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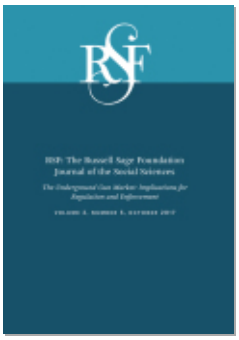

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This study assesses the impact of Maryland's Firearm Safety Act (FSA) of 2013 on indicators of diversion of handguns to prohibited persons. Interrupted time-series analyses were conducted, and the findings were supplemented by results from a survey of men on parole and probation regarding Baltimore's underground gun market. The FSA was associated with an 82 percent reduction in police recovery of handguns with strong indicators of diversion (IRR=0.18, p=.005). Forty-one percent of survey respondents reported having more difficulty getting a handgun after the FSA because of increased cost, lack of trusted sources, or people less willing to engage in straw purchases on their behalf. These findings are consistent with the theory that the FSA reduces the diversion of handguns into the underground market.

Keywords: underground market, gun policy, diversion

The potential effectiveness of gun sales laws rests not only on individuals at high risk of committing harm with guns being prohibited from purchasing or possessing guns, but also on how well the laws prevent the diversion of guns to prohibited persons. Various laws have been put in place to prevent the diversion of guns to prohibited persons. The foundation of these laws includes requirements that purchasers pass background checks and sellers maintain records of purchaser information, dates of sale, and the specifics of the guns, including serial numbers. These requirements allow law enforcement to trace guns they recover from criminal suspects or crime scenes to the original retail sale and, in some cases, even subsequent sales.

Research demonstrates that laws designed to prevent such diversion by increasing the accountability of gun sellers and buyers are as-

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sociated with lower levels of guns diverted to prohibited persons in cross-sectional studies. These laws include permit-to-purchase (PTP) laws for handguns, the extension of background check requirements to gun transfers between private parties, mandatory reporting of lost or stolen guns by owners, and strong regulation and oversight of licensed gun dealers (Webster, Vernick, and Bulzacchelli 2009; Webster et al. 2013; Pierce, Braga, and Wintemute 2015).

Current federal laws include many weaknesses that allow guns to be diverted to prohibited persons with relatively little risk to sellers (Webster and Wintemute 2015). Many states have passed laws that attempt to address deficiencies in federal law by extending background checks and record-keeping requirements—and in some cases gun theft reporting requirements—to transfers made by private gun owners. Nine states and the District of Columbia also have some form of licensing system for handgun purchasers that outlaws the transfer of a handgun to anyone who does not have a valid PTP. Because scofflaw retail gun dealers can potentially divert large quantities of guns to criminals over time, and federal law and oversight are somewhat weak, some states also have their own regulation of licensed gun dealers.

Studies of the diversion of guns for criminal use necessarily rely on crime gun trace data from the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF). These data provide information on the state of retail sale, state of crime involvement, whether the retail purchaser and the criminal possessor were the same person, and the dates the guns were first sold and then recovered by law enforcement. These dates allow ATF to generate a time-to-crime (TTC) for traced guns. The national average TTC for traced guns in 2015 was 10.48 years; Maryland's was 12.39 years (ATF 2016a). A gun recovered within one year of retail sale indicates to law enforcement that the gun was likely purchased with the intent of diverting that gun to a prohibited person (ATF 2002). The use of crime gun trace data to evaluate the diversion of guns to prohibited persons has gained increasing research support and validity, and supply-side constraints, such as requiring a PTP for handgun purchasers, are associated with reduced likelihood of the diversion of guns (Braga et al. 2012; Webster, Vernick, and Hepburn 2001).

Because most of the relevant laws have been in place for decades and few cities consistently traced the origins of the guns they recovered in crime before the late 1990s, opportunities to examine whether changes in these laws result in changes in indicators of diversion of guns for criminal use have been limited. Recent studies of changes in PTP handgun laws in Connecticut, which implemented its law along with universal background check requirements in 1995, and Missouri, which repealed its PTP law in 2007, provide evidence that these laws reduced criminal access to guns and homicides committed with guns. Using analytic methods to create so-called synthetic controls for Connecticut's gun and nongun homicide rates to estimate counterfactuals for the first ten years following the implementation of the law requiring background checks and PTP for all handgun purchases, researchers estimated that the law was associated with a 40 percent reduction in gun homicide rates over the first ten years it was in place (Rudolph et al. 2015). A separate study estimated that Missouri's repeal of its PTP law was associated with a 14 percent increase in murders during the first five full years after the law's repeal, with the effects specific to events involving guns (Webster, Crifasi, and Vernick 2014). Missouri's repeal of its PTP handgun law was also followed by a twofold increase in the percentage of crime guns with very short intervals between retail sale and crime involvement and a large increase in the share of crime guns from sales originating within Missouri versus other states (Webster et al. 2013). Another study provides evidence that the repeal was associated with increased risk of law enforcement officers being shot in the line of duty in ways consistent with PTP laws being protective against criminal gun use (Crifasi, Pollack, and Webster 2015).

