Long-Term Trends in the Sources of Boston Crime Guns

ANTHONY A. BRAGA

Analyses of firearm trace data, most collected over relatively brief periods, suggest that a noteworthy share of guns used in crime were recently diverted from legal commerce. This article analyzes a longitudinal database on firearm recoveries by the Boston Police Department between 1981 and 2015 and successfully traced handguns between 1991 and 2015. The percentage of high-capacity semiautomatic pistols among recovered handguns increased dramatically in the 1980s and 1990s. A persistent share of traced handguns were imported from licensed dealers in southern states and an increasing share first purchased at licensed dealers in New Hampshire and Maine. These analyses suggest that market disruption strategies may reduce illegal diversions of new handguns from licensed dealers and the passage of one-handgun-a-month laws may influence where criminals get their guns.

Keywords: firearms, gun trafficking, gun control, gun laws, firearm tracing

The question of whether the illegal supply of guns to criminals and juveniles can be disrupted has been vigorously debated in policy circles and in the literature on firearms and violence (see, for example, Cook, Braga, and Moore 2011; Kleck and Wang 2009). Estimates suggest that only about one of every six firearms used in crime was legally obtained (Reiss and Roth 1993). To the extent that criminals and juveniles in particular jurisdictions are supplied with guns through systematic gun trafficking, focused regulatory and investigative resources may be useful in disrupting the illegal supply of firearms to criminals (Braga et al. 2002). Unlike other contraband, the illegal supply of guns does not begin with illegal smuggling or in clandestine factories. Virtually every crime gun in the United States starts out in the legal market. This suggests a problem with illegal gun acquisition from regulated and

Anthony A. Braga is Distinguished Professor of Criminology and Criminal Justice and director of the School of Criminology and Criminal Justice at Northeastern University, a fellow of the American Society of Criminology, a fellow and past president of the Academy of Experimental Criminology, and the 2014 recipient of its Joan McCord Award.

© 2017 Russell Sage Foundation. Braga, Anthony A. 2017. "Long-Term Trends in the Sources of Boston Crime Guns." *RSF: The Russell Sage Foundation Journal of the Social Sciences* 3(5): 76–95. DOI: 10.7758/RSF.2017.3.5.04. This research was supported by funds provided by the Rappaport Institute for Greater Boston, Everytown for Gun Safety, and the Fund for a Safer Future. I would like to thank Boston mayor Martin Walsh, Boston police commissioner William Evans, superintendent Paul Fitzgerald, sergeant detective Catherine Doherty, Desiree Dusseault, Richard Laird, Ted Alcorn, and James Sullivan for their valuable assistance in the completion of this research. Points of view in this document are those of the author and do not necessarily represent the official position of the City of Boston or the Boston Police Department. Direct correspondence to: Dr. Anthony A. Braga at a.braga@northeastern.edu, School of Criminology and Criminal Justice, Northeastern University, 360 Huntington Ave., Boston, MA 02115.

unregulated legal sources and a corresponding need to intervene in these markets to make obtaining firearms for criminal use more expensive, inconvenient, or legally risky.

Effective supply-side efforts could help increase the price of guns sold to prohibited persons and increase the effective price of acquiring guns—the time and hassle required to make a connection to buy guns (see Moore 1973, 1976). The benefit of this approach would be an increased incentive for criminals and juveniles to economize on gun possession and use. As guns become more scarce and valuable, they will be slower to buy and quicker to sell. Thus, prohibited persons would have guns for shorter periods over the course of their criminal careers (Kennedy 1994). Unfortunately, direct evidence is scant that successful regulatory and enforcement actions against supply lines of guns to criminals and juveniles will actually reduce availability and hence gun use in crime (Wellford, Pepper, and Petrie 2005). Further research on the structure of illegal gun markets and experimentation with market disruption tactics is sorely needed.

The Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) is charged with regulating firearms commerce and enforcing federal firearms law. Historically, with the support of local, state, and federal law enforcement partners, ATF has pursued cases against armed career criminals and firearms traffickers (2000, 2002). The strategic analysis of firearms trace data to identify gun traffickers is a key component of ATF's efforts to address the illegal supply of guns. ATF encourages state and local agencies to engage comprehensive firearms tracing under which all firearms recovered by the police are submitted for tracing to determine where they were first sold and by whom they were first purchased. The resulting database of trace results is the raw material for improved intelligence on the channels through which criminals acquire guns (Cook and Braga 2001).

The use of firearms trace data to describe the sources of crime guns and to evaluate the impact of policy interventions on criminal access to and use of guns remains controversial. For instance, critics suggest that these data may be limited by police decisions on which recovered guns to submit for tracing (Bea and Burton 1992; Kleck and Wang 2009). However, comprehensive tracing of all firearm recoveries reduces some of the bias in trace data introduced by police decision making. Jurisdictions that submit all confiscated guns for tracing can be confident that the resulting database of trace requests is representative of a well-defined "population" of guns recovered by police during a particular period and a reasonable "sample" of guns used in crime (Cook and Braga 2001). Trace data have been used to describe the structure of illegal gun markets serving criminals (Kennedy, Piehl, and Braga 1996a; Braga et al. 2012) and in a number of policy evaluations (such as Weil and Knox 1996; Koper and Roth 2001; Braga and Pierce 2005).

This article presents a descriptive analysis of a unique longitudinal database on firearm recoveries by the Boston Police Department (BPD) between 1981 and 2015 and successfully traced recovered handguns between 1991 and 2015. These data are used to describe long-term trends in the types of firearms recovered, examine changes in the characteristics of first retail sales of traced handguns, and assess the influence of several policy interventions on the age and sources states of traced handguns over time in Boston. The following section briefly reviews the empirical evidence on the illegal supply of guns to criminals.

EMPIRICAL EVIDENCE ON ILLEGAL GUN MARKETS

Much of the empirical evidence on the illegal supply of guns comes from analyses of ATF firearm trace data and firearms trafficking investigations that indicate some percentage of the guns used in crime were recently diverted from legal firearms commerce (ATF 2000, 2002; Braga et al. 2012; Cook and Braga 2001; Pierce et al. 2004). Several findings are of particular note. First is that new guns are recovered disproportionately in crime (Cook and Braga 2001; Pierce et al. 2004; Zimring 1976). Another is that some licensed firearm retailers are disproportionately frequent sources of crime guns and are linked to more guns traced by ATF than would be expected from their overall volume of gun sales (on reasons for these patterns, see Wintemute, Cook, and Wright 2005). Sepa-

rately, under test conditions, significant proportions of licensed retailers and private party gun sellers will knowingly participate in illegal gun sales (Sorenson and Vittes 2003; Wintemute 2010). In addition, on average, about one-third of guns used in crime in any community are acquired in that community, another third from elsewhere in the same state, and a third from other states (ATF 2002; Cook and Braga 2001). Last are the long-standing interstate trafficking routes for crime guns, typically from states with weaker gun regulations to those with stronger ones. The best known of these is the so-called Iron Pipeline—from the Southeast to the Middle Atlantic and New England (Cook and Braga 2001; Pierce et al. 2004).

Analyses of ATF firearm trafficking investigation data reveal that illegal gun traffickers exploit an incredibly leaky legal firearms commerce system. For instance, a 2000 report examining 1,530 gun trafficking investigations made by ATF between July 1, 1996, and December 31, 1998, found that more than eighty-four thousand firearms were diverted legal to illegal commerce (ATF 2000). The report identified the primary gun trafficking pathways as scofflaw and negligent firearms dealers, straw-man legal purchasers who provide guns to criminals, and illegal diversions through secondary market sources such as gun shows, flea markets, and want ads. The analysis also revealed the organized theft of firearms from licensed dealers, common carriers, and residences as illegal diversion pathways. Moreover, ATF found that 61 percent of the cases involved the diversion of twenty or fewer firearms, and concluded that most but not all gun trafficking investigations involve a relatively small number of firearms (2000). The two largest cases involved the illegal diversion of some eleven thousand and ten thousand firearms, respectively.

Recent analyses of data drawn from the 2004 Survey of Inmates in State Correctional Facilities, the 2004 Survey of Inmates in Federal Correctional Facilities, and the 2002 Survey of Inmates in Local Jails suggest that very few illegal gun users directly acquire their guns through theft. Philip Cook, Susan Parker, and Harold Pollock find that only 4 percent of male respondents age eighteen to forty in the first two years of their prison term who admitted in the survey interview that they had a gun at the time of crime reported directly stealing their most recent crime gun. These authors further document that 10 percent of recently incarcerated state prison inmates who carried a gun indicated that they purchased that gun from a licensed dealer, such as a gun store or pawnbroker (2015). Most of the transactions—roughly 70 percent—were with social connections (friends and family) or with street sources (fences, drug dealers, illicit gun brokers, and gangs). These sources may well include traffickers who are buying from retail outlets and selling to prohibited persons.

Despite multiple illegal sources of firearms for criminals, ethnographic research suggests that illegal gun markets may not work very well in particular urban environments. Some evidence indicates considerable frictions in the underground market for guns in Chicago (Cook et al. 2007). These frictions were due primarily to the underground gun market being both illegal and thin—that is, the number of buyers, sellers, and total transactions was small, and relevant information on reliable sources of guns were scarce. The same research further reveals that Chicago street gangs helped overcome these market frictions, but economic interests caused gang leaders to limit supply primarily to gang members, and even then transactions were usually loans or rentals with strings attached. Thin underground gun markets may be particularly vulnerable to focused gun market disruption strategies.

