RESEARCH REPORT

The Effect of Gun Violence on Local Economies

Gun Violence, Business, and Employment Trends in Minneapolis, Oakland, and Washington, DC

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Contents

Acknowledgments

Executive Summary

We already know that gun violence exacts enormous costs. The fear of gun violence, and people's perceived risk, has been shown to impose heavy social, psychological, and monetary burdens on individuals that translate into monetary costs to society. We also know the health care costs of treating gunshot injuries: just under $630 million in 2010 (Howell and Abraham 2013). American society collectively pays all these costs. Yet we know comparatively little about the relationship between gun violence and the economic health of neighborhoods at the most grassroots levels; we don't know how businesses, jobs, and many more indicators of economic health respond to increased levels of gun violence. Could gun violence cause economic downturns? In communities and neighborhoods most affected by gun violence, does the presence of gun violence hold back business growth?

To answer these important research questions at the neighborhood level, we assembled gun violence and establishment data at the census tract level in six US cities. This report presents the initial findings of an in-depth analysis of the relationship between gun violence and local economic health in Minneapolis, Minnesota; Oakland, California; and Washington, DC. Our findings indicate a significant relationship between gun violence and the ability of businesses to open, operate, and grow in the affected communities. The data and research findings from this study can lend a new, economically driven lens to the debate on gun safety and gun control.

Highlights

To understand the relationship between gun violence and the subsequent economic health of communities, we looked at how communities within three cities varied by gun violence and economic indicators. After controlling for the census tract and year effects, we found the following:

- In Minneapolis, one less gun homicide in a census tract in a given year was statistically significantly associated with the creation of 80 jobs and an additional $9.4 million in sales across all business establishments the next year.

- In Oakland, every additional gun homicide in a census tract in a given year was statistically significantly associated with five fewer job opportunities in contracting businesses (businesses losing employees) the next year.

- In Washington, DC, every additional gun homicide in a census tract in a given year was statistically significantly associated with two fewer retail and service establishments the next year.

- Examining the relationship between gunshots in a given year and employment and sales in establishments that same year, we also were able to show that for Washington, DC, census tracts covered by ShotSpotter sensors, 10 fewer gunfire incidents in a census tract were significantly related to the creation of 20 jobs in new establishments, one new business opening, one fewer establishment going out of business, and $1.3 million more in sales at new establishments.

- According to a subset analysis of census tracts across all three cities that experienced a surge in homicides in 2011, controlling for existing levels of violence, we found that these surges were significantly associated with an increase in contracting businesses.

The Effect of Gun Violence on Local Economies

This research report—the first report from the Urban Institute's ongoing project on the effect of gun violence on local economies—provides findings from three cities: Minneapolis, Minnesota; Oakland, California; and Washington, DC.

We develop this report over four sections. First, we discuss what we know about the community-level economic impact of gun violence. Next, we describe the methodology used in this project. We then provide an overview of the annual broad trends in the level of gun violence, employment, and establishments in the three study cities. Last, we present the findings from the panel data analysis and conclude with a discussion of findings and suggestions for future work.

Background

Greenbaum and Tita (2004) and others (e.g., Stacy et al. 2016) argue that understanding businesses' responses to violent crime is essential to understanding how crime limits the economic and non-economic activities of community members (e.g., residents, business owners, and employees). In turn, understanding community members' responses to crime affects crime cycles.

Violence has an adverse impact on the economic health of communities, cutting into business revenues and limiting business activities (Bowes 2007; Fisher 1991). The fear of gun violence, and people's perceived risk, has already been shown to impose a wide array of social (Dugan 1999) and psychological burdens (Cohen 1988; Miller, Cohen, and Rossman 1993). Property values decrease as violent crime increases (Hipp et al. 2009; Kirk and Laub 2010; Shapiro and Hassett 2012).

Further, research has calculated the hospital and lifetime health care costs of treating gunshot injuries (Cook et al. 1999; Howell and Abraham 2013; Howell, Bieler, and Anderson 2014; Miller, Cohen, and Rossman 1993), costs associated with lost productivity (Cook and Ludwig 2000), and how much people are willing to pay to reduce the risk of gunshot injury (Cook and Ludwig 2000). In 2010, the total firearm assault injury costs were just under $630 million (Howell and Abraham 2013). Gun violence leads to higher associated costs across the criminal justice system because of prevention,

investigation, court, and prison costs.[1] All these factors translate into monetary costs that the public and society at large pay for.

Despite this evidence that violence, and especially gun violence, has strong negative impacts on the economic well-being of communities, we know comparatively little about the relationship between gun violence and the economic health of neighborhoods at the most grassroots levels. The impact of gun violence can extend beyond the victims and their families and can significantly affect the businesses and residents in neighborhoods of gun violence in the form of downsizing, decreased revenues, and, in its most severe form, the closing of businesses.

Very few studies have studied the impact of violent crime on local businesses with longitudinal data (Greenbaum and Tita 2004; Stacy et al. 2016). But what we do know from longitudinal data is that increases in deadly violence in zip codes caused businesses in the same zip codes to downsize and prevented new businesses from forming (Greenbaum and Tita 2004) and that growth in economic activity in a given year coincides with the decline in violent crime (Stacy et al. 2016).