In 1996, Maryland enacted a law that made all handgun transfers, including those made by a private seller, contingent on the purchaser passing a background check. In 2013, Maryland lawmakers enacted the Firearm Safety Act (FSA), which has multiple components that could potentially reduce diversion of guns into

the hands of prohibited persons. These include requiring a PTP for anyone purchasing a handgun from either a licensed gun dealer or a private owner, expanding authority for state police to act against gun dealers found to have violated state gun sales laws (such as fines or license suspension or revocation), and mandating that gun owners report within seventy-two hours any theft or loss of a regulated gun. Additionally, the FSA bans the sale of assault rifles, limits magazine size to ten rounds, and bars persons who receive probation before judgment for violent crimes from possessing guns.

The PTP provision requires prospective purchasers to obtain a license issued by Maryland State Police, contingent on their passing a background check and completing a four-hour safety training course conducted by an approved and registered instructor. Individuals who were registered handgun owners before the FSA went into effect are exempt from the safety training requirement. Applicants for the license must also be fingerprinted during the application process by certified vendors that submit digital images of the prints to the Maryland State Police.

This article assesses the impact of Maryland's FSA of 2013 on the underground gun market in Baltimore. We analyzed data from handguns recovered by police and submitted for tracing to assess whether the new law was associated with fewer crime handguns recovered shortly after a retail sale from someone other than the retail purchaser, and an increase in the number of recovered crime handguns initially purchased in other states. To assess the perceived impact of the FSA on the underground gun market, we supplemented the analysis of crime handgun trace data with a qualitative evaluation of knowledge of the FSA and the perception among individuals prohibited from purchasing or possessing guns—Baltimore City residents currently on parole or probation—of changes in gun accessibility following the implementation of the FSA.

METHODS

Data on guns recovered by police and submitted for tracing were obtained from the Baltimore Police Department (BPD) for the period from January 1, 2007, through September 30, 2015. When a gun trace was successful, the data included information on original sale date and purchaser, recovery date, possessor, and the type of incident in which the gun was recovered. Gun trace data were excluded from our analyses if the incident in which the gun was recovered was recorded as "found/recovered property" or as "safe-keeping/turn in/buyback." Such weapons were excluded so that only guns recovered in a crime were included in the dependent variable, making the analysis as specific as possible in testing the law's effect on the diversion of guns to criminals. Additionally, because most guns used in crime are handguns, and the FSA specifically licenses handgun purchasers, analyses were restricted to handguns.

We obtained data from Maryland State Police by month and year on the number of gun registration applications approved during the study period to have a proxy measure for the number of handguns also at risk for diversion to the underground gun market during the month and year a crime handgun was sold.

Because of legal restrictions on the sharing of crime gun trace data, simply no data are available at this granular level to generate an appropriate city-level comparison. The only available data are state-level reports of crime gun recoveries published by ATF; these reports, however, do not distinguish between types of guns (handgun or long gun), and they do not provide information on source state for short TTC guns, on whether the criminal possessor was the original purchaser, or in what month the gun was sold. These data elements are key to evaluating the effect of the FSA on the diversion of guns into the underground market. Thus, though we do present some state-level descriptive data, our time-series analyses are restricted to crime handguns recovered by police in Baltimore City and submitted for tracing.

Analytic Methods

We used an interrupted time-series design to test whether any changes were significant in key indicators of handgun trafficking or diversion of handguns for criminal purposes coincident with the implementation of the FSA on October 1, 2013. Similar to studies on gun trafficking or diversions of guns to individuals who

used those guns in crime, ours examined two trafficking indicators—short TTC following a retail sale and the percentage of crime guns initially sold by out-of-state retailers.

We used four outcomes with monthly time series: the number of handguns originally sold in Maryland with a TTC of less than one year; the number of handguns originally sold in Maryland with a TTC of less than one year and the criminal possessors were not the purchasers of record; the number of handguns originally sold by out-of-state gun dealers; and the number of handguns originally sold by out-of-state gun dealers and the criminal possessors were not the purchasers of record.