A growing body of evaluation evidence suggests that enforcement and regulatory interventions focused on retail sales practices can generate subsequent reductions in new guns recovered in crime. In Detroit and Chicago, the number of guns recovered within a year of first retail sale from someone other than the original purchaser was sharply reduced after undercover police stings and lawsuits targeted scofflaw retail dealers (Webster et al. 2006). In Milwaukee, the number of guns recovered within a year of first retail sale from someone other than the original purchaser significantly decreased after voluntary changes in the sales practices of a gun dealer that received negative

publicity for leading the United States in selling the most guns recovered by police in crime (Webster, Vernick, and Bulzacchelli 2006). In Chicago, an analysis of recovered crime handguns found that the 1994 implementation of the Brady Handgun Violence Prevention Act was associated with a marked decrease in crime handguns imported from states required to institute the provisions of the act (Cook and Braga 2001). The Brady Act mandated licensed dealers to conduct a criminal background check on all handgun buyers and required a one-week waiting period before transferring the gun to a criminal. The Cook and Braga (2001) analysis suggests that the Brady Act made interstate gunrunning from lax-control states less profitable by making it more difficult for traffickers to buy handguns from licensed dealers in those states.

The case for a supply-side approach to gun violence is generally supported by the empirical evidence on illegal gun market dynamics. However, rigorous research is sorely needed to determine whether supply-side interventions can actually affect the availability of guns to criminals. As the National Research Council's Committee to Improve Research Information and Data on Firearms concludes, "it is simply not known whether it is actually possible to shut down illegal pipelines of guns to criminals nor the costs of doing so" (Wellford, Pepper, and Petrie 2005, 8). Experimental evidence also needs to be developed to determine whether interventions designed to limit illegal transfers of firearms can indeed reduce gun violence.

GUNS AND SERIOUS GUN VIOLENCE IN BOSTON

Massachusetts is well known for having some of the strongest gun laws in the United States. In 2013, the Brady Campaign to Prevent Gun Violence ranked Massachusetts gun laws as the sixth strongest in the fifty states.[1] Importantly, Massachusetts regulates all secondhand gun transactions by requiring records of ownership transfers, thefts, and losses to be reported to the state (Braga and Hureau 2015). Massachusetts has also been noted as having very low prevalence of gun ownership relative to other U.S. states (Azrael, Cook, and Miller 2004). Survey research suggests that only 12.8 percent of Massachusetts households reported owning a gun (Okoro et al. 2005), versus 31 percent nationwide (Smith and Son 2015). A 2010 Harvard School of Public Health representative survey of Boston residents estimates that only 3.7 percent of respondents report that someone in their household owns a handgun (see Braga and Cook 2016).

Like many cities in the United States, Boston suffered a dramatic increase in gun violence in the late 1980s and early 1990s (Kennedy, Piehl, and Braga 1996a). Preceded by the arrival of crack cocaine in 1986, this epidemic, measured as a gun homicide problem, started in 1988 and was contained mostly within Boston's young black male population residing in a few disadvantaged neighborhoods (Braga 2003). Gangs and criminally active youth were at the core of the situation (Kennedy, Braga, and Piehl 1997). Boston experienced a sudden downturn in related violence in the mid- to late 1990s; however, the change was associated with the implementation of a strategic gang violence reduction initiative (Braga et al. 2001).

Gun violence surged again in Boston during the mid-2000s. Research conducted during this period once more revealed that it could be characterized as being driven by gang conflicts and highly concentrated among a small number of high-risk places and high-risk people. Roughly 5 percent of Boston's street block faces and intersections generated about 74 percent of fatal and nonfatal shooting incidents between 1980 and 2008 (Braga, Papachristos, and Hureau 2010). These hot spots were located in and proximate to gang turf and drug market areas and occupied small geographies within disadvantaged neighborhoods. In 2006, only 1 percent of Boston's population between the ages of fourteen and twenty-four were mem-

1. See "2013 State Scorecard," http://www.bradycampaign.org/2013-state-scorecard (accessed July 5, 2017). The Brady Campaign ranked all fifty states based on thirty policy approaches to regulating guns and ammunition, such as: background checks on gun sales; reporting lost or stolen firearms; and prohibiting dangerous people from purchasing weapons.

bers of street gangs involved in gun violence; at the same time, gang-related disputes generated more than two-thirds of gun homicides, and gang members were involved as offenders, victims, or both in nearly 70 percent of nonfatal shootings (Braga, Hureau, and Winship 2008). In a recent study of one disadvantaged Boston community, roughly 85 percent of all gunshot victims were in a single co-offending network representing less than 5 percent of the community's population (Papachristos, Braga, and Hureau 2012). Once again, a deterrence-based gang violence reduction strategy was credited with reducing serious gun violence in Boston during the late 2000s (Braga, Apel, and Welsh 2013; Braga, Hureau, and Papachristos 2014).

Most people arrested for illegal gun possession in Boston are not otherwise law-abiding individuals. In 2014, the BPD arrested 485 people for illegal gun possession and 228 for violent gun offenses. Eighty percent of the adult arrestees were found to have criminal records, and judging by criminal-history data, illegal gun possessors were as involved in crime as those who were arrested for gun violence—murder, robbery, and assault (Braga and Cook 2016). These data suggest that Boston has an ongoing problem with criminal access to firearms.

SOURCES OF CRIME GUNS

The Boston Gun Project was a problem-oriented policing initiative expressly aimed at reducing homicide victimization among youths in Boston in the mid-1990s (Kennedy, Braga, and Piehl 1996a). It represented an innovative partnership between researchers and practitioners to assess the city's youth homicide problem and implement an intervention designed to have a substantial near-term impact on the problem. Project research shows that the problem of youth homicide was concentrated among a few chronically offending gang-involved youth (Kennedy, Braga, and Piehl 1996a). The same research also shows that firearms associated with youth, especially with gang youth, tended to be semiautomatic pistols, often quite new and apparently only recently diverted from retail. Many of these guns were first sold at retail in Massachusetts or smuggled into Boston from out of state. The project began in early 1995 and implemented what is now known as the Operation Ceasefire intervention beginning on May 15, 1996. The intervention had two main elements: the "pulling levers" focused deterrence strategy to prevent gang violence and a direct law enforcement attack on illicit firearms traffickers supplying youth with guns.[2]

Boston Gun Project research initially focused on understanding and addressing the local illicit firearms market serving youth age twenty-one and younger. Youth gun acquisition was largely driven by fear, self-protection, and status concerns arising from a high-risk street environment dominated by violent gangs, drugs, and guns (Kennedy, Piehl, and Braga 1996a). Interviews with youth probationers in Boston reveal that guns were fairly easy to acquire either by buying them illegally or by borrowing them from friends and associates (Kennedy, Piehl, and Braga 1996a). For style reasons and to avoid being caught with an older gun that may have already been used in a violent crime, youth probationers expressed a strong preference for "new in the box" semiautomatic pistols.

To unravel the nature of the illegal gun market, the Boston Gun Project research team analyzed ATF firearms trace data for 1,550 firearms recovered from youth age twenty-one and younger in Boston between January 1991 and May 1995 (Kennedy, Piehl, and Braga 1996a). Some 82 percent of the recovered firearms were handguns and more than half were semiautomatic pistols. Recovered semiautomatic pistols were concentrated among a few calibers, such

2. Focused deterrence strategies honor core deterrence ideas, such as increasing risks faced by offenders, while finding new and creative ways of deploying traditional and nontraditional law enforcement tools. According to a 2001 National Institute of Justice evaluation, the intervention was associated with a 63 percent reduction in Boston youth homicide and similar large reductions in nonfatal serious gun violence (Braga et al. 2001). A more recent systematic review and meta-analysis of focused deterrence programs indicates that these initiatives generate statistically significant reductions in crime (Braga and Weisburd 2012).

as 9mm, .380, and .25. Roughly 52 percent of the firearms were successfully traced to their first retail sale. Almost 20 percent were not traced because the serial numbers had been obliterated. An analysis of the source states of traceable guns revealed that Boston had problems with diversions from both local and out-of-state federal firearms licensees (FFLs). Despite strict state controls on firearms commerce, 34 percent of traceable guns were first sold at retail in Massachusetts. Nearly 32 percent were first sold at retail in loose-control southern states, most notably along the I-95 Iron Pipeline—Florida, Georgia, Virginia, North Carolina, and South Carolina.

The time between a firearm's first sale at retail and subsequent recovery in crime is popularly known as time-to-crime (Pierce et al. 2004). Law enforcement investigators consider that a fast time-to-crime, defined by ATF as three years or less, suggests that a firearm may have been recently illegally diverted from retail outlets (ATF 2002): 35 percent of traceable Boston youth guns were fast time-to-crime guns. For all traceable new firearms, the first retail purchaser was a different person than the youth from whom the gun was recovered, suggesting a recent illegal diversion from legitimate firearms commerce.

