches for two standard deviations.

[42] When these variables are instead defined as representing individuals being above or below average height or weight rather than standard deviations above the mean, no pattern in the relationship between physical characteristics and daily effort levels emerge. This is not surprising given that an average police officer might not view a smaller deviation above the sample mean as a substantive increase in difficulty, especially if an average police officer possesses above average values of the aforementioned physical attributes.

TABLE 5. SUMMARY STATISTICS FOR PHYSICAL CHARACTERISTICS OF SUSPECTS

Variables	Mean	SD	Min	Max
Weight (in lbs.)	168.6	29.14	50	600
1 SD above mean	0.142	0.349	0	1
2 SD above mean	0.0342	0.181	0	1
Height (in inches)	68.59	3.28	24	99
1 SD above mean	0.191	0.393	0	1
2 SD above mean	0.0111	0.105	0	1
Large				
Body type descriptions: muscular or heavy	0.0891	0.285	0	1
"Large" body type with height and weight 1 SD above mean	0.0239	0.153	0	1

Notes: Body type consists of four categories: muscular, heavy, medium, and thin. The "large" body type includes muscular and heavy builds.

suspect was considered either muscular or heavy, with both weight and height being at least one standard deviation above their mean values.

A linear probability model is used to estimate a change in likelihood of stopped individual possessing unfavorable physical attributes during the second half of a month relative to the first half:[43]

$$AdversePhysique_s = \beta_L LastTwoWeeks_s + \boldsymbol{X}_s'\gamma + \varphi_{ymp} + \varepsilon_s \quad (2)$$

In contrast with equation (1), the unit of analysis is an individual stop s recorded in the SQF data. $AdversePhysique_s$ is a binary variable equaling one if stop involved an individual possessing an "unfavorable" physique and zero otherwise.

The main explanatory variable of interest is $LastTwoWeeks$, a binary variable indicating whether the stop occurred during the last or first two weeks of a month, similar to model (1). Vector $\boldsymbol{X}$ contains all other controls included in model (1). φ_{ymp} is a year-month-precinct fixed effect. The standard errors are clustered at the precinct level.

Table 5 provides descriptive statistics for the six dependent variables considered and the continuous variables used in their construction. Initially, the variables weight and height had unreasonably high and low ranges, reflecting inaccuracies in the recording of the data.[44] Their minimum and maximum values represent the adopted cutoffs. These cutoffs were based on historical records on minimum and maximum heights and weights. For robustness, equation (2) was also re-

[43] A logit model was also estimated. The logit estimates were quantitatively similar to those generated by the linear probability model.
[44] Weight ranged between 0 and 20,000 lbs. Height ranged between 0 and 162 inches, the height of an atom and a full size elephant.

TABLE 6. OLS ESTIMATES OF STOPS INVOLVING INDIVIDUALS WITH ADVERSE PHYSIQUES

Explanatory variables	Heavy		Tall		Large	
	Weight 1 SD above	Weight 2 SD above	Height 1 SD above	Height 2 SD above	Body type	Weight, height, and body type
Last two weeks	-0.00152***	-0.000975***	-0.000523	-0.000294**	-0.00126***	-0.000443***
	(0.000363)	(0.000191)	(0.000338)	(0.000125)	(0.000293)	(0.000138)
Holiday	-0.00151**	-0.000603**	-0.00183**	-0.000299	-0.00137***	-0.000784***
	(0.000593)	(0.00029)	(0.000756)	(0.000218)	(0.00045)	(0.000238)
Constant	0.146***	0.0303***	0.195***	0.00832***	0.081***	0.0229***
	(0.00592)	(0.00339)	(0.00709)	(0.00154)	(0.00528)	(0.0028)
Observations	4,627,886	4,627,886	4,657,513	4,657,513	4,656,386	4,562,656

Notes: Other included controls are temperature, lunar luminosity, rainfall, snowfall, daylight, dummies for days of the week, and month-year-precinct fixed effects. Standard errors are clustered at the precinct level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

estimated using more restrictive limits on permissible values for heights and weights, as well as unrestricted ranges. There were no substantive changes in the results (not shown here).