For the less than one year TTC outcomes, observations were based on the month the handgun was sold, which enabled us to categorize whether a handgun used in crime had been sold under FSA rules. Measures that involved handguns recovered from someone other than the lawful purchaser allowed for a direct assessment of the FSA's effect on the diversion of handguns for criminal purposes. Our hypothesis was that the FSA would be associated with reductions in measures of guns that originated in Maryland. If that proved true, we hypothesized a modest increase in measures of guns originating outside of Maryland as individuals seeking handguns for criminal use pursued alternatives to new handguns originating from retail sales in Maryland.

Interrupted time-series analyses were performed on crime handgun trace data to discern whether the implementation of the FSA was associated with changes in the outcomes described above. Negative binomial regression models were used due to overdispersion in the data (likelihood ratio test of alpha=0, $p<.05$). We controlled for baseline trends in the outcome variables in two ways, with year fixed effects and a linear trend term. Indicator variables for calendar month were evaluated for inclusion to adjust for potential seasonality in the outcome variables.

The number of less than one year TTC handguns recovered by police may be influenced by policing practices that vary over time with respect to the degree to which arrests for illegal gun possession are prioritized. Therefore, we controlled for variation in the mean number of all handguns recovered by the BPD during the twelve months following a sales month observation, *t*. Because of the short observation period following the law's implementation and the truncated follow-up period such that handguns sold after October 1, 2014, have less than one year in which they would be at risk of recovery by the BPD, we included a covariate to measure exposure for the number of months a handgun was at risk of being recovered in a crime.

Because of the limited control variables available, and the lack of an appropriate comparison jurisdiction with the same granular-level crime gun trace data, we evaluated our data's pre-intervention stationarity using autoregressive integrated moving average modeling. The autoregressive component to our outcome variables was significant; however, the inclusion of monthly gun recoveries accounted for the lack of stationarity and made the autoregressive component nonsignificant. We were therefore confident in our use of an interrupted time-series model with negative binomial regression controlling for monthly crime gun recoveries.

We also ran the models with and without a control for the number of gun registration applications approved during the month of a crime handgun's sale that originated in Maryland. An argument can be made for excluding approved gun applications from the regression models because it could partly mediate the effect of the FSA on handguns diverted for criminal use and bias estimates of the full effect of the new policies. We therefore present findings with and without controls for changes in the volume of gun purchase applications.

The estimated effects from the interrupted time-series analyses are presented as incident rate ratios (IRR) with 95 percent confidence intervals. Analyses were conducted using Stata IC version 14.2 (StataCorp 2015).

Survey Methods

To assess awareness and perceived impact of the FSA among persons legally prohibited from purchasing or possessing guns, we included four FSA-specific questions in a multipart survey designed to appraise gun availability in the underground gun market in Baltimore. Using

a convenience sampling methodology, we administered the survey in May and June 2016 to 195 men on parole or probation in Baltimore. The selection was to identify persons with recent interaction with the criminal justice system that would prohibit them from purchasing or possessing a gun under Maryland state law.

Survey respondents were recruited outside parole and probation offices in Baltimore. Men who asserted that they were over the age of eighteen, currently on parole or probation, and Baltimore residents were invited to complete the survey after eligibility was determined via screening questions. All participants were anonymous volunteers. If an individual met the eligibility criteria and was interested in participating, research assistants escorted him to a semiprivate location where he received additional information and specific instructions about the study.

Both the informed consent process and the survey were self-administered using a closed-ended computerized survey instrument with audio assistance to ensure confidentiality and prevent issues of low literacy from affecting participation. This methodology allowed for uniform and anonymous collection of data related to the underground gun market that would be otherwise difficult to obtain. Research assistants, who were trained in participant recruitment, supervised the survey completion and provided technical assistance when needed. The survey process took approximately thirty minutes. The four survey items specifically related to the FSA asked whether respondents perceived that the new law affected the following factors:

- the difficulty of obtaining a gun generally,
- the cost of a gun,
- the willingness of another individual to buy a gun on the respondent's behalf (a straw purchaser), and
- the ease of finding a trusted source that would sell a gun to the respondent.

A respondent who answered yes, to indicate that the law made it more difficult to obtain a gun, was presented with a narrative text box to provide detail on how the law made obtaining a gun more difficult. This study was approved by the Johns Hopkins Institutional Review Board.