Based on this analysis, the Operation Ceasefire gun market disruption strategy was appropriately focused on the illegal diversion of new handguns from retail outlets in Massachusetts, southern states along Interstate 95, and elsewhere (Braga and Pierce 2005). The key elements of the strategy were sevenfold:

> Expanded focus of local, state, and federal authorities to include *intrastate* firearms trafficking in Massachusetts in addition to interstate trafficking.
>
> Focused enforcement attention on traffickers of the makes and calibers of handguns most used by gang members.
>
> Focused enforcement attention on traffickers of handguns that had short time-to-crime intervals and, thus, were most likely to have been trafficked. The ATF Boston Field Division implemented an in-house tracking system that flagged handguns whose traces revealed a short time-to-crime interval.
>
> Focused enforcement attention on traffickers of handguns used by the city's most violent gangs.
>
> Attempts to restore obliterated serial numbers of confiscated handguns and subsequently investigate trafficking based on these restorations.
>
> Support for these enforcement priorities through strategic analyses of data generated by the Boston Police Department and ATF's comprehensive tracing of crime guns and by developing leads from the systematic debriefing of gang-affiliated arrestees and those involved in violent crime.
>
> Deliberate communication of successful investigations and prosecutions of gun traffickers to deter others from diverting firearms from retail sources to criminals and youth in Boston.

Half of the ATF gun trafficking investigations launched as part of this strategy focused on firearms illegally diverted from FFLs by straw purchasers. An impact evaluation in 2005 found that the gun market disruption strategy significantly reduced the illegal supply of new handguns to Boston criminals (Braga and Pierce 2005). However, the evaluation also suggests that gun traffickers may have substituted older handguns purchased through secondary market transactions to avoid enforcement attention.

As mentioned, the Boston gun market disruption strategy was implemented in conjunction with a powerful deterrence-based strategy to reduce gang violence. The National Institute of Justice–sponsored evaluators credited the Operation Ceasefire deterrence strategy with the sudden, large impact on youth homicide and gun violence (Braga et al. 2001). Their assessment that the principal impact was a demand-side, deterrence-based effect rather than a supply-side effect was based on two observations. First, it seemed implausible that supply-side efforts were responsible for the abrupt reductions in gun-related violence over the summer of 1996. Boston trafficking cases

followed that reduction, rather than anticipated it. Second, antitrafficking efforts in Boston did nothing to reduce the existing stockpile of illegally acquired and possessed firearms in Boston. Those guns held by gang members in Boston in May of 1996 were, for the most part, still held by them several months later when the violence reached its new, lower equilibrium. The immediate change was not in the extent of gun ownership but in gun use. Although it was unlikely that market disruption strategy had a meaningful short-term impact on serious gun violence, the available evidence suggests that the intervention had a meaningful longer-term impact on the illegal supply to Boston of newer handguns (Braga and Pierce 2005).

Boston has been the site of an ongoing series of research inquiries into the illegal supply of guns to criminals. Like others, Boston-based studies have generally analyzed the sources of illegal guns during specific periods, such as the early 1990s or late 2000s, rather than long-term trends. This article presents a descriptive analysis of a unique longitudinal data set on gun recoveries in Boston to uncover developmental trends in illegal gun market characteristics and dynamics that would be missed in existing cross-sectional data analyses. These data are also used to assess the impacts of two well-known policy interventions, one-gun-a-month laws and gun buy-back programs, on the characteristics of Boston crime guns.

DATA

This article uses detailed BPD firearm recovery data to examine long-term gun trends in Boston. The Ballistics Unit keeps records on the basic characteristics of all firearms recovered by BPD officers (type, manufacturer, model, and caliber-gauge). Prior to 1991, these data were maintained in carefully organized paper record files. Paper records on N=8,753 firearms recovered between 1981 and 1990 were entered into a computerized database for a previously completed research study (see Braga 2003). The data were acquired and supplemented with gun recovery data maintained by the BPD in their comprehensive firearms trace database.

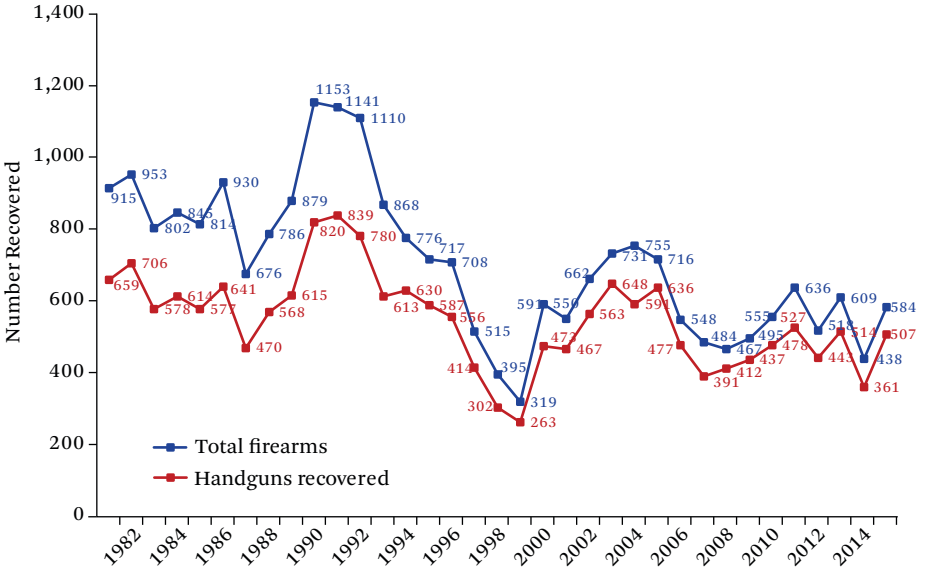
The Gun Control Act of 1968 (GCA) established a set of requirements that allows any given firearm to be traced from its manufacture or import to its first sale by a retail dealer (Zimring 1975; Cook and Braga 2001). The GCA mandates that each new firearm, whether manufactured in the United States or abroad, be marked with a serial number. In addition, the GCA requires all FFLs, including manufacturers, importers, distributors, and retail dealers, to maintain records of all firearms transactions. Firearms traces can be unsuccessful for a variety of reasons. ATF trace data can provide policy-relevant insights on illegal gun market dynamics when conclusions are based on careful analyses that are coupled with clear acknowledgments of data limitations (Cook and Braga 2001; Wellford, Pepper, and Petrie 2005).

The BPD has been comprehensively submitting all recovered firearms to ATF for tracing since 1991 (Kennedy, Piehl, and Braga 1996a; Braga and Pierce 2005). Between 1991 and 2015, the BPD recovered 15,888 firearms in illegal gun possession offenses (62.3 percent), public places (28.8 percent), violent crimes (6.3 percent), and drug offenses or other crimes (2.6 percent) that were subsequently submitted to ATF for tracing. This research analyzes trace data for the N=12,909 handguns recovered by the BPD during this period (81.3 percent of 15,888). Long guns, such as rifles and shotguns, were not included in the analyses. Handguns are the majority of crime guns recovered by the BPD. Some 58.3 percent (7,521 of 12,909) recovered between 1991 and 2015 were successfully traced to the first retail purchaser. Traces were not successful for pre-1968 manufacture (16.3 percent), obliterated serial numbers (13.7 percent), and data entry issues on the trace form (8.2 percent) or in dealer records (3.5 percent).

TRENDS IN FIREARM RECOVERIES, 1981–2015

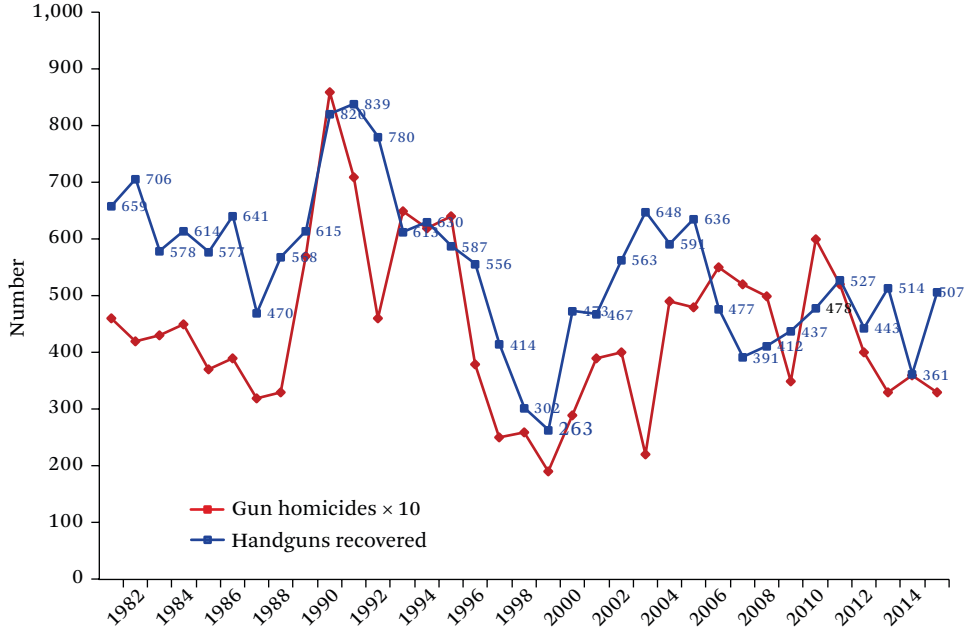
Figure 1 presents yearly trends in the total number of firearms and the total number of handguns the BPD recovered between 1981 and 2015. Nearly 78 percent of the total (24,641) were handguns (19,157). The number of recovered guns peaked in 1990 with 1,153 recoveries, and dropped to a low of 319 in 1999. The yearly number of handguns recovered closely followed the total number of firearms recovered. Figure 1 also shows that the share of recovered firearms that were handguns narrowed after 1996. Be-

Figure 1. Guns Recovered by Boston Police Department



Source: Author's calculations.