Table 6 reports the results for equation (2). The difference in the number of observations across the Heavy, Tall, and Large columns reflect incidences of missing and misreported values.[45] The first two columns consider weight as a potential determinant of difficulty. The first column labels an individual heavy if his or her weight is one standard deviation above the mean or greater. The coefficient of interest is equal to -0.00152 and is statistically significant at the 1% level. Given that 14.3% of all stopped individuals in the first two weeks of the month had recorded weights of at least one standard deviation above the mean, this coefficient indicates that the probability of a stop involving such an individual is 1.1% lower in the second half than in the first half of a month. Similarly, the second column shows that the probability of stopping an individual whose weight is at least two standard deviations above the mean is 2.8% lower in the last two weeks of a month.

The third and fourth columns consider the height of a suspect. There is no evidence that the likelihood of stopping a person whose height is one standard deviation above the mean is different throughout the month. In the fourth column, a person is considered tall if his or her height is more extreme, at least two standard deviations above the mean. The estimate on the second half of the month is statistically significant at a 5% level and reflects a 2.6% decreased chance of a stop involving a tall person during the second half relative to the first half.

[45] These instances do not correlate with the days of the month. Correlations between the occurrence of missing values for body build, weight, height and whether such observations fall in the first two weeks of the month are all approximately equal to zero.

The fifth column presents results for body type description. A person is considered large if his or her body build is described as muscular or heavy. The results show that the probability of stopping a large individual is 1.4% lower in the second half at the 1% significance level. The final column classifies an individual as large if he or she possesses comparatively extreme attributes for all of the physical characteristics considered. During the first two weeks, only 2.4% of all stops involved such individuals. The coefficient of -0.000443, therefore, translates to 1.9% fewer stops of large individuals during the last two weeks of a month.

To better conceptualize the above magnitudes, it is worth noting the coefficients on the holiday dummy across columns. The magnitudes and signs of these coefficients are similar to the ones observed on the second half of the month and with the exception of only one column, the coefficients on the holiday dummies are negative and statically significant. This shows that heavier, taller, and larger people are less likely to be stopped during holidays, the days that are typically associated with leisure and reduced labor efforts.[46] The magnitude of the aversion to potentially difficult stops during these days is comparable to the level of aversion observed in the second half of a month.

These results show that individuals with potentially threatening physical attributes are less likely to be stopped during the last two weeks of a month. Furthermore, a higher degree of such a threat further lowers the likelihood of being stopped during the second half. These findings suggest that the more difficult the task is, the more likely it is to be skipped as a month progresses. This observed relation between difficulty and aversion provides evidence that the intra-month criminal cycle could in part be driven by reduction in policing efforts. This conclusion of course hinges on the assumption that the distribution of crimes committed by heavier, taller, and larger people does not systematically differ from the rest of the criminals throughout the month. That is, as long as larger criminals do not commit more crime during the first half than the rest of the criminal population, then the results imply a change in the allocation of efforts on the part of police.

[46] It is possible that these holidays are associated with less crime overall which would produce a similar effect. However, as the discussion of the main empirical results suggests, these observations are likely to be driven by the effort reduction of police.

B. The Possibility of Discretion

If voluntary discretion to exert less effort is one of the mechanisms behind lower rates of criminal apprehension later in the month, then the tasks possessing less leeway in the potential range of efforts level should exhibit an attenuated cycle.

In the SQF data, the decision to initiate a stop can come from two different sources. The first source occurs when a police officer conducts a self-initiated stop during his patrol. The second source of a stop occurs when a police officer responds to calls for service from the public. These calls for service are communicated to a police officer via police radio, are assigned a job number, and are generally considered more urgent due to the immediacy of the assistance request. Logically, police officers' discretion with respect to whether to initiate an interaction is more limited during these "radio runs."[47]

Nonetheless, calls for service do not have to be equal in their severity and immediacy. Some calls could involve minor public infractions or delayed reports of past crimes. These calls, due to their lesser importance, allow for a greater degree of effort adjustments.[48] One way to narrow down the list of tasks which further deprive police officers of the latitude to shirk is to consider the outcome of the stop. Service calls resulting in arrests are, on average, an indication of their importance and immediacy. Therefore, to estimate this effect, model (3) is estimated, which takes as its unit of analysis a stop involving arrest:

$$RadioRun_a = \beta_L LastTwoWeeks_a + \boldsymbol{X}_a'\gamma + \varphi_{ymp} + \varepsilon_a. \quad (3)$$

The dependent variable is $RadioRun_a$, which equals one if arrest a was made due a service call and zero if it was made due to self-initiation by an officer. Given the binary nature of the dependent variable, equation (3) is a linear probability model.