RESULTS

The results are comprised of an analysis of BPD's crime gun trace data and surveys of prohibited purchasers in Baltimore City.

Crime Gun Trace Data

Over the study period, BPD submitted 21,546 guns for tracing. Of these, 6,520 were found guns or guns turned in by citizens and 5,476 were rifles or shotguns; these categories were excluded from the analysis. Data for 11,462 handguns that were connected to a criminal suspect, crime scene, or criminal investigation were submitted for tracing. More than half (55.6 percent) of the handguns were recovered in arrests for illegal handgun possession; 20.3 percent were recovered in drug-related arrests; and 17.8 percent were connected to some type of violent crime (see table 1).

Table 2 shows, by year, the total crime handguns recovered by BPD as well as the number and percentage that could be traced to the state of original retail sale. The number of handguns recovered and submitted for tracing declined through the study period. The proportion of handguns recovered by BPD that originated in Maryland hovered around 45 percent from 2007 to 2012, but declined gradually starting in 2013.

During the study period, Maryland State Police processed and approved 441,882 gun registration applications. Figure 1 presents the trend for the number of approved applications per month. A sharp increase occurred in late 2012, followed by a huge spike in purchase applications just before FSA implementation.

Figure 2 depicts a three-month moving average of the number of handguns that originated in Maryland and were recovered within one year of retail sale when the purchaser was someone other than the criminal possessor. The monthly count of crime handguns diverted within a year of retail sale hovered around a mean of two from 2009 through the first half of 2013 and then spiked in the third quarter of 2013, just before the FSA went into effect. The indicator then fell to less than one

Table 1. Handguns Recovered, January 2007 to September 2015

Crime Category	Number (n=11,462)	Percentage with Offense Type Listed (n=11,131)
Assault	910	8.2
Carjacking	48	0.4
Illegal discharge of firearm	67	0.6
Discharge (police involved)	15	0.1
Domestic assault	15	0.1
Drug related	2,252	20.3
Handgun violation	6,191	55.6
Homicide or attempted homicide	289	2.6
Homicide or attempt (police involved)	33	0.3
Nonfatal shooting/attempt	584	5.2
Nonfatal shooting or attempt (police involved)	97	0.9
Property crime	106	1.0
Questionable death	49	0.4
Rape/sex offense	15	0.1
Other	166	1.5
Missing	331	

Source: Authors' calculations based on Baltimore Police Department crime gun trace data.

Table 2. Crime-Involved Handguns Recovered, January 2007 to September 2015

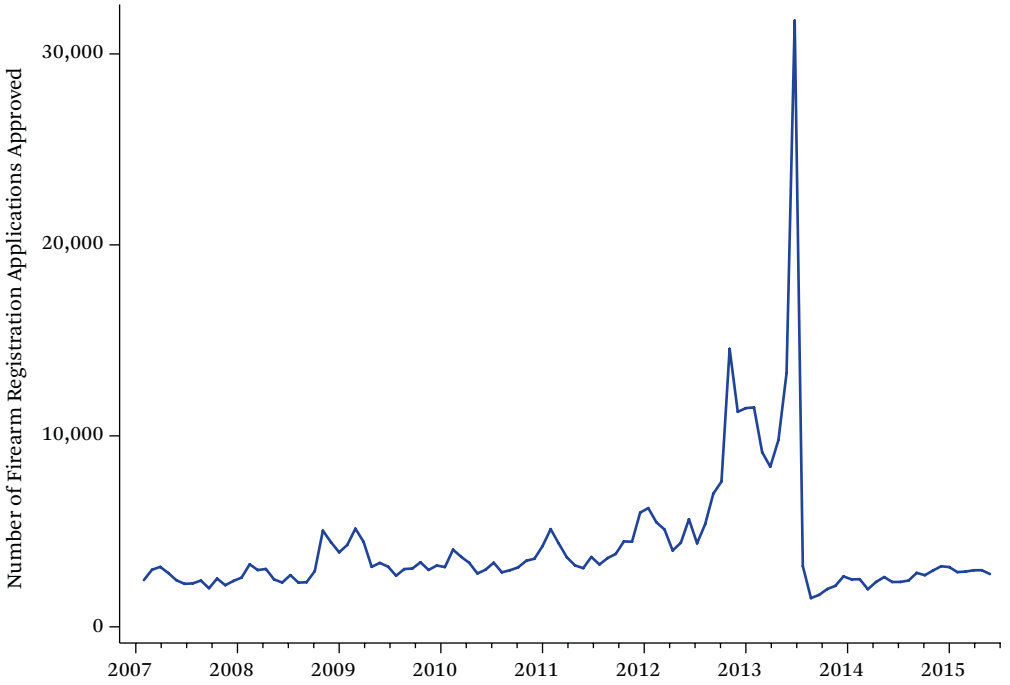
Year	Total Recovered: n	Traced to State of Retail Sale: n (percent)
2007	1,527	1,193 (78)
2008	1,383	1,046 (76)
2009	1,370	1,082 (79)
2010	1,308	1,027 (79)
2011	1,243	976 (79)
2012	1,202	1,012 (84)
2013	1,162	915 (79)
2014	1,238	929 (75)
2015[a]	1,029	845 (82)
Total	11,462	9,025