Our current ongoing research builds on previous studies by Greenbaum and Tita (2004) and Stacy and colleagues (2016). Our study leverages the precision of National Establishment Time-Series (NETS), homicide, and gunfire detection technology (GDT) data to explore how changes and substantial surges in gun violence affect the number of businesses, as well as employment and sales in businesses, in census tracts.

Methods

This project uses a unique combination of very recently available data and micro-level data to capture the effect of gun violence on local economies.

We use three annual measures for operationalizing economic activity at the census tract level: number of establishments and employment; business sales in a given year; and annual growth rates of net employment and the components of net employment, including the establishment, downsizing, and closure of businesses (see table 1 for economic activity measures).

We use gun homicides at the census tract level for Minneapolis, Oakland, and Washington, DC, along with additional gunshot data for DC, to measure gun violence.

TABLE 1

Economic Activity Measures

Employment outcomes
Employment in all establishment categories (hereinafter referred to as "all establishments")
Employment in retail and service industry establishments (hereinafter referred to as "retail and service establishments")
Employment in all new (birth) establishments
Employment in new (birth) retail and service establishments
Employment in all contracting establishments
Employment in contracting retail and service establishments

Establishment count outcomes
Number of all establishments
Number of retail and service establishments
Number of all new establishments
Number of new retail and service establishments
Number of all out-of-business (death) establishments
Number of out-of-business (death) retail and service establishments
Number of all contracting establishments
Number of contracting retail and service establishments

Sales outcomes
Sales in retail and service establishments
Sales in new retail and service establishments
Sales in contracting retail and service establishments

Gun Homicide Data

Homicide data were acquired from City of Minneapolis Police Department, Oakland Police Department, and the Metropolitan Police Department of Washington, DC. Homicide data presented in this report are all gun homicides between calendar years 2009 and 2012.

Gunshot Data

We acquired ShotSpotter gunshot data for Washington, DC, for the same period. Data from the ShotSpotter GDT system offers a new source of information on firearm-related crimes. GDT uses a network of acoustic sensors to identify the sound of a gunshot and relay this information to emergency services personnel (Eng 2004; Showen 1997; Siuru 2007). Beginning in the 1990s, increasing numbers of law enforcement agencies adopted GDT to improve their response to gun violence; by 2014, 50 cities and 267 square miles were covered by just one GDT vendor system.[2]

The technology uses sensors to identify the gunfire sound and triangulate its position (figure 1). Gunshots have a distinctive acoustic signature composed of the sound of the explosion, the muzzle blast, the sound of the firearm's projectiles, and, to lesser degrees, the mechanical sounds of the firearm and vibrations from any solid surfaces near the discharge of the weapon (Maher 2007). A byproduct of

FIGURE 1

How Gunfire Detection Technology Works

1 Gunfire produces sound waves that expand in every direction.

Gunfire
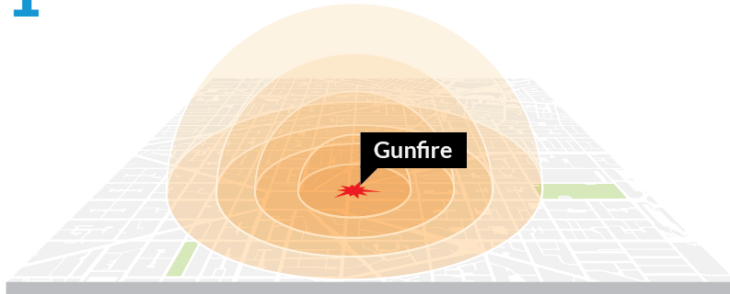
2 Acoustic sensors throughout the city listen for the distinctive waveforms that firearms produce. When detected, individual sensors calculate the distance to the sound.

Acoustic
Sensor

Distance to sound: shot location could be anywhere on the circumference of this circle.
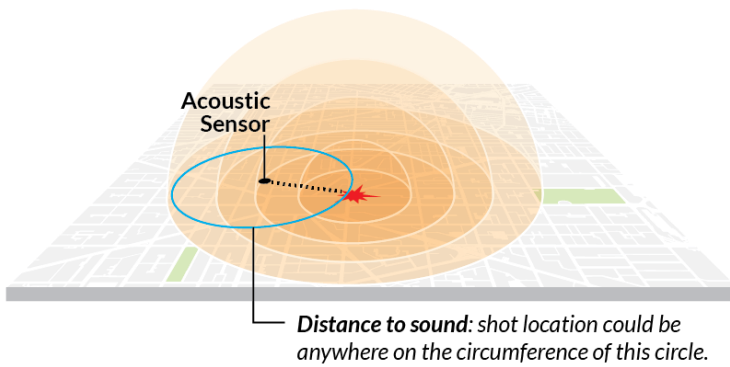
3 Readings from multiple sensors are used to triangulate the location of the shot.
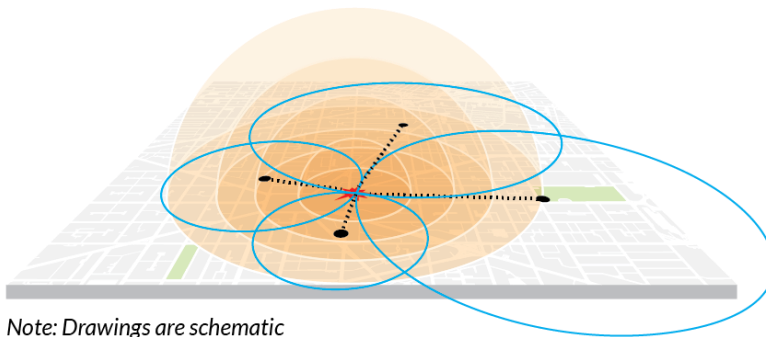
Note: Drawings are schematic