Given that arrests resulting from service calls are harder for an officer to avoid than arrests originating from an officer-initiated interaction, the probability of an arrest being generated due to a "radio run" would be higher in the second half of a month if police officers were indeed voluntarily

[47] One of the assigned duties to police officers is "monitor portable radio" which further limits the discretion even about being informed of the existence of service calls (Patrol Guide).

[48] Reporting a crime which happened days ago might cause an officer to delay his arrival at the scene. Reported acts that are not readily evident in their illegality, or crimes that are minor, might produce lower quality of investigative involvement on their part of the police officer.

scaling down on their efforts.[49] This conclusion relies on the assumption that the fraction of crime discovered through patrolling in the second half is not lower than in the first half[50] and that the fraction of crime reported by the public does not increase in the second half. This assumption is not necessarily true. It is possible that during the earlier days of the month different types of crimes are committed. These types might differ in their discovery and reporting rates from the rest of crimes. Controlled substances related offenses are prime examples of this. If early-in-a-month welfare disbursements induce recipients to purchase these substances, more illegal transactions and drug consumption may happen in the plain view of a police officer, leading to a higher general discovery rate. This will lead to a higher number of self-initiated apprehensions early in the month. Such offenses are also likely to have a lower reporting rate by the public due its victimless nature.[51] If there is a lower incidence of substance use in the second half of a month, the general report rate by the public will be higher. This would bias the interpretation of results that show a higher fraction of "radio run" arrests occurring later in the month by erroneously attributing the full effect to the reduced efforts narrative.

To avoid conflating the above effect with the discretionary reduction in efforts, equation (3) is reconsidered for the subsample of stops which did not record any criminal activity. This, of course, comes at the expense of identifying which calls were potentially important, hence partially lowering the ability to determine the extent to which police officers are able to exhibit discretion in how they deal with calls.

Table 7 presents the results of equation (3). The first column looks at the probability that arrests were generated as a result of service calls as opposed to self-initiative. The coefficient of interest shows a 0.0076 percentage point increase in such arrests during the last two weeks of the month, and is statistically significant at the 1% level. Given that 18.5% of all arrests in the first two weeks were a result of service calls, arrests during the second half have a 4.1% higher probability of being radio-call generated. The second column considers stops without criminal outcomes. Considering that 23.1% of such stops during the first two weeks of a typical month arose from service calls, the coefficient on the last two weeks translates to a 0.9% higher probability of a stop being radio-call generated in the second half of the month.

These results show that a higher fraction of non-criminal stops and arrests are generated as a

[49] Arrests are used as a proxy for importance of the call. A similar analysis was done for summonses as well. Although the coefficient on this analysis was positive as expected, it had a large standard error; therefore, nothing conclusive can be stated. It is not unexpected given the fact that these summonses ordinarily involve simple quality-of-life violations and fall short of the severity of the violations involving arrests.

[50] It is important to stress the difference between *discovered* and *apprehended*. It is the goal of this paper to demonstrate a lower apprehension rate in the second half. Discovered crimes represent all visible crimes to the police officers under a constant amount of efforts without making a statement on whether they are formally dealt with.

[51] 18% of all arrests in the data were a result of service calls by the public compared to only 7.5% of arrests involving controlled substances.

TABLE 7. OLS ESTIMATES FOR SERVICE CALLS RESPONSES

Explanatory variables	Among arrested	Among non-criminal stops
Last two weeks	0.00761***	0.00213**
	(0.00199)	(0.000978)
Constant	0.164***	0.213***
	(0.0388)	(0.0168)
Observations	280,721	4,097,359

Notes: Other included controls are temperature, lunar luminosity, rainfall, snowfall, daylight, dummies for days of the week, holiday dummies, and month-year-precinct fixed effects. Standard errors are clustered at the precinct level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

result of service calls — calls for assistance that are harder to ignore — during the last two weeks. This conclusion is consistent with less efforts being exerted in the last two weeks of the month as captured by attenuated monthly cycles in activities that are harder to skip due to reduced leeway in officers' ability to practice discretion.