Source: Authors' calculations based on Baltimore Police Department crime gun trace data.
[a] Data through September 2015.

per month after the FSA went into effect on October 1, 2013 (see figure 2). Overall, the mean number of handguns per month with TTC of less than one year for the retail sales period before the FSA was 6.0 (SD=3.31), dropped to 2.58 (SD=1.08) during the first twelve months the FSA was in effect, and then increased to 4.25 (SD=2.25) for the period between October 2014 and September 2015.

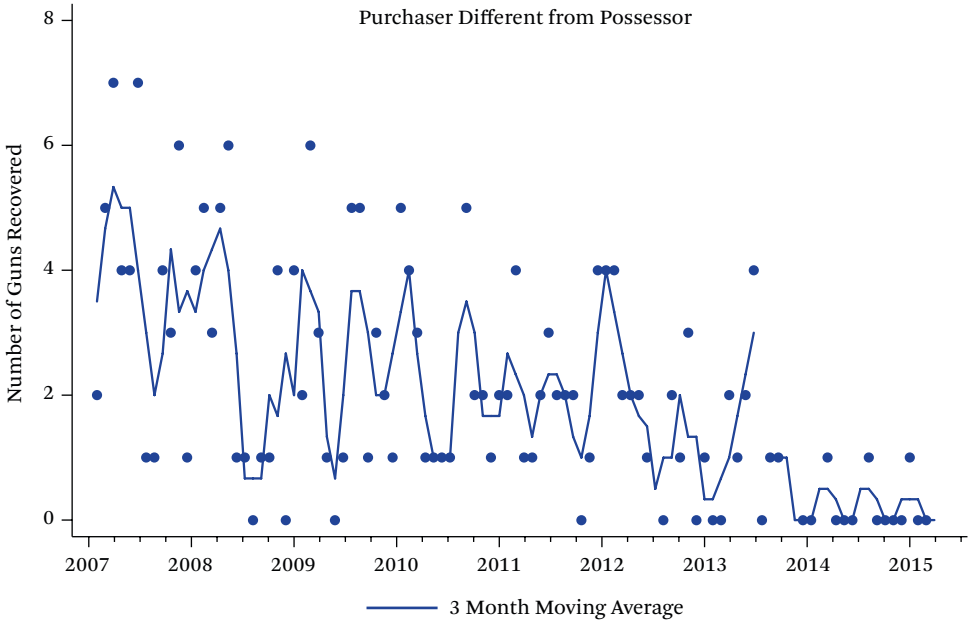
The results from the regression analyses are consistent with the hypothesis that the FSA would be protective against the diversion of guns into the underground market for criminal use (see table 3). For all handguns originally sold in Maryland that were recovered within one year of retail sale, the IRR for the FSA is 0.33 (p=.001), which translates to a 67 percent decline in this outcome. The FSA was associ-

Figure 1. Firearm Registration Applications Approved in Maryland



Source: Authors' calculations based on Baltimore Police Department crime gun trace data.

Figure 2. Handguns Sold in Maryland and Recovered in Criminal Incidents



Source: Authors' calculations based on Baltimore Police Department crime gun trace data.
Note: Within one year of retail sale, purchaser different from possessor.