Source: Urban Institute.

the detection process is considerably precise, standardized data recording the location and time of gunfire. The most recent versions of this technology also have been found to accurately record gunfire under most conditions.[3] Washington, DC's gunfire system, ShotSpotter, was installed in 2005 and currently covers a quarter (17 square miles) of the city's total land area. Shots occurring on January 1,

July 4, and December 31 were excluded because GDT systems tend to be overly sensitive on those days because of the large number of firework detonations (Carr and Doleac 2016).

National Establishment Time-Series (NETS) Database

The 2013 NETS database, developed through a partnership with Dun and Bradstreet, includes more than 52 million establishments with time-series information about their industries, location (by street address), headquarters, performance (including sales), employment, and many other indicators between 1990 and 2012. The establishments in this database cover all businesses including sole-proprietors and the self-employed. This database does not differentiate between full- and part-time employees.

In addition, this database counts owners as employees. Therefore, while a sole proprietor with three employees should be captured by the Bureau of Labor Statistics data as a three-employee firm, it will be captured as a four-employee establishment in the NETS database. We used several indicators of business health in the analytic models documented here (see table 1). The indicators used in each model are detailed in the corresponding model specification section.

American Community Survey Data

We conducted a subset analysis on the effect of a surge in gun violence on economic activity in neighborhoods with an increase in gun violence levels from a baseline year. The aim of this analysis is to understand the differential effect of a surge in gun violence in census tracts with already high levels of gun violence versus census tracts with comparatively low increases in gun violence.

We used five indicators from the 2006–10 ACS five-year estimates (percentage of female-headed households, unemployment rate, percentage of the population that is black, median household income, and median household value) to create matched control groups and test whether a substantial increase in homicides in a census tract affected employment and establishment growth rates in the subsequent year.

Though the gun homicide, gunshot, and NETS data are available at the address level, the smallest territorial unit for which ACS data are available is the census tract. Because of the rarity of gun homicides (relative to other forms of violent crimes) and the census tract–level resolution of ACS data, all other data were joined to the city census tracts (rather than block groups).

Regression Models

We used fixed-effects regression estimates and difference-in-differences estimates to examine the association between gun violence and economic activity at the census tract level (appendix A describes these methods and model specifications).

We defined economic activity by the number of establishments; employment and components of employment, including new, closed, and contracting establishments; and sales in all establishments and a subset of retail and service industries (see table 1). A new business is one at a particular location that had no employment in the previous year and had positive employment in the current year. A closed establishment had positive employment in the previous year and no employment in the current year. A contracting establishment had a higher number of employees in the previous year than the current year.

Building on the work of Greenbaum and Tita (2004), we used propensity score matching (see appendix A) to examine the impact of gun violence on net employment and components of net employment at the census tract level. The aim of this subset analysis is to explore how surges in gun violence affect the following economic outcomes in the subsequent year:

- employment growth in establishments

- employment growth in new establishments

- employment growth in contracting establishments

- growth in the number of establishments

- growth in the number of new establishments

- growth in the number of closed establishments

- growth in the number of contracting establishments

A census tract is considered to have surged if, following a baseline year (2010), it had at least one more homicide in the subsequent (observation) year and its level of gun homicide (number of homicides) is above the median count of homicides in all census tracts with an increase. The census tracts that experienced a surge in homicides in each city in 2011 were matched with non-surge census tracts *that also experienced an increase in homicides but had homicide levels below the median value in 2011*. Table 2 shows the surge status by city for all census tracts that had an increase in homicides in 2011.

TABLE 2

Census Tract Surge by City

Surge	Yes	No
Minneapolis	5	15
Oakland	15	33
Washington, DC	14	18

City Profiles

Minneapolis, Minnesota

The 48th largest city in the United States, Minneapolis's population was 382,578 in 2010.[4] The same year, the city's median household income was $46,075, compared with the US average of $49,445. The Minneapolis workforce is highly educated and skilled. Forty-seven percent of its residents held bachelor's degrees in 2010. Of the 206,892 residents employed in the workforce the same year, 44.3 percent held jobs in management, business, science, and the arts; 23.3 percent worked in sales and office occupations; and 18.3 percent worked in service occupations.[5]

The industries employing the largest percentage of the Minneapolis workforce were education, health care, and social assistance, which accounted for 25.7 percent of the workforce; professional, scientific, and management, and administrative and waste management services (14.4 percent each); arts, entertainment, and recreation and accommodation and food services (11.9 percent each); retail (11.5 percent); manufacturing (8.4 percent); and finance, insurance, and real estate (8.1 percent).[6] In 2010, the city's unemployment rate was 6.6 percent, while 16.4 percent of the city's population had income below the poverty level.