C. Welfare Differences Across Precincts.

The results in the preceding subsections demonstrate that efforts are reduced later in the month as indicated by a demonstrated greater aversion to difficult or less pressing tasks as a month advances. These results, however, do not rule out the possibility that police officers are simply working more in earlier days, reflecting higher returns on their efforts due to a larger supply of criminals engendered by the disbursement of benefits. This rational behavior would not require the existence of front-loading efforts as conscious precautionary measures.

To test whether this economic decision on the part of police officers drives all of the empirical results, precincts are divided into two groups of high and low welfare participation by their residents. To identify which precincts are characterized by lower or higher welfare participation, a variable is constructed which calculates the fraction of households receiving welfare within each precinct.

The data on welfare participation comes from the 2000 U.S. Decennial Census and American Community Survey (ACS) 5-year estimates for the years 2005–2009 (the earliest available 5-year estimates) and 2010–2014. Some of the information collected in the 2000 U.S. Census is incomparable to the information gathered in the ACS because of "differences in the universe, question wording, residence rules, reference periods, and the way in which the data are tabulated" (U.S. Census Bureau). A direct comparison of variables on welfare participation is possible only for public

assistance[52] and SSI.[53] The values from the ACS 5-year estimates were attributed to their middle years (2007 and 2012) for the regression analysis. The values on welfare participation for the years 2003–2006, 2008–2011, and 2013–2016 were calculated using linear interpolation between the values for the years 2000, 2007 and 2012.

For robustness, analyses were also performed using an alternative method. Values for welfare participation from the 5-year estimates were assigned to each of the years in the 5-year intervals, rather than just the middle year. That is, the value of welfare participation assigned to a particular precinct was constant over the years 2005–2009 and 2010–2014, as based on the 5-year estimates. In this alternative case, linear interpolation was utilized only for the years 2003, 2004, 2015, and 2016. The results (not shown here) were virtually identical.

The above data was obtained on census tract levels. Due to their larger geographical areas, precinct-level jurisdictions encompass many census tracts. In addition, some of the census tract boundaries encompass multiple precincts. Given this non-bijective association between the boundaries of tracts and precincts, ArcGIS was utilized for geographical matching. The data on geographical coordinates of NYPD precincts' and tracts' boundaries come from the NYC Department of City Planning and the US Census Bureau, respectively.

Precinct-level variables on welfare participation were created by identifying the fraction of a tract's area belonging to a particular precinct, then using this fraction as a weight for variables collected at the tract level, iterating the process for each of the remaining tracts that have common area with a precinct, and aggregating their values. Lastly, the estimated number of households receiving welfare is divided by the estimated total number of households in a precinct, producing a variable that measures the fraction of households receiving welfare for each precinct.[54]

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[52] "Public assistance income includes general assistance and Temporary Assistance for Needy Families (TANF) … [this] does not include Supplemental Security Income (SSI)" (U.S. Census Bureau, 2000 Census). Although "ACS/Census Table Comparison" states that the public assistance variable is identical in its comparison across years and surveys, denoted P064 to B19057 in the respective resources, the Census Bureau definitions of public assistance appear to differ in later versions. "Public assistance refers to assistance programs that provide either cash assistance or in-kind benefits to individuals and families from any governmental entity. There are two major types of public assistance programs; social welfare programs and social insurance programs … [some] of the major federal, state, and local social welfare programs are: Supplemental Security Income (SSI), Supplemental Nutritional Assistance Program (SNAP), … , General Assistance (GA)…" https://www.census.gov/topics/income-poverty/public-assistance/about.html. Further reading suggests that even social security is included. Overall, the comparability of variables measuring "public assistance" across these surveys is inconsistent.

[53] Public assistance corresponds to the variables P064 and B19057 in the 2000 Census and ACS, respectively. SSI income corresponds to the variables P063 and B19056 in the 2000 Census and ACS, respectively.