Figure 2. Handgun Recoveries and Homicides in Boston



Source: Author's calculations.

tween 1981 and 1996, almost 73 percent were handguns. Between 1997 and 2015, slightly more than 84 percent were.

Figure 2 presents the yearly numbers of handgun recoveries and of gun homicides in Boston between 1981 and 2015. Because the numbers of handgun recoveries were much greater, those of gun homicides were multi-

Table 1. Types and Calibers of Recovered Handguns in Boston

		Percentages				
Period	N	Semi-automatic	.22, .25, .32	.38, .357	.380, 9mm	.40, .44, .45
1981–1985	3134	34.6	44.9	38.6	7.5	4.3
1986–1990	3114	41.6	44.2	33.2	14.0	5.1
1991–1995	3449	60.9	38.3	23.3	30.2	4.8
1996–2000	2008	74.2	38.9	23.9	27.5	6.8
2001–2005	2905	75.7	29.2	20.9	29.7	12.9
2006–2010	2195	65.7	26.4	20.6	33.4	18.0
2011–2015	2,352	66.6	26.7	20.7	31.7	19.9

Source: Author's calculations.

plied by ten so that both trends could be represented on the same graph. Although yearly trends diverge in particular years, such as 1992 and 2003, gun homicides and handgun recoveries both show sudden increases between the late 1980s and early 1990s, steep declines between the middle and late 1990s, and more modest increases in the early to middle 2000s. The two trends have a Pearson's cross-temporal correlation coefficient r=0.574 (p<.01), suggesting a strong positive association between yearly number of handgun recoveries and yearly number of gun homicides.

Changes over time in the types and calibers of recovered handguns are summarized in table 1. Between 1981 and 1985, higher-capacity semiautomatic pistols represented "only" 34.6 percent of all handguns recovered. During this period, the vast majority of recovered handguns were revolvers (63.5 percent) and only a small share were derringers (1.6 percent). The proportion of semiautomatic pistols among recovered handguns increased dramatically over the course of the late 1980s, 1990s, and 2000s, reaching a peak of 75.7 percent between 2001 and 2005. The share of semiautomatic pistols then decreased moderately to roughly 65 percent between 2006 and 2015.

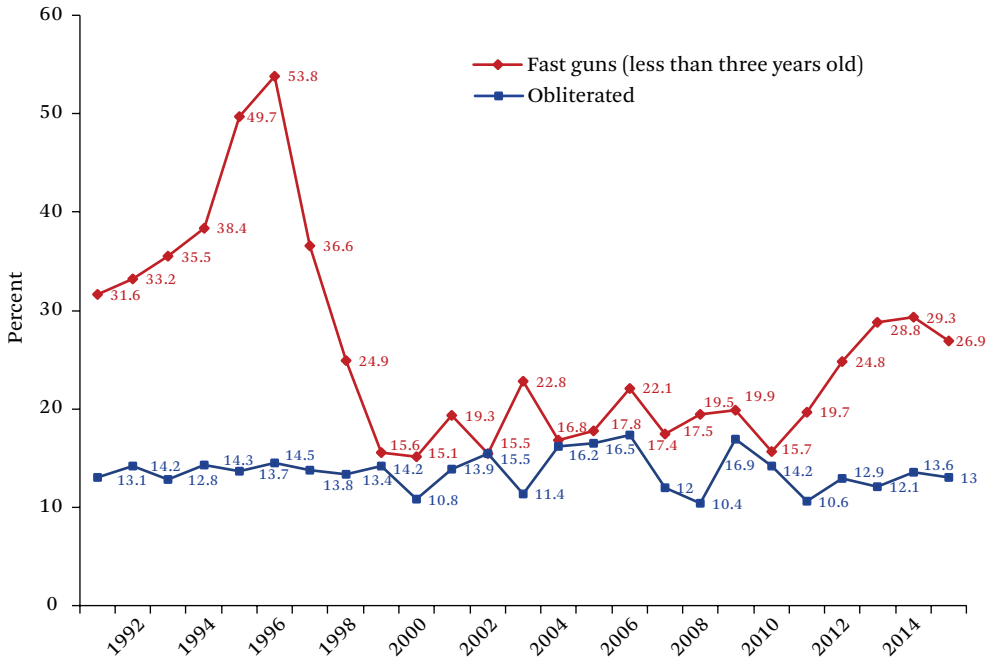
Consistent with the shift toward greater shares of semiautomatic pistols, the calibers of recovered handguns also changed over time. Between 1981 and 1985, medium-powered .380 and 9mm handguns represented only 7.5 percent of all handguns recovered. The share quadrupled to 30.2 percent between 1991 and 1995 and remained steadily more than 25 percent through 2015. In contrast, the share of .38 and .357 handguns declined from 38.6 percent between 1981 and 1985 to 20.7 percent between 2011 and 2015. Recoveries also shifted from lower-powered to high-powered handguns over the study period. Between 1981 and 1985, lower-powered .22, .25, and .32 handguns accounted for almost 45 percent of all recoveries; higher-powered .40, .44, and .45 handguns represented only 4.3 percent. By 2011 through 2015, .22, .25, and .32 handguns represented only 26.7 percent of recoveries; nearly 20 percent were .40, .44, and .45 handguns.

TRENDS IN KEY TRAFFICKING INDICATORS FOR TRACED HANDGUNS, 1991–2015

Obliterated Serial Numbers

The recovery of a firearm with an obliterated serial number is viewed as a strong indicator that a trafficker was involved in the illegal diversion of the firearm from legal commerce (ATF 2000, 2002; Cook and Braga 2001; Kennedy, Piehl, and Braga 1996a). Because defacing the serial number on a firearm is itself a crime (see 18 U.S.C. § 922(k)), obliterated numbers establish that a criminal possessed the gun at some time and is strong evidence that some past possessor wanted to obstruct tracing and prevent the firearm from being linked to a past transfer. Gun traffickers are likely to want to impede tracing so that they cannot be linked with their criminal associates, such as straw purchasers or a corrupt licensed dealer. Obliterated serial numbers were found on a modest

Figure 3. Handguns and Obliterated Serial Number Handguns



Source: Author's calculations.

share of handguns recovered by the BPD over time. Between 1991 and 2015, the trend in the yearly share of handguns recovered with obliterated serial numbers was stable, between roughly 10 percent and 17 percent per year (see figure 3). For the entire 1991 to 2015 period, 13.7 percent (1,763 of 12,909) had obliterated serial numbers.

BPD Crime Lab specialists, however, can sometimes restore obliterated serial numbers, and traces of guns can then proceed. Between 1995 and 2003, the BPD and ATF Boston Field Division made a concerted effort to restore and trace 910 firearms recovered with obliterated serial numbers as part of a special initiative to focus their enforcement efforts on the guns that seemed most likely to be trafficked (Braga and Pierce 2005). During this period, roughly 45 percent had their serial numbers successfully restored and subsequently traced to a first retail purchaser. These guns were a blend of new and secondhand firearms predominately purchased from out-of-state licensed dealers. Because as many as one in six recovered handguns have obliterated serial numbers in any given year, restoring defaced numbers seems to be high-value activity to generate investigative leads on gun traffickers diverting firearms from both primary and secondary market sources.

Age of Traced Handguns

As described, a traced firearm with a short time-to-crime is generally regarded as an indicator that the weapon may have been recently diverted from an FFL. Figure 3 presents the annual percentage of traced Boston handguns with a time-to-crime of three years or less between first retail sale and BPD recovery. Between 1991 and 1996, the share increased from 31.6 percent to 53.8 percent. The Operation Ceasefire gun trafficking strategy was associated with a large post-1997 reduction in the percentage of handguns recovered with fast time-to-crime (Braga and Pierce 2005). As figure 3 suggests, the annual percentage of fast time-to-crime handguns dropped sharply in 1997 and 1998. Between 1999 and 2011, the trend was relatively stable and only 18.4 percent of all traced handguns (638 of 3,475) had a fast time-to-crime. The rate remained above 25 percent between 2012 and 2015.

The Anthony Braga and Glenn Pierce evaluation used multivariate regression analyses to estimate the effects of the Operation Ceasefire intervention on new handguns recovered in crime between January 1991 and December 2003 (2005). To distinguish intervention effects from measurable rival causal factors, the final model controlled for existing linear and nonlinear trends, seasonal variation, Boston violent crime trends, handgun recovery numbers, trace result variations, and the February 1994 implementation of the Brady Handgun Violence Prevention Act. The analysis was supplemented by a postintervention-only comparison of Boston trends in new handgun recoveries to new handgun recovery trends in fourteen Youth Crime Gun Interdiction Initiative (YCGII) cities. YCGII cities participated in an ATF program that required local police departments to trace all recovered crime guns. The trends in the comparison group suggested that the Boston trend was unique.