The same year, the homicide rate in Minneapolis was 9.6 per 100,000 people, and the violent crime rate was 1,053.6 per 100,000 people. In 2012, Minneapolis's gun homicide rate increased to 10.7 per 100,000 people—exactly the national rate.[7] Looking closer, while 2009 marked the least gun-related homicides (12), this number tripled in 2010 and remained at the same level until 2012 (table 3).

TABLE 3

Census Tract Gun Homicide Statistics for Minneapolis, MN

	Observations	Mean	Standard deviation	Minimum	Maximum	Total
2009	134	0.1	0.3	0	2	12
2010	134	0.3	0.7	0	4	39
2011	134	0.3	0.6	0	4	37
2012	134	0.3	0.7	0	6	42

Source: City of Minneapolis Police Department Crime Incident data.

Between 2009 and 2012, employment in all city establishments increased from 326,800 to 352,766; in retail and service establishments, employment increased from 200,513 to 224,594 (table 4). However, the number of new establishments decreased (table 4). Average sales by census tract increased (table 5).

TABLE 4

Census Tract Establishment and Employment Statistics for Minneapolis, MN

	Observations	Mean	Standard deviation	Total
2009				
All establishments	134	214	323	28,697
Employment	134	2,438	7,454	326,800
New establishments	134	28	31	3,801
Closed establishments	134	60	85	8,151
Retail and service	134	153	222	20,507
Employment	134	1,496	4,023	200,513
New establishments	134	20	20	2,646
Closed establishments	134	43	56	5,882
2010				
All establishments	134	250	367	33,627
Employment	134	2,547	8,532	341,338
New establishments	134	50	67	6,734
Closed establishments	134	13	25	1,766
Retail and service	134	179	256	24,041
Employment	134	1,534	4,139	208,570
New establishments	134	35	49	4,785
Closed establishments	134	9	17	1,209
2011				
All establishments	134	250	363	33,544
Employment	134	2,593	8,768	347,595
New establishments	134	27	42	3,643
Closed establishments	134	27	42	3,666
Retail and service	134	178	254	23,892
Employment	134	1,556	4,241	208,596
New establishments	134	17	27	2,330
Closed establishments	134	19	27	2,479
2012				
All establishments	134	235	343	31,490
Employment	134	2,632	7,935	352,766
New establishments	134	10	16	1,356
Closed establishments	134	25	34	3,392
Retail and service	134	166	241	22,276
Employment	134	1,676	4,511	224,594
New establishments	134	6	10	782
Closed establishments	134	18	24	2,386

Source: National Establishment Time-Series database.

TABLE 5

Census Tract Establishment Sales Statistics for Minneapolis, MN

In 2009 dollars

	Mean	Standard deviation
2009		
All retail and service establishments	135,596,636	362,841,751
New retail and service establishments	6,485,154	22,460,687
Contracting retail and service establishments	8,726,646	35,720,373
2010		
All retail and service establishments	137,449,160	355,656,769
New retail and service establishments	4,826,065	10,064,000
Contracting retail and service establishments	1,234,342	7,968,967
2011		
All retail and service establishments	292,259,796	1,110,840,429
New retail and service establishments	6,456,195	24,600,000
Contracting retail and service establishments	4,207,987	14,809,862
2012		
All retail and service establishments	272,924,808	980,823,791
New retail and service establishments	3,029,733	10,378,623
Contracting retail and service establishments	4,664,542	20,283,735

Source: National Establishment Time-Series database.

Note: Sales for each year were converted to 2009 dollars using Consumer Price Index conversion factors.

Oakland, California

Oakland was the 47th largest city in 2010 with a population of 390,724.[8] The city's median household income was $49,721, roughly the same as the US average of $49,445. In 2010, 38.6 percent of Oakland residents held bachelor's degrees.

Of the 310,016 people in the workforce, 41.3 percent held jobs in management, business, science, and the arts; 20.8 percent worked in sales and office occupations; 19.3 percent worked in service occupations; and 10.1 percent worked in production, transportation, and material moving.[9]

The city's unemployment rate was 6.7 percent, while 15.7 percent of the city's families had incomes below the poverty level.[10] The violent crime rate in Oakland in 2010 was 1,529 per 100,000 people, with a homicide rate of 21 per 100,000 people. In 2012, Oakland's gun homicide rate increased to 28.9 per 100,000 people—2.5 times the national average.

Looking closer, while 2010 had the fewest gun-related homicides (78) between 2009 and 2012, this number increased to 116 in 2012 (table 6).

TABLE 6

Census Tract Gun Homicide Statistics for Oakland, CA

	Observations	Mean	Standard deviation	Minimum	Maximum	Total
2009	113	0.83	1.26	0	8	94
2010	113	0.69	1.14	0	8	78
2011	113	0.88	1.23	0	7	100
2012	113	1.02	1.32	0	7	116

Source: City of Oakland Police Department Crime Incident data.