[54] The variable transformation was done through the following formula:

$$Welfare\ Participation_{j,y} = \frac{\sum_i \left(W_{i,y} \frac{Area(i \cap j)}{Area(i)} \right)}{\sum_i \left(HH_{i,y} \frac{Area(i \cap j)}{Area(i)} \right)}$$

Where $Welfare\ Participation_{j,y}$ is the fraction of total households, HH, receiving assistance from the government, W, in precinct j throughout year y. $Area(i \cap j)$ is the shared area between precinct j and census tract i.

TABLE 8. SUMMARY STATISTICS FOR PRECINCT–LEVEL WELFARE PARTICIPATION

Variables	Mean	SD	Min	Max
Supplemental Security Income (SSI)	0.0775	0.0466	0.00609	0.229
High welfare precinct	0.387	0.487	0	1
Public Assistance	0.0523	0.039	0.00294	0.209
High welfare precinct	0.389	0.487	0	1

Notes: Public assistance includes welfare from TANF, SNA, and "general assistance." High-welfare precincts have a mean participation rates of 12.6% and 8.9% for SSI and public assistance, respectively. Low-welfare precincts have a mean participation rates of 4.7% and 2.8% for SSI and public assistance, respectively.

Using the above precinct-level information, the binary variable $HighWelfare_{yp}$ was constructed indicating whether a precinct p was considered to have a high or low welfare participation in year y. The division was based on the average fraction of all households in New York City receiving welfare assistance in a particular year. Therefore, $HighWelfare_{yp}$ is equal to one for precincts where the fraction of households receiving welfare exceeds the sample mean in a particular year. Delineating precincts in such a way allows for the consideration of temporal changes in welfare participation rates from year to year.

The above classification was also performed separately based on information on public assistance, which includes TANF and SNA along with "general assistance," and SSI. It is not clear from the information provided whether a household received only public assistance, only SSI, or both. In addition, there appears to be ambiguity in the comparability of the public assistance variables used in the 2000 Census and the ACS, as discussed in footnote 52. To avoid double counting and allowing for reliable comparison across precincts, output of the empirical analysis will present results using both types of welfare assistance.[55]

Table 8 presents summary statistics for welfare variables. Average welfare participation across all years and precincts ranges from 5.2% to 7.8%. Within a specific precinct, SSI participation goes as high as 22.9% in the year 2016. About 38% of all precincts are considered high welfare reflecting skewness in the distribution of welfare intensity.

The following regression specification is used to analyze whether the cycles differ between precincts with lower and higher welfare participations:

[55] The two measures appear to capture the welfare characteristics of precincts somewhat similarly. The correlation between the two welfare classifications is 0.71.

$$(4) \qquad Y_{dmyp} = \beta_L LastTwoWeeks_{dmyp} + \beta_D (LastTwoWeeks \times HighWelfare)_{dmyp} + \boldsymbol{X}'_{dmyp}\gamma + \varepsilon_{dmyp}$$

This specification is identical to equation (1), with the only difference arising from the interaction variable $LastTwoWeeks \times HighWelfare$. Each of the six dependent variables from equation (1) are considered.

The standalone indicator variable for high-welfare precincts is not included in equation (4) due to it being perfectly collinear with the month-year-precinct fixed effects. Given this specification, the coefficient on $LastTwoWeeks$, β_L, captures the difference in activities between the second and first halves of a month for low-welfare precincts, while the coefficient on the interaction variable, β_D, captures the difference in the effect of $LastTwoWeeks$ arising from precincts belonging to the high-welfare category. Both of these coefficients are of interest to this section's analysis as the former reveals if the cycle still persists in the regions with low welfare participation rates and the latter identifying if the cycle is dependent on the welfare participation intensity.

If the cycles are observed exclusively in precincts with higher welfare participation rates, then welfare-induced-crime and consequent efforts responding to such crime might be the driving forces behind the results. Alternatively, it could be that these high-welfare precincts have disproportionally higher precinct-specific quotas or performance standards (or low-welfare precincts do not have quotas in the first place), corresponding to higher crime statistics in these precincts, which could produce similar results. Although it is not easy to disentangle these two explanations from each other, it is not necessarily needed as long as the intra-month cycles of police activities are also present in the lower welfare precincts. This would suggest a presence of other behavioral mechanisms, such as precautionary measures, behind front-loading of efforts.