In their review of the Boston evaluation, Gary Kleck and Sung-Yung Wang speculate that the reported decline in the share of new recovered crime handguns was not due to the effects of the intervention but instead driven by a decline in Boston's burglary rate during the same period (2009). To support this assertion, the authors report a strong positive correlation between the percentage of crime guns with a time-to-crime of three years or less and Boston's burglary rate as reported in the Uniform Crime Reports between 1996 and 2003 (r=0.89). The Braga and Pierce analysis did not control for trends in Boston's burglary rate (2005).

To investigate whether burglary explained the decrease in new handguns recovered by the BPD over time, a covariate was added to the original Braga and Pierce model to account for Boston's monthly burglary rate for the full evaluation time period of January 1991 through December 2003. Following the Braga and Pierce model development strategy, the effects of Operation Ceasefire on the recovery of new handguns in Boston was estimated using ordinary least squares linear regression models. The impact on the percentage of recovered handguns that were new in Boston was measured at a one-year lag (dummy variable capturing the effect post–June 1, 1997). The dependent variable is, once again, the monthly percentage of traced recovered handguns that were recovered within three or fewer years of the first retail sale.

Table 2 presents the original results and those of the revised model that included the Boston burglary rate. A quick comparison of the regression coefficients between the two models reveals no substantive changes when the Boston burglary rate covariate is included. Controlling for other covariates, the burglary rate is not significantly associated with the percentage of new recovered handguns, which suggests that the causal relationship between burglary and new recovered handguns is spurious when other factors are considered. Table 2 also reveals that the lagged effects of the intervention on the percentage of recovered handguns that were new remained robust to the addition of the burglary rate covariate to the model. Holding the other predictor variables constant, the intervention was associated with a statistically significant 22.3 percent reduction in the mean monthly percentage of all recovered handguns that were new. This revised analysis suggests that the Operation Ceasefire strategy did affect the prevalence of new handguns recovered in Boston crime.

Source States of Traced Handguns

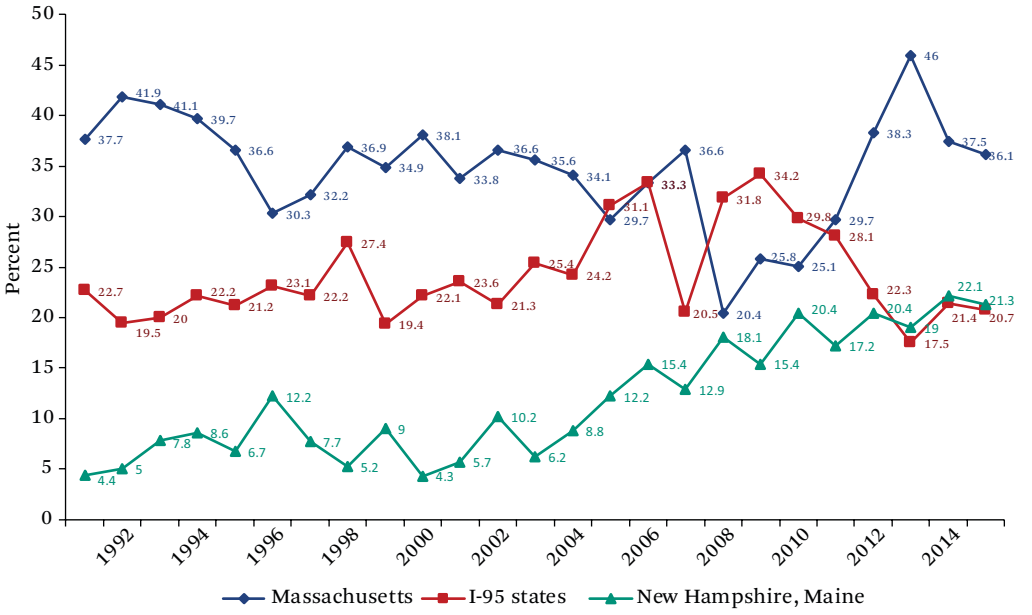
Figure 4 presents yearly trends in share of traced recovered handguns from selected source states between 1991 and 2015. Consistent with prior research, FFLs in Massachusetts consistently generated the largest share of Boston's recovered handguns relative to those from other states (see Kennedy, Piehl, and Braga 1996a; Braga and Hureau 2015). Between 1991 and 2007, the yearly proportion of traced handguns first purchased at Massachusetts FFLs generally varied between about 30 percent and almost 42 percent. In 2008, the share originating from Massachusetts FFLs dropped to 20.4 percent, followed by a steady increase over the next several years. In 2013, 46 percent of the traced handguns were first purchased at the Massachusetts FFLs. This one-year spike was mostly driven by a small number of seizures of multiple firearms from individuals who were once legal purchasers but became illegal pos-

Table 2. OLS Regressions, Effects of Operation Ceasefire

	Percentage of New Handguns					
	New Handguns			Controlling for Boston Burglary Rate		
Variable	B (SE)		t	B (SE)		t
Ceasefire (one-year lag)	−.227	(.040)	−5.65***	−.223	(.045)	−4.954***
Burglary rate	—		—	.00003	(.000)	.218
Trend	.001	(.002)	.285	.001	(.003)	.355
Trend^2	−.000006	(.000)	−.281	−.000008	(.000)	−.627
N violent gun crimes	.000	(.000)	1.00	.000	(.001)	.859
N handguns received	−.002	(.001)	−2.29*	−.002	(.001)	−2.29*
Percent handguns with no age	.182	(.094)	1.93	.184	(.095)	1.93
Brady Law enacted	.106	(.048)	2.27*	.108	(.049)	2.23*
Intercept	.253	(.135)	1.88	.254	(.133)	1.91
N	156			156		
R^2	.599			.599		
F-test	11.346***			10.676***		
Durbin-Watson test	1.74			1.77		

Source: Author's compilation based on Braga and Pierce 2005.
Note: Month dummy variables included in both regression models but not shown here.
*$p < .05$; **$p < .01$; ***$p < .001$

Figure 4. Source States of Traced Handguns in Boston



Source: Author's calculations.

sessors after a felony conviction or domestic assault incident.

A recent study examined whether Massachusetts state-level private gun transfer data could be used to understand how in-state secondary market transactions may influence the supply of handguns to Boston criminals (Braga and Hureau 2015). Using trace data on Boston recoveries between 2007 and 2013, traced Boston crime handguns first sold at Massachusetts license dealers were matched to state secondhand gun transfer data. Many crime handguns with records of secondary market transactions in Massachusetts moved rapidly from private transfer to police recovery, suggesting an in-state problem with illegal transfers to high-risk and prohibited persons. Unfortunately, important transaction data on the in-state sources of nearly 63 percent of recovered handguns were not readily available to law enforcement agencies. Braga and David Hureau conclude that a highly problematic gap between having strong gun laws in place and actually enforcing their provisions exists in Massachusetts (2015). This lack of enforcement seems to contribute to the relatively large number of crime guns directly or indirectly originating from Massachusetts FFLs over time.[3]

Traced handguns recovered in Boston tended to be imported from FFLs in two distinct geographic regions of states with less restrictive gun control laws: either nearby New Hampshire and Maine, or the Iron Pipeline states of Virginia, North Carolina, South Carolina, Georgia, and Florida. Between 1991 and 2004, about 23 percent of traced handguns were imported from FFLs in those five southern states and only 7.5 percent from the two northern ones. Between 2005 and 2015, the share of traced handguns imported from FFLs in the southern states increased slightly to 26.3 percent. However, during this same period, the share of traced handguns imported from FFLs in New Hampshire and Maine more than doubled, to 17.7 percent. ATF and BPD investigators suggest that drug trafficking supply lines from Boston into southern New Hampshire and Maine have intensified as high property values in the Boston area have caused a population shift to less expensive, out-of-state properties within commuting distance of the city; Boston gang members and other criminals increasingly export illegal drugs into New Hampshire and Maine, and import illegal guns from these loose gun control states (see, for example, Bever 2014).

To some observers, a crime gun with an out-of-state origin is not necessarily an indicator that a gun runner illegally moved the gun across state lines. Other explanations for this movement are possible, such as an owner legally moving to another state and having the firearm stolen from their new residence (Kleck and Wang 2009). Massachusetts state law requires all gun owners, including those who move into the state with their firearms, to report firearm losses and thefts to local and state police department. When recovered Boston crime guns are submitted to the BPD Ballistics Unit for processing, firearm examiners run the manufacturers and serial numbers through the National Crime Information Center (NCIC) stolen gun database and record whether the recovered crime gun was reported stolen.