Table 3. Estimated Effects of Maryland's Firearm Safety Act

Dependent Variable	FSA IRR (95 percent CI)	Overall Crime Gun Recoveries IRR (95 percent CI)	Linear Trend IRR (95 percent CI)
Guns sold in Maryland and recovered within one year of retail sale	0.33* (0.17 to 0.64)	1.03* (1.00 to 1.05)	1.00 (0.99 to 1.01)
Guns sold in Maryland and recovered within one year of retail sale and purchaser different from possessor	0.18* (0.05 to 0.60)	1.02 (0.99 to 1.06)	0.99 (0.98 to 1.01)
Guns sold outside Maryland	1.20 (0.61 to 2.37)	0.996* (0.99 to 1.00)	Year fixed effects used
Guns sold outside Maryland and purchaser different from possessor	1.13 (0.53 to 2.45)	0.996* (0.99 to 1.00)	Year fixed effects used

Source: Authors' calculations based on Baltimore Police Department crime gun trace data.
*$p < .05$

Table 4. Estimated Effects of Maryland's Firearm Safety Act, Controlling for Volume

Dependent Variable	FSA IRR (95 percent CI, p)	Overall Crime Gun Recoveries IRR (95 percent CI, p)	Total MD Firearm Registration Applications Approved IRR (95 percent CI, p)	Linear Trend IRR 95 percent CI, p)
Guns sold in Maryland and recovered within one year of retail sale	0.41* (0.20 to 0.82)	1.02 (1.00 to 1.05)	1.00 (1.00 to 1.00)	0.99 (0.98 to 1.00)
Guns sold in Maryland and recovered within one year of retail sale and purchaser different from possessor	0.24* (0.069 to 0.84)	1.02 (0.98 to 1.05)	1.00 (1.00 to 1.00)	0.99 (0.97 to 1.00)

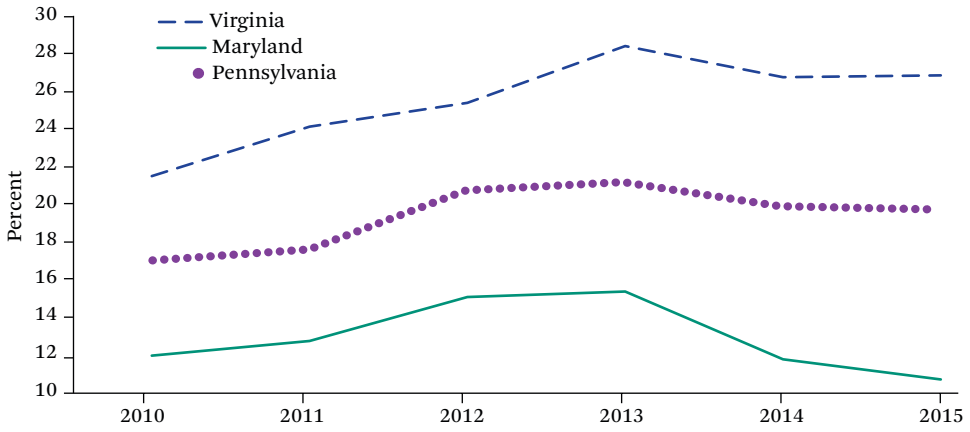
Source: Authors' calculations based on Baltimore Police Department crime gun trace data.
*$p < .05$

ated with an 82 percent reduction in the number of handguns originally sold in Maryland that were recovered within one year of retail sale and the purchaser was not the same as the possessor (IRR=.18, p=.005); this is a key indicator that a gun was purchased with the intent of diverting it for criminal use.

Controlling for the volume of gun registration applications approved in the month of a crime gun's sale (that is, how many handguns were at risk of being diverted for criminal purposes at the time a crime handgun was sold) did not remarkably affect the magnitude or significance of the estimates for the FSA (see table 4). After controlling for pre-FSA trend, the estimated increase in the number of handguns recovered by police that were originally sold outside of Maryland was 20 percent but was not statistically significant (see table 3).

Figure 3 depicts the percent of guns (includes handguns and long guns) recovered in crime within one year of retail sale that were

Figure 3. In-State Crime Guns Sold Within Year of Crime



Source: Authors' calculations based on ATF 2016a.

originally sold in the state of recovery for Maryland, Pennsylvania, and Virginia. These numbers are not to the same granular level as that of the time series for Baltimore City. The state-level data do not differentiate between type of gun and do not contain information on whether the purchaser was the criminal possessor or the month of sale. All three states were on an upward trajectory for the percentage of in-state crime guns with a TTC of less than one year. However, after 2013, although the indicators for Pennsylvania and Virginia leveled off, Maryland saw a 30 percent decline (see figure 3). This data provides further support to the hypothesis that the FSA reduced the diversion of guns into the underground market.

Parolee-Probationer Surveys

In May and June 2016, we fielded an audio-assisted computer-based survey of men on parole and probation in Baltimore. Our research teams approached 448 men and screened 251 for eligibility (55 percent). Of those who were screened, 216 were eligible to participate and 195 completed the survey on their experiences with the underground gun market in Baltimore (91 percent).