Between 2011 and 2012, the number of new establishments in Oakland decreased (table 7). In the same period, employment in all city establishments decreased from 210,132 to 205,008; employment in retail and service establishments decreased from 130,095 to 120,102. Average sales in census tracts increased from 2009 to 2012 (table 8).

TABLE 7

Census Tract Establishment and Employment Statistics for Oakland, CA

	Observations	Mean	Standard deviation	Total
2009				
All establishments	113	239	219	27,074
Employment	113	1,745	2,813	197,281
New establishments	113	22	18	2,575
Closed establishments	113	69	67	7,907
Retail and service	113	174	159	19,762
Employment	113	1,061	1,488	119,993
New establishments	113	22	18	2,575
Closed establishments	113	50	46	5,724
2010				
All establishments	113	288	247	32,567
Employment	113	1,806	2,726	204,140
New establishments	113	66	49	7,564
Closed establishments	113	17	20	1,997
Retail and service	113	226	193	25,566
Employment	113	1,155	1,544	130,440
New establishments	113	46	34	5,232
Closed establishments	113	12	14	1,397
2011				
All establishments	113	284	250	32,124
Employment	113	1,859	8,768	210,132
New establishments	113	28	29	3,273
Closed establishments	113	32	25	3,620
Retail and service	113	214	188	24,214
Employment	113	1,151	1,523	130,095
New establishments	113	19	19	2,196
Closed establishments	113	21	17	2,481

	Observations	Mean	Standard deviation	Total
2012				
All establishments	*113*	*262*	*236*	*29,616*
Employment	113	1,814	2,893	205,008
New establishments	113	12	10	1,356
Closed establishments	113	34	26	3,850
Retail and service	*113*	*187*	*170*	*21,177*
Employment	113	1,062	1,390	120,102
New establishments	113	6	6	752
Closed establishments	113	25	18	2,853

Source: National Establishment Time-Series database.

TABLE 8

Census Tract Establishment Sales Statistics for Oakland, CA

In 2009 dollars

	Mean	Standard deviation
2009		
All retail and service establishments	71,698,342	151,349,219
New retail and service establishments	2,600,692	7,309,972
Contracting retail and service establishments	1,155,057	4,319,208
2010		
All retail and service establishments	77,017,541	1,321,578,585
New retail and service establishments	3,849,431	5,157,433
Contracting retail and service establishments	1,269,176	5,086,610
2011		
All retail and service establishments	87,436,837	303,228,766
New retail and service establishments	21,950,718	191,243,164
Contracting retail and service establishments	762,437	2,446,322
2012		
All retail and service establishments	135,897,835	1,180,762,100
New retail and service establishments	20,304,911	2,767,566
Contracting retail and service establishments	795,563	3,718,190

Source: National Establishment Time-Series database.
Note: Sales for each year were converted to 2009 dollars using Consumer Price Index conversion factors.

Washington, DC

Washington, DC, was the 24th most populous city in 2010, with a population of 601,723.[11] The city's median family income was $70,883[12] and median home sales price was $563,000.[13] In DC, 57.7 percent of the workforce was employed in management, business, science, and the arts. The other largest occupations were sales and office (18.6 percent) and services (15.8 percent). The two largest industries

were finance, insurance, and real estate (22.4 percent); and educational services and health care and social assistance (19.7 percent each).

The violent crime rate in 2010 was 1,214 violent crimes per 100,000 people, above the average of 819 per 100,000 for US cities with populations between 500,000 and 999,999. Firearms were used in 76 percent of homicides, 19 percent of aggravated assaults, and 40 percent of robberies.[14] The sizeable amount of the city covered by SpotShotter gunshot detection technology—17.3 square miles—makes DC an ideal city to study the relationship between economic indicators and gun violence, measured by both gunshots and gun homicides. While 2009 marked a high point in gun violence with 114 gun homicides and 7,658 gunshots, these numbers fell by one-half by 2012 (table 9).

TABLE 9

Census Tract Gun Violence Statistics for Washington, DC

	Observations	**Mean**	**Standard deviation**	**Minimum**	**Maximum**	**Total**
2009						
Gun homicides	179	0.6	1.1	0	7	114
Gunshots	122	62.8	54.4	0	266	7,658
2010						
Gun homicides	179	0.6	1.0	0	5	97
Gunshots	122	39.0	37.9	0	209	4,760
2011						
Gun homicides	179	0.4	0.8	0	4	77
Gunshots	122	43.8	42.9	0	221	5,338
2012						
Gun homicides	179	0.3	0.7	0	4	57
Gunshots	122	30.8	30.2	0	149	3,760

Sources: Metropolitan Police Department of Washington, DC, Crime Incident and ShotSpotter data.
Note: Gunshot figures exclude gunshots on January 1, July 4, and December 31.

Between 2011 and 2012, employment in all DC establishments increased from 849,495 to 1,001,810; employment in retail and service establishments increased from 484,659 to 497,048 (table 10). However, in the same period the number of new establishments decreased and the number of closed establishments increased (table 10). Average sales in census tracts increased from 2009 to 2012 (table 11).