To further examine out-of-state origin as an indicator of illegal gun diversions, NCIC data collected by the BPD Ballistics Unit on N=1,479 handguns recovered by the BPD between 2007 and 2014 and subsequently traced to FFLs located outside Massachusetts were analyzed. Despite a state law requiring such reporting, not a single recovered handgun traced to FFLs outside Massachusetts was reported to NCIC as stolen. It is possible that law-abiding gun owners might be reluctant to report stolen guns to authorities or lacked enough information on stolen guns to file an accurate report. These problems, however, would affect recently transplanted residents and long-term residents alike. For comparative purposes, stolen gun re-

3. In comparison, only 12 percent of traceable firearms recovered by the New York City Police Department (NYPD) between 2010 and 2015 were first purchased at an FFL in New York State (trace data provided as part of an ongoing research partnership with NYPD to examine the sources of New York City crime guns). New York State has strong gun laws that are similar to Massachusetts gun laws. See the 2013 Brady Campaign scorecard (http://www.bradycampaign.org/2013-state-scorecard, accessed July 3, 2017).

cords were analyzed for 2007 to 2014 handguns traced to a Massachusetts FFL and not found to be recovered in the hands of the first retail purchaser. BPD Ballistic Unit records indicated that 10.8 percent (62 of 572) had been reported stolen to NCIC before recovery by BPD officers. If theft of guns from recently transplanted residents was a persistent problem, a similar stolen gun reporting rate would be expected. The "guns stolen from new residents" explanation for the interstate movement of crime guns therefore does not seem to apply to traced Boston crime guns imported from other states. Philip Cook and his colleagues come to a similar conclusion in their analysis of the sources of Chicago crime guns (2015).

USING LONGITUDINAL TRACE DATA IN POLICY EVALUATION

Effects of Limiting Handgun Purchases on Interstate Gun Trafficking

During the early 1990s, the Commonwealth of Virginia earned a reputation as a key source state for firearms illegally trafficked to cities in the northeastern United States (Larson 1994). In July 1993, Virginia enacted a law limiting individual handgun purchases to one per thirty-day period. The intention of the law was to limit the ability of illegal gun traffickers to make multiple purchases of handguns in a single transaction, thereby undermining the economic incentive generated by diverting multiple handguns from Virginia FFLs. Douglas Weil and Rebecca Knox used ATF trace data to examine the locations of crime gun purchases before (September 1989 through June 1993) and after (July 1993 through March 1995) the enactment of Virginia's one-handgun-per-month law (1996). Their analyses reveal noteworthy reductions, after passage of the bill, in the share of guns traced to Virginia FFLs for firearms traced from anywhere in the United States and for firearms traced from northeast corridor states.

The findings of the Weil and Knox evaluation are limited by the uncertain quality of the available ATF firearms trace information (1996). As the authors openly report, that used in their study was not collected in a comprehensive manner. It represented only the recovered crime guns that law enforcement agencies in study locations decided to submit to ATF for tracing. The trends and patterns documented by their analyses were therefore biased to an unknown degree. As described earlier, the BPD has been comprehensively tracing all recovered firearms since January 1, 1991. These comprehensive data allow a clearer assessment of the impact of the July 1993 law limiting handgun purchases to one per month on the movement of handguns from retail purchases at Virginia FFLs to recovery by the BPD.

In this partial replication of the Weil and Knox analysis, the sources of traced handguns recovered in Boston were compared for eighteen-month periods before (January 1991 through June 1993) and after (July 1993 through December 1995) implementation of the law. Between January 1991 and December 1995, 55.1 percent of handguns (1,893 of 3,438) recovered by the BPD were successfully traced by ATF to the first retail purchaser. Purchase dates were examined to determine whether Boston-recovered handguns were purchased at Virginia and other FFLs in I-95 southern states before or after the law was implemented. Virginia's one-handgun-per-month law was repealed in March 2012. To determine whether the repeal of the law affected interstate transfers of Boston crime guns, the sources of traced handguns recovered in Boston were compared for twenty-six months before (January 2010 through February 2012) and forty-six months after (March 2012 through December 2015). Between January 2010 and December 2015, 62.3 percent of handguns (1,764 of 2,830) recovered by the BPD were successfully traced by ATF to the first retail purchaser.

Table 3 presents the estimated odds ratios that a Boston-recovered handgun was purchased from a Virginia FFL relative to an FFL in another I-95 southern state for the implementation and repeal of Virginia's one-handgun-a-month law. Before the law was implemented, 20.1 percent of recovered handguns originating from an I-95 southern state were first purchased at a Virginia FFL; after the implementation, only 7.8 percent were. The likelihood that a Boston handgun would be traced to a Virginia FFL relative to licensed dealers elsewhere in I-95 southern states decreased by

Table 3. Estimated Odds Ratios, Recovered Handgun Purchases

Traced to I-95	Before Law N	Before Law Percentage	After Law N	After Law Percentage	Odds Ratio (95% CI)
After July 1993 law implementation comparison, January 1, 1991–December 31, 1995					
Southern state FFL	403	100.0	128	100.0	0.337
Virginia FFL	81	20.1	10	7.8	(0.169–0.671)
Other FFL	322	79.9	118	92.2	$Chi^2 = 10.33$ $p = .0013$
After March 2012 law repeal comparison, January 1, 2010–December 31, 2015					
Southern state FFL	251	100.0	65	100.0	1.878
Virginia FFL	27	10.8	12	18.5	(0.893–3.943)
Other FFL	224	89.2	53	81.5	$Chi^2 = 2.83$ $p = .0925$

Source: Author's calculations.

66.3 percent after the one-gun-a-month law took effect (OR=0.337, $p<.01$). Fifteen years later, before the law was repealed, 10.8 percent of recovered handguns originating from an I-95 southern state were first purchased at a Virginia FFL; after repeal, the figure was 18.5 percent. Although not statistically significant at the $p<.05$ level, the likelihood that a Boston handgun would be traced to a Virginia FFL relative to licenses dealers elsewhere in I-95 southern states increased by 87.8 percent after the law was repealed (OR=1.878, $p<.10$). These results are congruent with the findings of Weil and Knox's 1996 study and suggest that restricting handgun purchases to one per month may change where criminals get their guns.

Influence of Buy-Back Programs on Characteristics of Recovered Guns

Gun buy-backs involve a government or private group paying individuals to turn in guns they possess. Participants turning in guns are paid via cash disbursements, gift cards, or other compensation. To encourage participation by criminals, these programs do not require participants to identify themselves and do not maintain any records of the individuals who turned firearms in. The recovered guns are then destroyed. Despite empirical evidence that suggests gun buy-backs do not reduce violence, municipalities continue to implement these programs (Wellford, Pepper, and Petrie 2005; but see Leigh and Neill 2010). At least three problems are associated with the violence reduction theory underlying gun buy-backs: the guns turned in are the least likely to be used in criminal activities; because replacement guns are easy to acquire, the decline of guns on the street may be smaller than the number of guns that are turned in; and the likelihood that any particular turned-in gun will be used in crime is very low (Wellford, Pepper, and Petrie 2005).

Gun buy-back program implementers have responded to the empirical evidence by developing strategies to increase the likelihood that high-risk guns are turned in by high-risk individuals (Braga and Wintemute 2013). These strategies have included targeted advertising to young people in urban neighborhoods affected by high levels of gun violence and graded incentives to encourage the recovery of handguns and assault weapons. In response to community concerns over periodic outbreaks of serious gun violence, the City of Boston implemented gun buy-back programs three times: in 1993–1994, 2006, and 2014–2015. The characteristics of guns recovered during each period are presented in table 4.

In 1993 and 1994, a nonprofit crime preven-

Table 4. Characteristics of Firearms Recovered from Buybacks

	1993–1994	2006	2014–2015
N firearms	1,556	1,019	430
Percent handgun	56.1	85.7	89.1
Percent semiautomatic pistol	17.1	34.7	40.5
Percent .380, 9mm, .40, .45	1.9	26.1	11.4
Percent obliterated	4.3	4.1	3.9
Percent traced to first retail purchaser	11.1	33.9	44.2
Percent three years or less from first retail sale	4.1	9.2	5.3
Percent first sold at retail in I-95 states	15.7	18.8	13.7

Source: Author's calculations.

tion agency conducted buy-backs with the BPD and the Suffolk County district attorney, offering $50 per gun and recovering 2,158 guns (see Kennedy, Piehl, and Braga 1996b). BPD and ATF attempted to trace the chain of ownership from manufacturer to first retail purchaser of 1,566 (72.6 percent) of these: all 1,288 from 1993 but only the first 278 (31.9 percent) of 870 from 1994. BPD and ATF stopped comprehensive tracing efforts after finding that many were not traceable. Only 11 percent (173) were successfully traced to the first retail purchaser. BPD noted that licensed gun dealers from the suburbs used the event to clear their inventories of secondhand firearms that were worth less than the $50 incentive.

In 2006, then Boston mayor Thomas M. Menino, BPD, and numerous faith-based and community organizations launched the Aim for Peace gun buy-back program (see Braga and Wintemute 2013). It included four new programmatic elements designed to increase the number of handguns brought in from neighborhoods suffering from high levels of violence:

> Target gift cards for $200 were given for each handgun. Rifles and shotguns were accepted, but no incentives were provided.
>
> Individuals who turned in firearms had to prove that they were Boston residents before receiving a gift card. The names of participants were not associated with any recovered guns or recorded in any way.
>
> As in 1993–1994, BPD district stations served as gun drop-off locations. However, recognizing that some residents may not be comfortable walking into a police station with a gun, BPD also set up drop-off operations at eight community locations, such as churches and nonprofit organization offices, in neighborhoods with high rates of gun violence.
>
> A sophisticated communications campaign sought to engage Boston's youth via a podcast, more than thirty billboards in strategic locations frequented by city youth, and saturation advertising on city buses, subway cars, train stations, and bus stops.