Individuals completing the survey reported significant experiences with gun violence and the underground gun market. Sixty-three percent had been shot at one or more times in their lives, 48 percent had been shot at multiple times. Of the 122 men who had been shot at, 43 percent had suffered gunshot wounds (see table 5). The most common reasons respondents had been most recently jailed were related to violence (32 percent) or drugs (28 percent).

Of the 195 respondents, 41 percent stated that it was more difficult to obtain a gun after the passage of the FSA (see table 6). Forty percent perceived that the new gun law affected the cost of guns in the underground market. In referencing how the FSA affected cost, respondents stated that, for instance, the law "made guns more expensive." The law was also perceived to have affected access to individuals willing to purchase guns on behalf of the survey respondents (34 percent) and access to a trusted source who would sell guns to the respondents (25 percent) (see table 6). Respondents made comments related to the difficulty of finding trusted sources such as "u [*sic*] have to have a permit" or "cause you don't always know the person thats [*sic*] selling the gun."

DISCUSSION

Several components of Maryland's Firearm Safety Act of 2013—a handgun purchaser licensing requirement, mandatory lost or stolen gun reporting by gun owners, and stronger regulation of retail gun dealers—were designed principally to prevent the diversion of handguns to prohibited persons and those seeking to acquire guns for criminal purposes. Findings from the analysis of handguns recov-

Table 5. Demographic Characteristics of Survey Respondents

Demographics	N=195	Percent
Age (mean [range])	38.7 (19–69)	
Race (n=179)		
African American	144	80
White	23	13
Multiracial	12	7
Relationship status (n=192)		
Never married	153	80
Married	19	10
Previously married	20	10
Currently employed (n=192)		
No	142	74
Yes	50	26
Education (n=191)		
Middle school	17	9
High school	95	49
GED	42	22
Some college	29	15
Associate's degree or higher	8	4
Ever shot at (n=192)		
Never	70	37
Once	28	15
Multiple times	91	48
Ever hit when shot at (n=122)		
Yes	53	43
No	69	57
Last six months, ever carried or used a gun		
Did not carry or use a gun	130	67
Carried but not used	34	17
Pointed or shown gun	6	3
Fired in the air	7	4
Fired at an individual	6	3
Other	12	6

Source: Authors' calculations based on underground gun market survey.

ered by Baltimore police are consistent with the theory that the FSA suppressed diversions of guns for criminal use. Indeed, the FSA was associated with an 82 percent reduction in the risk of a handgun being recovered from a criminal possessor who was not the retail purchaser less than twelve months after its retail sale in Maryland. The data suggest that the new legislation, most probably the licensing requirement for handgun purchasers, may have also contributed to a reduction in the number of legal purchasers subsequently involved in a crime with the gun. In further support of the theory that the FSA reduced diversion of handguns into the underground gun market, Maryland saw a 30 percent reduction in in-state handguns recovered in crime less than a year after retail sale. Pennsylvania and Virginia,

Table 6. Baltimore Underground Gun Market Survey Respondents' Perceptions of the Impact of Maryland's Firearm Safety Act.

Survey Question	N=192	Percent
Have the new laws made it more difficult to get a gun?		
Yes	79	41
No	104	54
Don't know	6	3
Refuse to answer	3	2
Have the laws affected the cost?		
Yes	77	40
No	102	53
Don't know	9	5
Refuse to answer	4	2
Have the laws affected the willingness of someone to buy a gun on your behalf?		
Yes	66	34
No	106	55
Don't know	15	8
Refuse to answer	5	3
Have the laws affected how easy it is to find someone you trust to sell you a gun? (n=191)		
Yes	48	25
No	129	68
Don't know	11	6
Refuse to answer	3	2

Source: Authors' calculations based on underground gun market survey.

neighboring states that did not change their laws, did not see a similar decline.

Forty percent of the survey respondents, who were prohibited under Maryland law from legally purchasing or possessing guns, reported that the new law made it more difficult to get guns. More than 30 percent indicated that the law affected the willingness of other individuals to purchase guns on behalf of the respondents. Additionally, 25 percent reported that the law affected the ease of finding a trusted source who would sell guns to the respondents. This is an important factor in the underground gun market. The ability to find a trusted source, or to continue trusting a previously used source, can greatly influence a prohibited individual's ability to acquire a gun (Cook, Parker, and Pollack 2015). Respondents in our survey, when asked how the law made it more difficult to find a trusted source, said that they did not know whether they could trust the person or they were wary that the gun might have been stolen. Additionally, when asked how the law affected the willingness of a person to purchase a gun on the respondent's behalf, several respondents stated that purchasers now must have a permit and that laws are in place against straw purchases. These survey data, in conjunction with the analysis of the crime gun trace data, suggest that Maryland's FSA is reducing the diversion of guns to persons prohibited from legally acquiring or possessing them.