TABLE 10

Census Tract Establishment and Employment Statistics for Washington, DC

	Observations	Mean	Standard deviation	Total
2009				
All establishments	179	312	711	55,977
Employment	179	4,447	12,522	796,126
New establishments	179	27	46	5,000
Closed establishments	179	62	147	11,180
Retail and service	179	116	358	52,344
Employment	179	1,042	4,142	469,180
New establishments	179	22	36	3,909
Closed establishments	179	48	116	8,669
2010				
All establishments	179	144.9	422	65,241
Employment	179	1,796	7,138	808,438
New establishments	179	29	80	7,658
Closed establishments	179	8	29	3,775
Retail and service	179	120	360	54,005
Employment	179	1,066	4,165	479,795
New establishments	179	23	67	10,467
Closed establishments	179	8	28	3,775
2011				
All establishments	179	365	800	65,305
Employment	179	4,745	12,960	849,495
New establishments	179	37	83	6,549
Closed establishments	179	35	78	6,297
Retail and service	179	284	644	50,868
Employment	179	2,707	7,737	484,659
New establishments	179	26	61	4,686
Closed establishments	179	27	61	4,842
2012				
All establishments	179	347	749	62,062
Employment	179	5,597	16,505	1,001,810
New establishments	179	14	25	2,517
Closed establishments	179	36	77	6,484
Retail and service	179	295	659	52,832
Employment	179	2,776	8,270	497,048
New establishments	179	4	9	1,746
Closed establishments	179	11	32	5,025

Source: National Establishment Time-Series database.

TABLE 11

Census Tract Establishment Sales Statistics for Washington, DC

In 2009 dollars

	Mean	Standard deviation
2009		
All retail and service establishments	255,296,975	944,488,104
New retail and service establishments	6,485,154	22,460,687
Contracting retail and service establishments	8,726,646	35,720,373
2010		
All retail and service establishments	267,117,764	965,426,919
New retail and service establishments	30,004,562	254,899,263
Contracting retail and service establishments	1,234,342	7,968,967
2011		
All retail and service establishments	292,259,796	1,110,840,429
New retail and service establishments	35,464,489	182,904,262
Contracting retail and service establishments	4,207,987	14,809,862
2012		
All retail and service establishments	272,924,808	980,823,791
New retail and service establishments	3,029,733	10,378,623
Contracting retail and service establishments	4,664,542	20,283,735

Source: National Establishment Time-Series database.

Note: Sales for each year were converted into 2009 dollars using Consumer Price Index conversion factors.

Results

Table 12 shows the results of the regressions on the 17 establishment, employment, and sales outcomes listed in table 1 over the number of gun homicides in Minneapolis, Oakland, and Washington, DC. The results reported in the table control for year and census tract fixed effects.

In Minneapolis, one less gun homicide in a census tract was associated with the creation of 80 jobs and an additional $9.4 million in sales across all business establishments the next year. In Oakland every additional gun homicide in a census tract in a given year was significantly associated with five fewer job opportunities in contracting businesses the next year. In Washington, DC, every additional gun homicide in a census tract in a given year was significantly associated with two fewer retail and service establishments the next year.

TABLE 12

Gun Homicide Fixed Effects OLS Regression on Establishment Number, Employment, and Sales

By establishment type

City and industry	New	Closed	Contracting	Total
Minneapolis				
All				
Establishment	-3.4 (2.8)	1.5 (1.2)	-0.1 (0.2)	-2.42 (1.55)
Employment	-79.8 (60.9)	N/A	-4.3 (7.7)	- 80.0 (44.8)*
Sales	N/A	N/A	N/A	-9,481,988 (5e+07)*
Retail and service				
Establishment	-3.0 (2.3)	0.7 (0.7)	-0.01 (0.17)	-1.8 (1.1)
Employment	-79.8 (60.9)	N/A	-0.3 (5.1)	-42.8 (27.0)
Sales	-2,923,690 (2e+6)	N/A	2,709 (6e+5)	518,264 (5e+06)
Oakland				
All				
Establishment	0.6 (0.8)	0.3 (0.4)	0.1 (0.1)	0.5 (0.6)
Employment	16.3 (9.7)	N/A	-5.2 (3.1)*	12.1 (11.5)
Sales	8,473,020 (8e+6)	N/A	-200,789 (3e+5)	4,862,555 (4e+6)
Retail and service				
Establishment	0.3 (0.7)	0.2 (0.3)	0.16 (0.1)	-.8 (4.1)
Employment	-0.14 (2.9)	N/A	-0.9 (1.3)	-2.6 (5.6)
Sales	7,842,374 (7e+6)	N/A	11,469 (1e+5)	3,010,006 (3e+6)
Washington, DC				
All				
Establishment	-5.2 (3.5)	0.4 (0.5)	-0.1 (0.5)	2.9 (1.8)
Employment	4.7 (21.6)	N/A	1.29 (2.44)	-31.5 (129.2)
Sales	-5,670,451 (6e+6)	N/A	-58,533 (1e+6)	-5,670,451 (6e+6)
Retail and service				
Establishment	0.9 (1.3)	-2.7 (1.3)	-0.1 (0.1)	-1.9 (0.8)**
Employment	-6.4 (10.7)	N/A	0.8 (1.2)	34.9 (22.9)
Sales	-4,046,506 (4e+6)	N/A	-6,013 (1e+5)	-1,068,725 (4e+6)

Source: National Establishment Time-Series database.
Notes: Standard errors in parentheses. N/A = not applicable.
* $p ≤ 0.1$; ** $p ≤ 0.05$

We conducted additional regressions on the 17 establishment, employment, and sales outcomes controlling for the year and census tract effects. Examining the relationship between gunshots in a given year and employment and sales in establishments that same year, we show that for census tracts covered by ShotSpotter sensors, 10 fewer incidents of gunfire in a census tract were significantly related with the creation of 20 jobs in new establishments, one new business opening, one fewer business closing, and $1.3 million more in sales at new establishments.