The program operated from June 12 through July 14 and recovered 1,019 firearms; BPD attempted to trace all of them.

Beginning in March 2014 and continuing throughout 2015, mayor Martin J. Walsh and the BPD implemented the Your Piece for Peace program, which included some of the design features of the 2006 buy-back. Once again, the BPD provided a $200 Visa gift card for each turned-in handgun and, though long guns were accepted, no incentives were provided. Individuals were also required to prove they were Boston residents before they received a gift card. Although the launch of the program was publicized in the local media, it did not have the strategic advertising initiatives of its 2006 predecessor. The 2014–2015 buy-back did not have community-based drop-off locations and walk-in gun exchanges were limited to BPD district stations. Community members could, however, call the BPD and make arrangements for an officer to pick up firearms from their

residences. Although the program operated for an extended twenty-two months (and continued through 2016), the program yielded only 430 firearms. The BPD submitted all the buy-back guns to ATF for tracing.

Relative to the 1993–1994 program, the 2006 buy-back yielded more handguns, especially higher-powered semiautomatic pistols (table 4).[4] The 1993–1994 buy-back recovered more older long guns than newer handguns associated with the youth gun violence epidemic of the period (Kennedy, Piehl, and Braga 1996b). Although similar numbers of guns from the 1993–1994 and 2006 buy-backs had obliterated serial numbers, a much higher number from the 2006 program were successfully traced by ATF (Braga and Wintemute 2013). Relative to 1993–1994, the 2006 firearms were more likely to have been purchased within three years of their first retail sale and more likely to have originated from dealers along the Iron Pipeline. The 2014–2015 buy-back yielded fewer guns but did secure more handguns and semiautomatic pistols than its predecessors. ATF was also able to successfully trace 44.2 percent of the 2014–2015 guns, notably more than the earlier programs.

The features of the 2014–2015 program may have unintentionally diminished the overall number of recovered handguns and reduced the share of higher-powered semiautomatic pistols taken off Boston streets relative to the 2006 program. Traceable firearms were also less likely to have included newer guns that were first sold at retail outlets in the I-95 southern states. As described elsewhere in this article, increasing the number of recovered guns with these indicators provides law enforcement agencies with additional opportunities to identify and apprehend gun traffickers. Unfortunately, the 2014–2015 buy-back recovered fewer high-risk handguns than its immediate predecessor. Gun criminals in disadvantaged neighborhoods may have not been aware of the opportunity to turn in their guns given the lack of strategic advertising in the later program. Among those who were aware, some may have been dissuaded by the prospects of walking into a police station with a gun or calling the police to schedule a gun pick-up.

These analyses suggest that program design may matter when attempting to encourage high-risk individuals to turn in their guns. However, the first two programs did not reduce levels of gun violence in Boston after implementation (Kennedy, Piehl, and Braga 1996b; Braga and Wintemute 2013). Over the course of the 2014–2015 program, the number of fatal and nonfatal shooting victims increased by 14 percent from 214 in 2014 to 244 in 2015. These findings suggest that, even with program design modification that improved the kinds of guns turned in, buy-back programs are not an effective market intervention to reduce gun violence.

CONCLUSION

The longitudinal analyses of Boston firearm recovery and trace data shed some policy-relevant insight on evolving illegal gun market dynamics serving criminals in one jurisdiction. First, they suggest that handguns recovered by the BPD became increasingly deadly over time. Beginning in the 1990s, higher-capacity semiautomatic pistols capable of shooting larger numbers of bullets replaced revolvers as the most frequently recovered type of handgun in Boston. Equally concerning, the share of smaller caliber handguns among BPD recoveries diminished over the 2000s as the prominence of larger caliber handguns increased. This transition from revolvers to semiautomatic pistols recovered by law enforcement agencies mirrors national trends in handgun production in the United States between the 1980s and 1990s (Wintemute 2006). Given the increased killing power of handguns in the civilian firearms stock, it is imperative to block

4. As Braga and Wintemute note, the available data suggest that improvements in the guns recovered were driven by changes in buy-back design features rather than secular changes in the underlying distribution of crime guns during the intervening years (2013). In 1993 and 1994, the BPD submitted 1,637 recovered crime guns to ATF for tracing: 75.8 percent were handguns and 48.4 percent were traceable. In 2006, the BPD submitted 554 recovered crime guns to ATF for tracing: 89.5 percent were handguns and 53.9 percent were traceable. The 2006 guns more closely resembled the stock of crime guns.

access by criminals, juveniles, and other high-risk individuals.

Like many other U.S. cities, the bulk of Boston's serious gun violence problem is generated by a relatively small number of criminally active gang members (Braga 2003; Braga, Hureau, and Winship 2008; see also, for example, Papachristos and Wildeman 2014; Papachristos et al. 2015). Boston gun criminals seem to be supplied by illegal diversions of handguns from both out-of-state and in-state FFLs. The age of recovered handguns, as measured as the time between the first retail sale and confiscation by the BPD, has also increased, suggesting a problem with the illegal diversion of older firearms from secondary market sources.

Massachusetts gun laws should provide state and local law enforcement agencies with the necessary tools to regulate secondary transfers of firearms within the state. Unfortunately, as Braga and Hureau suggest, little enforcement and regulatory attention seems to be paid to the problem of suspicious transfer patterns in Massachusetts (2015). Long-term trends document a noteworthy share of traced handguns originating from FFLs in I-95 southern states and an increasing share from those in nearby New Hampshire and Maine. The lack of paperwork on secondary market transfers in these lax gun control states, however, makes launching investigations into interstate gun trafficking operations of older firearms very difficult.

Strategic enforcement programs focused on the illegal diversion of new firearms from primary markets may reduce the availability of new guns to criminals (Webster et al. 2006; Webster, Vernick, and Bulzacchelli 2006). The analyses presented here strengthened the case that the anti–gun trafficking component of Boston's Operation Ceasefire strategy did indeed reduce the prevalence of new handguns recovered by the BPD. What is more, this study suggests that the presence of state one-gun-per-month laws do influence where criminals acquire guns. Unfortunately, whether these market-based interventions reduced the overall availability of guns to criminals and whether supply-side interventions have a measureable impact on gun violence remain unclear. Modifying the programmatic features of buy-back programs in Boston seemed to increase the share of recovered semiautomatic pistols that could be traced to their retail origins. However, the implementation of gun buy-back programs in Boston was not associated with any gun violence reductions.

Rational debate on gun policy requires detailed information on crime guns. ATF currently produces modest summaries of the characteristics of crime gun traces for the fifty states, the District of Columbia, U.S. territories, Canada, Mexico, and the Caribbean (www.atf.gov/statistics/index.html). Unlike the national and city-level trace reports generated by the now-defunct Youth Crime Gun Interdiction Initiative (ATF 2002), ATF's current state-level crime gun summaries do not involve external academics and do not provide more rigorous and detailed analyses of crime gun sources, trends, and patterns. ATF should return to publishing these more detailed annual crime gun trace reports overseen by external academics. The Boston illegal gun market research summarized and extended here highlights the policy-relevant findings that can be generated through ongoing academic analyses of ATF trace data and local police data.

REFERENCES

Azrael, Deborah, Philip J. Cook, and Matthew Miller. 2004. "State and Local Prevalence of Firearms Ownership: Measurement, Structure, and Trends." *Journal of Quantitative Criminology* 20(1): 43–62.

Bea, Keith, and Michael J. Burton. 1992. "'Assault Weapons': Military-Style Semi-Automatic Firearms Facts and Issues." *CRS* Report no. 92–434. Washington, D.C.: Government Printing Office.

Bever, Fred. 2014. "When Mass. Criminals Want a Gun, They Often Head North," WBUR News, February 24. Accessed July 3, 2017. http://www.wbur.org/2014/02/24/gun-trafficking-into-massachusetts.

Braga, Anthony A. 2003. "Serious Youth Gun Offenders and the Epidemic of Youth Violence in Boston." *Journal of Quantitative Criminology* 19(1): 33–54.

Braga, Anthony A., Robert Apel, and Brandon C. Welsh. 2013. "The Spillover Effects of Focused Deterrence on Gang Violence." *Evaluation Review* 37(3–4): 314–42.

Braga, Anthony A., and Philip J. Cook. 2016. "The Criminal Records of Gun Offenders." *Georgetown Journal of Law and Public Policy* 15(1): 1–16.

Braga, Anthony A., Philip J. Cook, David M. Kennedy, and Mark H. Moore. 2002. "The Illegal Supply of Firearms." In *Crime and Justice: A Review of Research*, vol. 29, edited by Michael Tonry. Chicago: University of Chicago Press.