Table 9 presents results from estimation of equation (4) using SSI and public assistance information. Given the similarities across these two variables on welfare participation, the discussion focuses mainly on the results based on SSI. The difference in the number of observations across the columns largely follows the explanation of the difference in the number of observations found in the main results, as described in Section V. Additional differences in this exercise arise from the omission of the 22nd precinct section due to its jurisdiction exclusively covering Central Park, a non-residential area where the relevance of welfare participation is not applicable.

The first row shows that precincts with lower rates of welfare participation evince differences in police activity rates between the first and second halves of the month. This is true across each of the various dependent variables under consideration, and demonstrates that even when high-welfare

TABLE 9. OLS ESTIMATES USING WELFARE PARTICIPATION BY PRECINCT

Explanatory variables	Arrests	Summonses	Non-criminal Stops	Financially Motivated Arrests	Violent Arrests	Controlled Substance Arrests
Using Supplemental Security Income (SSI)						
Last two weeks	-0.00347***	-0.00225***	-0.00085***	-0.00183***	-0.00188**	-0.00439***
	(0.000469)	(0.000402)	(0.000234)	(0.000634)	(0.000809)	(0.000769)
(Last two weeks)×(high-welfare)	-0.000066	-0.000232	-0.00065**	0.000458	0.00135	-0.000974
	(0.000644)	(0.00067)	(0.000316)	(0.000954)	(0.00111)	(0.00104)
Constant	0.0286***	0.0324***	0.027***	0.0293***	0.0104	0.0172*
	(0.00527)	(0.0058)	(0.00316)	(0.0106)	(0.0101)	(0.00922)
Observations	336,280	298,144	352,324	276,304	212,436	260,764
Using public assistance						
Last two weeks	-0.00319***	-0.00223***	-0.000849***	-0.00172***	-0.00163**	-0.0038***
	(0.000492)	(0.000431)	(0.000239)	(0.000611)	(0.000771)	(0.000717)
(Last two weeks)×(high-welfare)	-0.000771	-0.00028	-0.00065*	0.000188	0.000699	-0.00237**
	(0.000597)	(0.000629)	(0.000351)	(0.00102)	(0.00112)	(0.00102)
Constant	0.0286***	0.0324***	0.027***	0.0293***	0.0104	0.0172*
	(0.00527)	(0.0058)	(0.00316)	(0.0106)	(0.0102)	(0.00923)
Observations	336,280	298,144	352,324	276,304	212,436	260,764

Notes: Other controls include temperature, lunar luminosity, rainfall, snowfall, daylight, dummies for days of the week, holiday dummies, and month-year-precinct fixed effects. Standard errors are clustered at the precinct level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

precincts are excluded, the principle result of decreasing police apprehensions persist. The "first-of-the-month" confounder, therefore, is not likely to be the driving force behind the results presented in Section V. This conclusion is further corroborated by the second row of coefficients in Table 9. These coefficients test for whether the differences in apprehension cycles are amplified by the intensity of welfare participation. For the specification using SSI information, only one coefficient is statistically significant across any of the six columns. From the specifications using public assistance information, another one emerges. This suggests that the welfare intensity is not entirely responsible for these cycles.

Examining the first two columns, it is apparent that arrests and summonses in lower welfare precincts follow a cycle that is almost identical to the ones found using all precincts (presented in Table 3). The difference in magnitudes is miniscule, corresponding to differences of 0.1% and 3.9% for arrests and summonses, respectively. Large standard errors on the interaction terms prevent any conclusion on the possibility of larger cycles in high-welfare precincts.

The third column, which uses non-criminal stops as the dependent variable, depicts a somewhat different story. Lower welfare precincts have an attenuated cycle because higher welfare precincts experience an additional decrease of 0.00065 percentage points in non-criminal stops during the last two weeks of the month. This drop is 76.5% larger compared to the one experienced by the lower welfare precincts. Although the percentage difference appears large, it is worth keeping in mind that these unproductive stops exhibited the weakest cycle, with a difference of 3.5% between the two halves of a month. Notwithstanding this smaller variation, it appears that unproductive efforts undergo a larger decline in the later days of the month within high-welfare precincts. This could potentially be explained by additional aversion towards policing these areas by officers, due to their disorder, once the numbers are met.