Although survey results indicate a possible deterrent effect of Maryland's FSA on access to guns among the prohibited persons interviewed, it is not possible from this study to statistically estimate an impact of the law on over-

all prohibited access to and use of guns. A shift toward a greater share of crime handguns from out of state following enactment of the FSA, however, might signal some degree of scarcity of handguns from local sources in Baltimore's underground market. As an example, federal and local law enforcement announced the arrest of a gun trafficking ring in December 2015 that was allegedly bringing thirty guns per week from Tennessee, where gun sales laws are much weaker than in Maryland, to gangs in Baltimore (Anderson 2015).

Additionally, the share of Baltimore crime handguns from states other than Maryland did increase steadily each year from 55 percent in 2012 (last full year before the FSA) to 64 percent through the first three quarters of 2015. The point estimate from our regression analysis indicated a 20 percent increase in out-of-state crime handguns recovered in Baltimore coincident with the FSA, but the change was not statistically significant. However, the nearly two-thirds of crime handguns in Baltimore traced to original out-of-state retail sales in 2015 further support the existence of notable constraints in the local supply lines to Baltimore's underground gun market (ATF 2016a).

The limited crime gun trace data publicly released by ATF greatly hampers the ability to draw conclusions about the effects of gun sales regulations, especially when juxtaposed against what our research team could do with the granular crime gun data used for this study, as well as in studies by other researchers using gun-level crime gun trace data supplied by local police (Cook et al. 2007; Cook et al. 2014). Discussions of the restrictions Congress has placed on access to ATF's crime gun trace data often focus on limiting law enforcement access and accountability of gun sellers, but these restrictions also hinder research that can inform gun policy decisions and enforcement efforts (Webster et al. 2012).

Although our analyses controlled for the overall number of crime guns being recovered by BPD and general baseline trends in the outcomes, as well as monthly gun registration application approvals before and after passage of the FSA, we did not have monthly handgun sales data to accurately measure and control for exposure risk for the number of handguns sold in each month. However, one way the FSA provisions may affect the rate of crime involvement of handguns sold in Maryland is in decreasing sales volume.

An important historical confounder we could not control for was the uprising and civil unrest in April 2015 following the death of Freddie Gray, who died of injuries sustained in a BPD van after being arrested. The unrest was followed initially by a decrease in arrests, including a decline in handgun violations, and a historically steep rise in homicides and nonfatal shootings. Weapon arrests subsequently increased and the rate of increase of homicides and shootings slowed (Morgan and Pally 2016). These events likely influenced Baltimore residents' purchases of handguns and the probability that police would arrest someone for illegally carrying or using a handgun during the last five months of the study period, which could influence the relationship between the FSA and recovery of crime guns. Additionally, although this is a longitudinal study, the lack of an appropriate comparison group limits our ability to draw causal inference regarding the effect of the FSA on Baltimore's underground gun market.

In the future, additional years of post-FSA data should be examined to assess whether the ratio of in-state to out-of-state source crime guns continues to trend toward more out-of-state crime guns. When Missouri repealed its handgun purchaser licensing law in 2007, the share of in-state to out-of-state crime guns shifted gradually but steadily over time, such that in-state crime guns rose from 56 percent during 2006 to 74 percent in 2014 (ATF 2016b). This increase coincided with an increase in gun homicide rates and police officers shot in the line of duty, suggesting that laws somewhat similar to the FSA affect criminal access to and use of guns (on rate change, Webster et al. 2014; on officers killed, Crifasi, Pollack, and Webster 2015).

This study offers an evaluation of the impact of the FSA both on indicators of diversion of handguns for criminal purposes and perceptions of the law's impact on the underground market by those prohibited from purchasing or possessing guns. The FSA appears to have constrained the local supply of illegal hand-

guns in Baltimore. Fewer handguns were being recovered with indicators of diversion (short TTC and a different purchaser and possessor), and prohibited purchasers in Baltimore (men on parole or probation) reported increased difficulty in obtaining guns. These findings are consistent with previous literature evaluating the effect of state laws designed to reduce diversion of guns to criminals.

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