Braga, Anthony A., and David M. Hureau. 2015. "Strong Gun Laws Are Not Enough: The Need for Improved Enforcement of Secondhand Gun Transfer Laws in Massachusetts." *Preventive Medicine* 79 (October): 37–42.

Braga, Anthony A., David M. Hureau, and Andrew V. Papachristos. 2014. "Deterring Gang-Involved Gun Violence: Measuring the Impact of Boston's Operation Ceasefire on Street Gang Behavior." *Journal of Quantitative Criminology* 30(1): 113–39.

Braga, Anthony A., David M. Hureau, and Christopher Winship. 2008. "Losing Faith? Police, Black Churches, and the Resurgence of Youth Violence in Boston." *Ohio State Journal of Criminal Law* 6(1): 141–72.

Braga, Anthony A., David Kennedy, E. Waring, and Anne M. Piehl. 2001. "Problem-Oriented Policing, Deterrence, and Youth Violence: An Evaluation of Boston's Operation Ceasefire." *Journal of Research in Crime and Delinquency* 38(3): 195–225.

Braga, Anthony A., Andrew V. Papachristos, and David M. Hureau. 2010. "The Concentration and Stability of Gun Violence at Micro Places in Boston, 1980–2008." *Journal of Quantitative Criminology* 26(1): 33–53.

Braga, Anthony A., and Glenn L. Pierce. 2005. "Disrupting Illegal Firearms Markets in Boston: The Effects of Operation Ceasefire on the Supply of New Handguns to Criminals." *Criminology and Public Policy* 4(4): 717–48.

Braga, Anthony A., and David L. Weisburd. 2012. "The Effects of Focused Deterrence Strategies on Crime: A Systematic Review and Meta-Analysis of the Empirical Evidence." *Journal of Research in Crime and Delinquency* 49(3): 323–58.

Braga, Anthony A., and Garen J. Wintemute. 2013. "Improving the Potential Effectiveness of Gun Buyback Programs." *American Journal of Preventive Medicine* 45(5): 668–71.

Braga, Anthony A., Garen J. Wintemute, Glenn L. Pierce, Philip J. Cook, and Greg Ridgeway. 2012. "Interpreting the Empirical Evidence on Illegal Gun Market Dynamics." *Journal of Urban Health* 89(5): 779–93.

Bureau of Alcohol, Tobacco and Firearms (ATF). 2000. *Following the Gun: Enforcing Federal Laws Against Firearms Traffickers*. Washington, D.C.: Bureau of Alcohol, Tobacco and Firearms.

———. 2002. *Crime Gun Trace Analysis (2000): National Report*. Washington, D.C.: Bureau of Alcohol, Tobacco and Firearms.

Cook, Philip J., and Anthony A. Braga. 2001. "Comprehensive Firearms Tracing: Strategic and Investigative Uses of New Data on Firearms Markets." *Arizona Law Review* 43: 277–309.

Cook, Philip J., Anthony A. Braga, and Mark H. Moore. 2011. "Gun Control." In *Crime and Public Policy*, rev. ed., edited by James Q. Wilson and Joan Petersilia. New York: Oxford University Press.

Cook, Philip J., Richard J. Harris, Jens Ludwig, and Harold A. Pollock. 2015. "Some Sources of Crime Guns in Chicago: Dirty Dealers, Straw Purchasers, and Traffickers." *Journal of Criminal Law and Criminology* 104(4): 717–59.

Cook, Philip J., Jens Ludwig, Sudhir Venkatesh, and Anthony A. Braga. 2007. "Underground Gun Markets." *Economic Journal* 117(524): 558–88.

Cook, Philip J., Susan T. Parker, and Harold A. Pollack. 2015. "Sources of Guns to Dangerous People: What We Learn by Asking Them." *Preventive Medicine* 79(1): 28–36.

Kennedy, David M. 1994. "Can We Keep Guns Away from Kids?" *American Prospect* 18(1): 74–80.

Kennedy, David M., Anthony A. Braga, and Anne M. Piehl. 1997. "The (Un)Known Universe: Mapping Gangs and Gang Violence in Boston." In *Crime Mapping and Crime Prevention*, *Crime Prevention Studies*, vol. 8, edited by David Weisburd and J. McEwen. Monsey, N.Y.: Criminal Justice Press.

Kennedy, David M., Anne M. Piehl, and Andrew A. Braga. 1996a. "Youth Violence in Boston: Gun Markets, Serious Youth Offenders, and a Use-Reduction Strategy." *Law and Contemporary Problems* 59(1): 147–96.

———. 1996b. "Gun Buy-Backs: Where Do We Stand and Where Do We Go?" In *Under Fire: Gun Buy-Backs, Exchanges, and Amnesty Programs*, edited by Martha R. Plotkin. Washington, D.C.: Police Executive Research Forum.

Kleck, Gary, and Shun-Yung Kevin Wang. 2009. "The Myth of Big-Time Gun Trafficking and the

Overinterpretation of Gun Trace Data." *UCLA Law Review* 56: 1233–94.

Koper, Christopher S., and Jeffrey A. Roth. 2001. "The Impact of the 1994 Federal Assault Weapons Ban on Gun Markets: An Assessment of Multiple Outcome Measures and Some Lessons for Policy Evaluation." *Journal of Quantitative Criminology* 17(1): 239–66.

Larson, Erik. 1994. *Lethal Passage: The Story of a Gun*. New York: Crown Publishers.

Leigh, Andrew, and Christine Neill. 2010. "Do Gun Buybacks Save Lives? Evidence from Panel Data." *American Law and Economics Review* 12(2): 462–508.

Moore, Mark H. 1973. "Achieving Discrimination in the Effective Price of Heroin." *American Economic Review* 63(2): 193–206.

———. 1976. *Buy and Bust: The Effective Regulation of an Illicit Market in Heroin*. Lexington, Mass.: Heath.

Okoro, Catherine A., David E. Nelson, James A. Mercy, Lina S. Balluz, Alex E. Crosby, and Ali H. Mokdad. 2005. "Prevalence of Household Firearms and Firearms Storage Practices in 50 States and the District of Columbia." *Pediatrics* 116(3): e370–76.

Papachristos, Andrew V., Anthony A. Braga, and David M. Hureau. 2012. "Social Networks and the Risk of Gunshot Injury." *Journal of Urban Health* 89: 992–1003.

Papachristos, Andrew V., Anthony A. Braga, Eric Piza, and Leigh S. Grossman. 2015. "The Company You Keep? The Spillover Effects of Gang Membership on Individual Gunshot Victimization in a Co-Offending Network." *Criminology* 53(4): 624–49.

Papachristos, Andrew V., and Christopher Wildeman. 2014. "Network Exposure and Homicide Victimization in an African American Community." *American Journal of Public Health* 104(1): 143–50.

Pierce, Glenn L., Anthony A. Braga, Raymond R. Hyatt, and Christopher S. Koper. 2004. "The Characteristics and Dynamics of Illegal Firearms Markets: Implications for a Supply-Side Enforcement Strategy." *Justice Quarterly* 21(2): 391–422.

Reiss, Albert J., and Jeffrey A. Roth, eds. 1993. *Understanding and Preventing Violence*, vol. 1. Washington, D.C.: National Academies Press.

Smith, Tom W., and Jackson Son. 2015. "General Social Survey Final Report: Trends in Gun Ownership in the United States, 1972–2014." Chicago: National Opinion Research Center at University of Chicago.

Sorenson, Susan B., and Katherine A. Vittes. 2003. "Buying a Handgun for Someone Else: Firearm Retailer Willingness to Sell." *Injury Prevention* 9(2): 147–50.

Webster, Daniel W., Jon S. Vernick, and Maria T. Bulzacchelli. 2006. "Effects of a Gun Dealer's Change in Sales Practices on the Supply of Guns to Criminals." *Journal of Urban Health* 83(5): 778–87.

Webster, Daniel W., April M. Zeoli, Maria T. Bulzacchelli, and Jon S. Vernick. 2006. "Effects of Police Stings of Gun Dealers on the Supply of New Guns to Criminals." *Injury Prevention* 12(4): 225–30.

Weil, Douglas S., and Rebecca C. Knox. 1996. "Effects of Limiting Handgun Purchases on Interstate Transfer of Firearms." *Journal of the American Medical Association* 275(22): 1759–61.

Wellford, Charles F., John V. Pepper, and Carol V. Petrie, eds. 2005. *Firearms and Violence: A Critical Review.* Committee to Improve Research and Information on Firearms. Washington, D.C.: National Academies Press.

Wintemute, Garen J. 2010. "Guns and Gun Violence." In *The Crime Drop in America*, rev. ed., edited by Alfred Blumstein and Joel Wallman. New York: Cambridge University Press.

Wintemute, Garen J., Philip J. Cook, and Mona A. Wright. 2005. "Risk Factors Among Handgun Retailers for Frequent and Disproportionate Sales of Guns Used in Violent and Firearm Related Crimes." *Injury Prevention* 11(6): 357–63.

Zimring, Franklin E. 1975. "Firearms and Federal Law: The Gun Control Act of 1968." *Journal of Legal Studies* 4(1): 133–98.

———. 1976. "Street Crime and New Guns: Some Implications for Firearms Control." *Journal of Criminal Justice* 4(1): 95–107.