We also conducted a difference-in-differences analysis to compare the pre-surge to post-surge growth rates in all establishments, retail and service establishments, and employment in both industry groups between treatment (*an increase from baseline year and a gun homicide level above the median gun*

homicides among all census tracts with an increase in gun homicides in the same year) and control (*an increase from baseline year and a gun homicide level below the median gun homicides among all census tracts with an increase in gun homicides in the same year*) census tracts. According to this subset analysis (table 13), controlling for existing levels of violence, surges in gun homicides from a baseline year were significantly associated with a 1 percent increase in the growth rate of all contracting establishments and contracting retail and service establishments.

OLS Regression on Number of Establishments and Employment
By establishment type

	New	Closed	Contracting	Total
All				
Establishment	-0.02 (0.02)	-0.01 (0.01)	0.01 (0.01)*	-0.01 (0.04)
Employment	-0.03 (0.04)	N/A	-0.01 (0.01)	-0.01 (0.04)
Retail and service				
Establishment	-0.03 (0.02)	-0.01 (0.1)	0.01 (0.01)*	-0.01 (0.03)
Employment	-0.01 (0.01)	N/A	0.01 (0.01)	0.04 (0.07)

Source: National Establishment Time-Series database.
Notes: Standard errors in parentheses. N/A = not applicable.
* $p \leq 0.1$

Conclusions

Our preliminary findings show that an increase in gun homicides or gunfire in neighborhoods can lower the number of establishments, employment in establishments, and sales in establishments. The city-specific results show that these effects can differ; however, in all cities an increase in gun violence has a negative effect on different components of establishments and employment. Results suggest that these negative effects can be felt more by new or contracting establishments. The results from our surge analysis indicate differences in the economic health of neighborhoods that experience a relatively high increase in gun homicides versus the ones that do not.

Our results support the findings from the recent but scant literature on the negative relationship between violent crime and neighborhood economic activity. With the availability of new datasets on neighborhood indicators of economic health and new measures of crimes and victimization (GDT technologies as well as crowdsourced victimization data), future research should continue examining how violent crime, and specifically firearm-related crimes and the fear of such, affect the choices and behavior of people who live in and visit high- and low-crime neighborhoods.

The preliminary findings from this study suggest that retail and service industries might be disproportionately affected by gun violence levels. Future quantitative and qualitative studies should pay particular attention to subcategories within retail and service industries and to different sizes of businesses. Such studies should explore if certain establishments that rely heavily on foot traffic and customer interaction suffer particularly from gun violence, in terms of additional costs required for security and difficulties attracting customers and employees.

Appendix A. Fixed Effects and Difference-in-Differences Estimates

Estimating the Fixed Effects

In researchers' quest to determine the causal effect of changing a variable x_1 (such as gun violence) on an outcome y (such as economic activity) the ideal source of variation is an exogenous variation in an experimental setting, where all variation would be independent of any other variables affecting the outcome.

Where such experimental settings are not possible, researchers overcome endogeneity issues using different methodologies, such as measurement error, simultaneity, and omitted variables. One of these methods is including a fixed effect to panel regression models to exploit within-group variation over time. A fixed-effects regression model essentially assumes that unobservable factors that might simultaneously affect the outcome and the predictor are time-invariant. In this study, to estimate the effect of gun violence on economic activity, we ran fixed effects regressions in the following form:

$$(E_{it}) = \delta_0 + \beta_1 GV_{it-1} + \gamma_i + \lambda_t + u_{it}$$

(1)

where the equation was estimated at the census tract level for each city separately. E_{it} is (1) the number of establishments; or (2) employment and components of employment, including establishment openings, closures, or downsizings; or (3) sales in all establishments and a subset of retail and service industries (see appendix B for the retail and service industry categories included in the analysis) in census tract i in year t. GV is the total number of homicides (and gunshots for Washington, DC) in census tract i in year t-1, and γ_i and λ_t are census and year fixed effects, respectively.

Contextual research on crime requires a measurement instrument for neighborhood characteristics to make unbiased inferences about neighborhood change. Nonetheless, demographic variables were not included in the fixed-effects regression analysis. Though ACS variables are available at the census tract level, for census tract and smaller territorial boundaries (such as block groups), the ACS provides only five-year estimates for demographics.