The fourth and fifth columns differentiate arrest rates across financially driven and violent-in-nature crimes, respectively. The coefficients are larger (12.7% and 44.4%, respectively) for lower welfare precincts than the ones presented in Table 3. However, the absence of statistical significance on the interaction term precludes any definite conclusion. The absence of a discernable effect across low and high-welfare precincts for financially-motivated crimes is of particular importance given the previously mentioned literature linking the incidence of such crimes to the timing of welfare payments. The absence of any such association here further discredits the "first-of-the-month" explanation.

The sixth and final column considers arrests for controlled substance crimes. For the low-welfare precincts, a cycle pattern in police efforts persists, albeit with a 8.7% lower magnitude compared with Table 4. The results in this column suggest a major divergence between the results derived using SSI versus public assistance. Using public assistance information, precincts with higher welfare participation rates experience an additional 62.3% drop-off in drug-related arrests during the last two weeks of the month. This is plausible considering the financial constraints face by welfare recipients by the end of the month. As police officers scale down their efforts, and fewer people abuse drugs, fewer drug-related arrests will be manifested. This last column shows that, as expected, welfare-induced crime still plays a role in explaining some of the empirical results.

The analysis of this subsection suggests that welfare difference across precincts do not explain away the main empirical results. Cycles in arrests, summonses, and non-criminal stops appear to be driven in part by cycles in police efforts. Furthermore, allocations of efforts are not solely contingent on the temporality of their returns. If they were, larger cycles would have been observed in precincts with higher fractions of households receiving assistance from the government.

VII. Conclusion

Analysis of the SQF data establishes the existence of criminal apprehension cycles in New York City and allows for the magnitude of these cycles to be quantified. This exercise reveals an intertemporal disparity in the way that members of the police force and the community interact. More arrests, summonses, and non-criminal stops are conducted in the earlier days of a typical month. When arrests are disaggregated along several dimensions, a similar trajectory is revealed for financially motivated, violent-in-nature, and controlled-substance-related crimes.

The findings highlight the role of behavioral mechanisms in how police officers determine their optimal allocations of effort in the presence of formal performance standards or a system of quotas. While these two evaluative regimes are subtly different in what they require of officers, "[i]n terms of the effect on police operations, the two ideas are virtually indistinguishable" (Sparrow 2016, 68).

Faced with a requirement to produce a certain number of summonses and arrests by the end of a month, police officers preproperate efforts in order to minimize the risk of not meeting expectations. This conclusion is supported by the evidence of discretionary effort adjustments on the part of police officers. This evidence includes greater aversion to difficult and discretionary tasks during the last two weeks. Furthermore, the main empirical results are not explained by the differences in the concentration of welfare recipients across police precincts.

This paper does not attempt to entirely rule out intra-month variation in crime as the mechanism that generates this cycle. In general, however, it demonstrates the existence of an intra-month criminal apprehension cycle that is driven, at least in part, by the temporal disparity in efforts undertaken by NYPD officers.

A concern over external validity is warranted. The findings of this paper are concentrated within New York City, reflecting the behavior of NYPD police officers. The attributes of this police organization and the characteristics of its workers may depart from the standards of other occupations, including those of other police departments. Notwithstanding this concern, the novel finding of the front-loading of efforts might manifest itself in other organizational settings whose participants face a similar incentive structure of uncertainty, deadlines, and corresponding returns on performance.

This work adds to the literature on the dynamic allocation of labor efforts by presenting evidence of preproperation. It also suggests a potential pitfall faced by future researchers studying

intra-month relationships who fail to account for their phenomena of interest potentially being influenced by the intertemporality of effort allocation. This pattern is of particular relevance for researchers investigating police or criminal behavior.

Furthermore, this research reveals potentially concerning welfare implications that stem from the existence of public policies that mandate or expect a minimum level of productivity from law enforcement. Such policies induce behavioral responses not consistent with an equal distribution of police activities over time. Such a status quo might engender suboptimal police protection during the later days of the month and/or excessive policing in the earlier days. The former could be capitalized on by savvy criminals who strategically allocate their criminal activities towards the days with a predictably lower police presence, whereas the latter might delegitimize law enforcement institutions in the eyes of the public. A full consideration of such effects is essential for designing and implementing policies concerning performance standards that encourage effective policing procedures.

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