Considering the panel nature of the data and the unavailability of annual demographic variables for the units of analysis, a fixed-effects panel estimator is very important. Although socioeconomic

characteristics are expected to differ across groups (census tracts), working with a short panel (three years) of crime and economic activity data, within-group differences of sociodemographic characteristics are expected to be relatively smaller. Table 1 (see page 3) lists the 17 economic activity measures we used in the fixed effects regressions, including establishment, employment, and sales outcomes.

Estimating the Difference-in-Differences with Propensity Score Matching

Another statistical method that has been widely employed in social sciences to estimate the causal effects of an intervention is the propensity score matching (PSM) techniques (Rosenbaum and Rubin 1983). A propensity score refers to the probability of the unit of analysis in a study (such as a census tract) receiving a treatment or condition (a surge in gun violence in our case) based on observational characteristics. The PSM method refers to a statistical procedure that uses observational characteristics to produce scores to match treatment and control groups.

In this project, using PSM, we build on the work of Greenbaum and Tita (2004) to examine the impact of gun violence on annual growth rate (at the census tract level) of net employment and components of net employment with a subset analysis of census tracts included in our analysis. The aim of this subset analysis is to explore how surges in gun violence from a baseline year affect the economic outcomes in the subsequent year, in comparison to the economic growth rates before the surge.

The dependent variables for this analysis are annual growth rates at the census tract level of net employment and the components of net employment including the births, deaths, and contractions of establishments. Similar to the fixed effects regression analysis method described earlier, the growth rates are calculated for all establishment categories and retail and service industry categories. The growth rate for each category of establishment is estimated as follows:

$$G^j_{it} = (E^j_{it} - E^j_{it-1})/E^j_{it-1} \qquad (2)$$

where growth *(G)* in each category *j* (new, closed, contracting) in census tract *i* is calculated by subtracting the employment at that category in the census tract in the previous year from the employment in the same category in the same census tract in the current year and dividing it by the total employment in the census tract in the previous year.

Growth rates for the number of establishments that are births and deaths for each category are defined as

$$G^j_{it} = N^j_{it}/N_{it} \qquad\qquad (3)$$

where *N* is the number of establishments. For the calculation of the growth in the number of contracting establishments in equation 3, the *E* in equation 2 is replaced with *N*.

The Propensity Score Matching Process

To compare economic activity in census tracts with a surge in gun violence with outcomes of census tracts with no surges in gun violence, every census tract that had a surge in homicides in 2011 needed to be matched with another census tract that did not have a surge in gun violence in the same year. The logic of assessing the impact of homicide surges rather than changes in raw homicides is that prior research (Greenbaum and Tita 2004) has shown that business activity could account for crime and violence levels in the area where the business is located. Thus, a neighborhood experiencing substantial changes in violence can affect business activity differently than a neighborhood with a consistent level of crime activity.

The independent variables included in the analysis to match surge and non-surge census tracts are measures that research has shown to impact the likelihood of a census tract to have a surge in gun violence. To estimate the probability of each census tract to have a homicide a surge indicator (a binary variable created based on the two-step definition above) is regressed on five sociodemographic variables of the census tracts (percent of female-headed households, percent unemployed, percent black population, median household income, and median house value) that were drawn from the ACS 2006–10 five-year estimates. The selection of these variables was informed by the literature on violent crime (see Greenbaum and Tita 2004 for a longer discussion). With these variables we aimed to capture the population characteristics in a census tract including demography, economic well-being, family structure, and housing attributes. Within each city we used a nearest neighbor method with replacement to match the propensity score of each census tract with a surge in homicides to a census tract without a surge that had the closest score.

After the matching process, we used difference-in-differences estimates to compare changes in employment growth rates from before to after extreme surges in homicide in the three study cities using the following equation:

$$y = \beta_0 + \beta_1 dB + \delta_0 d2 + \delta_1 d2 \bullet dB + u \tag{4}$$

where y is the outcome of interest and $d2$ is a dummy variable for the second time period. The dummy variable dB captures the differences between the surge and non-surge census tracts before the surge. The time period dummy, $d2$, captures factors that would cause changes in the outcome even in the absence of a surge. The coefficient of interest, δ_1, multiplies the interaction term, $d2 \bullet dB$, which is the same as a dummy variable equal to one for those observations in the treatment group in the second period. Standard errors for the model were clustered at the city level. The difference-in-differences estimate is

$$\Delta\delta = (\bar{y}_{B,2} - \bar{y}_{B,1}) - (\bar{y}_{A,2} - \bar{y}_{A,1}) \tag{5}$$

Appendix B. Selected Retail and Service Industry Codes

Code	Industry title
52	Building materials, hardware, garden supply and mobile home dealers
53	General merchandise stores
54	Food stores
55	Automotive dealers and gasoline service stations
56	Apparel and accessory stores
57	Home furniture, furnishings and equipment stores
58	Eating and drinking places
59	Miscellaneous retail
70	Hotels, rooming houses, camps, and other lodging places
72	Personal services
73	Business services
75	Automotive repair, services and parking
76	Miscellaneous repair services
78	Motion pictures
79	Amusement and recreation services
80	Health services
81	Legal services
82	Educational services
83	Social services
84	Museums, art galleries and botanical and zoological gardens
86	Membership organizations
87	Engineering, accounting, research, management and related services
89	Services, not elsewhere classified

Notes

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